F • I • N • A • L

Environmental Impact Statement

Getty and Cities Service Shale Oil Projects

Prepared by:
U.S. Army Corps of Engineers
Sacramento District

FINAL

Environmental Impact Statement
Getty and Cities Service Shale Oil Projects

Prepared by:

US Army Corps of Engineers
Sacramento District

with the assistance of:

Camp Dresser & McKee Inc.

5 October 1984

US Army Corps
of Engineers

Sacramento District
650 Capitol Mall
Sacramento, CA 95814

Public Notice

Public Notice No. 8157-FEIS   Date: October 5, 1984

In Reply Refer to: SPKCO-O   Comments Due by: November 5, 1984

TO WHOM IT MAY CONCERN:

Notice of Availability of Final EIS for Getty and Cities Service Shale Oil Projects, Garfield County, Colorado.

The Final EIS identifies the impacts of the construction and operation of the two 100,000 barrel per day shale oil projects and their alternatives. This EIS has been prepared as part of the Corps of Engineers' permit responsibilities under Section 404 of the Clean Water Act.

Written comments on the Final EIS that are received by **November 5, 1984** will be considered in making a decision on the GCC application. Comments should be sent to Tom Coe, Regulatory Section, at the above address.

Interested parties can obtain, or have access to the EIS by writing the address above, or by calling (916) 440-2541 (FTS 448-2541).

Notice of Modification of Plans for the GCC's water diversion facility on the Colorado River. New plans are shown on the attached drawings, figures 4 and 5.

The GCC has modified the plans for their intake structure because of requests by U.S. Fish and Wildlife Service and Colorado Division of Wildlife that they build a passive intake structure instead of the conventional intake originally proposed. A passive intake maintains a slower approach velocity than a conventional intake and is one of the better technologies to prevent fish from being caught in the structure.

The passive intake will be located approximately 600 feet upstream from the location that was proposed for the conventional intake. The new location will require that three cofferdams be constructed instead of one. The river inlet will require a single cofferdam in the main channel to enclose the construction area, and the sluiceway will require two cofferdams in the north channel during construction.

ARTHUR E. WILLIAMS
Colonel, CE
District Engineer

2 Drawings

No. 8157

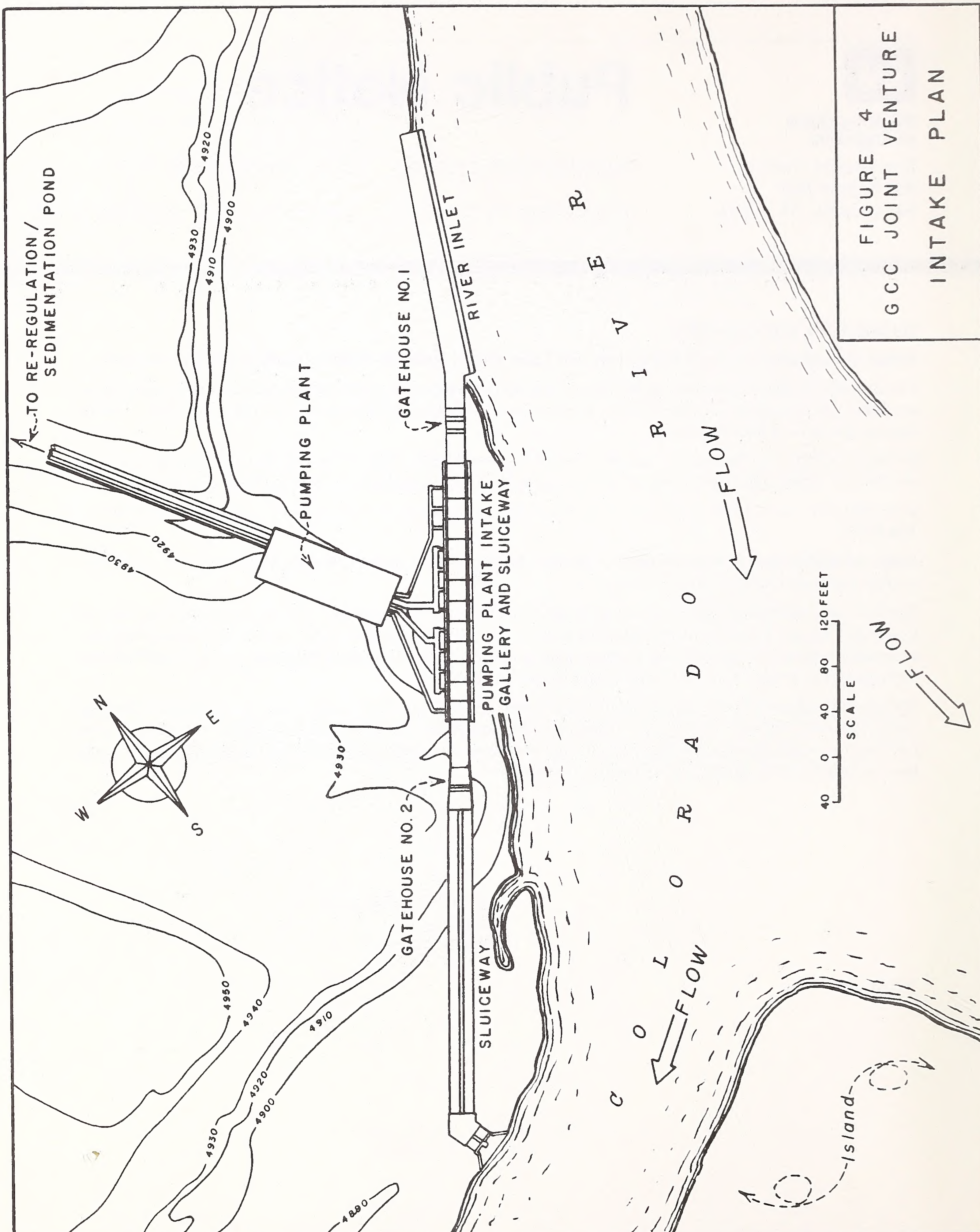

FIGURE 4
GCC JOINT VENTURE
INTAKE PLAN

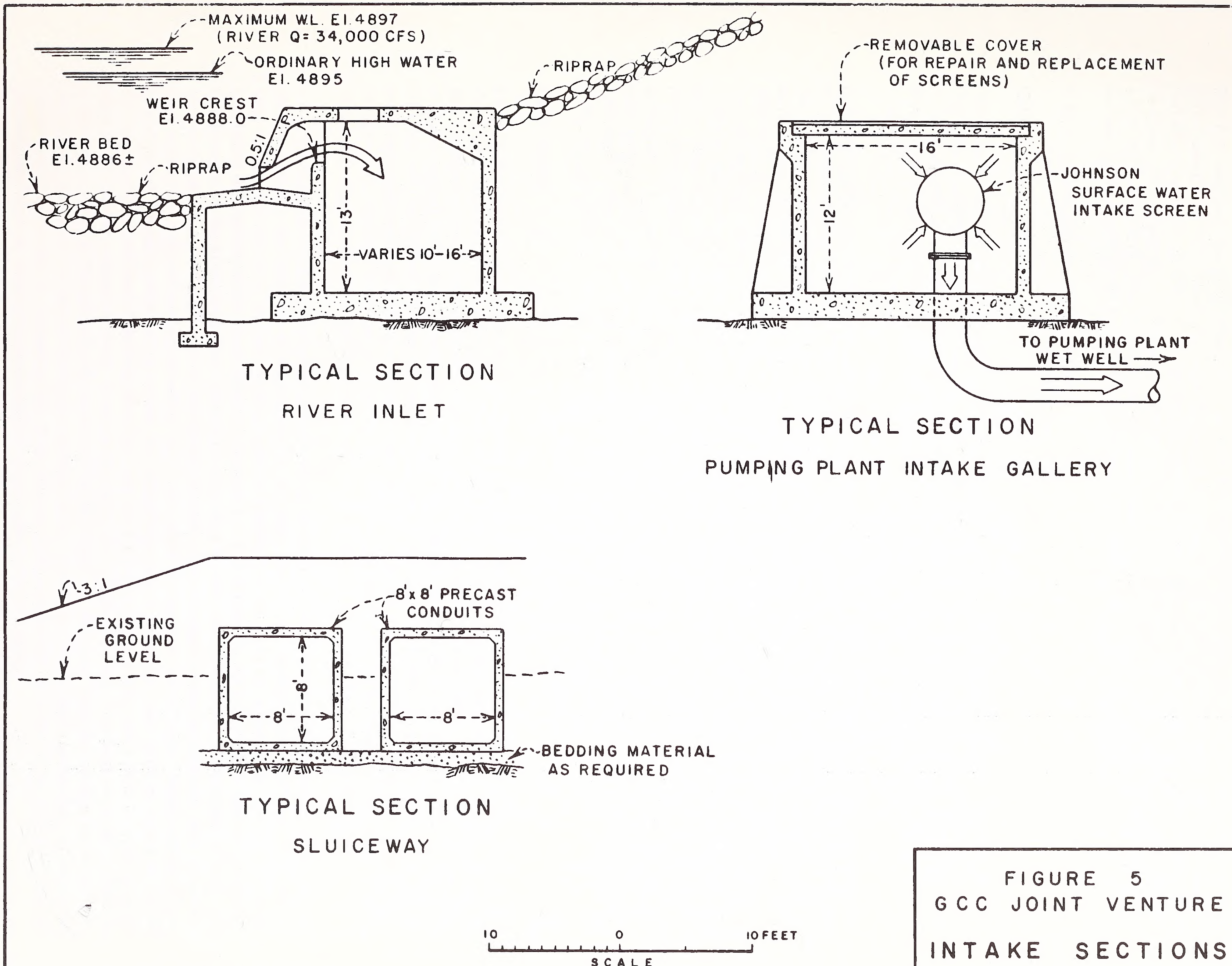

FIGURE 5
GCC JOINT VENTURE
INTAKE SECTIONS

ERRATA

Section 1.3.1, Page 1-3, 1st full paragraph, 2nd line, "are presently being reviewed by the FWS" should read "have been reviewed by the FWS".

Table 1.3-1, page 1-4, under Local Agencies, delete "Planning Commission" and the word "Permit" following Garfield County and Mesa County entries.

Section 1.4.1, page 1-6, 5th paragraph, 5th line, delete word "dollars".

Section 2.1, page 2-1, third bullet, "(Section 2.3.4.1 - Getty Project, Section 2.3.4.2 - Cities Service Project)" should read "(Sections 2.3.1.5 and 2.4.3.1.9 - Getty Project; Sections 2.3.2.5 and 2.4.3.2.11 - Cities Service Project)".

Figure 2.3-19, page 2-71, should be revised as follows:

- The "Alternative North Corridor for Syncrude" label should read "Alternative North Corridor for Power and Syncrude".
- The dotted line for that North Corridor should extend to the southwest onto the resource property and connect to the retorts area.
- The Roan Creek road should be shown as extending up Roan Creek to the northwest.
- The corridor up Roan Creek from De Beque should be labeled "Corridor for Power, Road, Water, and Alternative Railroad".
- The arrow denoting "Alternate Transfer Facilities Location" should be extended northward to the intersection of the corridor with Conn Creek.

Section 2.3.2.2, page 2-69, "T8S, R98W" should be inserted in the fifth line under "Township and Range" to the left of the Section 1 notation.

Page 2-72, Figure 2.3-20, the line showing the location of the crushing and screening facilities should be extended further north to also include the facility due north of the indicated facility.

Page 2-79, Figure 2.3-25, "Source: Cities (1984b)", should be "Cities Service (1983b)".

Page 2-80, second paragraph, fourth line, "15 round trips" should read "20 round trips".

Page 2-89, Post Reclamation, first line, the word "are" should be "is".

Page 2-97, Table 2.3-41, footnote "d" should read "N/A - Not Available".

Page 2-102, Table 2.3-43, under Cities Service Proposed Action, Flue Gas Desulfurization, "No" should be "Yes".

Page 2-103, Figure 2.3-33, the reference "Cities Service/Getty (1984a)" should read "Cities Service/Getty (1984b)".

Page 2-109, Table 2.3-50, the last footnote should be labeled "e"; the source "Cities Service/Getty (1984b)" should be "Cities Service (1983b)".

Section 2.3.2.3, page 2-120, Table 2.3-56, footnote "c", the reference to "Table 2.3-39", should be "Table 2.3-29".

Page 2-121, Water Supply System, last paragraph, the reference to "Table 2.2-1" should be "Table 2.2-2".

Section 2.4.3.2, page 2-146, the first sentence should read "The 24-hour TSP concentrations are predicted to consume or exceed the PSD Class II increment for all full production alternatives and for the reduced production split (Union B/VMIS) and for the reduced production rate all Union B retorts."

Page 2-151, Ground Water, the reference "(Bates 1983)" should be "(Bates 1983a)".

Page 2-155, Cultural Resources, the reference "BLM (1983)" should be "BLM (1983a,e).

Section 3.1.3.1, page 3-4, 2nd full paragraph, 4th line, "with typical value" should read "with typical values".

Section 3.3.3 Ground Water, page 3-13, 1st paragraph, 3rd line, reference for "Figure 3.1-3" should read "Figure 3.1-2".

Page 3-15, 1st full paragraph, 12th line, delete reference for Chevron 1983.

Section 4.1.2, page 4-3, Table 4.1-2, the runoff value with footnote "d" notation should read "c".

Section 4.2.2, page 4-10, Table 4.2-3, the heading "Percent Chance" should read "Percent Change".

Section 4.3.2, page 4-39, Table 4.3-3, the heading "Percent Chance" should read "Percent Change".

Section 4.3.3, page 4-45, first paragraph, fourth line, "10 percent in boron and fluoride" should read "30 percent in boron and 19 percent in fluoride".

Page 4-45, 2nd paragraph, second line, the word "railroad" should be deleted.

Section 4.3.8, page 4-68, Table 4.3-15, ninth alternative should read "50,000 bpd-40,000 Union B/10,000 VMIS Additional Fines Processing Retort".

Page 4-70, first paragraph under 50,000 bpd-All Lurgi Retorts, second line, the words "background concentrations" shoud read "total concentration".

Page 4-70, Second paragraph under 100,000 bpd-90,00 bpd Union B/10,000 bpd VMIS With Additional Fines Processing Retort, fifth line, the words "due to the additional fines processing retort alternative" should read "for this alternative".

Page 4-71, first paragraph under Subalternatives, the references to Table 4.3-16 and Table 4.3-15 should be Table 4.3-14 and Table 4.3-16, respectively.

Page 4-73, Table 4.3-17, the footnote "d" alongside heading Annual Emission Rate, should be "e". The footnote "e" alongside heading Particulate, should be "d".

Page 4-74, Table 4.3-18, footnote "a", the reference to "Table 4.3-6", should be "Table 4.3-7".

Section 5.3.3, page 5-7, response to comment #4, the reference to "figure 2.2-3" should be "Figure 2.3-3".

Page 5-11, response to comment #6, the report discussed should be referenced in the format "(Intera 1976)".

Page 5-11, comment #9, the reference to "Table 2.2-3" should be "Table 2.2-2".

Section 5.3.4, page 5-15, Cumulative Impacts, response to comment #2, should read: "Concur. Table has been revised."

Section 5.3.5, page 5-17, 3rd full paragraph, 8th line, reference for "(Moore 1983)" should read "(Moore 1982)."

Section 5.3-7, page 5-23, comment #12, the following should be added after VMIS, "retort construction and use. (12-13)"

Section 5.3.10, page 5-36, response #13, the last line should read "vegetation by project component can be found in Table 4.2-2 of the DEIS and Table 4.3-2 of the FEIS." This change also applies to page 5-40, response #10, second line.

Section 7.0, Glossary, under definition of Indirect above ground retort, "recycled gas heater" should read "recycle gas heater".

The following definition should be added to the Glossary: "Highest second-highest - The second-highest concentration predicted at an air quality receptor that recorded the highest concentration. (Note: All short-term air quality standards may be exceeded one time during an annual period, i.e., the maximum or highest value.)"

The definitions in response to comment #5, page 5-29, should also be added to the Glossary.

References:

The Cities Service/Getty 1984b reference should read:

Cities Service/Getty. 1984b. Letter from J. Hulsebos (Cities Service) to S. Mernitz (CDM) regarding EPA comments on the DEIS dealing with gaseous and solid waste emissions for the Cities Service and Getty Shale Oil Projects. July 5.

The Getty 1984c reference should read:

Getty. 1984c. Letter from C. Zimmermann (Getty) to T. Coe (U.S. Army Corps of Engineers) regarding alternative mitigation measures. June 19.

BLM. 1983. (Final EIS, Uintah Basin Synfuels) should be 1983c.

Add References:

In-Situ, Inc. 1984. Technical Report: Response to geotechnical and water resource issues - Getty/Cities Service Shale Oil Projects, Draft Environmental Impact Statement. Denver: In-Situ, Inc., prepared for Getty and Cities Service.

Intera Environmental Consultants Ltd (Intera). 1976. Field study and air quality report of the Roan Creek Meteorological study oil shale joint project participants. Houston: Intera; prepared for Cities Service, Getty, Texaco, and Chevron Shale Oil Company.

Mountain West Research - Southwest (MWSW). 1983. Getty-Cities Service EIS, socioeconomics, preliminary draft. Tempe, Arizona: MWSW; prepared for Getty and Cities Service.

U.S. Bureau of Land Management (BLM). 1983a. Draft environmental impact statement, Clear Creek Shale Oil Project. Grand Junction: BLM.

U.S. Environmental Protection Agency (EPA). 1977a. Trace elements associated with oil shale and its processing.

__________. 1977c. Compilation of emission factors, 3rd edition. Research Triangle Park, North Carolina: EPA, Office of Air Quality Planning and Standards.

APPENDICES

Title pages for Appendices D-1, D-2, and D-3, the word "Excerpt" should be "Excerpts".

GENERAL

Throughout the FEIS, the symbol for microgram should always read "μg". instead of "ug".

Throughout the FEIS, whenever the term ""Cities" is used, it should read "Cities Service".

Throughout the FEIS, wherever the reference "BLM 1983a" is used, the reader should also consider "BLM 1983e" (i.e., both the Draft and Final CCSOP EISs).

SUMMARY

This EIS addresses the environmental impacts of the proposed Getty and Cities Service shale oil projects in northwestern Colorado. The impacts of each project are assessed separately. Sections which apply specifically to the Getty project are on blue color-coded pages; sections which apply specifically to the Cities Service project are on green color-coded pages. Common environmental features, impacts, and DEIS comments and responses which apply to both projects are presented on plain white pages. The reader should refer to the Draft EIS for sections not reprinted in the Final EIS, and generally use both documents in combination.

A brief overview of each project follows.

Getty

Getty Oil Company owns oil shale properties adjacent to the Clear Creek drainage in Garfield County, Colorado. These properties are primarily in R97W and 98W, Township 5S. The properties include 20,880 acres of resource land and about 11,600 acres of valley support lands. The support lands extend from the Colorado River south of De Beque northward up the Roan Creek valley to Clear Creek, and include Clear Creek canyon bordering the resource property.

If economically justified, Getty proposes to develop the resource using conventional room-and-pillar underground mining, combined with surface retorting and shale oil upgrading. Ultimate capacity would be 100,000 barrels per day (bpd) of upgraded shale oil. If developed, the project would be developed in phases starting with 50,000 bpd and followed with a 50,000-bpd addition. Construction could commence as early as 1987 with production commencing in 1990. Expected project life would be 30 years. Major elements of the project would include a water supply system, an underground room and pillar mine, retorting and upgrading facilities, raw shale transporting systems, and a spent shale disposal system. The primary source of water would be the GCC Water Supply System, whose primary impacts are addressed in the Clear Creek Shale Oil Project (CCSOP) EIS (BLM 1983a). As currently envisioned, ancillary facilities would include, but would not necessarily be limited to, a syncrude pipeline, electric powerlines, access roads, and a utility corridor. Current plans specify that the initial surface plant site would be located in Section 32 of Township 5S, Range 97W, with retort additions at a plant site in Sections 15 and 22 of Township 5S, Range 97W, and the proposed location for the shale disposal system in Wiesse Creek gulch.

Cities Service

Cities Service Oil and Gas Corporation is planning a staged development of its oil shale holdings in the upper Conn Creek area of Garfield County, Colorado. These holdings are primarily in Range 97W, and Townships 6S and 7S. Most of this property, which includes the oil shale resource, was acquired by Cities Service in 1951. The property consists of 10,300 contiguous acres, with approximately 6,850 acres on the Roan Plateau underlain by oil shale and the remainder located in canyon drainages. Cities Service Oil and Gas Corporation has formed a subsidiary corporation named Conn Creek Shale Company to which it will transfer the property, the applicable permits and its interest in the GCC Joint Venture. For the purposes of this EIS, the term Cities Service means either Cities Service Oil and Gas Corporation or its subsidiary, Conn Creek Shale Company.

Cities Service's plans include development of conventional underground room-and-pillar mining, combined with surface retorting and shale oil upgrading during the early stage of the project. This development would be followed by the use of a vertical modified-in-situ (VMIS) process used to augment the surface retorting. Ultimately the capacity of the plant would be expanded to 100,000 barrels per day (bpd) of upgraded shale oil. Construction of the initial module is planned to commence in 1987 with production commencing in 1992. The ultimate production level is planned to be achieved by 2010. The estimated project life depends upon the precise implementation of the various project stages, but is expected to be a minimum of 25 years. Major elements of the project would include a water supply system, an underground room-and-pillar mine accommodating the VMIS process, surface retorts and upgrading facilities, raw shale transporting systems, and a retorted shale disposal system. The primary source of water would be the GCC Water Supply System. The impacts of this system are addressed in the Clear Creek Shale Oil Project (CCSOP) EIS (BLM 1983a,e). Ancillary facilities would include, but are not necessarily limited to, a syncrude pipeline, electric powerlines, access roads, and utility corridors. The surface plant site would be located on the Roan Plateau in the vicinity of the mine bench, and the proposed location for the shale disposal system would be Conn and Cascade canyons.

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1.0

Purpose and Need

Getty
Cities Service

1.0 PURPOSE AND NEED

1.1 Background

Getty Oil Company (Getty) and Cities Service Oil and Gas Corporation (Cities Service) each propose to independently develop their oil shale resource properties north of De Beque, Colorado (Figure 1.1-1). The ultimate capacity of each project is 100,000 bpd of shale oil. Details concerning the purpose and need for each project are given in Section 1.4.

The purpose of this EIS is: (1) to address the impacts of mine development and oil shale processing resulting from the granting of a Section 404 Dredge and Fill permit by the U.S. Army Corps of Engineers (the Corps) to the GCC Joint Venture (Getty, Cities Service, and Chevron Shale Oil Company participants); (2) to address the impacts of potential BLM land actions related to the Getty and Cities Service projects; and (3) to act as a supporting document for other permits. The 404 permit is a necessary part of constructing the water supply system, which would include an intake structure on the Colorado River, related pipelines, and a storage reservoir in the Roan Creek drainage. Getty, Cities Service, and Chevron have formed a joint venture called the GCC Joint Venture, the purpose of which is to develop a common water supply system that would allow each participant to divert and regulate water available under its respective, individual water rights for subsequent industrial use. Facilities associated with this system would extend from the intake in the Colorado River near De Beque through a main storage reservoir on Roan Creek referred to as the Roan Creek reservoir. The Joint Venture was formed because it is the policy of the State of Colorado, as indicated by its statutes, to encourage joint facilities for the conveyance of water and to minimize the number of structures which are used for the conveyance of water on improved or occupied lands. In addition, such joint facilities for water would be more efficient, economical, and would in turn minimize the environmental impacts. The impacts of the GCC Joint Venture water supply project and the Clear Creek Shale Oil Project were addressed in the Clear Creek Shale Oil Project (CCSOP) EIS (BLM 1983a,e).

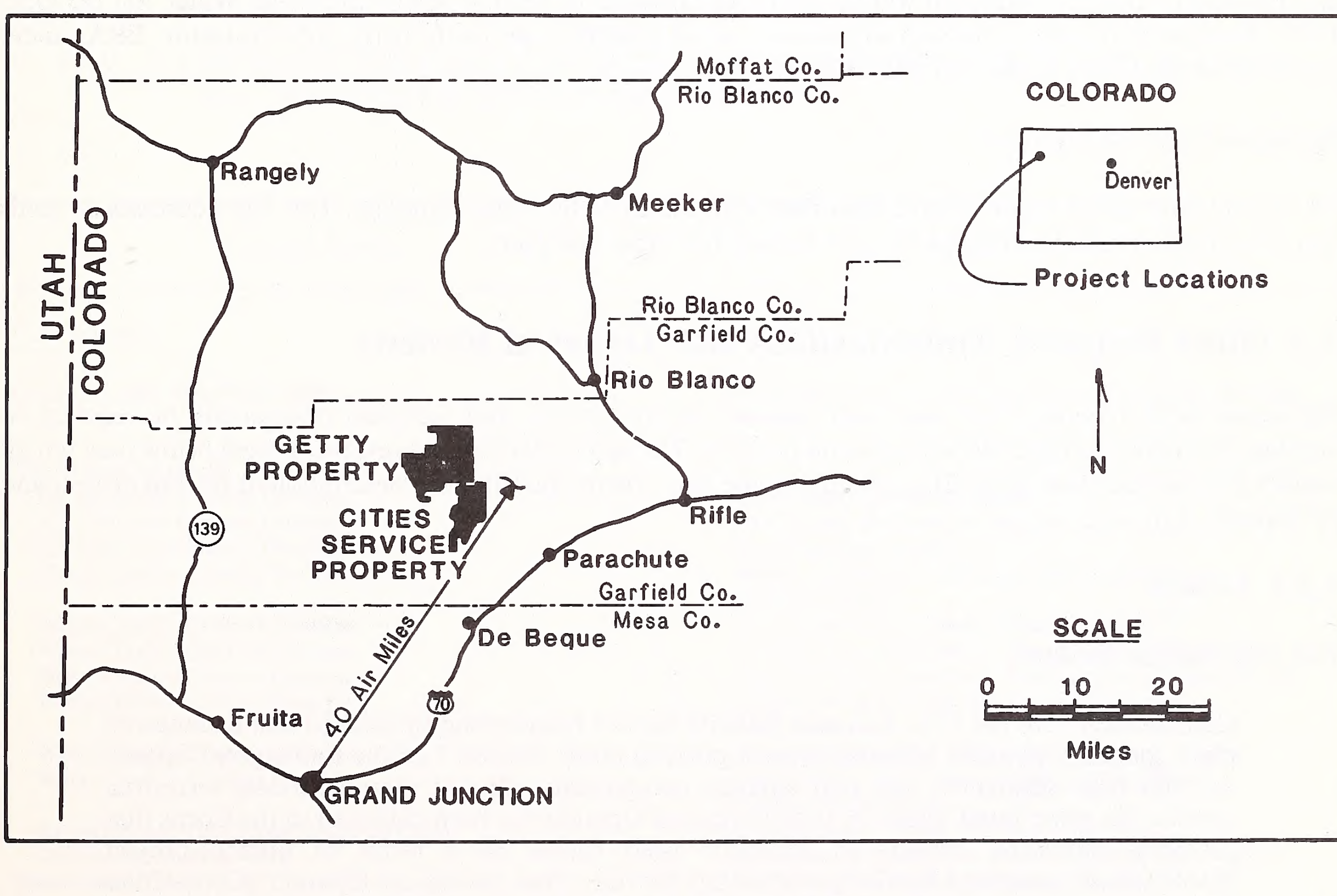


Figure 1.1-1 Getty and Cities Service Oil Shale Resource Property Areas.

This EIS addresses the impacts of water withdrawal and use related to the development of Getty and Cities Service shale oil projects. It also serves as the Technical Assistance Report, to address topics of interest to the U.S. Fish and Wildlife Service (USFWS) and the Colorado Division of Wildlife (CDOW) under the Fish and Wildlife Coordination Act of 1958. The appropriate information for USFWS and CDOW purposes is provided in Sections 3.1.7, 3.2.7, 3.3.7, 4.1.7, 4.2.7, and 4.3.7.

1.2 Regulatory Actions Initiating the EIS

This EIS satisfies the requirements of the National Environmental Policy Act [NEPA - PL91-190, specifically Section 102(2)(C)] for purposes of all federal, state, and local jurisdictions concerning the Getty and Cities Service shale oil projects. It will serve as a supporting document for many of the permits and approvals needed prior to and at the time of development for each project.

The "major Federal action" (see NEPA) which initiated this EIS is a Section 404 Dredge and Fill permit application to the U.S. Army Corps of Engineers, which serves as the lead federal agency in this EIS effort. The EIS also addresses and serves as a NEPA compliance document concerning the impacts of various land actions which are expected to be filed by each company with the U.S. Bureau of Land Management (BLM) pertaining to land exchanges, purchases, rights-of-way, or leases for purposes of project development, notably for corridors, roads, and reservoir sites. Each of these regulatory actions is addressed in more detail below.

Corps of Engineers

This EIS was initiated by a Section 404 permit application filed by the GCC Joint Venture, c/o Getty Oil Company, Los Angeles, California (as operator of the Joint Venture) with the U.S. Army Corps of Engineers, Sacramento, California. The application, No. 8157, is a modification of an earlier application (No. 5917) submitted by Getty Oil Company in 1976. The application is for dredge and fill activities in the Colorado River and the Roan Creek drainage and will be evaluated pursuant to Section 404 of the Clean Water Act (33 USC 1344). Evaluation of the application will assume use of guidelines set forth by the Administrator, EPA, under authority of the Clean Water Act (40 CFR Part 230).

Bureau of Land Management

No current land action requests have been filed with the BLM by either company. This EIS addresses all lands that would potentially be affected by such actions for either company.

1.3 Other Required Authorizations and Technical Reviews

Numerous other federal, state, and local permits, authorizations, and technical reviews will be required to develop the Getty and Cities Service shale oil projects. The authorizations and reviewers listed below may not all require prior preparation of an EIS, although some may rely on the EIS for a description of the full project and its impacts.

1.3.1 Federal

Fish and Wildlife Service:

> Consultation with the U.S. Fish and Wildlife Service (concerning threatened and endangered plant species potentially affected by each project) under Section 7 of the Endangered Species Act has been segmented into two separate components. One of these addresses terrestrial species, the other listed fishes. A final Biological Opinion has been delivered to the Corps that considers terrestrial impacts to federally listed species as a result of upland project developments proposed by Getty and Cities Service. That Biological Opinion (Getty-Cities Service Terrestrial Consultation, FWS File #6-5-85-0002; USFWS 1984a) finds that upland

developments are not likely to jeopardize the continued existence of any federally listed terrestrial species. Similarly, a Biological Opinion has been issued by the USFWS to the BLM concerning the CCSOP and GCC water system (FWS File #6-5-83-0016; USFWS 1984b). That document finds that terrestrial impacts of the GCC water system are not likely to jeopardize the continued existence of any federally listed terrestrial species.

It should be noted that the aquatic impacts to listed Colorado River fishes, as a result of proposed water withdrawals, are presently being reviewed by FWS under a third Section 7 consultation (GCC/CCSOP Aquatic Consultation, FWS File #6-5-84-0003; USFWS 1984c) with BLM. A "No Jeopardy" Biological Opinion with conservation measures has been issued and precedes final federal approvals for development of the GCC Joint Venture water system (see Appendix D).

The USFWS will also review the U.S. Army Corps of Engineers 404 Permit under authority of the Fish and Wildlife Coordination Act of 1958.

Environmental Protection Agency:

The EPA will: (1) act as joint reviewing agency with the Corps on the 404 permit application; (2) review for completeness and adequacy the Prevention of Significant Deterioration Permit (PSD) governing the effects of project construction and operation on existing air quality; (3) review handling of any toxic and hazardous wastes; and (4) issue permits and monitor compliance in these matters as applicable.

1.3.2 State of Colorado and Local Jurisdictions

A list of other state and local permits and approvals which may apply to the Getty and Cities Service shale oil projects is shown in Table 1.3-1.

Table 1.3-1 PERMITS, APPROVALS, AND CERTIFICATIONS GENERALLY APPLICABLE TO OIL SHALE DEVELOPMENT PROJECTS

Issuing Agency	Permit or Approval
State Agencies	
Colorado State Historical Society	National Historic Preservation Act Compliance; Cultural Resource Clearance
Department of Health	
Air Pollution Control Division	Air Pollutant Emission Permit
Air Pollution Control Division	New Source Performance Review Notification
Air Pollution Control Division	Open Burning Permit
Water Quality Control Division	National Pollutant Discharge Elimination System (NPDES Permit)
Water Quality Control Division	Site Approval for Sewage Treatment Facility
Water Quality Control Division	Construction Approval for Sewage Treatment Facility
Water Quality Control Division	Approval of Location and Construction of Water Works
Water Quality Control Division	License for Water and Wastewater Treatment Plant Operators
Water Quality Control Division	Subsurface Disposal System Permit
Water Quality Control Division	Certification of Dredge and Fill Permits (Water Quality Certification)
Radiation and Hazardous Waste Division	Certification of Solid Waste Disposal Site
Division of Medical Care	Certificate of Public Necessity for Health Care Facility
Department of Highways	Access Control Permit (Driveway Permit)
Department of Highways	Underground and Utility Permit

Table 1.3-1 PERMITS, APPROVALS, AND CERTIFICATIONS GENERALLY APPLICABLE TO OIL SHALE DEVELOPMENT PROJECTS (continued)

Issuing Agency	Permit or Approval
Department of Labor and Employment	
Division of Labor	Certificate for Boilers
Division of Labor	Permit for Explosive Materials
Department of Natural Resources	
Division of Mines	Operator's Notice of Activity
Division of Mines	Underground Diesel Permit
Division of Mines	Permit to Store and Use Explosives
Division of Mines	Permit for Underground Storage of Flammable Liquids
Division of Water Resources - District 5 Water Court	Application for Water Rights (Underground or Well)
Division of Water Resources - District 5 Water Court	Application to Make Absolute a Conditional Water Storage Right
Division of Water Resources - District 5 Water Court	Application to Make Absolute a Conditional Water Right
Division of Water Resources - District 5 Water Court	Water Augmentation Plan Approval
Division of Water Resources - State Engineer	Approval of Plans and Specifications for the Construction, Enlargement, or Repair of Dams
Division of Water Resources - State Engineer	Approval to Construct an Erosion Control Dam
Division of Water Resources - State Engineer	Permit to Construct or Relocate a Non-exempt Well (>15 GPM) Outside Designated Basins
Division of Water Resources -	Permit to Construct or Relocate an Exempt (<15 GPM) Well Outside Designated Basins
Division of Mined Land Reclamation	Notice of Intent to Conduct Prospecting Operations
Division of Mined Land Reclamation	Permit for Regular Mining Operation
State Board of Land Commissioners	Rights-of-Way
Division of Wildlife (Wildlife Commission)	Coordination with Other Agencies
Department of Regulatory Agencies	
Public Utilities Commission	Certificate of Public Convenience and Necessity
Local Agencies	
Garfield County Planning Commission	Special Use Permit
Garfield County Permits	Conditional Use Permit
Garfield County Permits	Sewage Disposal System
Garfield County Permits	Solid Waste Disposal
Garfield County Permits	Installation of Utilities in Public Rights-of-Way
Garfield County Permits	Driveway Permit Across County Roads
Garfield County Permits	Building Permit
Garfield County Permits	Permit to Conduct a Designated Activity of State Interest
Garfield County Permits	Impact Analysis - Planning Commission
Garfield County Permits	Area Wide Management Program Approval
Mesa County Permits	County Road Access
Mesa County Permits	Road Use
Mesa County Permits	Building Permit
Mesa County Permits	Mobile Home Siting
Mesa County Permits	Solid Waste Permit

Source: Adapted from BLM (1984a) and CDNR (1983).

1.4 Purpose and Need

Every regulatory permit application has both an applicant's purpose and need and a public purpose and need according to Corps EIS regulations. The purpose and need for the Getty and Cities Service shale oil projects is primarily to satisfy national energy requirements. The U.S. Congress and various Presidential Administrations have recognized the need for alternative forms of energy development. Synthetic fuels (e.g., shale oil) are a prime example of such alternative energy development. The western United States, and particularly the Green River Basin in Colorado, Utah, and Wyoming is rich in oil shale reserves and has been the focus of potential development activity. Getty and Cities Service have acquired lands and related resources for development of these oil shale reserves, and the purpose of this EIS is to analyze the environmental impacts of these developments.

Other forms of alternative energy development — notably solar, geothermal, wind, and biomass technologies — have been promoted by various parties, including the U.S. Government, and are in various stages of development and commercialization. Government and private economic forces have strongly encouraged the testing and potential use of shale oil. Shale oil has been shown to be one of the most feasible synthetic fuel alternatives from an economic and technical perspective. It can replace conventional crude oil, and yields a larger proportion of hydrocarbons used to make jet and diesel fuels, which are projected to show substantial increases in demand. This alternative energy technology is perhaps closer to commercialization than some of the others mentioned.

There are numerous other secondary public purposes and needs for the preparation of this EIS. As noted previously, this EIS was initiated to assess the impacts of granting a 404 Permit to the GCC Joint Venture for water development activities on the Colorado River and in the Roan Creek basin. This EIS will assess the impacts of that water use, notably development of the oil shale properties and related facilities. The public need for the shale oil beyond that primary need for energy sources noted above is also reflected in the economic benefits to localities in northwestern Colorado, the State of Colorado in general, and the nation. The jobs, income, expenditures, and subsequent economic development of this region resulting from the proposed developments would encourage economic growth in Colorado and the United States. These benefits are not without costs in terms of environmental impacts, however. Nearly every type of resource development involves environmental impacts (beneficial and adverse), while usually promoting economic and social growth. The purpose of this EIS is to compare and contrast these impacts for purposes of disclosure to agency reviewers, special interest groups, and the general public.

The purposes and needs for the Getty Project and the Cities Service Project are discussed separately below.

1.4.1 Getty

The purpose of the proposed Getty shale oil project is to produce shale oil in an environmentally and economically acceptable manner.

The Energy Security Act of 1980 states *"The Congress finds and declares that . . . the achievement of energy security for the United States is essential to the health of the national economy, the well being of our citizens, and the maintenance of national security".* Since enactment of this legislation, domestic crude production has continued to lag behind consumption, although consumption decreased during the early 1980's. The 1983 National Energy Policy Plan sees a continued lag in domestic energy production, with oil imports growing to approximately 5-6 million barrels per day by the year 2000.

To augment conventional oil and gas, Getty and other domestic energy companies have committed significant resources to the development of alternate fuels, such as tar sands, oil shale, and oil from diatomaceous earth. It is Getty's belief that, in the long run, development of alternate energy sources will contribute to the achievement of energy independence and security of the United States.

Development of an oil shale industry should provide western Colorado and the nation with benefits far outweighing the costs. The infusion of new revenue to the area will enable controlled growth of Western Slope communities, with old and new residents benefiting from the resulting improvements in quality of life, services, and facilities.

While development of an oil shale industry is not expected to close the domestic energy gap during this century, it has been suggested that this industry could reduce domestic vulnerability to a recurrence of the foreign crude oil supply disruptions of the 1970's. An oil shale production level of 500,000 barrels per day would also reduce our balance of payments deficit by over $5 billion annually, even assuming the currently depressed foreign crude price of $30 dollars per barrel.

1.4.2 Cities Service

The purpose of the proposed Cities Service shale oil project is to produce shale oil in an environmentally and economically acceptable manner.

The Energy Security Act of 1980 states *"The Congress finds and declares that . . . the achievement of energy security for the United States is essential to the health of the national economy, the well being of our citizens, and the maintenance of national security"*. Since enactment of this legislation, domestic crude production has continued to lag behind consumption, although consumption decreased during the early 1980's. The 1983 National Energy Policy Plan sees a continued lag in domestic energy production, with oil imports growing to approximately 5-6 million barrels per day by the year 2000.

To augment conventional oil and gas, Cities Service and other domestic energy companies have committed significant resources to the development of alternate fuels, such as tar sands and oil shale. It is the belief of Cities Service that, in the long run, development of alternate energy sources will contribute to the achievement of energy security for the United States.

The Canadian Syncrude Project, in which Cities Service has been a developing and long-term participant, and the Suncor Tar Sand Project are ventures that have proven that synthetic fuels can be developed in an environmentally sound, economically feasible, and socially responsible manner. The billions of dollars invested by private, public, and governmental interests in these ventures have provided the northern Alberta region with significant growth, as well as an enhanced quality of life for its residents. Looking beyond the local economies, development of the tar sands industry has benefitted Canada's national interest. During 1983, combined synthetic crude production from the Canadian Syncrude Project and Suncor Project is projected to exceed 55 million barrels, thereby reducing Canada's balance of payments deficit by over $1.6 billion.

Development of an oil shale industry should provide Western Colorado and the national interest with benefits far outweighing the costs. The infusion of new revenue to the area will enable controlled growth of Western Slope communities, with old and new residents benefiting from the resulting improvements in quality of life, services, and facilities.

While development of an oil shale industry is not expected to close the domestic energy gap during this century, it has been suggested that this industry could reduce domestic vulnerability to foreign crude oil supply disruptions, as experienced in the 1970's. An oil shale production level of 500,000 barrels per day would also reduce the U.S. balance of payments deficit by over $5 billion annually, even assuming the currently depressed foreign crude price of $30 per barrel.

2.0

Proposed Action and Alternatives

Getty
Cities Service

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Introduction

This section presents descriptions and comparisons of the proposed actions and alternatives for the Getty shale oil project and the Cities Service shale oil project (in separate subsections). In order to provide a basis for choice among varying alternatives by the Corps and the public, impact comparisons are presented for each discipline, based on the information provided in Section 3.0 — Affected Environment, and Section 4.0 — Environmental Consequences of the DEIS. This section addresses the following:

- Alternatives eliminated from detailed study and the reasons for elimination (Section 2.2.2 — Getty Project; Section 2.2.3 — Cities Service project)
- Description of the proposed action and reasonable alternatives (Section 2.3.1 — Getty project; Section 2.3.2 — Cities Service project)
- The No Action alternative for each project (Section 2.3.4.1 — Getty project, Section 2.3.4.2 — Cities Service project)
- A comparison of the environmental impacts of the alternatives considered in detail including the proposed actions (Section 2.4.3.1 — Getty project; Section 2.4.3.2 — Cities Service project)

2.2 Selection of Alternatives for Detailed Discussion

2.2.1 Introduction

The Corps identified the proposed action for the Getty and Cities Service projects, as well as the full range of alternatives to each proposed action. The alternatives considered or eliminated for each project are presented on the following pages.

2.2.2 Getty Project

The alternatives considered for the Getty project encompassed a wide range of realistic options. Evaluation of alternatives included production capacity, mining techniques, retort technology, and siting options. Table 2.2-1 presents the full range of alternatives considered and the reason for their inclusion or elimination from detailed study in the EIS. In general, alternatives were selected on the basis of relative efficiency, technical and economical feasibility, and minimal environmental impact. Alternatives were eliminated because of relative inefficiency, technical and economical problems, and major potential environmental impacts.

2.2.3 Cities Service Project

In arriving at project alternatives for the Cities Service Project, a wide range of options were investigated. Table 2.2-2 presents alternatives by categories (e.g., mine type, retort technology, transport corridors) considered and the reason for inclusion or elimination from detailed study in the EIS. Alternatives were included based on current planning, relative efficiency, technical and economical feasibility, and minimization of environmental impact. The basis for elimination of alternatives included relative inefficiency, technical and economic problems, and major potential environmental impacts.

Table 2.2-1 ALTERNATIVES CONSIDERED FOR OR ELIMINATED FROM DETAILED STUDY, GETTY SHALE OIL PROJECT

Alternative Category	Alternative Considered	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination (Alternative Type)[a]
Production Rate	100,000 bpd	Included	Current design basis. Most economical and efficient production rate, sufficient resource for project life (2)
	50,000 bpd	Included	May reduce overall impacts; may extend life of operation (2)
Mining Method	Underground	Included	Allows the selection of rich oil shale layer for processing (2)
	Surface	Eliminated	Uneconomical due to high ratio of overburden to reasonable grade oil shale resource (4)
Retort Type	Surface	Included	The surface retorting technology has been demonstrated and has a high probability of technical and economic feasibility (2)
	MIS	Eliminated	Technology less developed than surface retorting methods (4)
Surface Retort Technology	Union B	Included	Technology being developed commercially by Union Oil (2)
	Lurgi	Included	Technology developed and feasible (2)
Upgrading	Hydrotreating	Included	The hydrotreating of the shale oil results in a pipeline-compatible product (2)
	Refinery	Eliminated	Sufficient refining capacity is available off-site within economic pipeline distance (4)
Water Source	Surface	Included	It is an adequate supply (adjudicated) to meet project needs (1)
	Underground	Eliminated	It is not a sufficient supply to meet project needs (1)
Power Source	Purchase	Included	Most feasible in terms of efficiency and cost (2)
	Cogeneration	Included	Feasible use of byproduct energy (2)
Product Transport Methods	Pipeline	Included	Proven procedure for transport of oil products (2)
	Railroad	Eliminated	Logistics of transport of shale oil by railroad not proven, nor is it anticipated to be economical (2)
	Truck	Eliminated	Logistics of transport of shale oil by truck not acceptable (2)
Product Pipeline Route	La Sal	Included	Most feasible method of transport, approved project (2)
	Rangely	Included	Pipeline route established and previously analyzed (2)
Retort Site	Mesa	Included	Acceptable from an air quality impact standpoint (2)
	Valley	Eliminated	Projected unacceptable air quality impacts (2)
Upgrading Site	Mesa (Retort Site)	Included	Acceptable from an air quality impact standpoint; potential energy savings (2)
	Remote Location	Eliminated	Unacceptable logistics to move raw oil shale (2)

Table 2.2-1 ALTERNATIVES CONSIDERED FOR OR ELIMINATED FROM DETAILED STUDY, GETTY SHALE OIL PROJECT (concluded)

Alternative Category	Alternative Considered	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination (Alternative Type)[a]
Spent Shale Disposal	Wiesse Creek	Included	Close to retort sites; potential energy savings; environmentally acceptable (2)
	Tom, Buck, Doe Gulches	Included	Areas available for disposal (2)
	Underground Disposal	Included	Concept feasible but subject to technical and economic problems (2)
Retort Additions Site	Mid Property	Included	Potential energy savings if associated with second mine production inclines (2)
	Initial Site	Eliminated	Economic constraint due to distance from ore production and spent shale disposal (4)
Access Road	Getty Property	Included	No land ownership concerns; standard procedure (2)
	Other's property	Eliminated	Unacceptable anticipated logistics problems (4)
Water Supply System	GCC Joint Venture, Roan Creek Diversion and Reservoir, Tom Creek Reservoir	Included	Acceptable on an economical and technical basis; in advance stage of planning (1)
	GCC Joint Venture, Roan Creek Diversion, Tom Creek Reservoir, and West Fork Parachute Creek Reservoir	Included	Acceptable on an economical and technical basis; allows potential for emergency water supply (1)
	Ruedi Reservoir and Colorado River Diversion	Eliminated	Unacceptable source on an economic basis (4)
	Una Reservoir and Colorado River Diversion	Eliminated	Unacceptable source on an economic basis (4)
Transmission Line Corridor	Roan and Parachute Creeks	Included	Increased reliability due to looped system (2)
	Big Salt Wash Corridor	Included	Route previously established and analyzed (2)

[a] Alternative type as defined by Corps of Engineers regulations (33 CFR 230.26, Appendix B, paragraph 11b[5]).
The definitions of alternative type are summarized below:
(1) Within the capability of the applicant and within the jurisdiction of the Corps of Engineers
(2) Within the capability of the applicant, but outside the jurisdiction of the Corps of Engineers
(3) A reasonably foreseeable alternative, beyond the capability of the applicant but within the jurisdiction of the Corps of Engineers
(4) A reasonably foreseeable alternative, beyond the capability of the applicant and outside the jurisdiction of the Corps of Engineers
The regulations cited above should be consulted for additional explanation of alternative type.

Table 2.2-2 ALTERNATIVES CONSIDERED FOR OR ELIMINATED FROM DETAILED STUDY, CITIES SERVICE SHALE OIL PROJECT

Alternative Category	Alternative Considered	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination (Alternative Type)[a]
Production Rate	100,000 bpd	Included	Current design basis. Most economical and efficient production rate (2)
	50,000 bpd	Included	May reduce overall daily impacts; but not overall impacts; may extend life of operation (2)
Mining Method	Underground/Vertical Modified In Situ (VMIS)	Included	The combination of underground and MIS mining includes the ability to select rich oil shale and maximize resource recovery (2)
	Surface	Eliminated	Uneconomical due to high ratio of overburden to reasonable grade oil shale resource (4)
	Underground	Included	Viable means of resource extraction (2)
Retort Type	Surface/Vertical Modified In Situ (VMIS)	Included	The combination of surface and MIS technologies is being tested and demonstrated by Occidental Petroleum (2)
	Vertical Modified In Situ (VMIS)	Eliminated	Use of a single technology results in the waste of the oil shale resource (2)
	Surface	Included	Surface retorting technology has been developed and demonstrated (2)
Surface Retort Technology	Union B	Included	Technology being developed commercially by Union Oil (2)
	Lurgi	Included	Technology developed and demonstrated with numerous tests; would process shale fines (2)
Upgrading	Hydrotreating	Included	The hydrotreating of the shale oil results in a pipeline-compatible product (2)
	Refinery	Eliminated	Sufficient refining capacity is available off-site within reasonable pipeline distance (2)
	Coking	Eliminated	Results in lower syncrude yield (2)
	None	Eliminated	The resulting raw syncrude unacceptable for pipeline transport (4)
Water Source	Surface	Included	It is an adequate supply (adjudicated) to meet project needs (1)
	Underground	Included	While not a sufficient supply to meet total project needs, it remains a viable source for construction and initial project phases (3)
Power Source	Purchase	Included	Feasible in terms of efficiency and cost (2)
	Cogeneration	Included	Feasible use of by-product energy (2)
	Dedicated Power Plant	Eliminated	Uneconomical due to lack of system integration (4)
Product Transport Methods	Pipeline	Included	Proven procedure for transport of oil products (2)
	Railroad	Eliminated	Logistics of transport of shale oil by railroad not proven, nor is it anticipated to be economical (4)
	Truck	Eliminated	Logistics of transport of shale oil by truck not acceptable (4)
Product Pipeline Route	La Sal	Included	Feasible method of transport; approved project (2)
	Rangely	Included	Pipeline route established and previously analyzed (2)
	Gary	Eliminated	Insufficient capacity for anticipated project needs (4)
	SOPS (south)	Eliminated	SOPS pipeline project is in an indefinite state of development (4)

Table 2.2-2 ALTERNATIVES CONSIDERED FOR OR ELIMINATED FROM DETAILED STUDY, CITIES SERVICE SHALE OIL PROJECT (concluded)

Alternative Category	Alternative Considered	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination (Alternative Type)[a]
Retort Site	Mesa	Included	Suitable from an air quality impact standpoint (2)
	Valley	Eliminated	Projected unacceptable air quality impacts (4)
Upgrading Site	Mesa	Included	Suitable from an air quality impact standpoint (2)
	Valley	Eliminated	Projected unacceptable air quality impacts (4)
	Remote Location	Eliminated	No site available (4)
Spent Shale Disposal	Conn/Cascade Canyons	Included	Sufficient area and volume, minimize environmental impacts (2)
	Mesa/Cascade Canyons	Included	Viable sites for deposition of spent shale (2)
	Mesa	Eliminated	Insufficient area to handle anticipated volume (4)
	Underground	Eliminated	Method subject to technical and economic problems (4)
Access	On Cities Property	Included	No land ownership concerns; standard procedure (2)
	Rail Access/Road	Included	Feasible method of transport (2)
	Other private property	Eliminated	Unacceptable logistics (4)
	Northern Route	Eliminated	Unacceptable commuting distance and lack of existing road (4)
Water Supply System	GCC Joint Venture	Included	Acceptable on an economical and technical basis; in advance stage of planning (1)
	Larkin Ditch	Included	Acceptable means of obtaining water supply (1)
	Green Mountain Reservoir	Eliminated	Supply indefinite and unacceptable current economics (4)
	Ruedi Reservoir	Eliminated	Supply indefinite and unacceptable current economics (4)
	Una Reservoir	Eliminated	Supply indefinite and unacceptable current economics (4)
	Conn/Cascade Creeks	Eliminated	Insufficient supply (4)
Supplemental Energy	Natural Gas	Included	Existing supply available in the region (2)
	Coal	Eliminated	Unacceptable due to complexity of requirements for design and operation (4)
Fines Processing	Storage	Included	The option of future resource recovery retained (2)
	Retort	Included	Oil may be recovered from fines by installing an additional retort of different technology (2)
Underground Mine Technology	Room-and-Pillar	Included	Technology has been developed and proven for oil shale (2)
	Block Caving	Eliminated	Technology not developed for oil shale mining (4)
	Stoping	Eliminated	Technology not developed for oil shale mining (4)
Transmission Route	Loop to De Beque and Parachute Creek	Included	Looped system provides reliability (2)
	Radial to De Beque	Eliminated	Supply not of adequate reliability (4)
	Radial to Parachute Creek	Eliminated	Supply not of adequate reliability (4)

[a] Alternative type as defined by Corps of Engineers regulations (33 CFR 230.26, Appendix B, paragraph 11b [5]).
The definitions of alternative type are summarized below:
(1) Within the capability of the applicant and within the jurisdiction of the Corps of Engineers
(2) Within the capability of the applicant but outside of the jurisdiction of the Corps of Engineers
(3) A reasonably foreseeable alternative, beyond the capability of the applicant, but within the jurisdiction of the Corps of Engineers
(4) A reasonably foreseeable alternative, beyond the capability of the applicant, and outside the jurisdiction of the Corps of Engineers
The regulations cited above should be consulted for additional explanation of alternative type.

2.3 Description of Proposed Actions and Alternatives

2.3.1 Getty Project

2.3.1.1 Introduction and Overview

Getty Oil Company (Getty) owns properties adjacent to Clear and Roan creeks in Mesa and Garfield counties, Colorado (Figure 2.3-1). If economically justified, Getty proposes to develop the oil shale resource to ultimately produce 100,000 barrels per day (bpd) of shale oil for a period of approximately 30 years. The major components of the proposed operation include:

- An underground mine ultimately producing 150,000 tons per day (tpd) of shale
- Twelve retorting modules located in two areas on the mesa
- Four upgrading modules located on the mesa, each ultimately producing 25,000 bpd of shale oil
- Spent shale disposal in Wiesse Creek
- Support facilities, including a syncrude pipeline, electric transmission line, access road, railroad, and water supply system

A detailed description of the Getty proposed project is presented in Section 2.3.1.2.

Alternative facility sites and process methodologies were considered. Those alternatives considered can be categorized into the following major components.

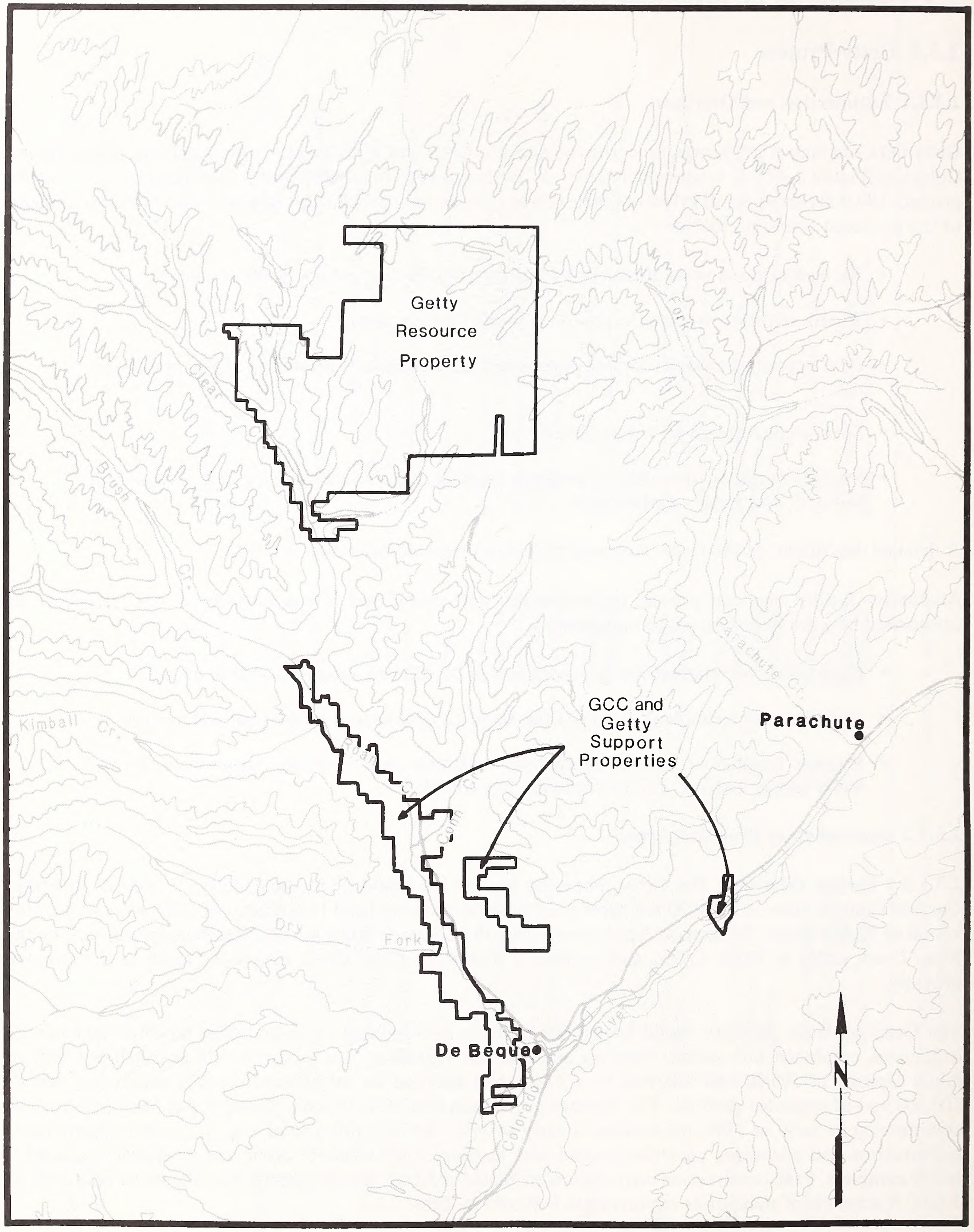
- Production rate alternatives — production of 50,000 bpd versus 100,000 bpd
- Surface retort technology — use of the Lurgi process instead of the Union B process.
- Support facilities — various alternatives regarding pipeline routes, spent shale disposal, water supply systems, and transmission line corridors.

2.3.1.2 Description of Proposed Action

2.3.1.2.1 Project Overview. The Getty properties are located primarily in Range 97W, Township 5S within Garfield County, and consist of 20,880 acres of oil shale resource land and 11,600 acres of valley support land for a total of 32,480 acres. The support lands extend from the Colorado River south of De Beque northward up the Roan Creek valley to Clear Creek, and includes a portion of Clear Creek canyon adjacent to the resource property.

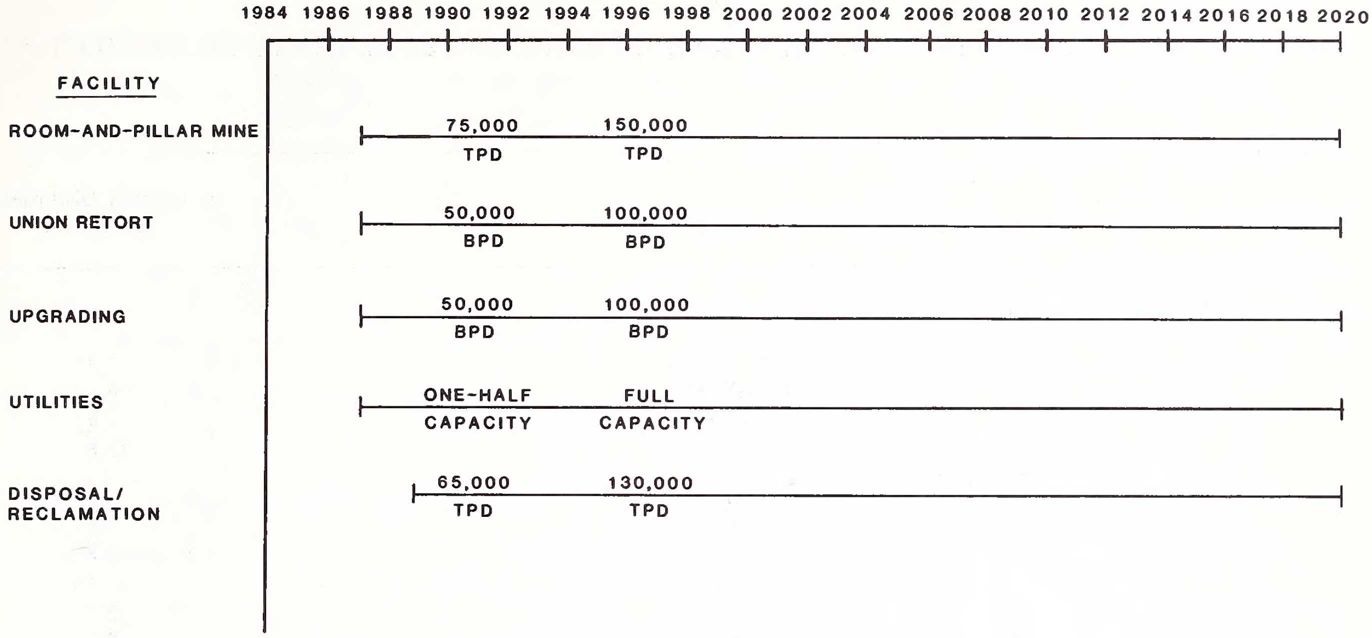
The Getty oil shale property would be developed using conventional room-and-pillar underground mining techniques, combined with surface retorting and shale oil upgrading. The project would be developed with an initial capacity of 50,000 bpd followed by a 50,000-bpd addition for an ultimate capacity production rate of 100,000 bpd of upgraded shale oil. The expected production lifetime is 30 years (Figure 2.3-2), with construction commencing as early as 1987; production as early as 1991. As currently envisioned, manpower requirements (construction and operations personnel) would peak at about 7,200 when the additional production capacity is nearly complete. Peak construction manpower is estimated at 5,000, and the operational manpower ultimately at 3,000. A schedule of manpower requirements is shown in Table 2.3-1.

Getty Oil Company's proposed project may affect public land in Roan Creek valley through development of the GCC Joint Venture reservoir and construction of various road, railroad, and power line rights-of-way. The public lands which may be affected and the area of those lands potentially disturbed are indicated in Table 2.3-2 and are shown on the background of various maps throughout the EIS.



SCALE 1:250,000

Figure 2.3-1 Getty Oil Company Shale Oil Resource Property.



Source: Getty 1983b.

Figure 2.3-2 Getty Shale Oil Project Development Schedule.

Table 2.3-1 GETTY PROJECT WORKFORCE

Year	Construction	Operation	Total
1987	100		100
1988	1,300		1,300
1989	2,500	300	2,800
1990	3,700	1,000	4,700
1991	5,000	1,600	6,600
1992	2,500	1,600	4,100
1993	2,500	1,600	4,100
1994	3,700	1,900	5,600
1995	5,000	2,200	7,200
1996	1,300	2,600	3,900
1997-2020		2,900	2,900

Source: Getty (1983b).

The areas potentially disturbed were determined by planimetry for reservoir inundation. For the rights-of-way, the length of each type of right-of-way in each piece of public land was measured and multiplied by the appropriate right-of-way width. The widths for road and railroad rights-of-way were determined to be approximately 60 feet, and the width for a power line right-of-way was estimated to be 100 feet based on construction experience in Colorado.

Table 2.3-2 PUBLIC LANDS POTENTIALLY AFFECTED BY THE GETTY SHALE OIL PROJECT[a,b,c]

	Public Land	Potentially Disturbed Area (Acres)
PARCEL A (Township 7 South, Range 98 West)		
Section 3:	NW 1/4 NW 1/4	2.7
	NE 1/4 SW 1/4	6.1
	SW 1/4 SE 1/4	3.8
		12.6
Section 10:	NE 1/4 NE 1/4	1.6
	SE 1/4 NE 1/4	7.9
		9.5
Section 11:	NW 1/4 SW 1/4	2.8
	SE 1/4 SW 1/4	0.3
		3.1
Section 14:	SE 1/4 NE 1/4	0.9
	NE 1/4 SE 1/4	8.0
		8.9
Section 13:	NW 1/4 SW 1/4	1.8
	SW 1/4 SW 1/4	2.0
		3.8
Section 24:	NW 1/4 NE 1/4	2.0
	NE 1/4 NE 1/4	1.7
	SE 1/4 NE 1/4	0.8
		4.5
Parcel Total		42.4
Use: Railroad, road, and power line right-of-way Relevant EIS Sections: 2.3.1.2.4, 3.2, 4.2, 2.4.3.1		
PARCEL B (Township 7 South, Range 97 West)		
Section 19:	SW 1/4 NW 1/4	2.2
	SE 1/4 NW 1/4	0.4
	NE 1/4 SW 1/4	2.0
	NW 1/4 SE 1/4	1.3
Parcel Total		5.9
Use: Railroad, road, and power line right-of-way Relevant EIS Sections: 2.3.1.2.4, 3.2, 4.2, 2.4.3.1		
PARCEL C (Township 7 South, Range 98 West)		
Section 36:	NE 1/4 SW 1/4	1.7[d]
	SW 1/4 SE 1/4	12.3[d]
Parcel Total		13.4[d]
Use: Reservoir inundation. Relevant EIS Sections: 2.3.1.2.4, 3.2, 4.2, 2.4.3.1		

Table 2.3-2 PUBLIC LANDS POTENTIALLY AFFECTED BY THE GETTY SHALE OIL PROJECT[a,b,c] (continued)

	Public Land	Potentially Disturbed Area (Acres)
PARCEL D (Township 7 South, Range 97 West)		
Section 31:	NW 1/4 NW 1/4	14.1[d]
	NE 1/4 NW 1/4	8.1
	NW 1/4 NE 1/4	0.1
	SE 1/4 NW 1/4	8.1[d]
	SE 1/4 NW 1/4	1.8
	SW 1/4 NE 1/4	7.0
	NE 1/4 SW 1/4	23.1[d]
	NW 1/4 SE 1/4	7.4[d]
	NW 1/4 SE 1/4	3.1
	NE 1/4 SE 1/4	6.9
	SW 1/4 SE 1/4	14.9[d]
	SE 1/4 SE 1/4	5.21[d]
		99.81
Section 32:	NW 1/4 SW 1/4	7.1
	SW 1/4 SW 1/4	17.0[d]
		24.1
Parcel Total		120.91
Use: Reservoir inundation and railroad, road, and power line right-of-way.		
Relevant EIS Sections: 2.3.1.2.4, 3.2, 4.2, 2.4.3.1		
PARCEL E (Township 7 South, Range 97 West)		
Section 1:	NE 1/4 NE 1/4	14.3[d]
	SW 1/4 NE 1/4	2.3[d]
	SE 1/4 NE 1/4	8.6[d]
	NW 1/4 SE 1/4	3.4[d]
	NE 1/4 SE 1/4	30.5[d]
	SE 1/4 SE 1/4	6.7[d]
Parcel Total		65.8[d]
Use: Reservoir inundation.		
Relevant EIS Sections: 2.3.1.2.4, 3.2, 4.2, 2.4.3.1		
PARCEL F (Township 8 South, Range 97 West)		
Section 5:	NW 1/4 NW 1/4	19.5[d]
	NW 1/4 NW 1/4	5.2
	NE 1/4 NW 1/4	5.2[d]
	NE 1/4 NW 1/4	7.7
	SW 1/4 NW 1/4	3.1
	NW 1/4 SW 1/4	1.1
	SW 1/4 SW 1/4	1.1
		42.9

Table 2.3-2 PUBLIC LANDS POTENTIALLY AFFECTED BY THE GETTY SHALE OIL PROJECT[a,b,c] (continued)

	Public Land	Potentially Disturbed Area (Acres)
PARCEL F (Township 8 South, Range 97 West) (cont.)		
Section 6:	NW 1/4 NE 1/4	40.0[d]
	NE 1/4 NE 1/4	35.9[d]
	NE 1/4 NE 1/4	0.1
	SW 1/4 NE 1/4	40.0[d]
	SE 1/4 NE 1/4	10.8[d]
	SE 1/4 NE 1/4	4.2
	NW 1/4 SE 1/4	40.0[d]
	E 1/4 SE 1/4	13.3[d]
	NE 1/4 SE 1/4	4.9
	SW 1/4 SW 1/4	17.2[d]
	SE 1/4 SE 1/4	13.3[d]
	SE 1/4 SE 1/4	4.7
		224.4
Parcel Total		267.3
Use: Reservoir inundation and railroad, road, and power line right-of-way Relevant EIS Sections: 2.3.1.2.4, 3.2, 2.4, 2.4.3.1		
PARCEL G (Township 8 South, Range 97 West)		
Section 8:	NW 1/4 NW 1/4	2.2
	SW 1/4 NW 1/4	3.5
	NW 1/4 SW 1/4	3.3
	SW 1/4 SW 1/4	1.7
		10.7
Section 16:	SW 1/4 SW 1/4	0.1
		0.1
Section 21:	SE 1/4 NW 1/4	6.4
	NE 1/4 NW 1/4	0.7
	SW 1/4 NE 1/4	0.9
		8.0
Section 22:	SE 1/4 SW 1/4	0.4
	SE 1/4 SE 1/4	2.5
		2.9
Section 27:	NE 1/4 NW 1/4	4.7
	NW 1/4 NE 1/4	1.9
		6.6
Parcel Total		28.3
Use: Railroad, road, and powerline right-of-way Relevant EIS Sections: 2.3.1.2.4, 3.2, 4.2, 2.4.3.1		

Table 2.3-2 PUBLIC LANDS POTENTIALLY AFFECTED BY THE GETTY SHALE OIL PROJECT[a,b,c] (concluded)

	Public Land	Potentially Disturbed Area (Acres)
PARCEL H (Township 6 South, Range 98 West)		
Section 15:	SW 1/4 SE 1/4	10.0
	S 1/2 SW 1/4 SW 1/4	8.1
		18.1
Section 22:	W 1/2 NW 1/4	80.0
	N 1/2 SW 1/4	64.0
	SE 1/4 NW 1/4	10.2
	S 1/2 S 1/2 SE 1/4 SW 1/4	9.4
		163.6
Section 27:	NE 1/4 SW 1/4	20.0
	NW 1/4 SE 1/4	20.0
	E 1/2 NW 1/4	36.4
	W 1/2 NE 1/4	36.4
	S 1/2 S 1/2 SW 1/4	8.1
		120.9
Section 34:	NW 1/4 NW 1/4	32.2
		32.2
Parcel Total		334.8
Use: Corridor for power, railroad, and water pipeline Relevant EIS Sections: Impacts to these lands are addressed in Mobil-Pacific Oil Shale EIS (BLM 1984a) Sections 4.1.1.1, 4.1.1.5, 4.2, 4.3, 4.4.3.1.		
PARCEL I (Township 6 South, Range 97 West)		
Section 3:	SW 1/4 SW 1/4 SW 1/4	6.0
Section 4	NW 1/4 SE 1/4	20.0
Section 10	NW 1/4 NW 1/4 NW 1/4	14.0
Parcel Total		40.0
Use: Alternative spent shale disposal, road corridor. Relevant EIS Sections: 2.3.1.3, 3.2, 4.2, 2.4.3.1.		

Source: Getty (1984b).

[a] No federal lands were identified north of the Getty property where the interconnection to the La Sal pipeline would occur.
[b] Baseline studies covering these areas include: GCC (1981a,b,c,d,e,f; 1982a,b,c,d,e,f)
[c] The lands potentially affected by the GCC reservoir were calculated considering the maximum (175,000 ac-ft) reservoir size.
[d] Values represent reservoir inundation.

A total of 65 plots of approximately 40 acres and two approximately 6-acre plots were identified as public lands which would be affected by the project as currently proposed. Therefore, approximately 2,600 acres of public land would potentially need to be acquired. Of those lands, only approximately 500 acres would actually be affected (see Table 2.3-2). The reservoir would require acquisition of twenty-five 40-acre plots and the various rights-of-way would require acquisition of an additional forty 40-acre plots and two plots less than 10 acres each of public land.

2.3.1.2.2 Facility Sites and Processes. Major elements of the project include an underground room-and-pillar mine, retorting and upgrading facilities, raw shale transporting systems, a retorted (spent) shale disposal system, and a water supply system. The general arrangement of the proposed project facilities is shown in Figure 2.3-3. The detailed plot plans are shown as Figure 2.3-4.

Support facilities include a product syncrude pipeline, a natural gas pipeline, electric transmission loop, access road, railroad, and a water pipeline. A product (syncrude) intertie pipeline is planned from the upgrader modules to the La Sal pipeline. Road and rail access is planned up the Roan Creek and Clear Creek valleys. Total electric power requirements for 100,000 bpd-production would be approximately 210 Mw (Table 2.3-3). Water usage would average approximately 17,000 gpm (Table 2.3-4). Fuel utilized within the proposed project would include high-Btu gas, upgraded shale oil, natural gas, and diesel fuel. Total quantities of fuel use would be 6,750 MM Btu/hr (Table 2.3-5).

The water management plan is based on zero discharge, with all the process wastewater streams being treated and reused. Off-site water would be clarified to provide cooling tower makeup and treated to provide potable water. Sanitary wastewater would be treated biologically, and process wastewater would be separated into oily water and sour water. Oily water would be treated in an API separator; sour water would be stripped of ammonia and acid gas.

Details on each of the components of the project, including mining, feed preparation and handling, retorting, upgrading, and spent shale disposal, are presented in the following sections. Details on the various waste streams associated with the proposed project are presented in Section 2.3.1.2.3.

Mining

The oil shale resource (Mahogany Zone) is about 100 feet thick centered at approximately 7,500 feet above mean sea level (MSL). Underground mining is planned to extract the oil shale from a horizon 60 feet thick. The mining operation would cover the surface equivalent of approximately 13,800 acres and would progress as shown on Figure 2.3-5. Underground mining will advance up to the Getty property line, in accordance with standard mining practice and in compliance with Colorado mining law. The surface disturbances associated with the underground mine would comprise approximately 50 acres.

The main features of the underground mine would be the mine bench, vertical shafts, decline, adits, production panels, service facilities, and ventilation system. The mine bench would be constructed to provide horizontal access to the Mahogany Zone on the east wall of Tom Creek canyon. A decline would be sited to the west of the initial surface processing site to provide access to either the raw shale stockpile or the feed preparation plant. A vertical shaft would be constructed at the retort additions site. The second mine may or may not be connected to the first mine for safety, operating, economic, or other reasons. Production panels would be approximately 1,000 feet wide and 2,000 feet long, situated on both sides of the entry drifts.

Mine development on the Getty property is expected to produce approximately 200,000 tons of waste rock. In addition, 1,310,000 tons of quality oil shale would be mined during the development stage, crushed, and stored for later use during startup of the surface facilities.

Mine service facilities would include dewatering, refueling, vehicle and equipment storage, warehousing, and personnel services. Mine safety facilities would also be included.

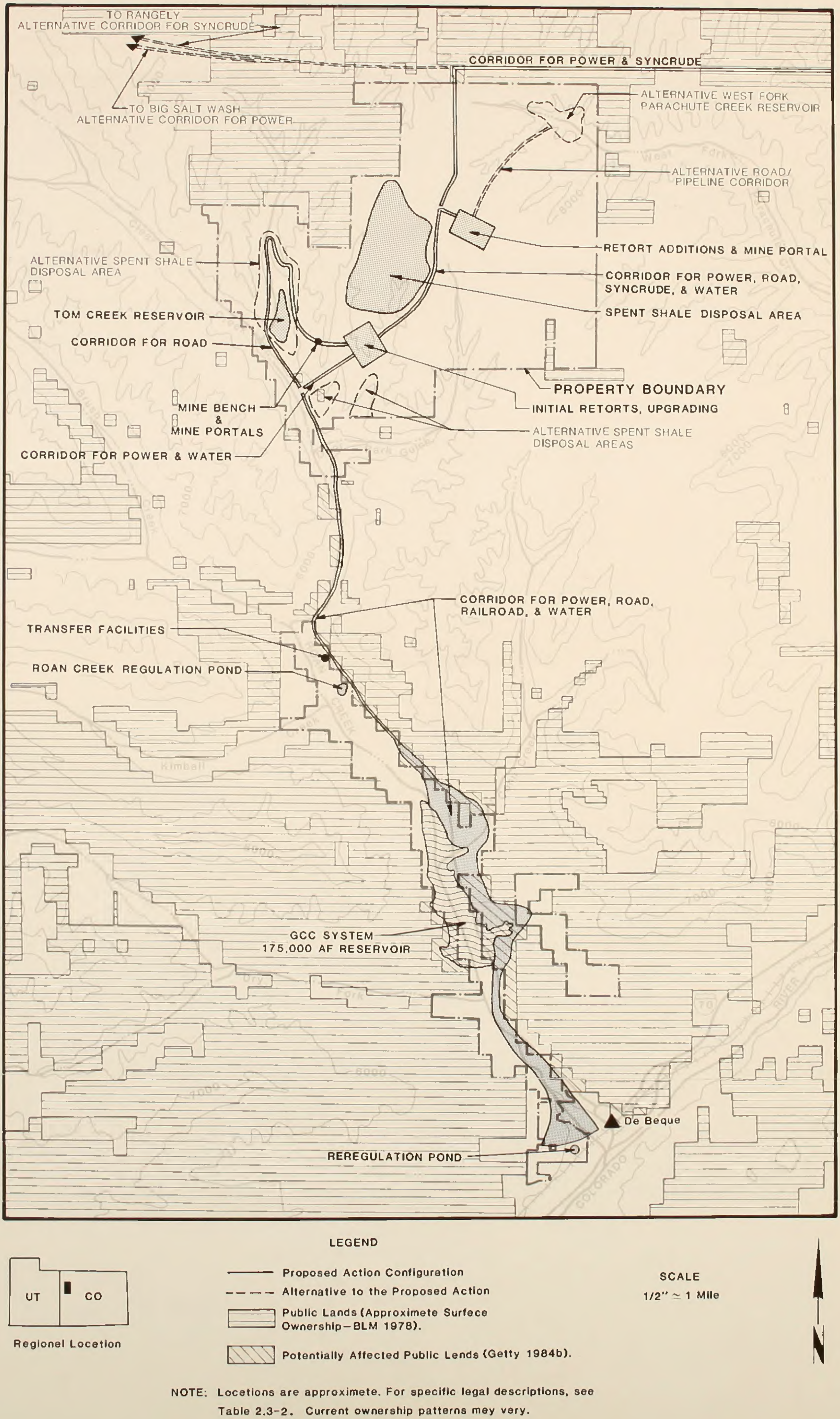


Figure 2.3-3 General Arrangement of Proposed Project Facilities, Getty Shale Oil Project.

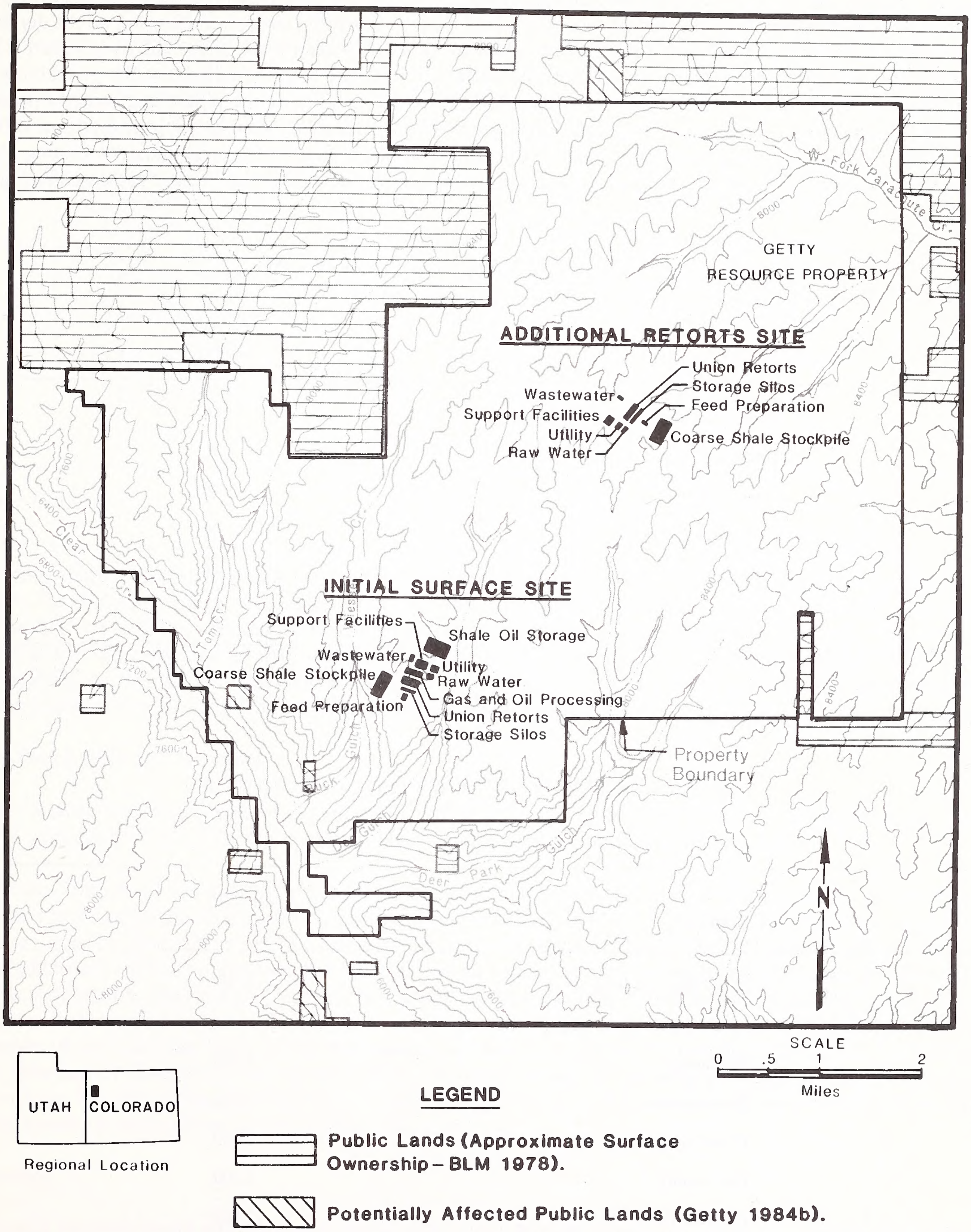


Figure 2.3-4 Plot Plan for Initial Surface Site and Additional Retorts Site, Getty Shale Oil Project.

One of several objectives of the mining plan is to maximize oil shale resource recovery. The planned resource recovery within the proposed mining height is about 75 percent within the panels or about 60 percent overall. The support pillars would be approximately 60 feet high by 60 feet square. This mine plan is the state-of-the-art for oil shale room-and-pillar mining. The mining recovery percentage and the pillar sizes would depend on the depth of the overburden over the panels in all areas of the planned mine. In other words, where the overburden is the greatest, the mining recovery would be the lowest. Surface subsidence is a possibility but the probability of occurrence is, by design, relatively low. As mining progresses the stability of the pillars and mined openings would be closely monitored by the rock mechanics program. These data, along with the mining experience gained during the mine development and initial years of operation, would be employed to optimize the mining plan, mine stability, and the resource recovery. A conceptual diagram of underground mining is presented in Figure 2.3-6.

Table 2.3-3 GETTY PROJECT POWER USE

Purpose	Quantity (Mw)
Mining, Crushing, and Conveying	80
Union Retort	70
Upgrading	30
Raw Water Supply	10
Miscellaneous[a]	20
TOTAL	210

Source: Getty (1983b).

[a] Includes utility and support services.

Table 2.3-4 GETTY PROJECT WATER CONSUMPTION

Purpose	Quantity (gpm)
Spent Shale Cooling	6,500
Spent Shale Moisturizing	2,000
Upgrading	2,000
Reclamation	1,500
Power Generation	1,500
Community	1,500
Miscellaneous[a]	2,000
TOTAL	17,000

Source: Getty (1983b).

[a] Includes mine, crushing facilities, potable water, service water, and water treatment losses.

Table 2.3-5 GETTY PROJECT FUEL CONSUMPTION

Combuster	Quantity (MM Btu/hr)	Fuel Type
Recycle Gas Heater	3,000	High-Btu Gas/Natural Gas
Reboiler	300	High-Btu Gas/Natural Gas
Boiler	1,000	High-Btu Gas/Natural Gas
Reformer Heater	2,000	Shale Oil/Natural Gas
Hydrotreater Heater	200	Shale Oil/Natural Gas
Tail Gas Incinerator	50	High-Btu Gas/Natural Gas
Mobile Equipment	200	Diesel Fuel
TOTAL	6,750	

Source: Getty (1983b).

The mine ventilation system would be sized to control dust levels to meet Mine Safety and Health Administration standards. Within the mine, wet suppression and deposition in the exhaust system would control particulate emissions from blasting, mining, and transfer operations. Surface material handling of dry, high-volume material would include dust control systems at transfer points, screening, and crushing operations. Particulate emissions from disposal and stockpile areas would be suppressed by dust control methods and minimizing the area exposed to wind erosion. The water management plan would be based on zero discharge to surface streams.

Feed Preparation and Handling

The raw shale would be hauled to the mine bench. Primary crushing of shale would be conducted on the mine bench with conveying to a feed preparation plant located near the initial surface plant site.

The main features of raw shale handling would be the primary crusher, conveyor system, coarse ore stockpile, and feed preparation plant. The primary crusher would produce raw shale of less than 12 inches in size. From the primary crusher, raw shale would be conveyed to either the stockpile or the feed preparation plant. The ore stockpile would contain approximately 1,000,000 tons and would be used to compensate for surges in either mine or retort operation. The feed preparation plant would perform secondary crushing and screen-out fines less than 2 inches in size, prior to conveying ore to the storage silo serving each Union B retort. The fines would be disposed of with the spent shale, unless the quantity justifies the addition of a fine shale feed retort. In the event that retorting of fines proves to be economical, the likely choice of retorting processes would be the Lurgi technology. Because of the uncertainty of the need for fines retorting, it is not a part of the proposed action. The Lurgi process is evaluated as an alternative in Section 2.4.

Retorting

Retorting facilities would utilize Union B retorts. The Union B retort process is a continuous process, where shale is fed through the bottom of the inverted cone vessel by a rock pump (Figure 2.3-7). Hot gases enter the top of the retort and pass down through the rising bed, causing kerogen pyrolysis. The shale oil and gas flow down through the bed. The oil accumulates in a pool at the bottom, which seals the retort and acts as a settling basin for entrained shale fines. The shale oil and gas are withdrawn from the bottom and top of the pool, respectively. The gases are split into three streams. One is reheated and reinjected to induce additional kerogen pyrolysis; one is

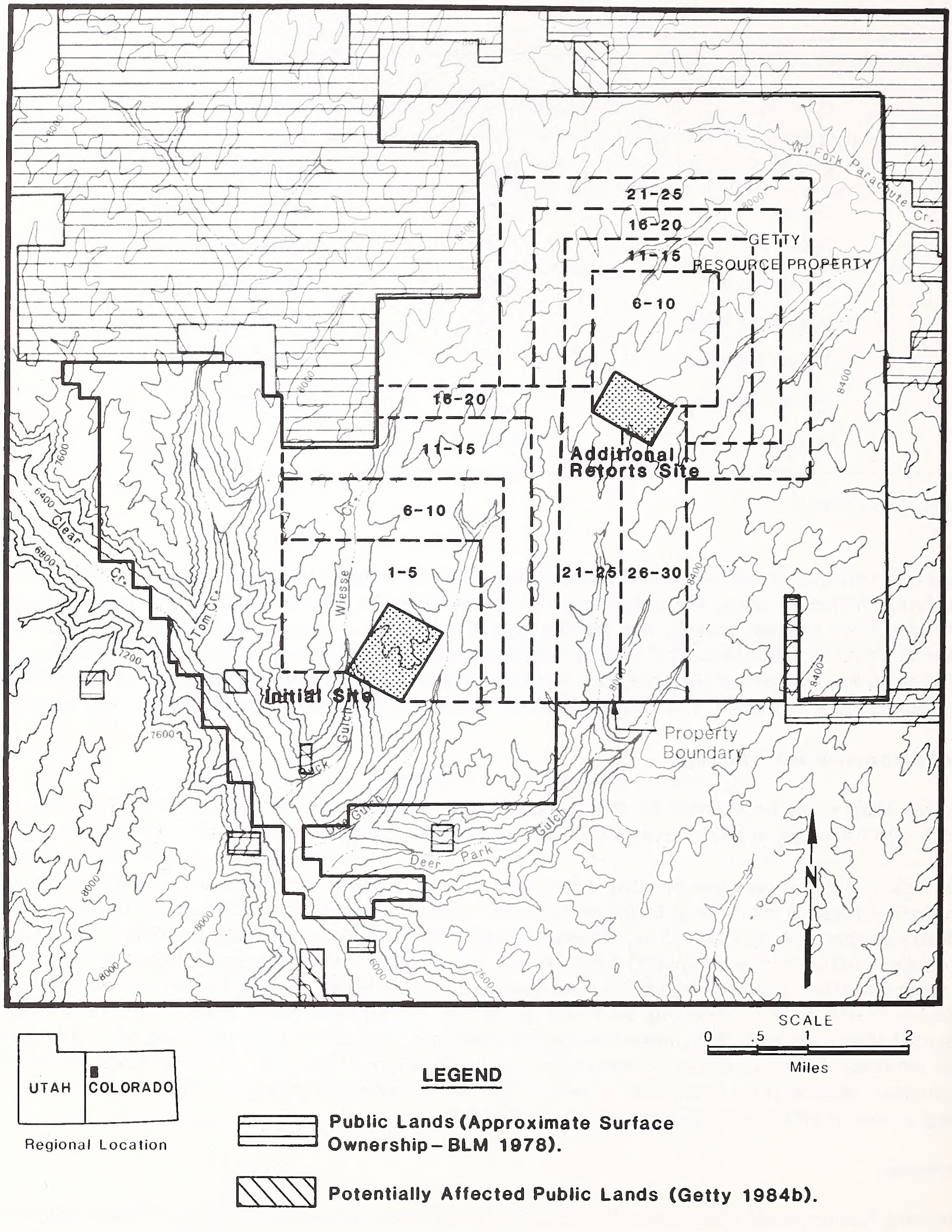
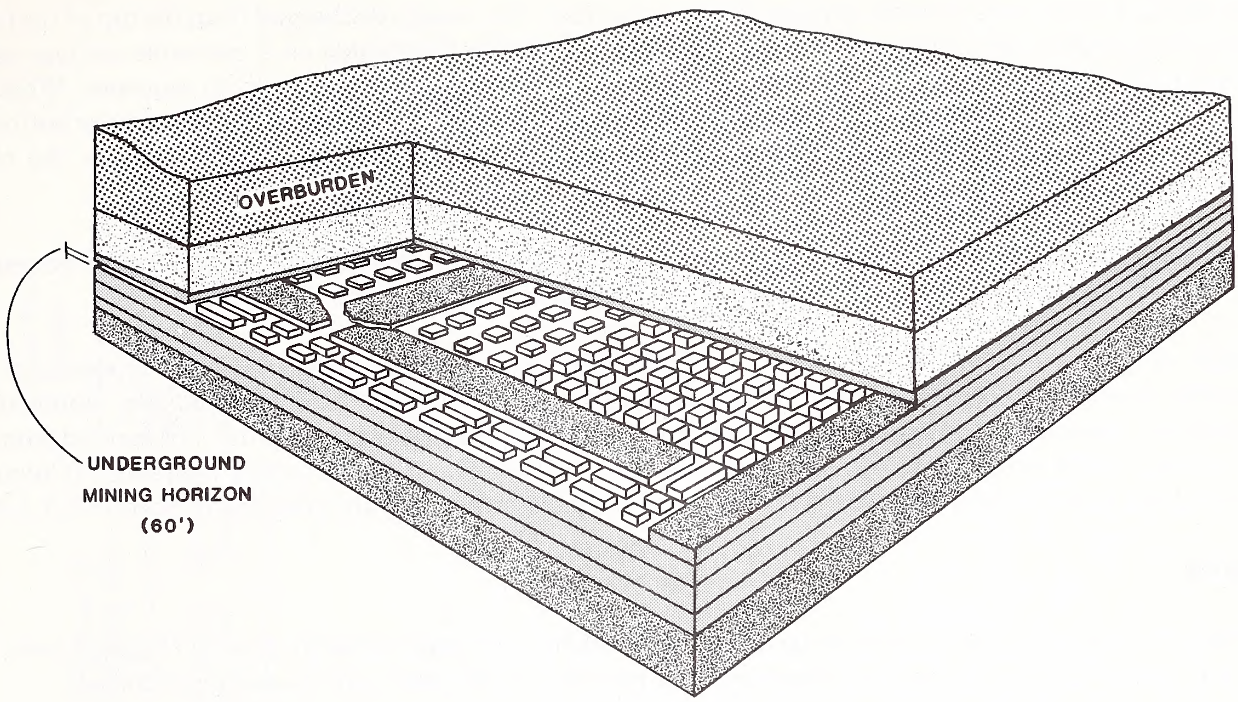
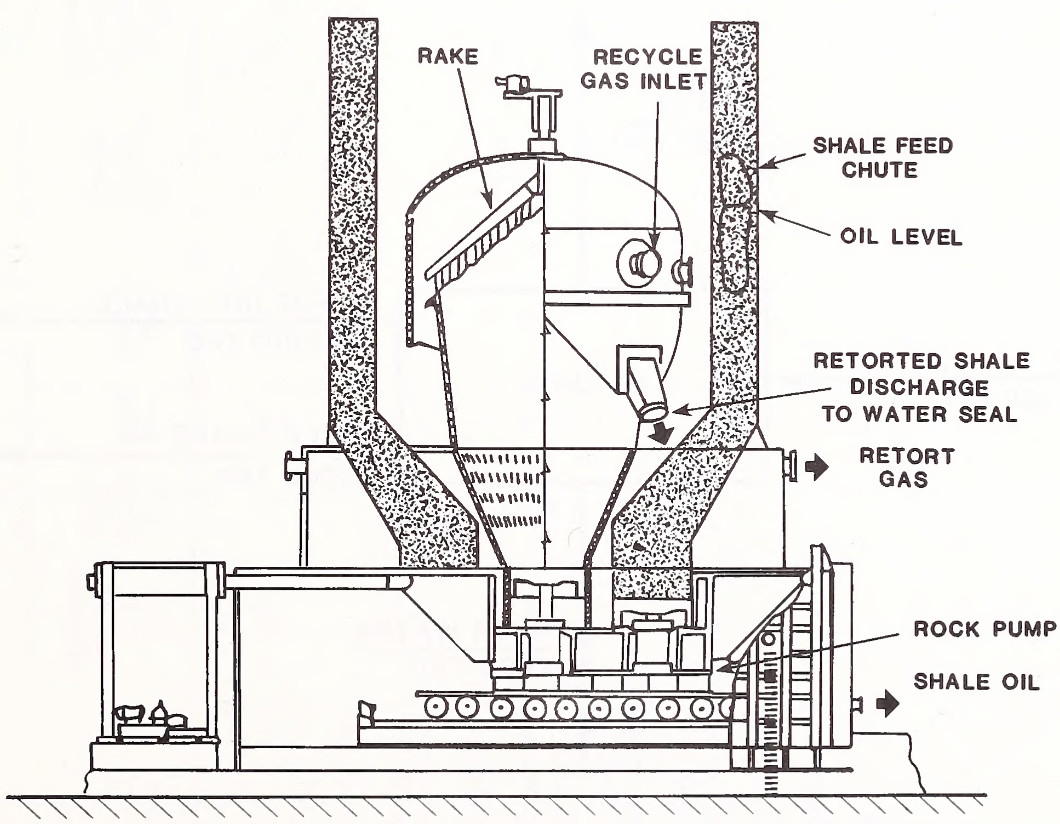


Figure 2.3-5 Mine Progression (years), Getty Shale Oil Project.



Source: Adapted from BLM (1983a).

Figure 2.3-6 Conceptual Diagram of Underground Mining, Getty Shale Oil Project.



Source: Getty (1983b).

Figure 2.3-7 Conceptual Diagram of the Union Oil "B" Retorting System.

used as fuel in the reheating furnace; and one is the net product. The shale is discharged from the top of the retort and falls into a water bath in the spent shale cooler. The rock pump is mounted on a moveable carriage and is immersed in the shale oil pool. The pump consists of two hydraulic assemblies that act in sequence. While the cylinder of one assembly is filling with spent shale, the other is charging a batch of raw shale into the bottom of the retort. When this operation is completed, the carriage moves until the full cylinder is under the retort entrance, and the process is reversed.

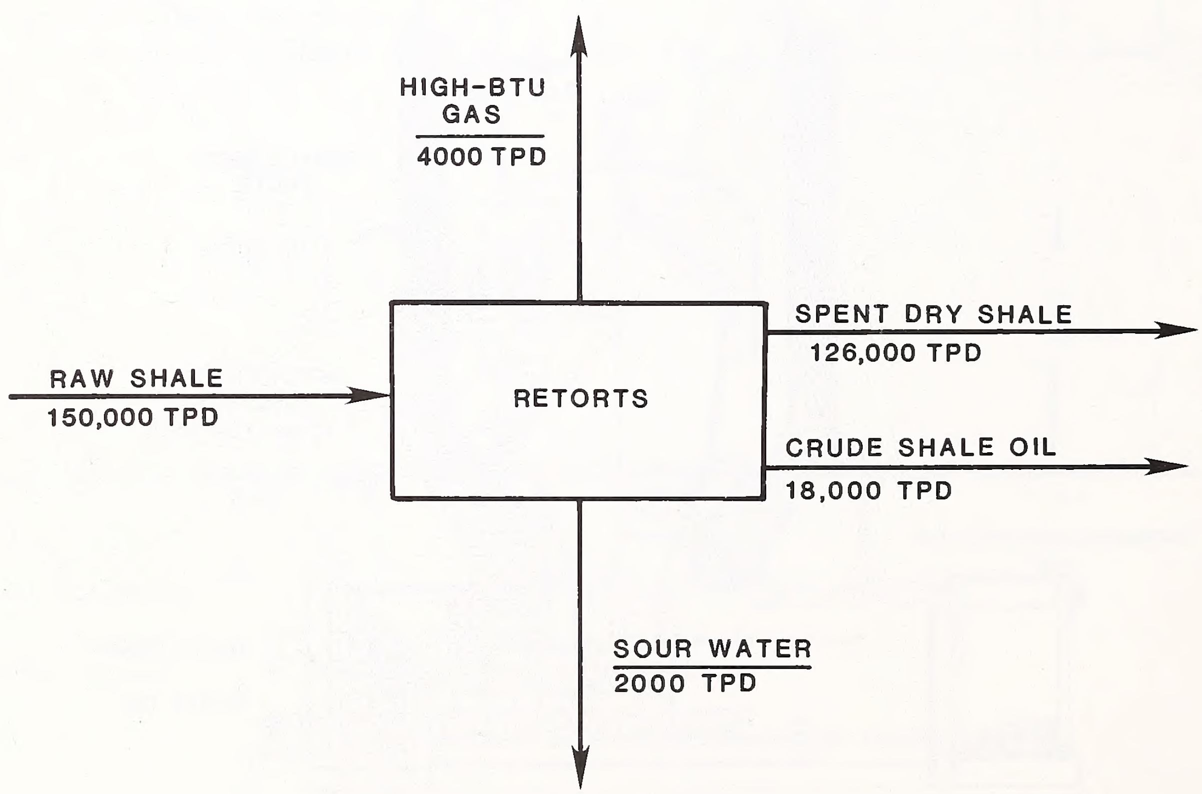
The raw shale oil resulting from this process is approximately 2 percent by weight nitrogen, and 0.8 percent by weight sulfur. The material balance for the Union B retort process is shown in Figure 2.3-8.

Emissions of primary pollutants are shown in Table 4.2-6. Union Oil Company (1982a) reports that the combustion source emissions occur for sulfur dioxide, nitrogen dioxide, carbon monoxide, nonmethane hydrocarbons, particulates, and sulfuric acid mist. All other regulated pollutants are either not emitted from the retort process, or are estimated to be below regulated levels considering the total facility operations (Union Oil Company 1982a). Additional information on waste streams from retorting are provided in Section 2.3.1.2.3.

Upgrading

Upgrading facilities would be located on the mesa, and would occupy approximately 30 acres (Figure 2.3-4). The retort and upgrading plants would be connected by a pipeline running through the middle of the site.

The upgrading process takes blended and filtered raw shale oil and catalytically hydrotreats it to remove nitrogen, sulfur, and metal compounds. The nitrogen content would be reduced to approximately 1,000 ppm and sulfur content to approximately 10 ppm. A portion of the product oil may be used directly for fuel. A flow diagram of the upgrading process is shown in Figure 2.3-9. On-site storage would include 1,500,000 barrels (each) for raw and upgraded shale oil.



Source: Getty (1983b).

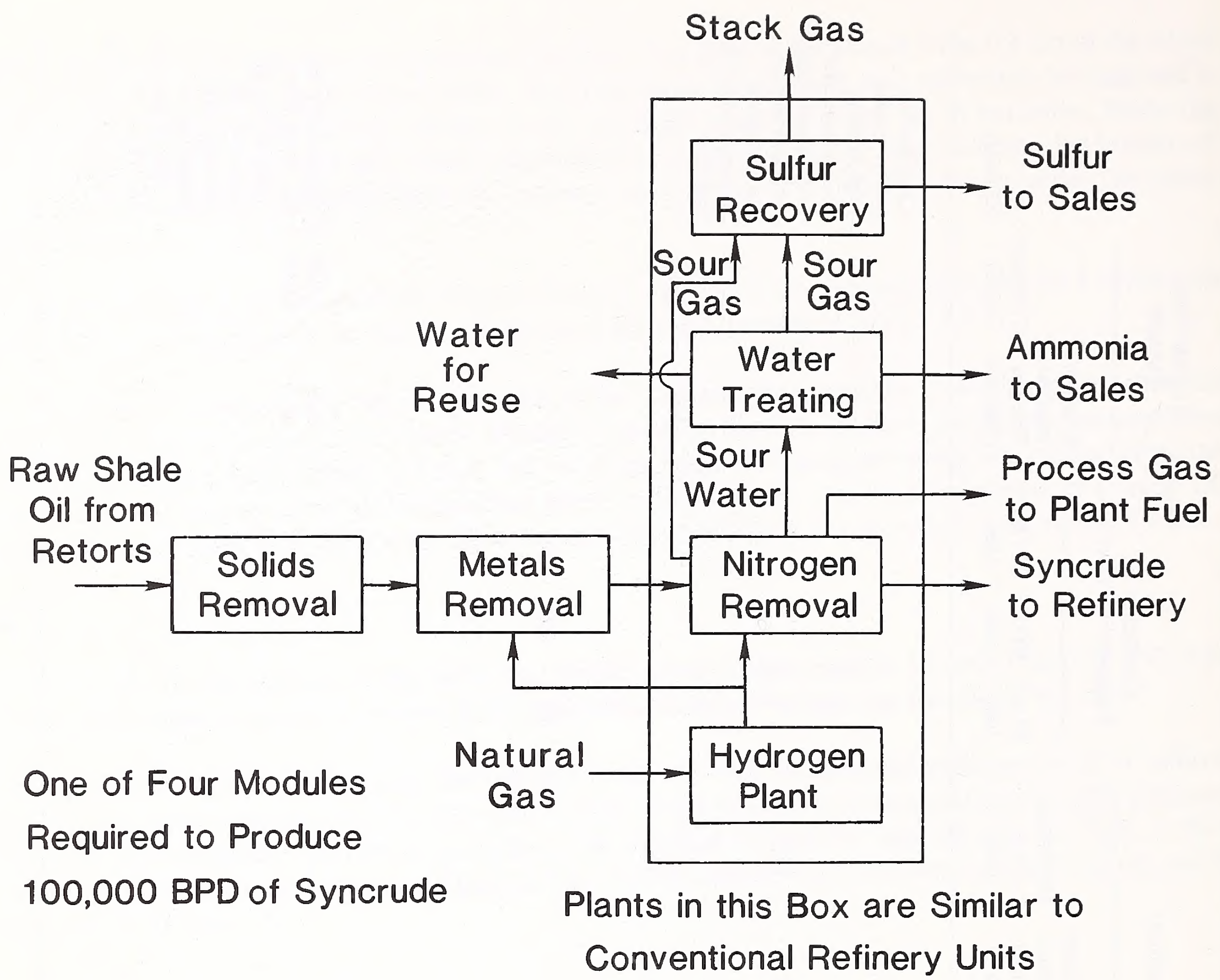
Figure 2.3-8 Union Oil "B" Retort Material Balance, Getty Shale Oil Project.

Table 2.3-6 PHYSICAL PROPERTIES OF UNION B RETORTED SHALE[a]

Item/Condition	Gradation: Maximum Particle Size (in.)	Silt[b] & Clay (%)	Sand[c] (%)	Gravel[d] (%)	Compaction: Specific Gravity (apparent)	Optimum Moisture Content (%)	Maximum Dry (pcf)	Coefficient of Permeability (ft/yr): 50 psi load	100 psi load	200 psi load	Triaxial Shear Strength: Angle of Internal Friction (degrees)	Cohesion (psf)	Remarks
As received													Classified as poorly graded, slightly silty, sand gravels (GP-GM) in accordance with Unified Soil Classification System (ASTM D 2487)
1978 data	1.5	10	28	62									
1982 data	3	8	26	66									
Compacted to ASTM D 1557					2.56	20.5	99.4						
Before Compaction	3/4	31	25	44									
After Compaction	3/4	54	31	15									
Compacted to ASTM D 698					2.56	22.1	93.9				36.1	1,300	
Before Compaction	3/4	31	25	44									
After Compaction	3/4	48	31	21									
96.6 pcf dry density, 23.6% moisture cont.								3.4	4.6	4.1			
99.4 pcf dry density, 20.5% moisture cont.								4.0	2.9	2.6			
Specific Gravity Range					2.52-2.59								
Confining Pressure													Values reported for Stress Path Analysis for tri-axial tests on retorted shale compacted to ½ ASTM D 698 and ASTM D 698 conditions and for centrifuge tests.
0-80 psi											38.4	630	
70-320 psi											35.4	2,350	

Source: In-Situ (1984).

[a] Properties summarized from those reported in Colorado Mined Land Reclamation Board Permit Application, Phase II, Parachute Creek Shale Oil Program, Parachute, Colorado (UOC 1982b) and Long Ridge Experimental Shale Oil Plant Mined Land Reclamation Permit Application (UOC 1979); both by Union Oil Company of California.
[b] Smaller than No. 200 sieve.
[c] No. 4 to No. 200 sieve.
[d] Plus No. 4 sieve.



Source: Getty (1983b).

Figure 2.3-9 Flow Diagram of Upgrading Process, Getty Shale Oil Project.

Off-gas and sour water from the hydrotreaters are sent to gas cleaning and sour water treatment, respectively. Hydrogen for hydrotreating is furnished from the hydrogen plant by steam reforming retort gas and hydrogen purification. The gas cleaning plant recovers oil, removes acid gas for sulfur recovery, and provides treated fuel gas. Sour water is processed to recover ammonia, stripped of acid gas, and is reused. Acid gas is treated to recover elemental sulfur. Additional information on waste streams from upgrading is provided in Section 2.3.1.2.3.

Approximately 500 tpd of ammonia and 400 tpd of sulfur would be recovered in the sour water and sulfur recovery plants, respectively. Approximately 10 days of on-site storage would be provided. Both by-products would be trucked to a transfer station in the Roan Creek valley and loaded into rail cars for transport to markets.

Spent Shale and Waste Rock Disposal

Pile Construction. At the ultimate production rate of 100,000 bpd, approximately 130,000 tons of spent shale would be generated per day. The total amount of spent shale generated for the project life would amount to approximately 1,300 million tons, and would be deposited in the Wiesse Creek Gulch (Figure 2.3-3). As previously mentioned, approximately 200,000 tons of waste rock would be produced during mine development. This waste rock would also be deposited in Wiesse Creek gulch. The progression of spent shale disposal is shown on Figure 2.3-10.

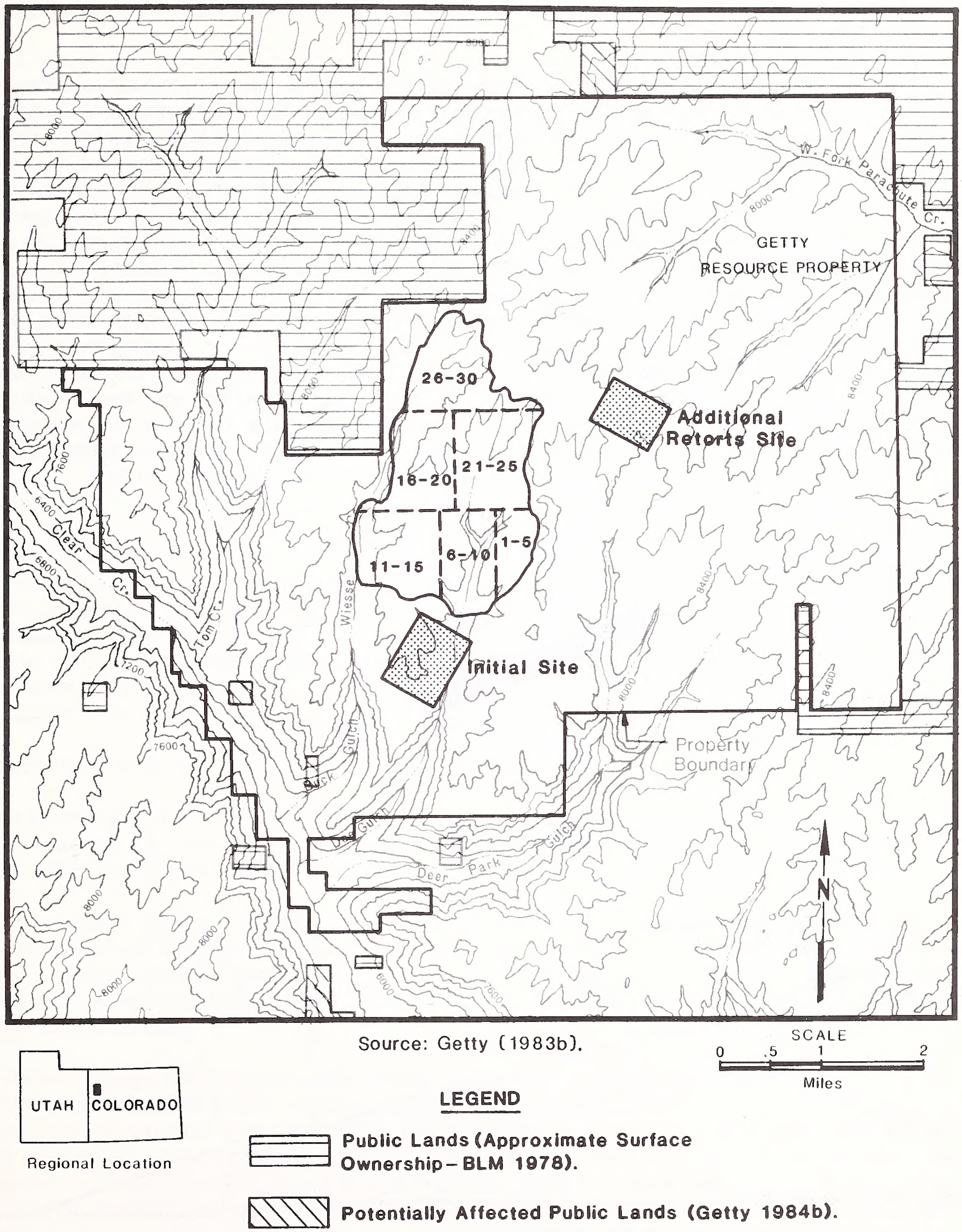
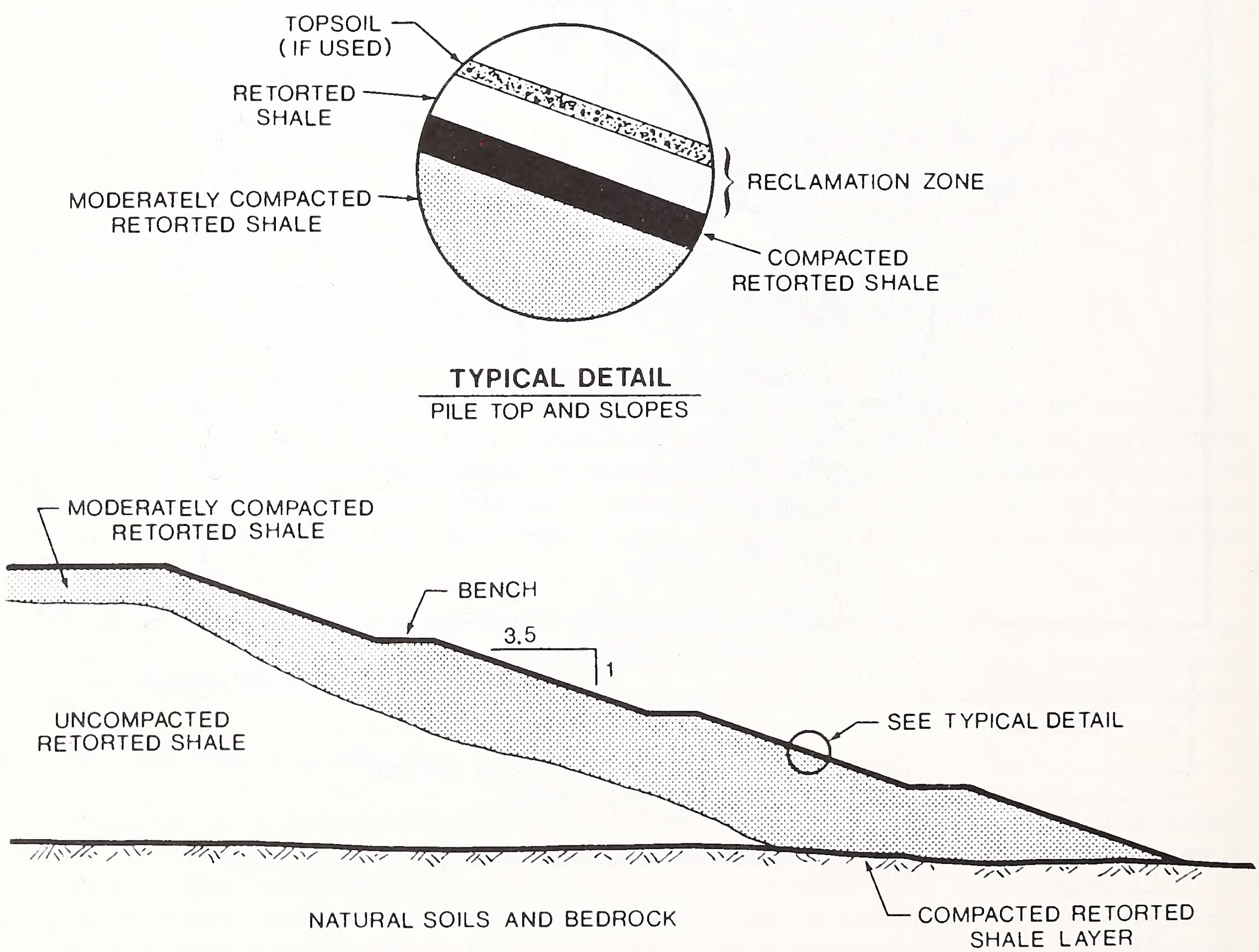


Figure 2.3-10 Spent Shale Disposal Progression (years), Getty Shale Oil Project.

The proposed spent shale pile involves the construction of a layered fill made entirely of retorted shale. Past investigations indicate that this technique provides a disposal pile that is economically and environmentally sound (Gerhart and Holtz 1981; In-Situ 1984; UOC 1982b). A cross-section of the spent shale disposal pile is presented in Figure 2.3-11.

Prior to the disposal of the shale, topsoil would be removed and stockpiled. Most of the retorted shale would then be dumped in thick, uncompacted lifts. However, prior to and concurrent with placement of the dumped retorted shale, a compacted retorted shale lining would be placed over the ground surface. The primary purpose of the compacted lining would be to control and collect runoff from the shale pile during its construction. Runoff from precipitation on as yet unreclaimed areas of the retorted shale pile could be routed to and collected with a system of ditches and low dikes. Retention dams would be located on the south end of Wiesse Creek and Short Gulch basins. The dam on Wiesse Creek would be approximately 450 feet long, with a maximum height of 96 feet. The dam on Short Gulch would be approximately 400 feet long with a maximum height of 81 feet, and the pool behind the dam would have an area of approximately 14 acres. Runoff from natural areas around the planned pile location and from as yet undisturbed natural areas would be routed around the retorted shale with a similar system of ditches and dikes. Water collected from the shale pile would be evaporated or used to facilitate retorted shale compaction and to reduce dusting. The compacted lining would have a relatively low coefficient of permeability to lower the risk of temporarily ponded water seeping through the pile and into the underlying natural ground. Water collected from undisturbed natural areas would be directed to sedimentation ponds where the water would have an adequate residence time to settle out any sediment. The water remaining in these ponds could be used in the commercial oil shale operation or may be discharged to natural drainages.



Source: In-Situ (1984).

Figure 2.3-11 Spent Shale Cross-Section, Getty Shale Oil Project.

A similar compacted retorted shale layer, which would be connected to the compacted retorted shale beneath the pile, would be placed over the pile end slopes and top. The purpose of that compacted zone would be to reduce moisture infiltration into the pile while vegetation on the overlying reclamation zone becomes established.

Most of the retorted shale placed in the disposal pile would be placed in thick, uncompacted loose lifts. Compacting the retorted shale blanket over that loose material would be difficult. To facilitate that compaction, a zone of moderately compacted retorted shale could be located at the pile end slopes directly beneath the compacted blanket. That moderately compacted zone would also enhance slope stability.

The dumped retorted shale could be transported to disposal areas using conveyors and/or large trucks. The thickness of the dumped lifts will depend upon the area being filled and the type of equipment used to place the lifts. Thicknesses up to 150 feet have been planned by other operations (UOC 1982b). Materials to be placed in the compacted retorted shale blankets could also be transported to the disposal area using conveyors and/or trucks. At the disposal area those materials would be spread and compacted using conventional earth moving techniques. They would be placed in thin, loose lifts, generally less than 1 foot, moistened to the optimum moisture content for compaction and compacted with conventional heavy compaction equipment. The desired degrees of compaction can probably be achieved with six to eight passes of conventional heavy vibrating rollers or the equivalent (UOC 1983; Holtz 1983). Moderately compacted retorted shale zones could be achieved by spreading the materials in relatively thin lifts (less than 5 feet) and compacting them by selective routing of hauling equipment over the lifts surfaces.

Locating disposal piles at or as close as possible to the upstream end at drainages (head of hollow) would reduce the quantity of runoff water from the drainage areas that needs to be routed around the piles. That generally reduces the active areas of the pile from which retorted shale runoff water would need to be managed. Scheduling pile construction from the upstream to downstream also is advantageous as the upstream portion of the pile can be completed and reclaimed as other downstream construction continues. Such scheduling also reduces temporary water diversions at the upstream end of the pile as such diversions can be more easily incorporated into the permanent diversion plan. Most of the natural terrain within the ultimate areal extent of the pile will be downstream of the disposal pile if it is constructed from upstream to downstream; runoff from those areas will be handled in the sedimentation pond system. Such pile construction techniques will be considered.

Retorted Shale Properties

Some physical properties of Union B retorted shale have been reported by Union Oil Company of California in permit applications to the Colorado Mined Land Reclamation Board for the Parachute Creek shale oil project (UOC 1979; UOC 1982b). Those properties are summarized on Table 2.3-6 and are discussed below.

The maximum particle size of the Union B was 3 inches and the material contained between about 8 and 10 percent silt and clay sizes. Between about 62 and 66 percent gravel sizes and 26 and 28 percent sand sizes were reported. Specific gravities ranged between 2.52 and 2.59. The retorted shale was non-plastic, and would be classified as poorly graded, slightly silty sandy gravels (GP-GM) in accordance with Unified Soil Classification system (ASTM D 2487).

Gradation tests were performed to evaluate particle breakdown under standard and modified compactive efforts (ASTM D 698 and ASTM D 1557, respectively). Considerable breakdown of the materials occurred, particularly in the gravel size particles. Those tests, which were performed on the minus ¾-inch fraction of the as-received shale material indicated that gravel sizes (plus No. 4 sieve) changed from 44 percent of the samples tested prior to compaction to only 21 and 15 percent after compaction. Similarly, silt and clay sizes (minus No. 200 sieve) increased from 31 percent before compaction to 48 and 54 percent after compaction. The increase in smaller particle sizes would result in compacted Union B being less permeable than uncompacted retorted shale. A maximum dry density of 99.4 pounds per cubic foot (pcf) at an optimum moisture content of 20.5 percent was obtained for the modified compaction test, and 93.9 pcf and 22.1 percent for the standard compaction test.

Two permeability tests were reported, each for samples compacted to densities near the maximum obtained for the modified compaction test. Those tests showed coefficients of permeability of 4.6 feet per year, or less, at confining pressures of 50, 100 and 200 psi.

Triaxial strength tests on the Union B samples compacted to ASTM D 698 conditions showed an angle of internal friction of 36.1° and a cohesion of 1300 psf. An angle of internal friction of 38.4° and a cohesion of 630 psf was reported from centrifuge tests and materials compacted to ½ ASTM D 698 and ASTM D 698 conditions for confining pressures of between 0 and 80 psi. For pressures between 70 and 300 psi, an angle of internal friction of 35.4° and a cohesion of 2350 psf was indicated.

Except for having a slightly lower specific gravity, the physical properties of the Union B discussed in the permit applications are similar to and within the range of properties typical of a slightly silty, sandy gravel soil. Low to high strengths, low to moderate compressibilities under applied loads, and moderate to high resistance to seepage flows could be exhibited by the retorted shale in disposal areas, depending on the densities to which it is compacted.

Pile Stability

Pile settlement and the long-term stability of pile slopes affect retorted shale disposal pile stability. Settlement (consolidation) of natural soils beneath a retorted shale disposal pile and of previously placed retorted shale will occur as additional lifts of retorted shale are placed on the pile. The amount of settlement and the time period during which it occurs is dependent upon many factors. Settlement of natural materials beneath the pile depends upon applied loads (the height of pile), soil moisture conditions, horizontal and vertical variations in the soil profile, and the depth to bedrock. The time rate of settlement depends upon the rate of load application, the time involved for structural readjustment of the soil particles under those loads, and soil permeability. As the depth to bedrock should be shallow atop ridges flanking the Roan Creek valley, less settlement should occur beneath disposal piles placed there than for disposal piles placed in the valley or its principal drainages.

It has been estimated by Union Oil Company that a 1,000-foot-high pile placed in the East Fork Parachute Creek, would cause the underlying natural soils (approximately 100 feet thick) to settle from 5 to 15 feet (UOC 1982b). Because the natural soils are essentially granular materials (sands and gravels) that settle relatively quickly after application of load, the settlement of those soils should be essentially complete at the end of construction of the retorted shale disposal pile.

Settlement of retorted shale within a pile depends upon the gradation of the retorted shale materials, strength of the individual particles and groups of particles, pile height, moisture conditions and placement methods and the resulting initial placement densities. Preliminary estimates of total pile settlement for a 1,000-foot high retorted shale pile constructed of Union B process retorted shale placed in thick and uncompacted loose lifts indicate that as much as 80 to 100 feet of movement may occur (UOC 1982b). However, it is estimated that because Union B process retorted shales are granular materials, most of that settlement should occur as the pile is being constructed. The total downward movement of the pile settlement should only be a fraction of the anticipated total settlement.

The settlement of a retorted shale pile for the Getty Project would be on the order of, or less than that estimated by Union Oil Company for retorted shale disposal piles in the East Fork Parachute Creek. If the piles are located atop the ridges where the depth to bedrock is shallow, considerably less settlement should occur.

Because expected pile settlement due to the underlying natural soils and material within the pile are expected to essentially occur during construction, such settlement should not detrimentally affect long-term pile stability.

As currently planned, a compacted retorted shale lining will be placed over the natural ground surface prior to, and concurrent with, the placement of other retorted shale over it. The lining will assist in controlling and collecting runoff from the retorted shale disposal pile during construction. In addition, the pile slopes and top will be covered with a compacted, retorted shale blanket. The blanket will underlie the reclamation zone and will reduce moisture infiltration into the pile while vegetation becomes established in the reclamation zone. However, infiltration of moisture into and through the retorted shale disposal pile, including the compacted retorted shale blanket encapsulating the pile, would eventually occur.

Tests have shown that when the moisture content of retorted shale reaches a level called field capacity, which is below saturation conditions, no more water can be held by the material. Any water entering the material will then be passed through to underlying materials. Therefore, an entire pile could eventually reach field capacity conditions. The field capacity of retorted shale depends upon its density and other physical properties. Higher values of field capacity are expected for retorted shale materials deeper in a pile that have become densified due to the placement of overlying materials, and for compacted retorted shale linings. However, those field capacity values should be, in general, below saturation conditions.

The currently planned pile incorporates slopes of 3.5:1 (horizontal:vertical) for the embankment or toe section. Union Oil Company (UOC 1982b) performed computerized theoretical stability analyses of models of their generalized embankment section constructed of Union B spent shale. The overall slopes of that model were also 3.5:1. A layered-pile section, as previously discussed, and material properties for Union B spent shale obtained from the laboratory tests were used in the analyses. Seismic parameters were included in the study. The resulting factors of safety for the ultimate 1,000-foot-high pile slope ranged from 2.2 to 3.0 and were considered to be well within the limits of standard engineering practice for the type of facility being planned. Their stability analysis assumed lower parts of slopes could not be saturated. However, it is anticipated that laboratory tests on saturated retorted Union B process shale samples will show nearly the same strength parameters as were assumed for the unsaturated condition stability analyses. Therefore, it is expected the overall stability of a pile with localized or broad saturated areas would be similar to that expected for an unsaturated pile.

As discussed previously, the physical properties reported for Union B retorted shales are within the range of those reported for naturally occurring soils whose classifications are the same as the retorted shale. No retorted shale pile of the height and volume of materials that is planned for the project has yet been constructed. However, numerous embankment fills, earth dams and other similar structures have been constructed of naturally occurring soils. Many of those structures have overall pile slopes steeper than the planned 3.5:1 to be used for this project. Such structures have performed well, and it is felt that similar well constructed stable embankment fills could be constructed of retorted shale.

Retorted Shale Disposal Pile Leachate and Runoff Potential

The leachate and runoff potential of the retorted shale disposal piles for the Getty project was estimated for two sets of conditions: (1) during pile construction, and (2) post-reclamation (In-Situ 1984). During construction of the retorted shale disposal pile, the overall goal is to minimize leachate potential. This is accomplished with a sufficient depth of retorted shale so that precipitation falling directly on the retorted shale disposal pile would be redistributed as the wetting front moves downward resulting in little or no leachate, given the water-holding characteristics of the in-place retorted shale. Post-reclamation has the general goal of minimizing leachate potential by establishing a revegetated surface and controlling the quantity of precipitation infiltrating the pile by evapotranspiration from vegetation. Both of the above cases were analyzed using empirical equations and an analytical unsaturated flow model to calculate water movement downward through the retorted shale disposal pile. The model was developed for Union Oil Company (UOC 1982b) and was revised and updated by Kunkel and Murphy (1983).

The model utilizes a risk-based approach. In this approach, rainfall probabilities are assessed for input to the analytical unsaturated flow model. For this analysis probability of leachate and runoff potential for the wettest year in 2, 5, 10, 20, 50, and 100 years of annual precipitation was estimated. The model then takes into account water movement under unsaturated conditions within the retorted shale disposal pile. The model can be utilized for both during construction and post-reclamation cases by varying the input data. It should be noted that the timing of leachate generation would not be concurrent with the annual precipitation event.

Within the model, the upper 6 feet of the retorted shale pile is conceptualized as a layered system. The upper 1 foot consists of soil or loose retorted shale. The lower 5 feet is moderately compacted retorted shale. Water movement into and out of this zone is calculated by the model by using the water-balance equation. The water-balance equation consists of precipitation input and calculated runoff, change in storage of water ponded on the surface, evapotranspiration, drainage in soil moisture storage, and deep percolation below the root zone.

The model may be used for both during-construction and post-reclamation cases by changing the input data and characteristics of the reclamation zone. For the during-construction case, some sections of the pile will have been reclaimed; but on the unreclaimed sections, infiltrated water cannot be transpired because no vegetation would be growing on the surface. Therefore, the water which enters the pile would increase the in-place retorted shale moisture and/or move downward into the pile. In the model, evaporation is assumed to occur from the wet shale surface to a depth of approximately 6 inches. The post-reclamation analysis differs from the during-construction analysis in that evapotranspiration can remove water up to 6 feet below the shale pile surface.

Inputs to the analytical model include physical parameters of the retorted shale disposal pile such as initial or placement shale moisture content, field capacity, permanent wilting point percentage, saturated hydraulic conductivity, porosity, a curve of relative hydraulic conductivity versus saturation for the retorted shale, and Soil Conservation Service (SCS) hydrologic runoff curve number. Climatalogical related inputs include precipitation and potential evaporation or evapotranspiration. Model outputs include the water content of each layer at each time step, along with periodic monthly and annual water-balance estimates, including precipitation, actual evapotranspiration or evaporation, change in shale moisture storage, total runoff, total change in ''pond'' surface storage, and total deep percolation. The primary interest in the assessment of leachate potential and the water-quality impacts associated with runoff and leachate, involves the water-balance terms associated with deep percolation and runoff.

Retorted Shale Characteristics

Table 2.3-7 summarizes the retorted shale characteristics used in the during-construction and post-reclamation unsaturated flow modeling. These values typify the expected retorted shale characteristics for both the during-construction and post-reclamation cases (Woodward-Clyde 1984). Except for the top 1 foot of the pile, which represents either a loosely placed topsoil or retorted shale, the remainder of the upper 6 feet was assumed for the analyses to consist of retorted shale at a placement moisture of 16 percent by volume and a dry density of 88 lbs/cu-ft. The compactive effort required to obtain this dry density is that exerted by the equipment used to place the retorted shale (such as mobile conveyors and trucks). The saturated hydraulic profile of the retorted shale is based on laboratory tests performed on numerous samples of Union retorted shale (Woodward-Clyde 1984).

Results of the unsaturated flow modeling in terms of runoff and leachate potential, both during pile construction and post-reclamation, are summarized below and further discussed in Chapter 4.0 under the applicable disciplines.

Runoff during pile construction at the Getty retorted shale disposal pile (elevation 8,650 feet msl) ranges from approximately 5.4 inches for the 50 percent chance year to over 11 inches for the 1 percent chance year. Water infiltrating the retorted shale disposal pile from precipitation during construction would range from approximately 2.6 inches for the 50 percent chance year to about 5.8 inches for the 1 percent chance year.

In order to reduce the potential for infiltration to eventually appear at the bottom of the pile as leachate during construction, the water-holding capacity of the retorted shale would be considered. As summarized in Table 2.3-7, a majority of the disposed retorted shale would be placed at a density of 88 lbs/cu-ft with a placement moisture of 16 percent by volume. Water movement in the retorted shale is essentially zero at saturations less than 50 percent or approximately 22 percent by volume. Therefore, the additional available water-holding capacity of the retorted shale during construction is approximately 6 percent by volume (22 percent less 16 percent). Assuming a unit depth of retorted shale at an initial moisture content of 35 percent of saturation, 1 inch of infiltrated water could be stored in approximately 1.4 feet of retorted shale without raising the percent saturation above 50 percent. Based on this, the anticipated thickness of retorted shale which could store 1-year's infiltration was estimated. About 10 feet of retorted shale at placement moisture (35 percent of saturation) would be needed to store an average year, with about 14 feet of thickness being able to store the annual infiltration

Table 2.3-7 SUMMARY OF RECLAMATION ZONE RETORTED SHALE CHARACTERISTICS

	Reclamation Zone Depth[a]					
Characteristic	0-1 ft	1-2 ft	2-3 ft	3-4 ft	4-5 ft	5-6 ft
Dry Density (lb/ft^3)	70	88	88	88	88	88
Porosity (%)	56	44	44	44	44	44
Saturated Hydraulic Conductivity (ft/yr)	720	32	32	32	32	32
Field Capacity (% by volume)	28	22	22	22	22	22
Permanent Wilting Point (% by volume)	14	11	11	11	11	11
Placement Content (% by volume)	13	16	16	16	16	16

Source: Woodward-Clyde (1984).

[a] 0-1 ft layer loosely placed retorted shale or topsoil; other layers are *"wheel-rolled"* compacted retorted shale.

resulting from the wettest year in 100 years. This analysis implies that additional lifts should be placed within at least 1 year to control leachate potential for the recurrence interval year desired.

The lift thicknesses indicated for the during-construction case do not include water which may be added to the retorted shale disposal pile for leaching of salts during reclamation or irrigation in excess of consumptive use during initial reclamation. However, the lift thicknesses may be increased to accommodate these inputs at a rate of about 1.4 feet of shale per inch of water added to the pile.

Runoff potential for the post-reclamation case, based on the unsaturated flow model, is estimated to range from about 5.4 inches for the 50 percent chance year to over 11 inches for the 1 percent chance year. Leachate from the retorted shale disposal pile would range from approximately 2.2 inches for the 50 percent chance year to about 6.6 inches for the 1 percent chance year.

Reclamation

The reclamation activities for the proposed project would be conducted in two components: (1) reclamation of the shale disposal area, and (2) reclamation of other disturbed areas.

Spent Shale Disposal Area Reclamation. As previously described, retorted shale from the Union B process has properties of a slightly silty, sandy, gravel soil; is high in soluble salts; has a moderate pH; and is low in available phosphorus and nitrogen. Other mineral nutrients are low to adequate and within the range found in Colorado soils. The major problems encountered in establishing vegetation on retorted shale are the shale's low fertility, high sodium adsorption ratio, and high soluble salt content.

The amount of subsoil and topsoil to be placed upon the shale disposal area would be determined during the permit application review by the Colorado Mined Land Reclamation Division. As parts of other reclamation testing programs, researchers have successfully produced vegetative cover on various soil and subsoil combinations, including growing plants directly on spent shale from a variety of retorting processes. Union Oil Company has conducted tests with bare retorted shale and 12 inches of soil coverage or 6 inches of soil coverage over retorted shale from the Union B process. Their 6-year analysis indicated the highest plant cover values with the 6-inch soil cover. Although the soil-covered shale tests had better initial coverage, later stages of development of all tests were similar. The current plan for reclamation of the spent shale on the Getty property would involve placing the spent shale with unretorted waste shale rock followed by soil, soil amendments, and seeding as necessary. The depths of these layers would be determined by availability of materials and the appropriate permit requirements.

The final cross-section of the spent shale disposal pile is shown in Figure 2.3-11. The faces of the pile would be formed in lifts of 50 feet with the final slope of these faces approximately 3.5:1. The top of the pile would be gently sloped from north to south at an approximate 4 percent grade. As final contours of the faces of the disposal pile are realized, these areas would receive the final reclamation treatment including grading, subsoil and topsoil cover, and seeding. This activity primarily would involve the benches constructed to form sequential lifts of spent shale. Active waste disposal areas would be minimized to the extent possible and additional interim reclamation procedures would be employed, as required, to control erosion.

Other Disturbed Areas Reclamation. Construction of the processing and support facilities for the Getty project would require local topographic modifications to provide level areas for construction. After decommissioning, those areas would be reclaimed according to the specific conditions of the Colorado Mined Land Reclamation permit. Although the exact conditions of the permit cannot be accurately predicted at this time considering the current state of oil shale reclamation, the following procedures are anticipated. Surface disturbance areas would be graded and disced to break up the surface. Available topsoil would be redistributed, and appropriate seed mixtures and plantings would be placed. Monitoring plans are expected to evaluate the success of returning the various areas to a condition suitable for the planned post-mining land use.

Major pieces of equipment, structures, and foundations would be decommissioned as required by the reclamation permit. Embankments, waste piles, and other disturbed areas would be reclaimed as described above.

Erosion control would be accomplished using the appropriate type of control method for the situation at hand. Depending on the material to be controlled and the time requirement associated with the control, physical and chemical barriers such as riprap, mulches, netting, coagulants, and emulsifiers may be used. More permanent control would be accomplished through soil preparation and revegetation efforts. Control of suspended solids resulting from erosion would be exercised by collection of runoff from eroding areas in sediment ponds.

Specific seed mixtures for short-term stabilization, long-term stabilization, and permanent revegetation efforts would be included in the specific reclamation procedures proposed as part of the permit application to the Colorado Division of Mined Land Reclamation. A seed mixture, as presented in Table 2.3-8, is considered to be representative of the mixture expected to accomplish reclamation goals. This mixture may be modified to reflect state-of-the-art reclamation knowledge as well as specific site conditions.

2.3.1.2.3 Waste Streams. There are various waste streams associated with the production of shale oil. These streams can be generally classified into wastewaters, air emissions, and solid wastes. The waste streams (air, water, solid wastes) can be further subdivided into wastes resulting from mining, retorting, upgrading, and solid waste disposal. Each of these areas are discussed below.

Wastewater Streams

Oil shale retorting produces water, partly by combustion of hydrogen and oxygen, and partly by release of combined and free moisture in the shale. Most of this water leaves the retort in the vapor phase with the raw gas and is recovered as a condensate when the gas is cooled prior to treating. Potential constituents within the gas condensate include dissolved ammonia, carbon dioxide and some hydrogen sulfide. Some volatile organics will be present in the gas, as well as inorganic salts.

Table 2.3-8 GETTY PROJECT PROPOSED SEED MIXTURE[a]

Scientific Name	Common Name		PLS/Acre[b]
XERIC SITE			
Agropyron inerme	Beardless bluebunch wheatgrass		1.0
Agropyron tricophorum	Pubescent wheatgrass		2.0
Elymus junceus	Russian wildrye		1.0
Agropyron riparium	Streambank wheatgrass		1.0
Agropyron smithii	Western wheatgrass		2.0
Agropyron desertorum	Crested wheatgrass		1.0
Festuca ovina	Hard fescue		2.0
Sporobolus airoides	Alkali sacaton		0.1
Sporobolus cryptandrus	Sand dropseed		0.1
Melilotus officinalis	Yellow sweet clover		0.5
Artemesia tridentata vaseyana	Mountain big sagebrush		0.1
Purshia tridentata	Bitterbrush		0.5
Hedysarum boreale	Utah sweetvetch		0.1
Kochia prostrata	Summer cypress		0.5
		TOTAL	11.9
SHRUB SEEDLING MIXTURE			Seedlings/Acre
Prunus virginiana	Chokecherry		100
Rosa woodsii	Woods Rose		50
Symphoricarpos oreophilus	Snowberry		150
Amelanchier alnifolia	Serviceberry		50
Quercus gambelii	Gambels Oak		100
		TOTAL	450

Source: Getty (1983b).

[a] Seed mixtures are those to be used for permanent reclamation.
[b] PLS = Pure Live Seed; 1.0 lb/acre is equivalent to 60 seeds/square foot.

Some water condenses out with the raw shale oil and may contain some heavy oil and organics. Inorganic salts, particularly bicarbonates, may also be present in this wastewater if the water has been in contact with the inorganic matrix during retorting.

The wastewater treatment scheme for Getty involves removal of contaminants prior to disposition on the spent shale pile. Figure 2.3-12 presents the overall flow of wastewater generation and treatment. A summary of the processes is presented below.

The proposed action for wastewater treatment is based on state-of-the-art treatment technology. Water consumption figures are based on the concept of water recycle and reuse. It must be noted that no overall treatment scheme has yet been tested on oil shale process waters on a demonstration plant scale or, in some instances, even on a pilot scale. Thus, the treatment schemes and stream qualities must be viewed as preliminary and can be expected to change as the technology evolves. The major wastewater categories requiring treatment are described below.

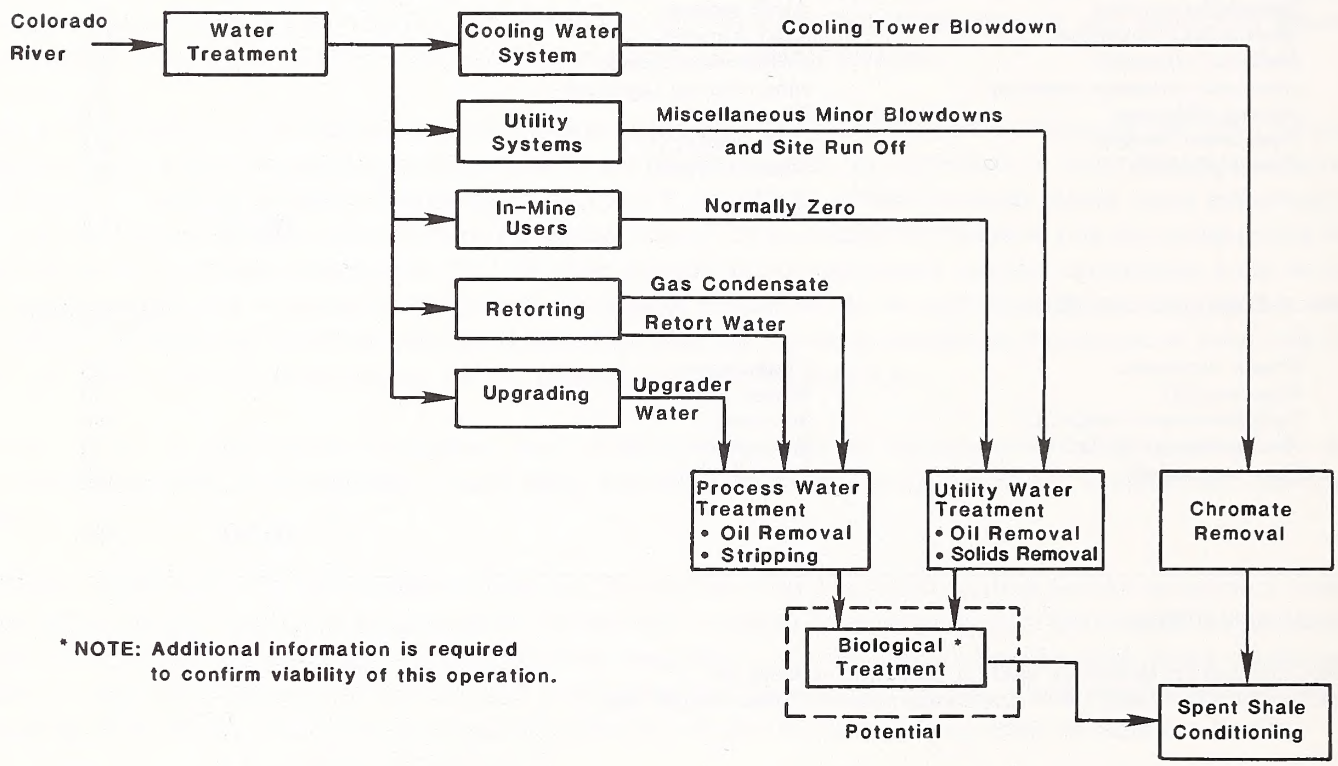
- Sour water generated from the retorting and upgrading processes would be treated for oil separation prior to steam stripping for removal of hydrogen sulfide and ammonia. The resulting stream may be treated for biological oxidation of organics. At this time, the success of biological treatment of these waters has yet to be verified.

- Water streams from the utility systems and site runoff, together with any excess mine water, would be combined for removal of oil and solids, and may be further treated by biological oxidation.

- Cooling tower blowdown water would be treated for the removal of chromates.

- Runoff impounded below the spent shale pile and from any other runoff collection facilities would be reused for secondary crushing or processed shale management needs.

- Sanitary wastewater from the plant and mine areas would be treated by conventional techniques.



Source: Cities Service/Getty (1984a).

Figure 2.3-12 Wastewater Generation and Treatment Flow Diagram, Getty Shale Oil Project.

Oil Shale Water Pollutants

Major types of waterborne contaminants found in oil shale facilities are summarized below.

Suspended solids contained in wastewater streams originate mainly from dust suppression operations in the material handling areas. In retorting where water contacts oil shale, some entrainment of fines will occur. The resulting level of solids is expected to be low and should be easy to treat. Cooling water blowdown will contain certain inorganic solid material.

Oil and grease will be present in retort waters. The amount of hydrocarbon contained in these waters depends upon the process conditions during retorting and retorted oil characteristics. Some of the oil forms an emulsion which may be difficult to break, hence requiring the use of de-emulsifiers. Raw shale oil from retorting is de-ashed through contact with water. The retort water from this operation is expected to contain non-volatile hydrocarbons and shale fines. These hydrocarbons may be present in a water soluble form or as a residual emulsion. Retort condensate is generated in the gas cooling train. Water condensed in this stream will contain dissolved volatile organic materials. These constituents can be relatively easily removed by conventional separation techniques such as gravity separation.

Dissolved gases are present in gas condensate wastewater from retorting and upgrading. These gases are primarily ammonia, carbon dioxide and hydrogen sulfide. They can be easily removed by stripping operations.

Dissolved inorganics are present in wastewater streams which contact oil shale. Mine drainage water and retort waters are the major sources of these chemicals.

Dissolved organics arise mainly from the organic species in raw shale oil which have been altered during pyrolysis. Retorting conditions such as temperature and the presence or lack of oxygen will affect the type and concentration of the compounds. Data on these organic compounds is very limited, but it is known that a wide range of compounds, particularly carboxylic acids and neutral compounds can be expected. Many of these compounds should be biodegradable, but studies have shown that complete removal of the organic matter may require further processing in addition to conventional biological oxidation. This is attributed in part to the effect of certain compounds on the waste treatment bacteria.

Trace materials occur in wastewater from elements or metals leaching or being volatilized from oil shale during retorting operations, or from trace organics formed during pyrolysis. Information on these materials is very limited, and the issue is further complicated by the high variability in trace material concentration between locations in the Piceance Basin. Specialized operations such as ion exchange or membrane processing may be required to remove these materials.

Wastewater treatment. Wastewaters originate primarily from the cooling water system, retorting, and upgrading units as shown on Figure 2.3-12. In addition to these sources, wastewaters will be produced from utility operations, runoff and mine drainage.

Retort water is formed when water and oil vapors are condensed. The stream is contaminated with oil, dissolved gases, dissolved inorganics and dissolved organics. The wastewater is first treated in an oil/water separator, and emulsion breaking is applied as necessary. The resulting stream is then stripped to remove dissolved gases, including acid gases, and volatile organics. Lime addition may be necessary prior to stripping to minimize ammonia fixation and enhance precipitation of inorganics. Recovery of the stripped ammonia for sale is feasible by using the Phosam-W process.

Removal of dissolved organics has not been adequately demonstrated. Should treatment for removal of these materials be employed, options include biological treatment, carbon adsorption and oxidation. Biological treatment is the most adaptable to large scale, low cost operations, however to date it has not proven successful due to the presence of resistant and toxic materials. An alternative is the use of this stream to produce steam with the contaminants withdrawn as sludge. Mechanical limitations may preclude this option.

Gas condensate produced by cooling of light hydrocarbon streams is a potentially simpler treatment operation. Dissolved gases and volatile organics are successfully removed by stripping. Oil/water separation may be required, but difficulties are not expected because any oil present should be light and thus separate easily. However, dissolved organics present in the stream are different from those present in retort condensate, and thus it is unclear whether removal of these compounds can be satisfactorily achieved by biological treatment.

Treatment of upgrader wastewater should be similar to that for gas condensate. Composition is expected to be similar except that upgrader wastewater will have negligible carbon dioxide content. After treatment, these wastewaters are combined with utility blowdowns and any excess mine waters. Mine waters will be used within the mining and feed preparation areas for dust control and normally should not be in excess of these requirements.

The treated wastewater from the process and utility units is combined with cooling tower blowdown, which has been treated for chromate removal, and the composite stream is used for conditioning of the spent shale pile.

Water quality. The characteristics of wastewater produced during oil shale operations have not yet been clearly defined, as demonstrated by the wide variations in published information. These wastewaters can, however, be generally characterized in the form of water quality parameters. The presence and proportion of these constituents are the determining factors in the choice of treatment method.

Table 2.3-9 lists the range of retort water and gas condensate qualities measured by numerous investigators. Union has presented information on reclaimed process water for their Phase I Shale Oil facility. This information, based on pilot scale testing and engineering estimates, is presented in Table 2.3-9. Removal efficiencies can be estimated by comparing the untreated compositions presented in Table 2.3-9 with the treated compositions. Removal of ammonia is in excess of 90 percent. There also appear to be substantial reductions in organic content.

Table 2.3-9 RETORT WASTEWATER QUALITY (mg/l)

	Untreated Retort Water	Untreated Retort Gas Condensate	Untreated Hydrotreater Water	Treated Union B Spent Shale Wetting
Alkalinity	6,690 - 35,200	12,900 - 46,000	N/A[a]	2,000
BOD5	5,000 - 12,000	N/A	10,000	N/A
Carbon, bicarbonate	5,000 - 26,000	6,280 - 24,000	N/A	1,700
carbonate	2,000 - 24,000	22,000	N/A	400
inorganic	223 - 1,600	N/A	N/A	N/A
organic	3,910 - 29,000	11,760	N/A	1,350
COD	7,700 - 136,000	19,200	N/A	6,500
Nitrogen, ammonia	1,340 - 31,700	14,350 - 16,800	41,000	35
ammonium	16,800	13,540	N/A	N/A
organic	N/A	189	N/A	N/A
Oil and Grease	392 - 2,210	N/A	N/A	1,300
Phenols	8 - 50	1	N/A	125
Solids, total	1,856 - 160,000	429 - 15,528	N/A	3,100
Sulfur, sulfate	29 - 8,720	N/A	low	1,500
Sodium	30 - 308	N/A	low	1,500
References	b,c,d,e,f,g	b,c,d,f	c	f

Source: Cities Service/Getty (1984a).

[a] N/A - Not Applicable.
[b] Day and Rawlings (1981).
[c] OTA (1980).
[d] Higgins et al. (1982)
[e] Nowacki (1981).
[f] UOC (1982c).
[d] Goldstein et al. (1979).

Table 2.3-9 also lists typical hydrotreater condensate concentrations. Since shale oil produced by different retorts is not markedly different in nitrogen and sulfur contents, it is reasonable to assume that the wastewater will be similar.

As stated earlier, composition of upgrader wastewater is expected to be similar to retort gas condensate and treatment options should be similar. Furthermore, this stream will show many similarities to wastewater from refinery upgraders; thus, treatment options are expected to be within state-of-the-art.

Additional wastewater is generated from the de-arseniting pretreatment unit. This unit removes arsenic from the shale oil prior to upgrading. No data are available on this stream; however, Union has provided data on arsenic concentration in the final effluent water.

The compositions of the cooling tower blowdown depends on the quality of the raw water going to the plant. Table 2.3-10 shows the estimated quality of cooling water blowdown based on raw water supply from the Colorado River at Cameo.

Table 2.3-10 COOLING WATER BLOWDOWN QUALITY

Parameter	mg/l
Calcium	215
Chloride	615
Fluoride	---
Magnesium	60
Sodium	460
Sulfate	840

Source: Cities Service/Getty (1984a).

Wastewater Quantity. Table 2.3-11 presents the principal process wastewater streams and their flow rates. These rates are based on previous designs for oil shale facilities (OTA 1980), but must be considered preliminary because the information is not based on site-specific project information. These numbers are based on data on the Union B, Tosco II and Paraho indirect processes.

Table 2.3-11 PRINCIPAL PROCESS WASTEWATER STREAMS AT 100,000 BPD PRODUCTION

Source	gpm
Cooling Tower Blowdown	2,000
Retort Water	600
Gas Condensate	1,000
Upgrader Condensate	1,000

Source: Cities Service/Getty (1984a).

Final effluent water quality for the Getty project can be estimated using the information presented above in conjunction with the removal efficiencies presented in Table 2.3-12. This table, while showing data for Vertical Modified In Situ (VMIS) retort water, indicates the relative level of removal efficiency and summarizes the potential benefits of biological treatment for purposes of the Getty project analysis. The final effluent streams have been calculated both with and without biological treatment. Currently it is unclear whether this operation will be included, because its merit has not been demonstrated. Table 2.3-13 presents the results together with Union published data (based on pilot data and engineering estimates). The treatment scheme for Union's effluent water quality does not include biological treatment and thus should only be compared to the similar streams for Getty. Table 2.3-13 is based on the following assumptions.

- In Table 2.3-9, where data are not available, average values are substituted based on other wastewater streams.

- In Table 2.3-9, hydrotreater wastewater is assumed to have the same composition as retort gas condensate wastewater.

- Data from Table 2.3-9 not presented in Table 2.3-10 for cooling tower blowdown are assumed to have zero value.

- Removal efficiencies are based on Table 2.3-12, together with a degree of conservatism, to account for the very preliminary nature of the information and its limited data base. Table 2.3-14 summarizes the removal efficiencies used.

A comparison of the effluent water qualities presented in Table 2.3-13 with EPA Interim Drinking Water Standards and the EPA Agricultural Use Standards shows the effluent water to contain higher pollutant levels. However, the likelihood of the effluent water reaching drinking or agricultural water systems is very low. Operating practices will comply with all appropriate regulations, and should an accidental spill occur, the likelihood of the wastewater reaching drinking water or agricultural use systems is extremely low due to remoteness of the facility from these systems.

Gaseous Stream Emissions

Federal and state agencies have set regulatory standards to be met by new facilities. These standards control both ambient pollution levels downwind of a facility and the incremental volume of pollutants which can be added to the ambient air within certain designated sensitive areas. Oil shale development will need to comply with these regulatory standards by using Best Available Control Technology (BACT). The application of BACT to the proposed Getty oil shale project, emphasizing control of those pollutants regulated by ambient air quality standards, is discussed below. The pollutants addressed, known as criteria pollutants, are sulfur dioxide, nitrogen dioxide, ozone, non-methane hydrocarbons, carbon monoxide, total suspended particulates, and lead.

Air Pollution Sources. The major processes associated with the production of shale oil all are potential sources of air pollution. Each is categorically discussed below.

Oil shale *mining* activities which include excavation, blasting, crushing, and transportation generate air pollution. While particulate matter is the major emission from mining operations, most of the other criteria pollutants are also generated. Explosives can produce carbon monoxide, nitrogen oxides and hydrocarbons, while possibly releasing some trace materials from the rock. Mining equipment will produce carbon monoxide, nitrogen oxides, sulfur dioxide and hydrocarbons.

The primary pollutant from *feed preparation* is fugitive dust generated during material handling operations. In this operation, run of mine material is crushed, conveyed to the plant site and processed to final feed specifications prior to aboveground retorting.

Gaseous emissions from *retorting and upgrading* include sulfur dioxide, hydrogen sulfide, particulates, nitrogen oxides, hydrocarbons, carbon monoxide and trace metals. Sulfur emission control from retorting and upgrading

Table 2.3-12 STRIPPING OF MODIFIED IN-SITU RETORT WATER

Parameter	Raw (mg/l)	Stripped (mg/l)	Reduction (%)	Biologically Treated (mg/l)	Reduction (%)
Carbon, organic	2,800 - 3,300	2,200 - 3,300	26	220 - 370	90
COD	8,400 - 9,100	7,000 - 7,200	19	580 - 980	91
Nitrogen, ammonia	1,100 - 1,250	7 - 40	98	10 - 21	99
ammonium	N/A[a]	21	38	9 - 16	63
organic	45	18 - 24	53	<1	99

Source: Torpy et al. (1982).

[a] N/A = Not Available

Table 2.3-13 FINAL EFFLUENT WATER QUALITY TO SPENT SHALE PILE, GETTY OIL SHALE PROJECT

Parameter	Getty With Biological Treatment (mg/l)	Union[a] Without Biological Treatment (mg/l)
BOD5	1,700 - 2,100[b]	2,000
Carbon, organic	2,800 - 4,500[b]	N/A
COD	4,700 - 5,000[b]	5,500
Nitrogen, ammonia	600 - 850	35
organic	50[b]	N/A
Oil and Grease	50	1,300
Phenols	0-1[c]	125
Solids, Total	400 - 8,800	3,100
Sulfur, Sulfate	650 - 2,500	500
Sodium	600	1,500
Arsenic	6.5[a,d]	6.5
Flow Rate (gpm)	4,600	--

Source: Cities Service/Getty (1984a).

[a] Engineering Science (1984).
[b] Numbers may increase by up to 100% if biological treatment is not included.
[c] Numbers may increase by up to 1,000% if biological treatment is not included.
[d] It is assumed that biological treatment will have no effect on arsenic removal. No published data are available to confirm this assumption.

has received considerable attention with identification of appropriate sulfur control technology being a major factor in project development. Currently, BACT can remove in excess of 90 percent of the sulfur from gaseous streams.

Raw shale contains up to 3 percent sulfur with a typical shale in the Green River Formation containing about 0.7 percent sulfur. About one-third of the sulfur is present as organic species and the remainder inorganic. During pyrolysis, the organic fraction undergoes reaction with about 40 percent being released in the form of hydrogen sulfide. The remaining 60 percent stays in the shale oil product as heavier sulfur containing compounds. About 2 pounds of sulfur per ton oil shale is available for reaction. Assuming a Fischer assay of 25 gpt and a 100,000 bpd operation, about 150 tpd of sulfur could be emitted in an uncontrolled release. These compounds include sulfur dioxide, hydrogen sulfide, and small amounts of carbon disulfide and carbonyl sulfide.

In addition to sulfur emissions, retorting may release other particulates, nitrogen oxides and hydrocarbons. Particulates may be released from the oil shale during retorting. Nitrogen oxides are released during combustion of fuel to support the retorting and processing operations. Hydrocarbons are present in the retorting gas stream and have the potential of ultimately being released to the atmosphere.

Air Pollution Control Technologies. Various technologies have proven effective in controlling air pollution associated with industrial operations. These are briefly summarized below.

Particulate Control. Particulate control can be achieved by using techniques such as water sprays, cyclones, scrubbers and filters.

- Water sprays are used to control dust from such facilities as roadways, storage piles and mining and material handling operations.

- Cyclones are used primarily to clean retort off-gases and possibly for primary dust control at the crushing operation.

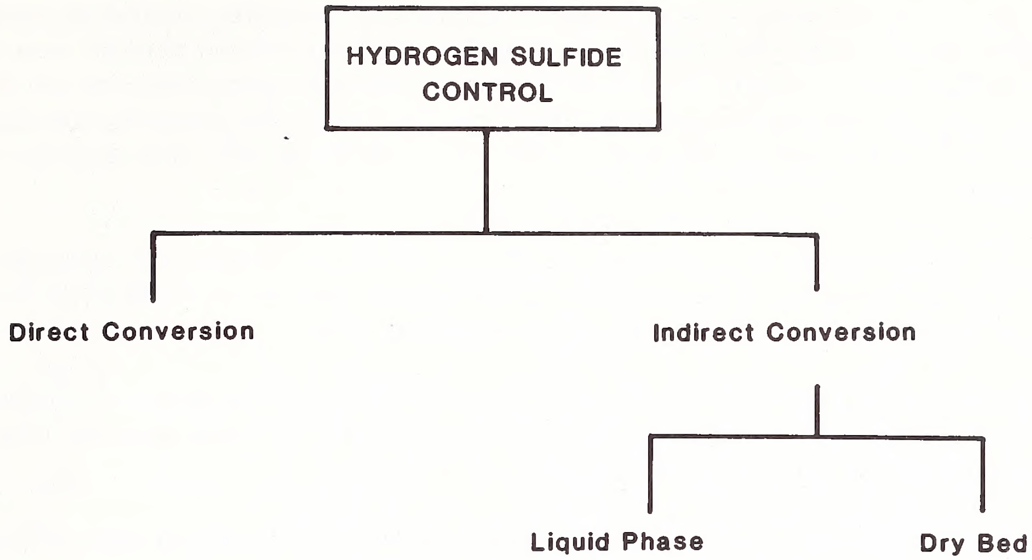
- Scrubbers use water to remove dust entrained in gas streams. They have the same general application as cyclones, but have a higher removal efficiency at a cost of increased energy requirements.

- Baghouse filters are used for dust control in the feed preparation system such as crushing operations and feed shale conveying. Should further dust removal be required, then high efficiency electrostatic precipitators can be employed.

Nitrogen Oxides Control. Nitrogen oxides are produced during the combustion of hydrocarbons. In oil shale processes, nitrogen oxides are formed during two operations — the combustion of gaseous or liquid products, and the combustion of process heater fuels. Nitrogen oxides control can be achieved by adjusting combustion conditions to minimize formation. Stack gas clean-up techniques are being developed; however, they are not yet commercially demonstrated.

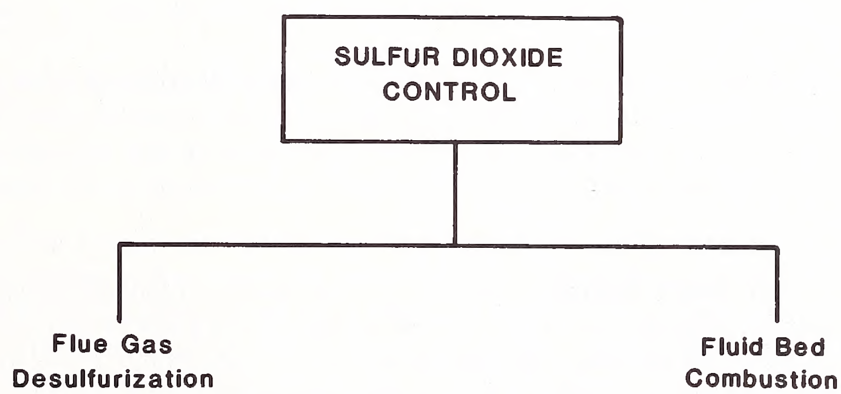
Hydrocarbon and Carbon Monoxide Control. These materials occur primarily in emissions from process heaters under conditions of incomplete combustion. State-of-the-art combustion technology will be used to minimize formations. Small amounts of hydrocarbons are also emitted to the atmosphere through leaks in processing or storage equipment. These will be controlled by use of state-of-the-art sealing in process and storage equipment. Hydrocarbons are also present in retort gas streams prior to sulfur removal, and operating conditions will be adjusted to ensure hydrocarbon condensation prior to treatment.

Sulfur Control. Sulfur may be removed from oil shale operations in the form of hydrogen sulfide or as sulfur dioxide. Numerous processes are available for removal of these species, and the general approaches for removal are shown in Figures 2.3-13 and 2.3-14.



Source: Cities Service/Getty (1984b).

Figure 2.3-13 Technology Options for Hydrogen Sulfide Control, Getty Shale Oil Project.



Source: Cities Service/Getty (1984b).

Figure 2.3-14 Technology Options for Sulfur Dioxide Control, Getty Shale Oil Project.

The hydrogen sulfide removal processes use either direct or indirect conversion (Figure 2.3-13). In the direct conversion process, sulfur compounds are directly oxidized to elemental sulfur. In the indirect conversion process, the hydrogen sulfide is separated from the feed gas and recovered separately.

Direct conversion processes are best suited for treatment of gases containing low concentrations of hydrogen sulfide. In these processes, hydrogen sulfide is directly oxidized to elemental sulfur. However, any sulfur in a form other than hydrogen sulfide, such as carbonyl sulfide or carbon disulfide, is only partially removed. The Stretford and Unisulf processes are examples.

Indirect conversion removes sulfur by either chemical conversion of the hydrogen sulfide to another compound, absorption into a liquid or adsorption onto a solid. Chemical conversion appears to be the most practical option for oil shale desulfurization. Absorption processing requires higher pressures than practical for oil shale gas streams, and adsorption processing is not applicable because of bed fouling problems from high contaminant loadings. As with direct conversion processes, sulfur present in forms other than hydrogen sulfide is only partially removed.

In the chemical conversion process, hydrogen sulfide is removed by reacting with an amine solution. The hydrogen sulfide is released in a concentrated stream from the amine in a stripping step and subsequently processed in a Claus sulfur recovery plant to produce elemental sulfur.

The tail gas from the Claus plant may require further treatment. This process combination is best suited to off-gas streams from indirect retorting since concentrations of hydrogen sulfide from direct retorting operations are too low for practical operation of the Claus process.

Sulfur dioxide removal processes include flue gas desulfurization or fluid bed combustion. These technologies are used either for final capture of sulfur from Claus plant tail gas, or removal of the bulk of the sulfur where concentrations are too low for other techniques. The flue gas desulfurization process is normally used for these applications.

Flue gas desulfurization processes may be of two types, regenerable or non-regenerable. The regenerable processes involve reaction of an inorganic chemical with sulfur dioxide. The sulfur dioxide is subsequently removed as a concentrated stream for further processing and sale, while the inorganic chemical is regenerated for further sulfur dioxide removal. The non-regenerable process involves reaction of sulfur dioxide with limestone to produce a non-hazardous sludge for disposal. While the sulfur dioxide removal processes are less effective than the hydrogen sulfide processes, they represent the state-of-the-art for sulfur removal from dilute gas streams.

Fluid bed combustion of process off-gas and oil shale fines, a potential alternative to flue gas desulfurization, is currently being evaluated by researchers. The off-gas is burned in the presence of oil shale fines and the inorganic component of the oil shale fines acts as a captor for the sulfur species in the gas. This option has the synergistic features of simultaneously desulfurizing the off-gas together with processing the oil shale fines in a beneficial manner.

Technological Status. As previously discussed, there are a wide variety of control technologies that could be applied to oil shale processes. The selection of suitable technologies for a given facility is based on a number of factors, including the nature of the ore body, the characteristics of the emission streams, the technological status of the control technology, and the applicable environmental regulations.

Currently research is proceeding and technology is evolving in most areas of oil shale processing and pollution control. Because results from commercial experience are not available, streams from pilot oil shale facilities together with commercial applications in analogous services are used to assess efficiencies of pollution control technologies. Thus, it is desirable to maintain maximum flexibility to accommodate future process improvements.

Table 2.3-15 summarizes the technological status of the major control technologies, along with the proposed action for Getty.

Proposed Action. For each of the potential pollutants described above, Getty has selected a control technology that will achieve the appropriate level of control. These are described below.

Figure 2.3-15 is a process block diagram for Getty's sulfur control systems. Table 2.3-16 shows the BACT removal efficiencies for this system. Table 2.3-17 shows the sulfur dioxide emissions lists for the proposed project.

Table 2.3-14 REMOVAL EFFICIENCIES UTILIZED IN WASTEWATER STREAM ANALYSIS

Parameter	Percent Removal Efficiency[a] From Table 2.3-12	Percent Removal Efficiency[a] Used for Table 2.3-13
BOD5	N/A[b]	50/10
COD	91/19	50/10
Carbon, Organic	90/26	50/10
Nitrogen, ammonia	99/98	95/95
organic	63/38	50/10
Oil and Grease	N/A	90
Phenols	99/53	95/50
Solids, Total	N/A	0
Sulfur, Sulfate	N/A	0
Sodium	N/A	0

Source: Cities Service/Getty (1984a).

[a] With/without biological treatment (i.e., BOD5 removal is 50% with biological treatment and 10% without biological treatment).
[b] N/A = Not Available.

The gas product from the Union retorts is primarily a light hydrocarbon stream containing 3 to 4 percent hydrogen sulfide. This stream is desulfurized in a Unisulf unit, a process licensed by Union Oil, converting in excess of 99.9 of the hydrogen sulfide in the gas to elemental sulfur. Union has stated (UOC 1984) that, under normal operating conditions, concentrations of hydrogen sulfide in the desulfurized gas should not exceed 10 ppmv and concentrations of trace organics should not exceed 50 ppmv.

The Unisulf process is less effective in removing trace organics than removing hydrogen sulfide. The feed concentration level of these trace organics has not yet been defined. Researchers have developed data (Table 2.3-18) which can be used to establish a preliminary range. However, recent information from the U.S. EPA, also shown in Table 2.3-18, indicates significantly higher trace organics levels. Depending on the concentration of these materials, and the removal efficiency of the control process additional specialized sulfur removal steps may be necessary to convert the organic materials to hydrogen sulfide.

The product gas from upgrading is a sour hydrocarbon stream containing hydrogen sulfide and potential trace organic sulfur species. These materials are removed by amine treating and combined with hydrogen sulfide produced from stripping of sour process waters. The desulfurized gas, containing a maximum concentration of 100 ppmv of sulfur species is used for fuel. Depending upon the specific amine selected, it may be necessary to provide additional treatment of the type described above for removal of the trace sulfur species. The composite sour gas stream is then processed in a Claus plant to produce elemental sulfur. Tail gas from the Claus plant, containing residual sulfur dioxide, is treated as necessary for final removal of sulfur. Tail gas concentration of hydrogen sulfide, trace organic materials and any residual sulfur dioxide is predicted to total 100 ppmv.

Table 2.3-15 STATE OF DEVELOPMENT OF AIR POLLUTION CONTROL TECHNIQUES

Control Techniques	Development Status[a]	Getty Proposed Action	Comments
Particulates			
Water Sprays	High	Yes	
Cyclones	High	Yes	
Scrubbers	High	Yes	
Filters	Medium	Yes	Further testing required, especially electrostatic precipitators
Nitrogen Oxides			
Combustion Control	High	Yes	
Chemical Conversion	Low	No	Substantial testwork required
Hydrocarbons and Carbon Monoxide			
Combustion Control	High	Yes	
Sulfur Control			
Hydrogen sulfide			
Direct conversion (e.g., Stretford)	Medium	Yes	
Indirect conversion (e.g., Amine/Claus)	High	Yes	
Sulfur Dioxide			
Flue Gas Desulfurization	Medium	No	Improvements in control efficiency may be necessary; substantial testwork required
Fluid Bed Combustion	Low	No	

Source: Cities Service/Getty (1984b).

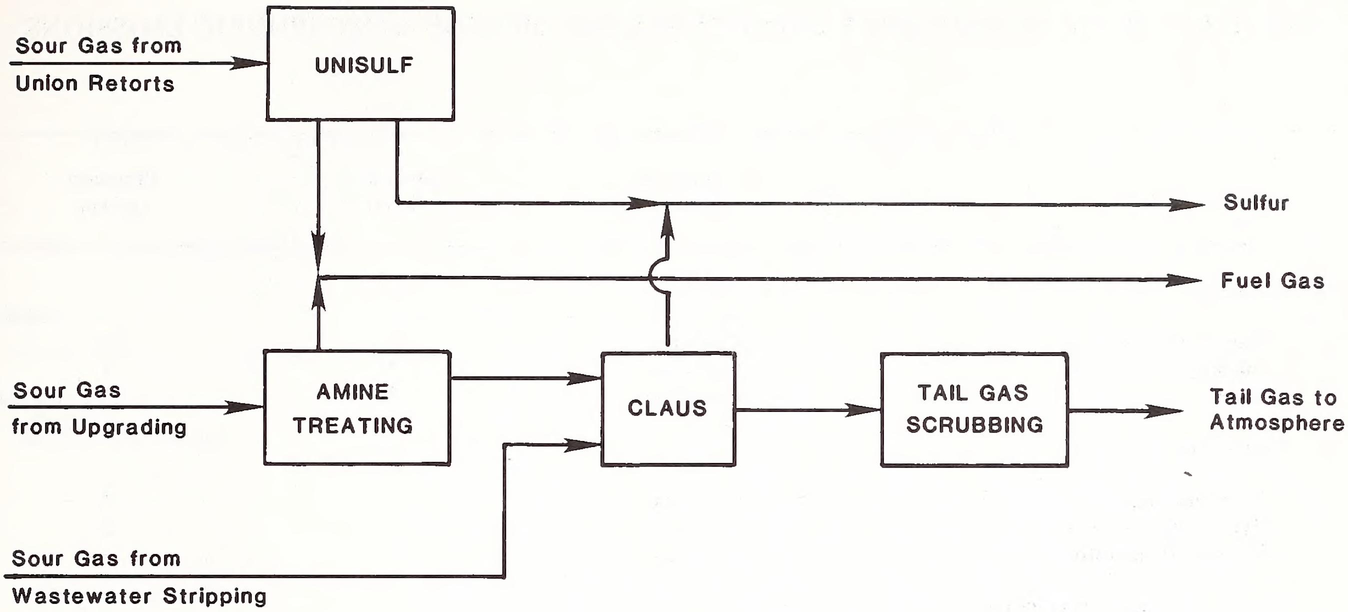
[a] High = Well-developed; technology in current use.
Medium = Some technical improvements are needed for commercial oil shale operations.
Low = Substantial work required prior to commercial demonstration on oil shale.

There are additional releases of sulfur dioxide from process heating, utility heating and material handling operations. The major releases occur from process and utility heating and are based upon BACT for combustion services operating on sweet fuel gas. Mining and spent shale disposal operations will contribute small amounts of sulfur dioxide from mobile equipment exhausts.

There are other criteria pollutants that will be subject to various control mechanisms. Table 2.3-19 summarizes those pollutants and control technologies.

Particulates, nitrogen oxides, carbon monoxide and hydrocarbons in addition to sulfur species are emitted from the recycle gas heater, oil stripper reboiler, and tail gas incinerator. State-of-the-art combustion technology will be employed as discussed earlier. The recycle gas water and oil stripper reboiler will utilize a desulfurized high BTU fuel gas. The tail gas incinerator will combust the treated gas stream from the tail gas unit.

The principal emission from mining and materials handling operations would be suspended particulate matter. This material would consist largely of raw or spent shale fines from the proposed facilities. Activities that



Source: Cities Service/Getty (1984b).

Figure 2.3-15 Sulfur Control Systems, Getty Shale Oil Project.

Table 2.3-16 SUMMARY OF BEST AVAILABLE CONTROL TECHNOLOGY (BACT) FOR SULFUR

Source	Proposed Action	BACT[a,b]
Sour Gas from Union Retorts	Unisulf	100 ppmv
Sour Gas from Upgrading	Amine Treating	100 ppmv
	Claus	> 95% H_2S removal
	Tail Gas Scrubbing	100 ppmv
Sour Gas from Wastewater Stripping	Claus	> 95% H_2S removal
	Tail Gas Scrubbing	50 ppmv

Source: Cities Service/Getty (1984b).

[a] Removal for total of H_2S, SO_2, trace organics.
[b] ppmv = parts per million volume.

produce fugitive particles include blasting; loading, haulage, crushing and stockpiling of raw and retorted shale; and disposal pile development. Dust is also produced by vehicular traffic on access roads. Appropriate dust suppression facilitates, of the type discussed earlier, would be included.

Combustion emissions are produced from blasting operations, from vehicular traffic in the mine and at the various storage and disposal operations near the plant site. Hydrocarbon emissions will be produced from product storage tanks. As appropriate, a vapor collection system will be installed to minimize these emissions.

Table 2.3-17 SUMMARY OF GETTY PROJECT SULFUR DIOXIDE ATMOSPHERIC EMISSIONS

	Emission Source	Emission Level	Emission (g/sec)
Retorting			
- Recycle Gas Heater	Fuel Gas	a	58
- Oil Stripper Reboiler	Fuel Gas	a	5
- Boiler	Fuel Gas	a	19
Upgrading			
- Reformer Heater	Fuel Gas	a	2
- Hydrotreater Heater	Fuel Gas	a	2
- Tail Gas Incinerator	Fuel Gas	a	1
Mining and Material Handling			
- Mining Equipment	Diesel Fuel	b	3
- Spent Shale Haulage Equipment	Diesel Fuel	b	1
			91

Source: Cities Service/Getty (1984b).

[a] 100 ppmv (parts per million volume) H_2S, SO_2, trace organics.
[b] Varies by equipment type and size.

Table 2.3-18 TRACE ORGANIC CONCENTRATION FROM GETTY PROJECT ABOVE-GROUND RETORTING[a]

	Indirect Above-Ground Retorting[b]	
	Research Testing[c]	USEPA[d]
Carbonyl Sulfate	135 - 550	100 - 1000
Carbon Disulfide	0 - 20	100 - 1000
Methyl Mercaptan	35 - 165	50 - 500

Source: Cities Service/Getty (1984b).

[a] Units in parts per million by volume (ppmv).
[b] See definition in Glossary.
[c] Enviroscience (1982).
[d] Bates (1984).

Table 2.3-19 SUMMARY OF NON-SULFUR EMISSIONS, GETTY SHALE OIL PROJECT

Source	Pollutant	Emission Factor	Control	Emission (g/sec)
Retorting				
Recycle Gas Heater	TSP	[a]	None	2
	CO	[a]	None	6
	HC	[a]	None	1
	NO_x	[a]	Low NO_x Burners	74
Oil Stripper Reboiler	TSP	[a]	None	0
	CO	[a]	None	1
	HC	[a]	None	<1
	NO_x	[a]	Low NO_x Burners	7
Boiler	TSP	[a]	None	1
	CO	[a]	None	25
	HC	[a]	None	1
	NO_x	[a]	Low NO_x Burners	34
Upgrading				
Reformer Heater	TSP	[a]	None	1
	CO	[a]	None	3
	HC	[a]	None	1
	NO_x	[a]	Low NO_x Burners	37
Hydrotreater Heater	TSP	[a]	None	0
	CO	[a]	None	1
	HC	[a]	None	0
	NO_x	[a]	Low NO_x Burners	7
Mining				
Mobile Equipment	TSP	0.018 lb/gal	None	2
	CO	0.092 lb/gal	None	9
	HC	0.030 lb/gal	None	3
	NO_x	0.524 lb/gal	None	52
Mining	TSP	0.1 lb/ton	Wet Suppression (95%)	4
	CO	0.2 lb/ton	None	150
Raw Shale Handling				
Crushing	TSP	0.7 lb/ton	Wet Suppression (99%)	6

Table 2.3-19 SUMMARY OF NON-SULFUR EMISSIONS, GETTY SHALE OIL PROJECT (concluded)

Source	Pollutant	Emission Factor	Control	Emission (g/sec)
Conveying	TSP	0.2 lb/ton	Wet Suppression (99%)	3
Upgrading				
Process Area Handling	TSP	0.02 lb/ton	Wet Suppression, Baghouses	15
Disposal/Reclamation				
Transfer Point	TSP	--	Baghouse	1
Mobile Equipment	TSP	0.018 lb/gal	None	1
	CO	0.092 lb/gal	None	3
	HC	0.030 lb/gal	None	1
	NO_x	0.524 lb/gal	None	17
Spent Shale Pile	TSP	1 T/A year	Wet Suppression (75%)	1
Spent Shale Handling	TSP	0.1 lb/ton	Wet Suppression (95%)	4
Topsoil Pile	TSP	1 T/A year	Wet Suppression	1
Miscellaneous				
Tankage Evaporation	HC	0.00003 lb HC/day/gal	Floating Roof	20

Source: Cities Service/Getty (1984b); UOC (1982b).

[a] Summary of Combustion Emission Factors (UOC 1982b).

	Process Heaters (lb/MMBTU)	Steam Boilers (lb/MMBTU)
Nitrogen Dioxide	0.135	0.162
Particulates	0.005	0.005
Hydrocarbons	0.003	0.003
Carbon Monoxide	0.016	0.150

Solid Waste Emissions

Solid wastes include large amounts of spent shale, some quantities of raw shale fines, waste rock, and other non-hazardous materials, and small amounts of hazardous materials.

Table 2.3-20 lists the probable wastes from the Getty shale oil facility, and also presents the proposed action. The disposal techniques and destinations for these wastes are discussed elsewhere. Characteristics of the wastes are briefly described below.

Representative information on Union B processed shale is available and is presented in Table 2.3-21.

Raw shale fines are produced from crushing and screening the mined shale. This material is less than 1/8 inch in size and cannot be processed in the Union B retorts. Characteristics are generally similar to raw shale.

Waste rock is low grade oil shale, produced during mine development operations, that cannot be economically processed.

Table 2.3-20 SUMMARY OF SOLID WASTE MATERIALS AND SOURCES, GETTY SHALE OIL PROJECT

Source	Classification[a]	Disposal Method	Quantity
Spent Shale	NH	Spent Shale Pile	115,000 tpd (dry)
Raw Shale Fines	NH	Spent Shale Pile[b]	10,000 tpd
Waste Rock	NH	Mine Bench Construction	200,000 tons
Upgrading Catalysts			
- Hydrogen Plant	H	Off-site	Ni 37,000 lb/yr (approx.) Fe-Cr 170,000 lb/yr (approx.) ZnO 100,000 lb/yr (approx.) Co-Mo 22,000 lb/yr (approx.)
- Hydrotreating	H	Off-site	Al_2O_3 155,000 lb/yr (approx.) Ni-Mo 1,555,000 lb/yr (approx.)
- Sulfur Recovery	H	Off-site	Al_2O_3 14,000 lb/yr (approx.) Act. Alum. 100,000 lb/yr (approx.) Co-Mo 12,000 lb/yr (approx.)
Water Treatment			
Sludges, Floats	NH	Spent Shale Pile	1000 tpd (dry)
Biological Sludges	NH	Soil Conditioning	100 tpd (dry)
Flue Gas Desulfurization Sludge	NH		--

Source: Cities Service/Getty (1984b).

[a] NH = Non-Hazardous
H = Hazardous
[b] Technique for disposal within the spent shale pile has not been determined.

Table 2.3-21 UNISHALE B RETORTED SHALE CHEMICAL COMPOSITION (REPRESENTATIVE SAMPLE)

Chemical Component	% by Weight
SiO_2	31.5
CaO	19.6
MgO	5.7
Al_2O_3	6.9
Fe_2O_3	2.8
Na_2O	2.2
K_2O	1.6
SO_3	1.9
P_2O_5	0.4
Mineral CO_2	22.9
Organic C	4.3
Trace Elements	$<$ 0.15
Nitrogen	0.2
	100.00

Source: Cities Service/Getty (1984b).

Catalysts are utilized in shale oil upgrading operations to produce refinery quality feedstock. These catalysts become progressively deactivated and require changeout every several years. In addition to the materials listed in Table 2.3-20, the hydrotreating catalyst contains quantities of arsenic and heavy metals adsorbed from the shale oil. The spent catalysts are classified as hazardous materials and would be transported to off-site disposal or reprocessing facilities. The method of transport has not been determined at this time, and would depend on the disposal site location and facilities available at the disposal site.

Sludges and floats from feedwater treatment consist mainly of non-hazardous silty material removed from the water supply. Biological sludges may be produced from wastewater processing and may be used as a soil conditioner in revegetation operations.

The flue gas desulfurization system will produce sludge which consists mainly of calcium sulfite and calcium sulfate. This sludge, containing approximately 50 percent solids, will be disposed of in the spent shale pile.

2.3.1.2.4 Support Facilities. In order for the project to be constructed and operated, provisions must be made for the supply of personnel, equipment, water, and electricity to the site, as well as provision for the removal of product and waste. The various access corridors shown in Figure 2.3-3 constitute the current plan for support facilities. Details of any of these support facilities would be addressed in the appropriate land use (e.g., Right-of-Way) applications made to the appropriate agencies.

Transportation Systems

Getty's plans for transporting workers, major materials, and by-products is based on development of a new railroad line from De Beque, up Roan Creek valley, to a transfer facility located at approximately the confluence of Roan and Clear creeks. The plans for the transfer facility are indefinite at this time. The general location of the transfer facility is shown in Figure 2.3-3; the specific location would be dictated by grade limitations and the constriction of Clear Creek canyon above the location.

A light-rail transportation system would extend from the transfer facility to a point below the Tom Creek reservoir site. Construction and operating workers would be transported from De Beque to Clear Creek canyon below the oil shale property via this light-rail transportation system. From Clear Creek canyon, workers may utilize elevators to access the main plant site.

Also connecting the transfer facility would be the main access road to be constructed in Roan Creek valley, which would extend up Clear Creek canyon and up Tom Creek canyon to the plateau. The road would be designed as a two-lane paved road, and would provide a safe traveling surface by improving the existing county and private road. The road grade would be limited to 8 percent. The total length of the route from De Beque to the plant site would be approximately 20 miles.

Materials delivered to the transfer facility by train would be transferred to trucks for delivery to the main plant site on the plateau. Likewise, by-products and materials leaving the site would be transported down the access road to the transfer facility, where they would be loaded into rail cars for shipment to their final destination. In some cases, trucks could proceed directly to their final destination. Table 2.3-22 summarizes the transportation requirements of the proposed project.

Access would be limited to the site at Getty's southern property boundary in Clear Creek canyon by a security gate and guard. Only authorized personnel would have access to the site.

Water Sources and Supply Systems

The primary source of water for the proposed project would be the Colorado River near De Beque. As shown in Table 2.3-23, Getty owns water rights for 56 cfs with appropriation and adjudication dates of 1950 and 1966, respectively, and has leased 16.5 cfs of the Kobe Canal with appropriation and adjudication dates of 1936 and 1970, respectively. Getty, Cities Service, and Chevron Shale Oil Company have formed the GCC Joint Venture,

Table 2.3-22 TRANSPORTATION REQUIREMENTS, GETTY SHALE OIL PROJECT

Transportation Item	Number or Quantity	Mode	Required No. of Round Trips/Day[a]
Work Force	7,000 people[b]	Train (70 cars)	3
	3,000 people[c]	Train (30 cars)	3
Catalysts	2,000 tons/year	Truck	0.3
Explosives[d]	75 tons/day	Truck	7
By-products			
Ammonia	400 tons/day	Truck	16
Sulfur	400 tons/day	Truck	16
Diesel Fuel	17,000 gal/day	Truck	2
Chemicals, Solids, and Wastes	80 tons/day	Truck	3

Source: Getty (1983b).

[a] Train round trip from De Beque to Transfer Station is approximately 17 miles. Truck round trip from the Transfer Station in the Roan Creek valley to the plant is approximately 16 miles.
[b] Peak construction (combined with operation) transportation requirements occur in the year 1995
[c] Peak operating transportation requirements occur in the year 1997.
[d] Explosive ingredients (dry-ammonia nitrate) would be delivered to the Transfer Station via railroad tank car. Trucks would be used to transport the ingredients to the site. Final explosive preparation would be done on-site (i.e., mixing ammonia nitrate with fuel oil). Shipments to the site would not be an explosive hazard.

Table 2.3-23 WATER RIGHTS OWNED OR LEASED BY GETTY OIL COMPANY THAT MAY BE UTILIZED TO FULFILL WATER REQUIREMENTS OF WATER SUPPLY ALTERNATIVES FOR GETTY SHALE OIL PROJECT LISTED IN TABLE 2.2-1

Name	Source	Amount	SEO[a] 1981 Basin Rank	Adjudication Date	Appropriation Date	Civil Action
Kobe Canal	Colorado River	17.5 cfs	3288	11/10/70	6/30/36	6404
Roan Creek Feeder	Roan Creek	75.0 cfs	3288	11/10/70	6/30/36	6404
Mt. Logan Canal	Roan Creek	40.0 cfs	3288	11/10/70	6/30/36	6404
Mt. Logan Reservoir	Roan Creek	10,000 ac-ft	3288	11/10/70	6/30/36	6404
Pacific Western P.P.	Colorado River	56.0 cfs	4281	11/10/66	9/3/50	4914
Long Point Reservoir	Roan Creek	12,396.5 ac-ft	4775	11/10/70	7/7/61	6404
Roan Creek Reservoir	Roan Creek	58,903.5 ac-ft	5151	11/10/70	3/2/67	6404
Getty Sleepy Gulch Reservoir	Roan Creek Tributary	6,538.0 ac-ft	5177	11/10/70	6/26/67	6404
W. Fork Parachute Creek Reservoir	W. Fork Parachute Creek	4,658.0 ac-ft	6183	12/31/74	6/27/67	W-2243

Source: Getty (1984a).

[a] SEO - State Engineer's Office.

the purpose of which is to develop a common water supply system that will allow each participant to divert and regulate water available under their respective, individual water rights for subsequent industrial use. Facilities associated with this sytem would extend from a water intake in the Colorado River near De Beque through a main storage reservoir on Roan Creek, referred to as the Roan Creek reservoir. The water developed from Getty water rights will be diverted from the Colorado River and delivered to the GCC Roan Creek reservoir through the GCC water supply system described in the CCSOP EIS. The GCC water supply system consists of an intake on the Colorado River near De Beque capable of diverting sufficient quantities of water to satisfy the needs of all the venturers. The water from the intake is delivered to a low-lift pumping plant, which delivers the water via pipeline to a sedimentation and reregulation pond. A pumping plant would lift the water from the sediment reregulation pond via a pipeline to the GCC Roan Creek reservoir. Two of the reservoir rights shown on Table 2.3-23, Long Point Reservoir and Roan Creek Reservoir, would be utilized at the GCC Roan Creek reservoir.

The remainder of the Getty Oil Company water system (i.e., from the GCC Roan Creek reservoir to the plant site) would serve only the Getty Shale Oil Project. The Getty facility would consist of a pumping plant from the GCC Roan Creek reservoir, which would deliver water via a pipeline to a small regulation pond near the confluence of Roan and Clear creeks. A diversion dam located on Roan Creek near the confluence of Roan and Clear creeks also would deliver water to the small regulation pond. The diversion dam on Roan Creek would provide a secondary source of supply to the Getty Oil Company water system and would utilize the Roan Creek Feeder Canal water rights for 75 cfs with appropriation and adjudication dates of 1936 and 1970, respectively. Water from the small regulation pond would be pumped to the Tom Creek Reservoir near the plant site via a pipeline. From Tom Creek Reservoir, water would be pumped to the plant site via a pipeline. The GCC water supply system is described in in the CCSOP EIS (BLM 1983a).

The intake structure would be near the north bank of the Colorado River approximately 600 feet downstream of the confluence with Roan Creek. A system of low head pumps and short discharge lines would deliver water to adjacent sedimentation ponds. The ultimate capacity of the system would be 442.25 cubic feet per second. A 23,000-foot-long water pipeline system with a high head pumping plant is planned along the Roan Creek valley floor to the Dry Fork storage site. The length of the dam crest would be about 4,000 feet with a maximum height of 225 feet. The area of the reservoir would be about 2,600 acres, with an ultimate capacity of 175,000 acre-feet. Getty would install separate facilities to withdraw its water from the reservoir and to pump the water up Clear Creek canyon to the plant site along the corridor.

Four Getty facilities would be required to deliver water from the GCC reservoir to the plant site. A pumping plant from the reservoir, connected to a 24-inch pipeline (nominal capacity of 14,000 gpm), would deliver water to a small regulation reservoir near the confluence of Roan and Clear creeks. A diversion dam on Roan Creek and a short pipeline would also deliver water to this regulation reservoir. A pumping plant near the small regulation reservoir, connected to a pipeline, would deliver water to a second regulation reservoir on Tom Creek. From that point, water would be delivered to the plant site area.

Transmission Lines

The power requirements for the project are presented in Table 2.3-3. The corridors extend from De Beque up Roan and Clear creek valleys, over to Davis Point on Parachute Creek, down-valley to the town of Parachute and back to De Beque. This transmission line loop would be designed to provide reliable service.

A 345-kV capacity transmission line is anticipated for the Getty project. This same line would serve the proposed Cities Service project. Depending on the ultimate power requirements of the projects and the ultimate number of other project loads in the area, more than one line could be required. Rights-of-way requirements for a single 345-kV transmission line would be 150 feet.

The type of structure that would be utilized will depend on the conductor size and terrain limitations. Wood H-frame design, lattice steel towers, and steel poles are all possible alternatives. The wood H-frame structure requires more structures per mile of line length, compared to steel towers or poles, but the latter typically require more land disturbance during construction of each structure.

Product Pipeline

Getty proposes to connect its syncrude pipeline with the La Sal pipeline, which was originally planned to transport syncrude from the Colony Oil Shale Project to existing refineries. Although the construction of the La Sal pipeline has been delayed, it remains a viable link for product transport. The pipeline would be 16 inches in diameter, and would have a nominal operating capacity of 100,000 bpd.

Waste Disposal

At this time, mining wastes are not classified as hazardous. However, some wastes could be generated by the retorting and upgrading processes that may be classified as hazardous. Waste types and estimated quantities were previously presented in Section 2.3.1.2.3. Any hazardous waste would be handled by a qualified and licensed contractor, and disposed of off-site in a licensed facility. If on-site disposal is utilized, a waste disposal management plan would be developed and filed with the appropriate agencies.

Non-hazardous wastes generated by the proposed project has also been summarized in Section 2.3.1.2.3. The proposed plan is to dispose of these wastes in the spent shale pile. If another on-site or off-site location is utilized, a waste management plan would be developed and filed with the appropriate agencies.

2.3.1.2.5 Committed Mitigation Measures - Proposed Action. Mitigation involves avoiding, minimizing, compensating, reducing, or eliminating an adverse environmental impact (CEQ 1978). Mitigation measures committed by Getty are presented by discipline in Table 2.3-24. These mitigation measures presented assume, as applicable, that reclamation of disturbed land would occur according to current state and federal requirements. Correspondingly, all other environmental performance standards currently in place are assumed to remain. Concerning wildlife mitigation measures, the USFWS (1984d) "believes that the intent and implementation of these measures will insure compliance with provisions of the Fish and Wildlife Coordination Act."

These mitigation measures were taken into account when analyzing environmental impacts. This consideration is reflected, as appropriate, in Section 2.4 and Chapter 4.0.

2.3.1.3 Alternatives to the Proposed Action

2.3.1.3.1 Alternatives Considered for Detailed Study. This section presents descriptions of alternatives to the various components of the proposed action. A wide range of options were investigated. Table 2.2-1 (Section 2.2.2) presents the alternative categories which have been considered and the various options in each category. Each alternative selected for detailed discussion is described below. For some categories, there were no alternatives included for detailed discussion. These include mining method, retort type, upgrading, water source, product transport methods, retort sites, upgrading site, retort additions site, and access road. Table 2.2-1 presents summaries of the reasons for elimination of alternatives by category.

Production Rate

The alternative to the preferred 100,000-bpd production rate is a 50,000-bpd rate. This alternative would still utilize room-and-pillar underground mining and surface retorting, but at a reduced level. The project life would be doubled. The net consumption per year of water and power would be less than the 100,000-bpd alternative. Air and water emissions would also be less on an annual basis. Overall resource recovery and process efficiency is also expected to be less because of the loss of the economies of scale. The 50,000-bpd alternative will involve only the initial surface site, with one-half of the retort modules (6), and with one-half of the upgrading facilities and mine capacity.

Retort Technology and Pile Stability

Use of the Lurgi retorting technology alternative would be reasonable, based upon Getty experience in processing diatomite. The key elements of the Lurgi retort process are illustrated in Figure 2.3-16. Shale fines are fed to a horizontal mechanical screw mixer where heating is accomplished by mixing with recycled shale. The retorted oil

Table 2.3-24 LIST OF COMMITTED MITIGATION FOR THE GETTY PROJECT

Project Feature/Discipline	Mitigation Measure
Project Design and Operation	• Implement practices for oil and grease spills and proper storage of such chemicals and fuels as is required by good management practice.
	• Develop emergency clean-up programs (under SPCC requirements).
	• Implement required pipeline break and accidental spill prevention and control plans.
	• Operator will consider the development of contingency plans for hazardous materials, pipeline break and spills, and power supply system failures.
	• Proper spillway design to prevent undercutting of the dam toes, use of riprap, gabions, or similar technques will be employed on dams and reservoirs.
	• Slope stability will be enhanced by proper engineering design.
	• Dam failure potential will be monitored as required.
	• Proper construction methods on dams will be employed to minimize water quality and aquatic life impacts.
	• Proper erosion and sediment control plans will be employed to minimize water quality impacts.
	• Where practical, revegetate reservoir shoreline areas with vegetation mixtures favorable to wildlife.
Surface Water	• Operator commits to engineer routing of all surface flow from spring discharges around disturbed areas.
	• Operator will consider use of poor quality runoff, as collected in sedimentation ponds, for operations uses.
	• Operator commits to implement proper erosion and sedimentation control plans.
	• Operator commits to a vegetation buffer zone between roads and streams to minimize high TSS runoff and keep road clean of all refuse.
	• Operator will consider programs to monitor water quality and quantity downstream of dams.
	• Operator will enforce best management practices to prevent spillage of oils, fuels, and other hazardous materials.
	• Operator will utilize proper construction techniques to prevent the introduction of high TSS/TDS water into reservoirs and receiving streams, and to ensure minimal watershed disruption as is practical.
	• Operator will use best engineering practices to control drainage from spent shale piles and other processing facilities to prevent contamination of nearby surface runoff.
	• Operator will use best engineering practices to ensure proper routing and containment of underdrain discharges if it has poorer quality than the receiving water.
Ground Water	• Operator commits to design, construction, and maintenance of drainage control systems for disturbed areas.
	• Operator commits to the design and installation of a leachate collection system as required by regulation.
	• Operator commits to best mining and engineering practices which will minimize subsidence potential, yet facilitate resource recovery.

Table 2.3-24 LIST OF COMMITTED MITIGATION FOR THE GETTY PROJECT (continued)

Project Feature/Discipline	Mitigation Measure
Aquatic Ecology[a]	• Operator commits to installation of a passive intake structure for the GCC water system on the Colorado River as described in the Public Notice 8157-FEIS at the front of this FEIS.
	• As is feasible, operator will schedule construction activities to reduce impacts related to runoff.
	• Operator will use best engineering practices for containment techniques for spent shale disposal areas to reduce leachate contamination to streams.
	• Operator will consider mosquito control programs in cooperation with local appropriate control areas.
Soils	• Operator will comply with the conceptual reclamation plan outlined in Sections 2.3.1 of the EIS.
	• Operator commits to minimize topsoil stockpiling, where practical, through direct replacement.
	• Operator commits to perform, as practical, slope reduction, revegetation, and wind and water erosion control measures on impacted areas of the plant site, pipelines, and road corridors.
Vegetation[a]	• Operator will minimize impacts to all listed threatened and endangered plant populations.
	• Operator has committed to evaluate the feasibility of transplanting, artificial propagation, and re-establishment of threatened and endangered affected plants in consultation with USFWS.
	• Operator will consider minimizing direct impacts to riparian areas, as practical.
	• Operator will revegetate disturbed areas with appropriate vegetation mixtures including native plant materials, as available.
	• Operator will use best practice available to establish vegetation on disturbed areas, including spent shale areas.
	• Operator will perform field surveys for threatened and endangered plant species on public lands prior to land disturbance.
	• Operator will minimize disturbance within corridors through right-of-way overlaps, as practical.
	• Operator will minimize mechanical disturbance of vegetation, as practical, during construction of transmission lines, pipelines, and roadways.
	• Operator will control access to threatened and endangered plant areas, as practical, on operator controlled lands.
Wildlife[a]	• The operator will cooperate with FWS and CDOW to avoid all Category 1 habitats through proper siting.
	• Undetermined acres of Category 2 habitat/ranges may be impacted by development. Although no commitment to required mitigation acreages is presented, the Operator recognizes that some acres may need to be enhanced to offset project impacts. New enhancement technologies in effect at the time of project development may change the acres required.

Table 2.3-24 LIST OF COMMITTED MITIGATION FOR THE GETTY PROJECT (continued)

Project Feature/Discipline	Mitigation Measure
Wildlife[a] (cont.)	
	• Undetermined acres of Category 3 habitat/ranges may be impacted by development. Although no commitment to required mitigation acreages is presented, the Operator recognizes that some acres may need to be enhanced to offset project impacts. New enhancement technologies in effect at the time of project development may change the acres required.
	• Operator will work closely with USFWS and CDOW to determine appropriate buffer zones for sage grouse leks and federal and state protected raptor nest sites.
	• The Operator will develop appropriate reservoir management plans as long as such plans do not preclude the Operator's intended use.
	• The Operator commits to install "electrocution proof" transmission lines for raptors.
	• Operator will work closely with USFWS and CDOW in implementing in-house wildlife monitoring programs on its properties.
	• Operator commits to no taking of raptors or nests unless specifically permitted by USFWS and CDOW.
	• Operator will consider, as it is feasible, timing construction to avoid critical raptor nesting and big game concentration periods.
	• Operator recognizes the importance of riparian/wetland habitats and will work closely with USFWS and CDOW in minimizing impacts to such areas if they are encountered.
	• Operator commits to fencing practices which minimize wildlife impacts and excludes wildlife from hazardous areas.
	• Operator agrees to implement appropriate means to minimize big game road kills if kill frequencies exceed 10 per mile per year.
	• Operator commits to reseed roadway shoulders, where possible, with vegetation unpalatable to wildlife.
	• At the time of project development and in cooperation with other developers, the operator will investigate the use of mass transportation of its workers as a means of reducing big game road kills if the kill frequency exceeds 10 per mile per year.
	• Operator commits to enforce reduced speed limits at key big game crossing areas.
	• Operator commits to promote wildlife education program as a part of employee orientation.
	• Operator commits to implement a company firearm policy to curb employee possession of weapons while at work and while commuting to the project site.
	• Operator agrees to revegetation of disturbed areas, except those adjacent to roadways, with revegetation mixtures favorable to wildlife in cooperation with USFWS, CDOW, and its MLRB permitting.
	• In cooperation with CDOW, USFWS, other agencies and other oil shale developers, the Operator will assist in the development of a regional wildlife management plan to address cumulative wildlife impact issues.
	• During construction and operation the Operator agrees to enhance adjacent areas, using enhancement technology in effect at the time, so there is no net loss to in-kind habitat value.

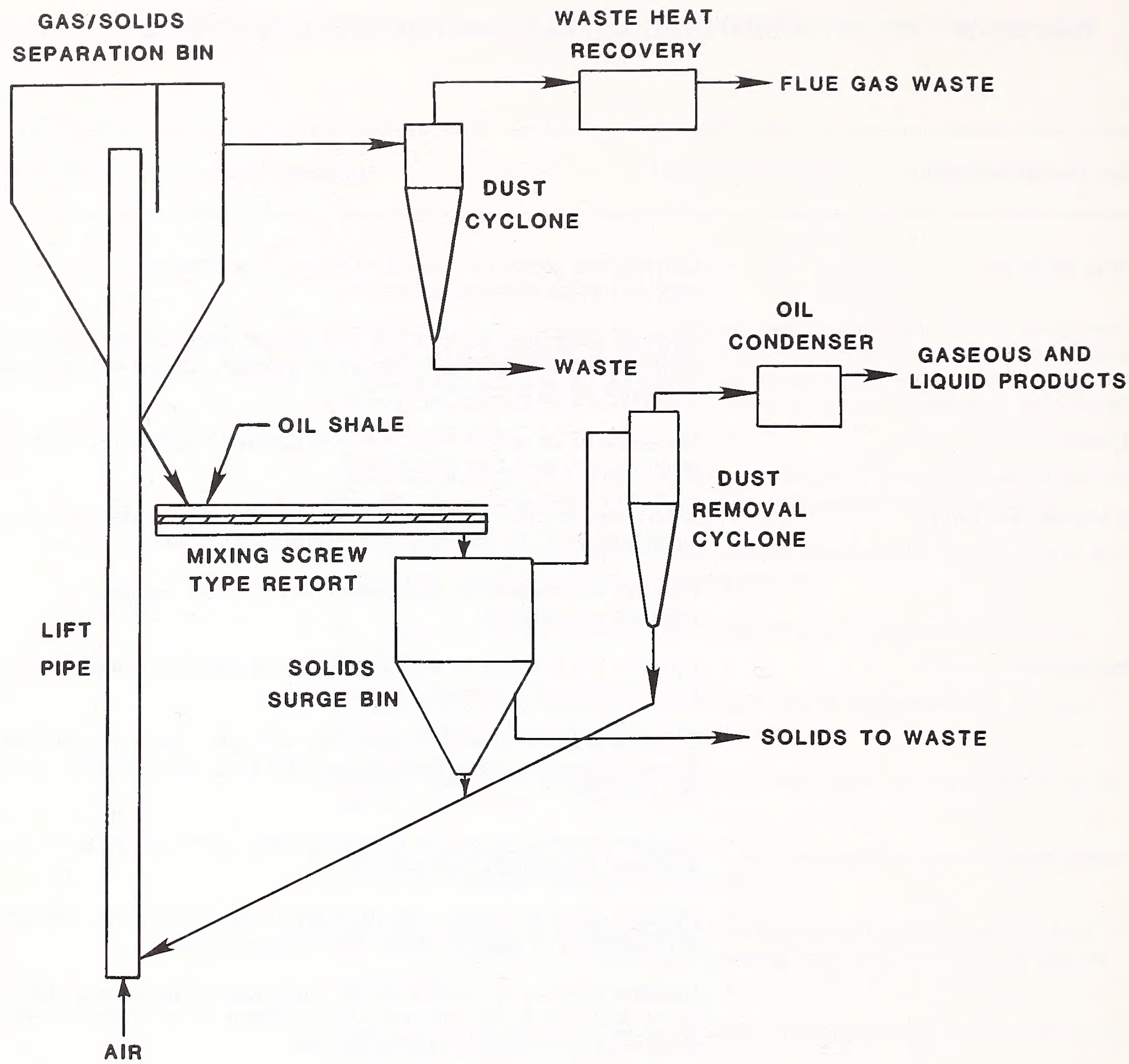
Table 2.3-24 LIST OF COMMITTED MITIGATION FOR THE GETTY PROJECT (concluded)

Project Feature/Discipline	Mitigation Measure
Cultural Resources	• Operator will complete a Class III field survey of potentially disturbed public lands prior to surface disturbance activities.
	• Operator commits to perform required cultural resources and paleontological surveys prior to surface disturbing activitities. If necessary, excavation, recordation, or avoidance would be performed.
Air Quality	• Mitigation of air quality impacts will be achieved by implementation of control measures as specified by regulations.
Land Use and Recreation	• In conjunction with special use permits, operator will consider assisting municipalities in the development of recreational facilities.
	• Operator will assist in the development of alternative rangeland and livestock drive trails for area affected.
Socioeconomics[b]	• Operator will continue its historic cooperation with the Cumulative Impact Task Force (CITF) and local government agencies.
	• Operator proposes to work cooperatively with government officials to ensure that adequate financing would be available at the front end to provide necessary services and facilities.
	• Operator proposes to develop a socioeconomic monitoring program in conjunction with local governments and agencies.
	• Operator proposes to work with local government and entities to identify impacts attributable to its shale oil project and possible solutions.
	• Operator proposes to provide regular employment estimates and updated scheduling information and would also provide information to new employees concerning the availability of housing and public services.
	• Operator proposes to encourage employees to locate in communities with current or planned infrastructure capacity to absorb new growth. This could require various types of incentive programs to ensure the timely availability of housing in certain communities. This would allow growth without exceeding the capacity threshold of their public facilities.
	• A key factor considered in determining the spatial allocation has been the desire by Getty to minimize the number of affected communities. Getty can, thereby, target its mitigation efforts and develop more comprehensive effective strategies rather than diluting its efforts over numerous communities. De Beque has been identified as the area where Getty's growth and mitigation efforts would be concentrated.
	• Operator is aware that some infusion of capital into local financial institutions could be needed so that private capital construction such as housing and commercial development could occur. Similarly, in order to achieve its spatial allocation goals, Operator would use incentives both for the housing industry and for employees.
Transportation	• In conjunction with future special use permitting requirements, the Operator will consider its part of future road upgrading.

Source: Getty (1983g; 1984c).

[a] Mitigation measures for these environmental resources will also include the mitigation planned as part of the Section 7 requirements under the Endangered Species Act. See Appendix D.

[b] Specific mitigation measures for socioeconomics impacts will be based on the results of a socioeconomics monitoring program and negotiations with local government officials at the time of project development.



Source: Getty (1983b).

Figure 2.3-16 Lurgi-Ruhrgas Retort Process, Getty Shale Oil Project.

is discharged from the mixer with the gas. The gas is quenched in a heavy oil scrubber which is designed to contain most of the dust in the heavy oil fraction. The lighter oils are further quenched and water is separated. The heavy oil is dedusted by a dilution centrifuge process which returns the spent shale to the retort collection bin. Heat is supplied to the process by combusting the carbon on a mixture of recycled and freshly-processed shale in a fluidized bed lift pipe which discharges into a collection bin. The flue gas from the combustor passes through a heat exchanger to preheat combustion air and to generate steam. Relative to the Union retort, less high-Btu gas and more sour water are produced. Substantial quantities of flue gas dust must be collected while sulfur dioxide is emitted primarily from the lift pipe.

Some physical properties of Lurgi process retorted shale have been summarized by the U.S. Environmental Protection Agency (1983), as shown on Table 2.3-25. The Lurgi process retorted shale tested was a fine material with a maximum size of 3/8 inch and between 64 and 67 percent minus the No. 200 sieve size. It would be classified as sandy silt (ML) in accordance with the Unified Soil Classification System. A specific gravity of 2.83 was reported.

Compaction permeability, triaxial, and unconfined shear strength test results for three levels of compactive effort were reported. A maximum dry density of 85.6 pcf at an optimum moisture content of 30.3 percent,

Table 2.3-25 PHYSICAL PROPERTIES OF LURGI RETORTED SHALE

														Shear Strength				
		Gradation					Compaction			Permeability ft/yr			Triaxial Shear				Unconfined	
Test Condition	Max. Part. Size (in.)	% Clay[a]	% Silt[b]	% Sand[c]	% Gravel[d]	Remarks	Spec. Grav.	% Opt. Moist.	Max. Dens. (pcf)	Load, 50 psi	Load, 100 psi	Load, 200 psi	Fric. Coef. Tan Ø	Intern. Angle of Fric.	Cohes. psi	Satur. Cohes. psi	Days Cured at 120°F	Uncon-fined Comp. psi
As Received	3/8	17.1	47.8	33.4	1.7		2.83											
	3/8	15.3	46.4	36.6	1.7		2.84											
Compacted	--	16.2	48.2	35.6	0.0	Initial		30.3	85.6	0.002	0.003	--	0.69	34.5	22.2	7.6	0	28.8
1/2 D 698	--	17.6	44.2	38.2	0.0	After Compaction											0	33.1
(6,200 ft-lbs)	--	15.5	37.9	46.6	0.0	After Triaxial											7	590.7
		15.5	37.9	46.6	0.0	Shear Test											7	785.9
																	14	575.0
																	14	682.4
																	28	--
																	28	--
Compacted	--	16.2	48.2	35.6	0.0	Initial		28.5	88.2	0.003	0.005	--	0.62	32.0	33.3	13.9	0	38.5
D 698	--	18.8	44.2	37.0	0.0	After Compaction											0	42.5
(12,375 ft-lbs)	--	8.8	42.5	48.7	0.0	After Triaxial											7	874.5
						Shear Test											7	865.5
																	14	940.8
																	14	912.1
																	28	1,222.2
																	28	1,222.1
Compacted	--	16.2	48.2	35.6	0.0	Initial		23.2	96.8	0.001	0.001	--	0.80	38.5	41.0	27.8	0	378.5
D 1557	--	0.1	56.3	43.6	0.0	After Compaction											0	350.8
(56,250 ft-lbs)	--	12.8	45.9	41.3	0.0	After Triaxial											7	971.1
						Shear Test											7	1,182.6
																	14	986.5
																	14	1,081.0
																	28	--
																	28	--

Source: USEPA (1983).

[a] 0.005 mm
[b] −200 mesh to 0.005 mm
[c] 4 to 200 mesh
[d] +4 mesh

coefficients of permeability of 0.002 and 0.003 ft/yr, an angle of internal friction of 34.5° and moist and saturated cohesions of 22.2 and 7.6 psi, respectively, were reported for retorted shale compacted with 6,300 ft-lbs of energy per cubic foot of sample (½ ASTM D 698). Samples compacted to ASTM D 698 standards (12,375 ft-lbs) showed a maximum dry density and optimum moisture content of 88.2 pcf and 28.5 percent, respectively, coefficients of permeability of 0.003 and 0.005 ft/yr, a friction angle of 32°, and moist and saturated cohesions of 33.3 and 13.9 psi. A maximum dry density of 96.8 pcf at an optimum moisture content of 23.2 percent, coefficients of permeability of 0.001 ft/yr, friction angle of 38.5°, and moist and saturated cohesions of 41.0 and 27.8 psi, respectively, were reported for samples compacted at a high compactive energy (56,250 ft-lbs, ASTM D 1557). About 3 to 8 percent breakdown of particle sizes was experienced when the samples were compacted. About 6 to 11 percent particle size breakdown was reported when the samples were tested in triaxial shear.

The Lurgi process retorted shale exhibited cementitious properties when wetted and compacted. The degree of cementation can be measured by unconfined compressive strength tests. Unconfined compressive strengths of between 28.8 and 1222 psi were reported, depending upon the degree of compaction and the number of days the samples were cured.

The test results reported for the Lurgi process retorted shale are similar to those discussed by others (Gerhart and Holtz 1981) for high temperature retorted shales. Except for the strength properties, those properties are also within the range of physical properties typical of sandy silt soils. The measured strengths of the retorted shale were considerably higher than would be expected for a "typical" silt soil, and are the result of cementitious processes that occur between particles when they are moistened. The degree of strength gain is likely dependent on several factors, including the quality and quantity of the water used, the degree to which the retorted shale is compacted, and the time between wetting and compaction. The high strengths that result due to the cementitious properties of Lurgi process retorted shale are favorable to disposal pile designs and construction. However, even discounting cementitious effects, the Lurgi process retorted shale exhibits properties that indicate that such materials could be designed and constructed into stable disposal piles.

Since Lurgi process retorted shale is a finer material than Union B process retorted shale, somewhat more settlement occurring over a somewhat longer period of time might be anticipated for a Lurgi process retorted shale disposal pile. However, the cementitious properties of the Lurgi process shale could result in less settlement, as much of the pile could be bonded into a single mass. The physical properties reported for the Lurgi processed retorted shale are within the range of those reported for naturally occurring soils whose classifications are the same as the retorted shales. The strengths of the Lurgi process retorted shale could be higher than for similar natural soils due to its cementitious properties.

The thermal efficiency of the Union B process could be improved by utilizing energy remaining in the spent shale. The Union Oil Company is currently developing a process, the Unishale C process, which would use a spent shale combustor to gasify residual coke and supply energy for process heating. Getty plans to monitor development of this technology and evaluate its use when available.

Unishale C technology has not yet been commercialized; however, certain test data have been published by Union (Duir et al. 1977). For Colorado oil shale having a Fischer Assay of 34 gal/ton, Union reports that products have the following energy distribution: oil - 75 percent, gas - 12 percent, carbonaceous material on spent shale - 13 percent. This compares well with the reported 13 percent increase in overall thermal efficiency when the spent shale compustion step is added to the Union B process. Union reports that this combustion mode operation does not consume any of the net product oil or fuel gas, and produces enough energy to supply most of the plant power requirements. Product oil and gas compositions are unchanged.

Spent shale properties are different for the two operating modes. As shown in Table 2.3-26, these differences are primarily in organic carbon and mineral CO_2 content (CSM 1975). The Union B retorted shale contains about 4 percent organic carbon. As a result of the relatively low (950-1,000°F) retorting temperature, only a small fraction of carbonate minerals in the raw shale feed decomposes. In the case of the Unishale C shale, combustion of the spent shale is nearly complete and the carbonates are largely decomposed at the maximum temperature (1,500-1,600°F) of the combustor.

Table 2.3-26 COMPOSITION OF UNION B AND UNISHALE C RETORTED SHALE

Component	Union B Retorted Shale (% by weight)	Unishale C Decarbonized Shale (% by weight)
SiO_2	31.5	39.2
CaO	19.6	27.3
MgO	5.7	8.2
Al_2O_3	6.9	8.9
Fe_2O_3	2.8	3.8
Na_2O	2.2	3.7
K_2O	1.6	2.7
SO_3	1.9	1.4
P_2O_5	0.4	0.5
Mineral CO_2	22.9	3.1
Organic C	4.3	0.3
Trace Elements	$>$0.15	0.9
Nitrogen	0.2	--
	100.0	100.0

Source: CSM (1975).

The Unishale C spent shale has a pH of 12.5 and is considerably more alkaline than the Union B spent shale which has a pH of 8.7. This higher pH is an indication of partial decomposition of carbonates into oxides which are hydrolyzed to form alkalis.

Physical properties of Union B and Unishale C spent shales have been measured relative to their potential for being successfully vegetated. Table 2.3-27 shows the results of these tests. Compared to Union B spent shale, decarbonized shale will likely require a reduction in alkalinity to enhance revegetation, require a greater amount of moistening, and will exhibit improved cementing properties. Due to its higher porosity from undergoing decomposition of most of its mineral carbonates, decarbonized shale has a compacted dry bulk density of only about 70 pcf in contrast to about 90 pcf for Union B spent shale. Also, due to this porosity, held moisture of decarbonized shale should be considerably higher than the 21-23 weight percent reported for compacted retorted shale. The 361 psi compressive strength reported for the decarbonized shale indicates that this material has a significant amount of natural cementing activity, which will be an important factor in its disposal.

Power Source

Getty may install an on-site power plant as an alternative to ensure reliability of power supply. The capacity of the power plant would be determined based upon critical loads, steam requirements, and the availability of fuel. The output of this cogeneration plant would be electricity and process steam, and the ratio of the two products would vary with plant design. The assumed fuel for cogeneration would be upgraded shale oil, which has minimal sulfur content. The cogeneration plant would be located at the initial surface site, close to the fuel supply.

Product Pipeline Route

The Rangely product pipeline alternative occupies the same corridor as described in the CCSOP EIS (BLM 1983a). It would connect to an existing pipeline in Rangely, supplying crude oil to Salt Lake City refineries. However, this pipeline has insufficient capacity for 100,000 bpd and available refining capacity in Salt Lake City is also inadequate to handle 100,000 bpd. A pipeline interconnection to the existing system at Rangely would require additional governmental approvals.

Table 2.3-27 PROPERTIES OF UNION B AND UNISHALE C RETORTED SHALE AFFECTING REVEGETATION

	Union B		Unishale C	
	Initial Compaction	Compaction to 12,375 psf	Initial Compaction	Compaction to 12,375 psf
Particle Size (%):				
1-6 in.	--	--	--	--
4.8 mm - 1 in.	74	37	75	53
0.07 mm - 1 in.	16	39	16	14
0.005 mm - 0.07 mm	9	17	5	33
0.0-0.005 mm	1	7	4	
Soil Grouping[a]	GP-GM		GM	
Texture	Silty Gravel		Silty Gravel	
Color	Black		Buff	
Solid Density (g/cc)	2.59		2.69	
Dry Bulk Density (pcf)	61	90.4		68.5
Unconfined compressive strength after 28 days cure at 125 °F		13		361
Field moisture, wt% of dry solids	16	21-23		

Source: Allred (1983).

[a] GP = Poorly graded gravel
GM = Gravel with appreciable amounts of fines
GP-GM = Combination of GP and GM

Spent Shale Disposal Sites

Alternative spent shale disposal sites are in Tom, Buck, and Doe gulches. Shale disposal in these areas would require filling them to approximately the top of the cliffs (i.e., 7,600 feet). Conveyor length would be increased from the additional retorts site.

Because of the expansion of volume associated with spent shale, disposal of all of the spent shale in the underground mine would not be possible. In addition, disposal of spent shale underground would preclude possible future recovery of oil shale in the mine pillars. The logistics of underground disposal would also be more complex. Mine design and subsurface environmental conditions would delay the start of underground spent shale disposal to a time when side operations would not interfere with normal mining functions. This may be 5 to 10 years after the start of shale oil production. Additionally, in order to put the spent shale underground properly, it would still have to be cooled, perhaps even more than for surface disposal, because it would have to be handled underground by men and machinery. Hence, underground disposal could require more water than surface disposal.

However, approximately one-half of the total volume of spent shale could be disposed in the underground mine, thereby potentially reducing the total disturbed area for surface spent shale disposal and the depth of spent shale at the surface site(s).

If the Lurgi retort is utilized, the resulting spent shale would be deposited in the same areas, utilizing the same methods as in the proposed action and alternatives discussed herein.

Water Supply System

One water supply alternative has been developed. Others have been eliminated due to technical and economic reasons (Table 2.2-1). Both the proposed action and the 50,000-bpd alternative would include the GCC Joint Venture System (diversion dam, pumping plants, sedimentation and regulation ponds, pipeline, and storage dam).

To recall, the Getty proposed action (see Section 2.3.1.2.3) requires four facilities to deliver water from the GCC reservoir. A pumping plant at the reservoir, connected to a 24-inch pipeline (nominal capacity of 14,000 gpm), would deliver water to a small regulation reservoir at the confluence of Roan and Clear creeks. A diversion dam on Roan Creek and a short pipeline would also deliver water to this regulation reservoir. A pumping plant at the Tom Creek reservoir and a pipeline would deliver water to the initial surface plant site and the retort additions site.

The alternative would require six facilities to deliver water from the GCC reservoir. A pumping plant at the GCC reservoir and a pipeline would deliver water to a small regulation reservoir near the confluence of Roan and Clear creeks. A diversion dam on Roan Creek and a short pipeline would also deliver water to this reservoir. A pumping plant at the Roan/Clear Creek regulation reservoir and a pipeline would deliver water to a regulation reservoir on Tom Creek. A pumping plant at Tom Creek reservoir and a pipeline would deliver water to the initial surface plant site and to a regulation reservoir on the West Fork of Parachute Creek. A pumping plant at the West Fork of Parachute Creek reservoir and a pipeline would deliver water to the retort additions site and under emergency conditions could deliver water to the initial surface and plant site. In summary, the alternative simply adds the West Fork Parachute Creek reservoir and related facilities to the proposed action, primarily to supplement water to the Getty retort additions site.

Power Supply Route

An alternative power supply route would be the Big Salt Wash transmission line corridor which would enable Getty to contract with either Colorado-Ute Electric Association or Public Service Company of Colorado. The route of this line is described in the CCSOP EIS (BLM 1983a). The design details are as previously described for the transmission line.

2.3.1.3.2 Alternative Mitigation Measures. This section presents mitigation measures (Table 2.3-28) that may be considered in addition to those being proposed by Getty in Section 2.3.1.2. The mitigation measures presented in Table 2.3-28 could be applied to features of the proposed action or to the alternatives presented in this section.

2.3.1.4 Preferred Alternative - Getty

For regulatory permit actions, the Corps takes an impartial position whether to issue or deny a particular application until the public interest review is complete. At no time is the Corps a proponent of any action. It simply determines whether or not certain actions proposed by applicants are in the public interest and under what circumstances such proposals, if modified, would be in the public interest. The Corps' actual decision that is made by the final decision maker will be stated in the Record of Decision. This does not negate the requirement under 40 CFR 1505.2(b) for the district engineer to objectively state the "environmentally preferred alternative."

2.3.1.5 No Action Alternative - Getty

Consideration of the No Action alternative is required in any EIS, in accordance with regulations issued by the Council on Environmental Quality (CEQ 1978), and under the provisions of the National Environmental Policy Act of 1969. Under the No Action Alternative, the construction of the shale oil facility would not take place. No action would occur due to (1) the denial of the 404 Permit by the Corps, or (2) a decision by Getty not to proceed with the project. The impacts of the No Action alternative for Getty are described and compared in Section 2.4.3.1.9.

Table 2.3-28 POTENTIAL ADDITIONAL MITIGATION MEASURES FOR THE GETTY PROJECT

Project Feature/Discipline	Mitigation Measure
Topography/Geology/Paleontology	• Avoidance of paleontological resources and, if necessary, extraction and preservation of scientifically important fossils
Ground Water	• Installation of effective liners for all ponds and disposal areas
Noise	• Proper equipment selection, design, and operation schedules • Increased noise absorbers or deflectors
Cultural Resources	• Conduct of cultural resources and paleontological surveys and appropriate mitigation measures on significant sites on private lands
Land Use, Recreation, and Wilderness	• Development of alternate rangeland areas and livestock drive trails • Operator would assist in development of land use planning and control
Transportation	• Shift scheduling • Mass transit systems
Energy	• Energy conservation measures

2.3.2 Cities Service Project

2.3.2.1 Introduction and Overview

Cities Service plans to develop its oil shale properties in the upper Conn Creek area of Garfield County, Colorado (Figure 2.3-17). The proposed project would ultimately produce 100,000 barrels per day (bpd) of shale oil, and would have a minimum life of 25 years. Important components of the operation include:

- An underground mine ultimately producing 135,000 tons per day (tpd) of shale
- Ten retorting modules located on the Roan Plateau
- A total of 18 Vertical Modified In Situ (VMIS) retorts
- Four upgrading modules, one producing 10,000 bpd, and the other three producing 30,000 bpd each
- Spent shale disposal in Conn and Cascade Canyons
- Shale fines and waste rock disposal on the Roan Plateau
- Support facilities, including a product syncrude pipeline, a natural gas pipeline, electric transmission loop, access road, railroad spur, and water supply system.

A detailed description of the Cities Service proposed project is presented in Section 2.3.2.2.

The alternatives to the proposed action considered can be categorized into the following major components.

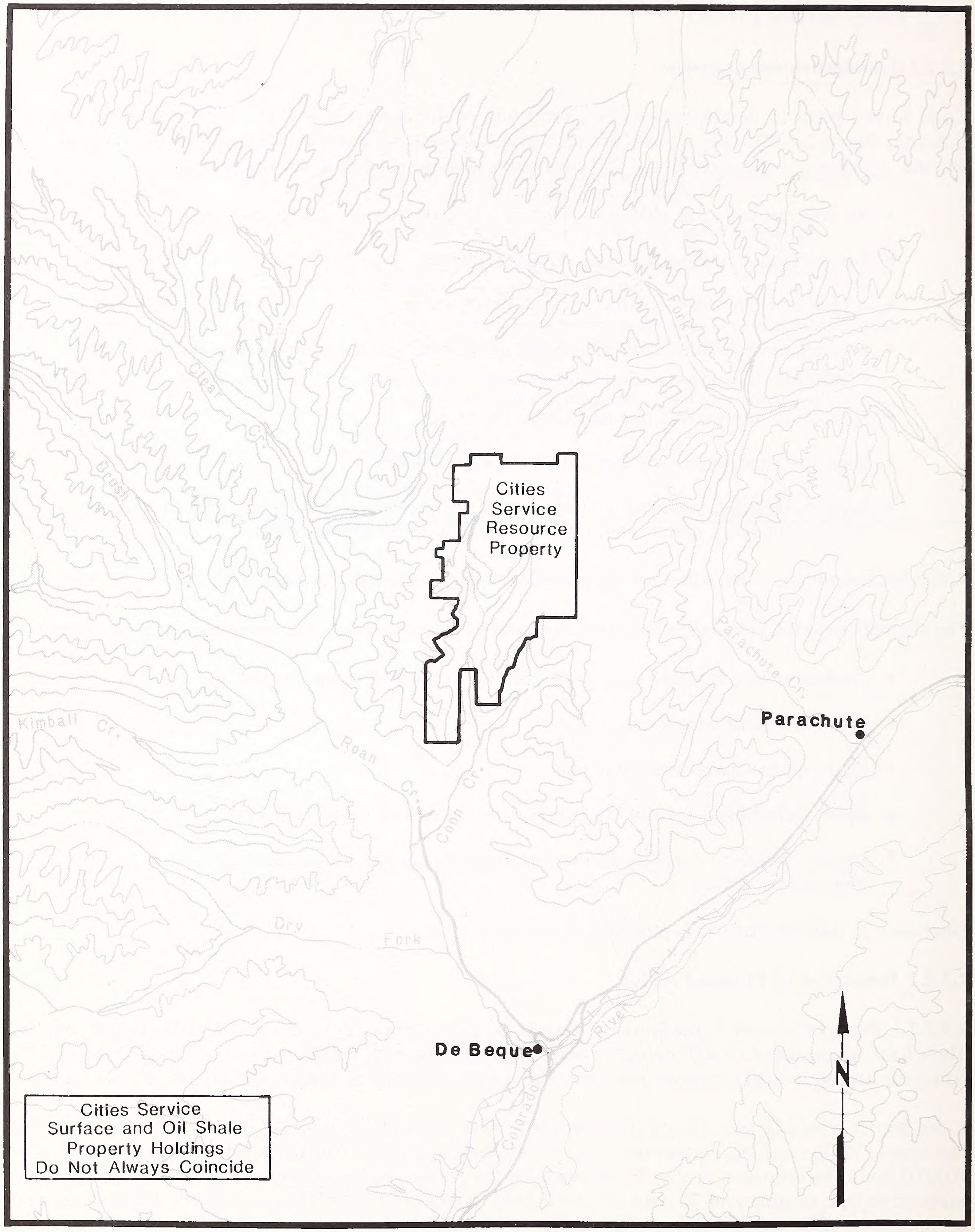
- Production rate alternatives — production of 50,000 bpd versus 100,000 bpd
- Room-and-pillar mining only
- Retort type — surface retorting only
- Retort technology — use of the Lurgi process instead of Union B process
- Support facilities — various alternatives regarding pipeline routes, shale disposal sites, and water supply systems

Discussion of these alternatives is presented in Section 2.3.2.3.

2.3.2.2 Description of Proposed Action

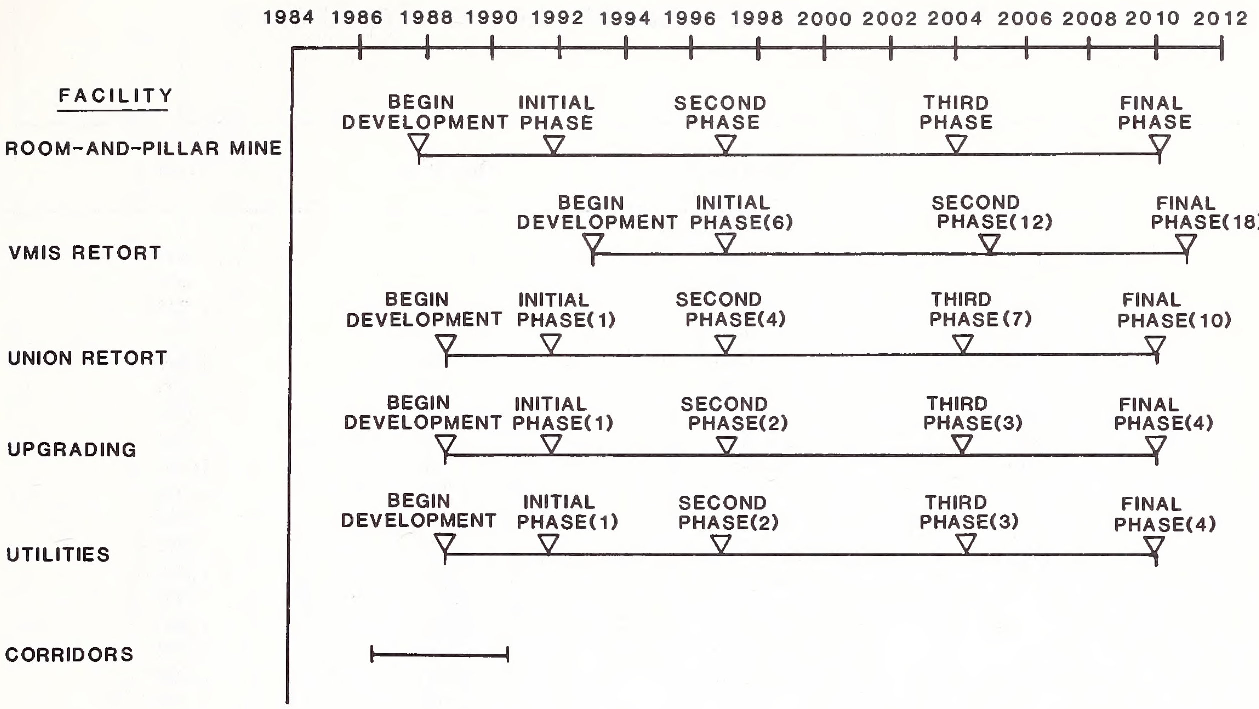
2.3.2.2.1 Project Overview. Cities Service properties are located primarily in Range 97W, Townships 6S and 7S. These holdings consist of 10,300 contiguous acres, with approximately 6,850 acres on the Roan Plateau and the remaining acreage located in canyon drainages. The acreage on the Roan Plateau contains the oil shale resource.

Cities Service would develop the oil shale property using conventional room-and-pillar underground mining techniques, VMIS retorting, surface retorting, and shale oil upgrading. Ultimate production capacity would be 100,000 bpd. The estimated project life depends on the precise implementation of the various stages, but is expected to be a minimum of 25 years (Figure 2.3-18). Initial production of approximately 10,000 bpd could commence in 1992 with the ultimate production of 100,000 bpd potentially achieved by 2010. Manpower requirements would peak at about 6,000 and would include construction and operations personnel. Peak construction manpower would be approximately 3,000 and ultimate operational manpower at capacity production would be approximately 4,000. A schedule of manpower requirements by year is shown in Table 2.3-29.



Source: Cities Service (1983b). SCALE 1:250,000

Figure 2.3-17 Oil Shale Resource Property, Cities Service Shale Oil Project.



Source: Cities Service (1983b).

Figure 2.3-18 Cities Service Shale Oil Project Development Schedule.

Certain components of the Cities Service proposed project may affect public land in Roan Creek valley through development of the GCC Joint Venture reservoir and construction of various multiple-use roads, powerline, and water pipeline rights-of-way specific to the Cities Service project; and on the Roan Plateau through development of the underground mine and construction of syncrude pipeline and powerline rights-of-way. Table 2.3-30 identifies public lands on the Roan Plateau, in Conn Creek canyon, and in Roan Creek valley which may be affected and the area of those lands potentially disturbed. The areas of public lands are shown as background to various figures in Section 2.3.2.

Parcels of land were identified from the Bureau of Land Management (BLM) master title plats and supplements current to March 21, 1984. Public lands were indicated only for those sections contiguous to project features. Areas of potentially disturbed land were estimated by planimetry or by measuring the length of each type of right-of-way width. Those estimates were recorded in full acre units to account for incidental construction impacts (e.g., an impact of 0.1 acres was considered 1 acre, an impact of 1.1 acres was considered 2 acres). Based on construction experience in Colorado, the following right-of-way widths were used:

- Road - 60 feet
- Water pipeline - 50 feet
- Syncrude pipeline - 50 feet
- 345-kV transmission line - 100 feet

A total of 128 parcels of potentially affected public land were identified corresponding to 5,037.08 acres which may eventually be involved in land trade, land purchase, or BLM right-of-way negotiations related to the project as currently proposed. Of these lands, a surface area of less than 610 acres would be expected to be actually impacted. In addition, subsurface impacts could be as much as 565 acres. The various parcels are described in detail on Table 2.3-30.

Table 2.3-29 CITIES SERVICE PROJECT WORKFORCE

Year	Construction	Operation	Total
1986	400		400
1987	400		400
1988	600	100	700
1989	600	100	700
1990	1,700	100	1,800
1991	1,700	400	2,100
1992	--	500	500
1993	100	700	800
1994	400	700	1,100
1995	800	700	1,500
1996	2,100	1,000	3,100
1997	2,800	1,500	4,300
1998	--	1,800	1,800
1999	--	1,800	1,800
2000	100	1,800	1,900
2001	700	1,800	2,500
2002	900	1,800	2,700
2003	2,200	2,100	4,300
2004	3,100	2,600	5,700
2005	--	2,800	2,800
2006	100	2,800	2,900
2007	400	2,800	3,200
2008	1,800	2,900	4,700
2009	3,000	3,100	6,100
2010	600	3,500	4,100
2011[a]		3,700	3,700

Source: Cities Service (1983b).

[a] Steady-state operation until shutdown.

2.3.2.2.2 Facility Sites and Processes. Major elements of the project include an underground room-and-pillar mine (a portion of which would accommodate VMIS processing), retorting and upgrading facilities, raw shale transporting systems, a retorted shale disposal system, and a water supply system. The general arrangement of the proposed project facilities is shown in Figure 2.3-19 and a plot plan for surface facilities is shown in Figure 2.3-20.

Support facilities include a product syncrude pipeline, a natural gas pipeline, electric transmission loop, access road, railroad spur, and a water supply system. The syncrude pipeline would tie to the proposed La Sal pipeline for syncrude transport. Natural gas would be supplied from the existing Rocky Mountain Natural Gas line. Road and potential rail access would be up the Roan Creek and Conn Creek valleys. Current plans call for the unloading of material and equipment at De Beque for subsequent road transport to the project site. Rail access is also being considered as an alternative for access to the project site. Total daily electric power requirements would be approximately 160 Mw (Table 2.3-31). Water requirements for processing average approximately 12,500 gpm daily. Total water usage for the project would be approximately 17,500 gpm daily after inclusion of community and power generation requirements (Table 2.3-32). Fuel utilized would include high-, medium-, and low-Btu gas, natural gas, and diesel fuel. Total quantities of fuel use would be 11,100 MM Btu/hr (Table 2.3-33).

The water management plan is based on zero discharge to surface waters and all process wastewater streams would be treated and reused. Current plans call for off-site water to be mixed with clarified water to provide cooling tower makeup, chlorinated to provide potable water, and treated by carbon filter, reverse osmosis, and demineralizer to provide boiler feedwater. Mine water would be filtered and clarified. Sanitary wastewater would be treated biologically. Process wastewater would be separated into oily water and sour water. Oily water would

Table 2.3-30 PUBLIC LANDS POTENTIALLY AFFECTED BY THE CITIES SERVICE SHALE OIL PROJECT[a]

Township and Range	Section	General Location	Parcel	Area (acres)	Area Potentially Disturbed (acres)	Projected Use[b,c]	Relevant EIS Sections
T4S, R97W	34	NW 1/4 SW 1/4	NW 1/4 SW 1/4	40.00	3	Syncrude pipeline and T-line[d,e]	2.3.2.2.4, 3.3, 4.3, 2.4.3.2
		SW 1/4 SW 1/4	SW 1/4 SW 1/4	40.00	6	Syncrude pipeline and T-line	
T4S, R96W	31	NE 1/4 SW 1/4	NE 1/4 SW 1/4	40.00	2	Syncrude pipeline and T-line (alt.)	
		[f]	Lot 3	24.70	2	Syncrude pipeline and T-line (alt.)	
		[f]	Lot 5	37.71	3	Syncrude pipeline and T-line (alt.)	
		[f]	Lot 6	23.51	3	Syncrude pipeline and T-line (alt.)	
T5S, R96W	6	[f]	Lot 3	50.75	6	Syncrude pipeline and T-line (alt.)	
		[f]	Lot 4	52.75	6	Syncrude pipeline and T-line (alt.)	
		[f]	Lot 5	52.77	6	Syncrude pipeline and T-line (alt.)	
		[f]	Lot 6	52.79	6	Syncrude pipeline and T-line (alt.)	
	18	[f]	Lot 4	51.46	6	Syncrude pipeline and T-line (alt.)	
T6S, R97W	3	NE 1/4 NE 1/4	Lot 5	57.68	58[g]	Mining[h]	2.3.2.2.2, 3.3, 4.3, 2.4.3.2
		NW 1/4 NE 1/4	Lot 6	57.69	58[g]	Mining[h]	
		NE 1/4 NW 1/4	Lot 7	57.69	58[g]	Mining[h]	
		NW 1/4 NW 1/4	Lot 8	57.70	58[g]	Mining and syncrude pipeline (alt.)[h]	
	4	NE 1/4 NE 1/4	Lot 5	47.49	48[g]	Mining and T-line (alt.)	
		NW 1/4 NE 1/4	Lot 6	40.45	41[g]	Mining	
		NE 1/4 NW 1/4	Lot 7	40.35	41[g]	Mining	
		NW 1/4 NW 1/4	Lot 8	40.25	41[g]	Mining syncrude pipeline, T-line	
	15	SW 1/4	SW 1/4	160.00	160[g]	Mining[h]	
T7S, R97W	5	[f]	Lot 5	7.23		May be affected depending on final design	2.3.2.2.2, 2.3.2.2.4, 3.3, 4.3, 2.4.3.2
		[f]	Lot 6	7.54		May be affected depending on final design	
		[f]	Lot 7	7.34		May be affected depending on final design	
		[f]	Lot 8	7.12		May be affected depending on final design	
	8	NW 1/4 NE 1/4	Lot 1	38.86	1	Access road	
		NW 1/4 NW 1/4	Lot 2	47.01		May be affected depending on final design	
		SW 1/4 NW 1/4	Lot 3	47.47		May be affected depending on final design	
		NW 1/4 SW 1/4	Lot 5	47.77		May be affected depending on final design	
		SW 1/4 SW 1/4	Lot 6	48.07		May be affected depending on final design	
		[f]	Lot 7	23.91		May be affected depending on final design	
	17	[f]	Lot 2	0.38		May be affected depending on final design	
		NW 1/4 NW 1/4	Lot 3	47.74	1	T-line and water pipeline	
		SW 1/4 NW 1/4	Lot 4	45.31	7	Access road, water pipeline, and T-line	
		[f]	Lot 6	27.72		May be affected depending on final design	
		[f]	Lot 7	11.85	2	Access road, water pipeline, and T-line	
		[f]	Lot 8	28.50	1	Water pipeline and T-line	
		SE 1/4 SW 1/4	Lot 9	41.50		May be affected depending on final design	
		[f]	Tract 111	160.00		May be affected depending on final design	
	18	NE 1/4 SE 1/4	Lot 5	36.30	1	Access road	
		[f]	Lot 10	12.43		May be affected depending on final design	

Table 2.3-30 PUBLIC LANDS POTENTIALLY AFFECTED BY THE CITIES SERVICE SHALE OIL PROJECT[a] (continued)

Township and Range	Section	General Location	Parcel	Area (acres)	Area Potentially Disturbed (acres)	Projected Use[b,c]	Relevant EIS Sections
T7S, R97W (cont.)	18	SW 1/4 SE 1/4	SW 1/4 SE 1/4	40.00		May be affected depending on final design	
	19	f	Lot 5	11.96	1	Access road	
		SW 1/4 NW 1/4	Lot 7	30.13	3	Joint use railroad	
		f	Lot 8	11.53	4	Access road, water pipeline, and T-line	
		f	Lot 9	10.78		May be affected depending on final design	
		NW 1/4 SE 1/4	Lot 10	38.57	2	Joint use railroad	
		NE 1/4 SW 1/4	Lot 11	38.49	2	Joint use railroad	
		NW 1/4 SW 1/4	Lot 12	30.39	1	Access road	
		SW 1/4 SW 1/4	Lot 13	36.70	3	Access road	
		SE 1/4 SE 1/4	Lot 14	30.42		May be affected depending on final design	
		NW 1/4 NE 1/4	NW 1/4 NE 1/4	40.00			
		SW 1/4 NE 1/4	SW 1/4 NE 1/4	40.00	3	Access road, water pipeline, and T-line	2.3.2.2.2, 2.3.2.2.4,
		SE 1/4 NW 1/4	SE 1/4 NW 1/4	40.00		Joint use railroad	3.3, 4.3, 2.4.3.2
	20	f	Lot 1	27.88		May be affected depending on final design	
		f	Lot 2	28.25		May be affected depending on final design	
	30	NE 1/4 NE 1/4	Lot 5	30.63		May be affected depending on final design	
		SE 1/4 NE 1/4	Lot 6	31.71		May be affected depending on final design	
		NW 1/4 SE 1/4	Lot 7	33.25		May be affected depending on final design	
		f	Lot 8	1.34		May be affected depending on final design	
		f	Lot 9	1.70	1	Road, railroad, and utilities	
		SW 1/4 SE 1/4	Lot 10	33.96		May be affected depending on final design	
		NE 1/4 SE 1/4	NE 1/4 SE 1/4	40.00		May be affected depending on final design	
		SE 1/4 SE 1/4	SE 1/4 SE 1/4	40.00		May be affected depending on final design	
	31	NE 1/4 NW 1/4	Lot 5	39.84	10	Road, railroad, and utilities	
		NW 1/4 NW 1/4	Lot 6	30.68	15	Reservoir	
		NE 1/4 NW 1/4	Lot 7	33.55	12	Reservoir, pipeline, and T-line	
		NE 1/4 SW 1/4	Lot 8	33.03	24	Reservoir	
		SW 1/4 SE 1/4	Lot 9	32.08	16	Reservoir and pipeline	
		SE 1/4 SE 1/4	Lot 10	40.60	7	Water pipeline	
		NW 1/4 NE 1/4	NW 1/4 NE 1/4	40.00	1	Railroad	
		NE 1/4 NE 1/4	NE 1/4 NE 1/4	40.00		May be affected depending on final design	
		SW 1/4 NE 1/4	SW 1/4 NE 1/4	40.00	8	Road, railroad, and utilities	
		SE 1/4 NE 1/4	SE 1/4 NE 1/4	40.00		May be affected depending on final design	
		NW 1/4 SE 1/4	NW 1/4 SE 1/4	40.00	13	Pipeline, T-line, and reservoir	
		NE 1/4 SE 1/4	NE 1/4 SE 1/4	40.00	7	Road, railroad, and T-line	
	32	f	Lot 1	8.98		May be affected depending on final design	
		f	Lot 2	8.41		May be affected depending on final design	
		SW 1/4 SW 1/4	Lot 3	40.83	18	Reservoir and railroad	
		f	Tract 58	160.00		May be affected depending on final design	
		NW 1/4 SW 1/4	NW 1/4 SW 1/4	40.00	8	Road and T-line	
	33	NW 1/4 SW 1/4	Tract 58	i		May be affected depending on final design	

Table 2.3-30 PUBLIC LANDS POTENTIALLY AFFECTED BY THE CITIES SERVICE SHALE OIL PROJECT[a] (continued)

Township and Range	Section	General Location	Parcel	Area (acres)	Area Potentially Disturbed (acres)	Projected Use[b,c]	Relevant EIS Sections
T7S,R98W	36	SE 1/4 NW 1/4	SE 1/4 NW 1/4	40.00		Reservoir[j]	2.3.2.2.2, 2.3.2.2.4, 3.3, 4.3, 2.4.3.2
		NE 1/4 SW 1/4	NE 1/4 SW 1/4	40.00	2	Reservoir	
		SW 1/4 SE 1/4	SW 1/4 SE 1/4	40.00	4	Reservoir[j]	
		SE 1/4 SW 1/4	SE 1/4 SW 1/4	40.00		May be affected depending on final design	
	1	NE 1/4 NE 1/4	Lot 1	39.99	15	Reservoir	
		SW 1/4 NE 1/4	SW 1/4 NE 1/4	40.00	3	Reservoir	
		SE 1/4 NE 1/4	SE 1/4 NE 1/4	40.00	9	Reservoir	
		NW 1/4 SE 1/4	NW 1/4 SE 1/4	40.00	4	Reservoir	
		NE 1/4 SE 1/4	NE 1/4 SE 1/4	40.00	31	Reservoir	
		SE 1/4 SE 1/4	SE 1/4 SE 1/4	40.00	7	Reservoir	
		SW 1/4 SE 1/4	SW 1/4 SE 1/4	40.00		May be affected depending on final design	
	12	NE 1/4	NE 1/4	160.00		May be affected depending on final design	
T8S, R97W	5	NW 1/4 NE 1/4	Lot 2	39.37		May be affected depending on final design	2.3.2.2.2, 2.3.2.2.4, 3.3, 4.3, 2.4.3.2
		NE 1/4 NW 1/4	Lot 3	39.23	13	Road, railroad, and T-line	
		NW 1/4 NW 1/4	Lot 4	39.07	25	Reservoir and railroad	
		SW 1/4 NW 1/4	SW 1/4 NW 1/4	40.00	4	Reservoir, railroad, road, and T-line	
		SE 1/4 NW 1/4	SE 1/4 NW 1/4	40.00		May be affected depending on final design	
		NW 1/4 SW 1/4	NW 1/4 SW 1/4	40.00	2	Road, railroad, and T-line	
		SW 1/4 SW 1/4	SW 1/4 SW 1/4	40.00	2	Road and railroad	
		SW 1/4 NE 1/4	SW 1/4 NE 1/4	40.00		May be affected depending on final design	
		NE 1/4 SW 1/4	NE 1/4 SW 1/4	40.00		May be affected depending on final design	
	6	NW 1/4 NE 1/4	Lot 2	39.38	40	Reservoir and pipeline	
		SW 1/4 SW 1/4	Lot 7	38.95	18	Reservoir	
		NE 1/4 NE 1/4	Lot 8	36.76	36	Reservoir	
		SE 1/4 NE 1/4	Lot 9	37.76	13	Reservoir and pipeline	
		NE 1/4 SE 1/4	Lot 10	37.59	20	Reservoir, pipeline, and T-line	
		NW 1/4 SE 1/4	Lot 11	34.18	35	Reservoir	
		NW 1/4 SE 1/4	Lot 12	3.47		Reservoir[h]	
		SE 1/4 SE 1/4	Lot 13	37.14	20	Reservoir, pipeline, and T-line	
		SE 1/4 SE 1/4	Lot 14	0.63		Reservoir[h]	
		SW 1/4 NE 1/4	SW 1/4 NE 1/4	40.00	40	Reservoir	
	7	NW 1/4 NW 1/4	Lot 1	39.08		May be affected depending on final design	
		SW 1/4 NW 1/4	Lot 2	39.00		May be affected depending on final design	
		SE 1/4 NW 1/4	SE 1/4 NW 1/4	40.00		May be affected depending on final design	
	8	NW 1/4 NW 1/4	NW 1/4 NW 1/4	40.00	3	Road and railroad	
		SW 1/4 NW 1/4	SW 1/4 NW 1/4	40.00	4	Road and railroad	
		NW 1/4 SW 1/4	NW 1/4 SW 1/4	40.00	4	Road and railroad	
		SW 1/4 SW 1/4	SW 1/4 SW 1/4	40.00	2	Railroad and T-line	
	16	SW 1/4 SW 1/4	SW 1/4 SW 1/4	40.00	1	Railroad	

Table 2.3-30 PUBLIC LANDS POTENTIALLY AFFECTED BY THE CITIES SERVICE SHALE OIL PROJECT[a] (continued)

Township and Range	Section	General Location	Parcel	Area (acres)	Area Potentially Disturbed (acres)	Projected Use[b,c]	Relevant EIS Sections
T8S, R97W (cont.)	17	NE 1/4 SE 1/4	NE 1/4 SE 1/4	40.00	1	Railroad	
	17	NE 1/4 NW 1/4	NE 1/4 NW 1/4	40.00	1	Railroad and road	
	21	NE 1/4 NW 1/4	NE 1/4 NW 1/4	40.00	1	Railroad	
		SE 1/4 NW 1/4	SE 1/4 NW 1/4	40.00	7	Railroad and T-line	
		SW 1/4 NE 1/4	SW 1/4 NE 1/4	40.00	1	Railroad	
	22	SE 1/4 SW 1/4	SE 1/4 SW 1/4	40.00	1	Railroad	
		SE 1/4 SE 1/4	SE 1/4 SE 1/4	40.00	3	Railroad	
	27	NE 1/4 NW 1/4	NE 1/4 NW 1/4	40.00	5	Railroad and T-line	
		NW 1/4 NE 1/4	NW 1/4 NE 1/4	40.00	2	Railroad	

Source: Cities Service (1984d).

[a] Baseline studies covering those areas include: GCC (1981a,b,c,d,e,f; 1982a,b,c,d,e,f).
[b] The Roan Creek corridor delineated here is relocated slightly from that analyzed in the CCSOP EIS (BLM 1983a).
[c] The lands potentially affected by the GCC reservoir were calculated considering the maximum (175,000 ac-ft) reservoir size.
[d] T-line refers to electrical transmission line right-of-way.
[e] Connection to La Sal pipeline.
[f] General location by quarter-quarter section is inappropriate for this parcel.
[g] The area potentially disturbed primarily is related to underground effects of mining; however, some minimal surface disturbance may be included.
[h] U.S. owns minerals only.
[i] Tract 58 is partially in Sections 32 and 33; its area is given under the entry in Section 32.
[j] U.S. owns minerals in NE 1/4 only.

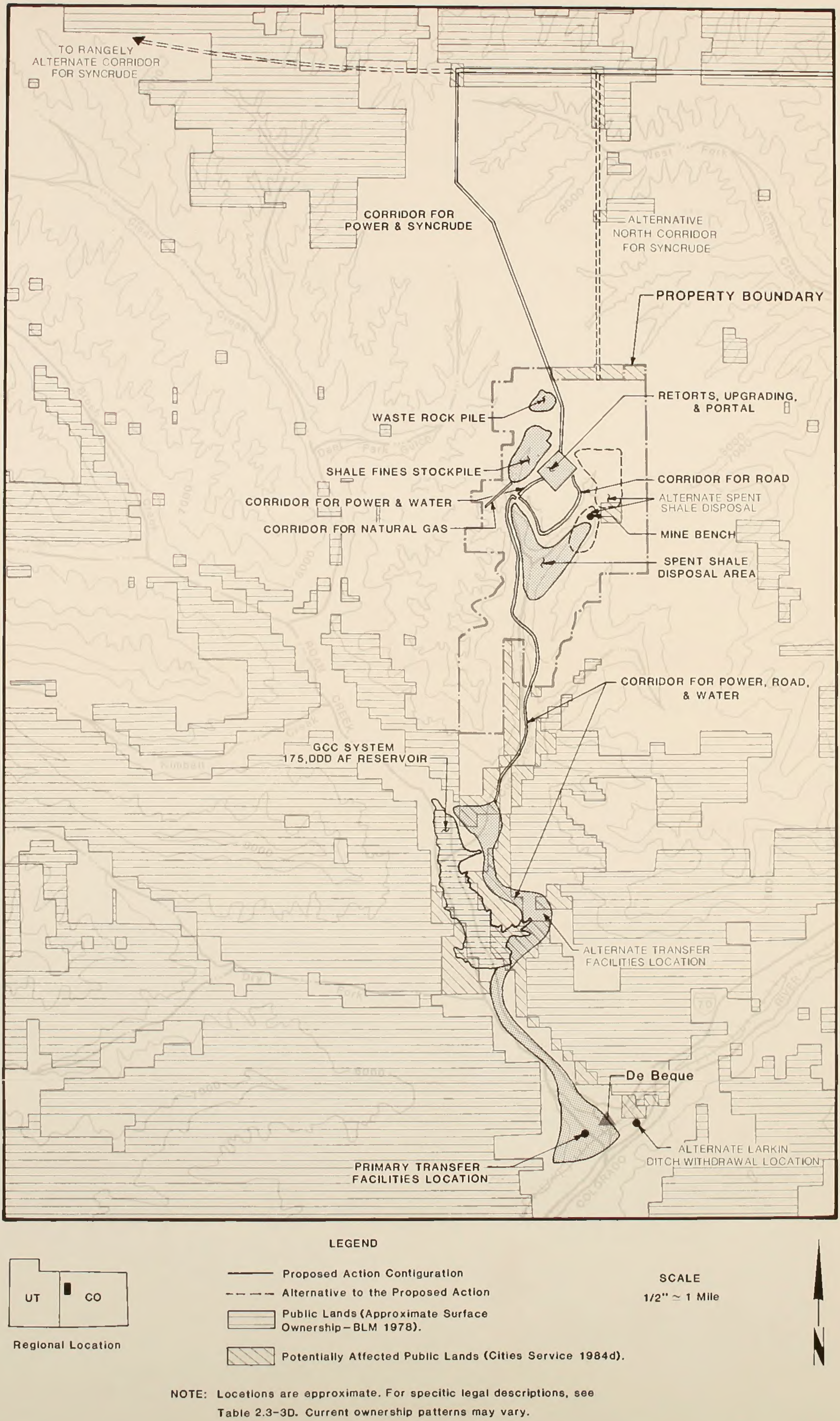


Figure 2.3-19 General Arrangement of the Proposed Project Facilities, Cities Service Shale Oil Project.

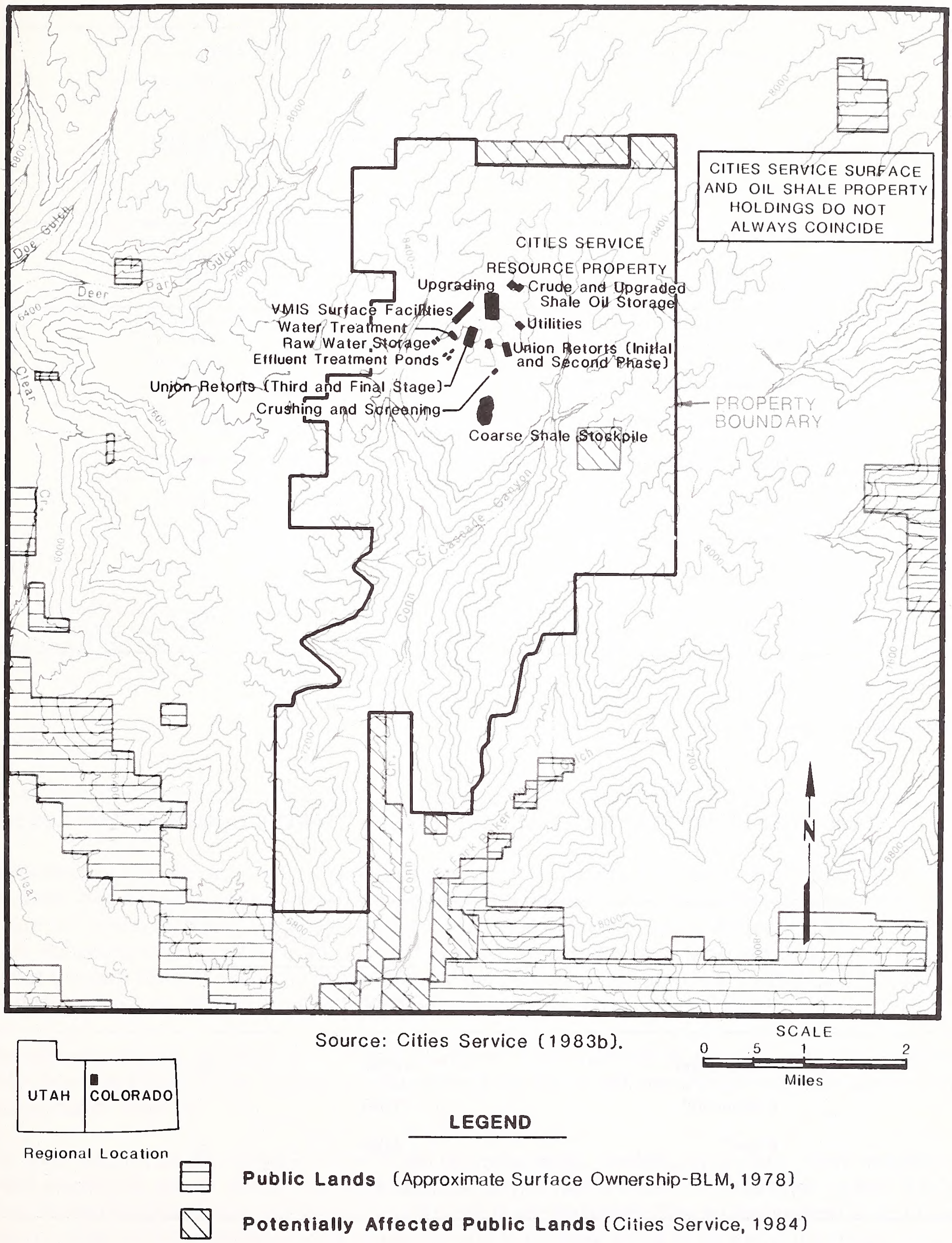


Figure 2.3-20 Plot Plan for Surface Facilities, Cities Service Shale Oil Project.

be treated in an API separator. Sour water would be stripped of ammonia and acid gas. Stormwater would be recycled to the feedwater treatment system. Additional information on waste streams is provided in Section 2.3.2.2.3.

Details on each of the components of the project are presented in the following section.

Table 2.3-31 CITIES SERVICE SHALE OIL PROJECT POWER USE

Intended Use	Quantity (Mw)
Mining and Underground Processing	30
Materials Handling	20
VMIS Surface Facilities	10
Above Ground Retorting	40
Upgrading	40
Raw Water Supply	10
Miscellaneous[a]	10
TOTAL	160

Source: Cities Service (1983b).

[a] Includes utility and support services.

Table 2.3-32 CITIES SERVICE SHALE OIL PROJECT WATER CONSUMPTION

	Quantity	
Intended Use	(gpm)	(cfs)
Process Plant	12,500	28
Community[a]	3,000	7
Power[b]	2,000	4
TOTAL	17,500	39

Source: Cities Service (1983b).

[a] Allowance for total population impact of project.
[b] Allowance for generation of project power requirements.

Table 2.3-33 CITIES SERVICE SHALE OIL PROJECT FUEL CONSUMPTION

Combuster	Quantity (MM Btu/hr)	Fuel Type
Recycle Gas Heater	2,400	High-Btu Gas[a]
Reboiler	200	High-Btu Gas[a]
Boiler	300	Natural Gas
Reformer Heater	200 1,600	High-Btu Gas[a] Medium-Btu Gas[b]
Hydrotreater Heater	500	High-Btu Gas[a]
MIS Boiler	1,900 300	Low-Btu Gas[c] High-Btu Gas[a]
Mobile Equipment	100	Diesel Fuel
Hydrogen Feedstock	3,600	Natural Gas
TOTAL	11,100	

Source: Cities Service (1983b).

[a] From treated Union retort make gas
[b] From hydrogen purification
[c] From treated VMIS make gas

Mining

Extraction of the oil shale resource on the Cities Service property would involve a room-and-pillar underground mine and VMIS processing.

The in-place oil shale resource of the Conn Creek property is estimated at 3.2 billion barrels utilizing a 15 gpt cut-off grade. The mineable oil shale for the 15 gpt and higher grade lies in a zone approximately 300 feet thick. Within this zone is the higher grade Mahogany Zone. It is 100 feet thick, and is centered at an elevation of about 7,500 feet above mean sea level (msl). The underground room-and-pillar mining technique would be used to recover the shale from an interval of 65 feet of the Mahogany Zone. The proposed VMIS process would recover the shale oil from the leaner portions of the 300-foot oil shale interval.

The underground mine would cover the surface equivalent of approximately 5,700 acres, and would extend to the limits shown on Figure 2.3-21. The surface disturbances associated with the underground mine would comprise approximately 50 acres.

The main features of the underground mine are the mine bench, declines, entry drifts, room-and-pillar and VMIS production panels, primary crushing facilities, service facilities, and the ventilation system. The mine bench would be constructed to provide horizontal access to the Mahogany Zone on the northern wall of Cascade Canyon. A decline for conveying oil shale from the mine to the plant would be located at the surface processing site. This decline would also provide access for equipment and personnel. Another decline would be located to the north of the surface processing site to convey waste rock from underground to the waste rock disposal site. Cross drifts would be situated in each entry to allow truck travel between production panels and crusher stations. The production panels would be approximately 800 feet wide and 3,200 feet long, situated on both sides of the

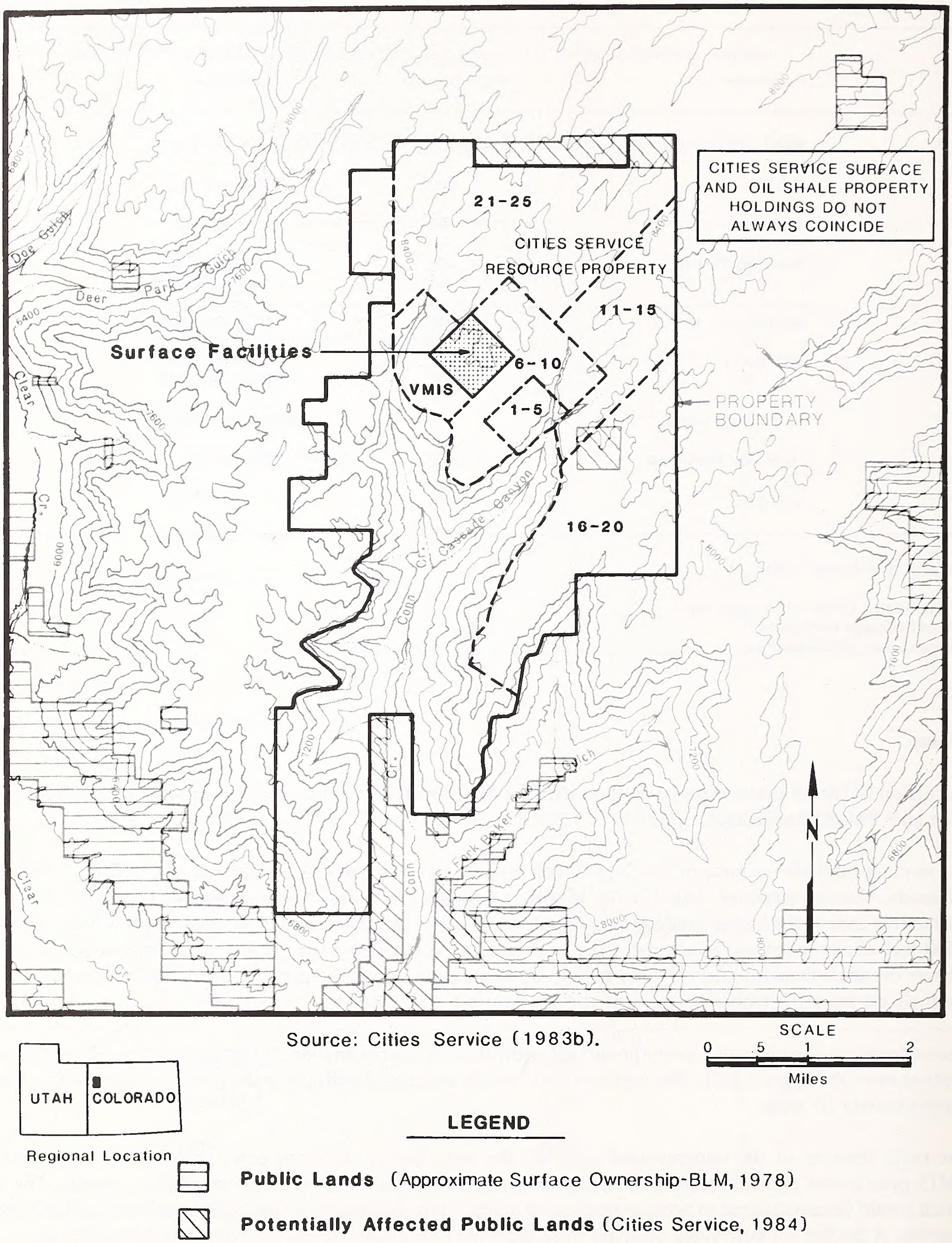


Figure 2.3-21 Mine Progression (years), Cities Service Shale Oil Project.

entry drifts. As currently envisioned, the mining pillars would be 60 feet square by 65 feet high, allowing approximately 60 percent removal of the resource in the 65-foot zone. The proposed mine plan is the state-of-the art for oil shale room-and-pillar mining. The mining recovery percentage and the pillar sizes would depend on the depth of the overburden over the panels in all areas of the planned mine. In other words where the overburden is the greatest, the mining recovery would be the lowest. Surface subsidence is a possibility but the probability of occurrence is, by design, relatively low. As mining progresses the stability of the pillars and mined openings would be closely monitored by a rock mechanics program. This data along with the mining experience gained during the mine development and initial years of operation would be employed to optimize the mining plan, mine stability, and the resource recovery.

A conceptual diagram of the underground mining operations is presented as Figure 2.3-22. At ultimate production capacity approximately 135,000 tpd of oil shale, having an average grade of 29 gpt, would be mined. Over the life of the project, approximately 4,600,000 cubic yards of waste rock and 41,200,000 cubic yards of shale fines would be generated from mine development, production mining, and VMIS retort void development. The waste rock would consist primarily of raw, low-grade oil shale. Some of this material could be used as a capillary barrier for revegetation of the retorted shale pile.

Shale fines from the Cities Service mine would consist of particles less than 1/8 inch in nominal diameter. These particles would have the general characteristics of raw oil shale with a Fischer Assay of 29 gpt.

Within the mine, wet suppression and deposition in the exhaust system would control particulate emissions from blasting, mining, transfer operations, and primary crushing. Surface material handling of dry, high-volume material would include baghouses at transfer points, screening, and secondary crushing operations. Particulate emissions from disposal and stockpile areas would be suppressed by wetting and minimizing the area exposed to wind erosion prior to revegetation.

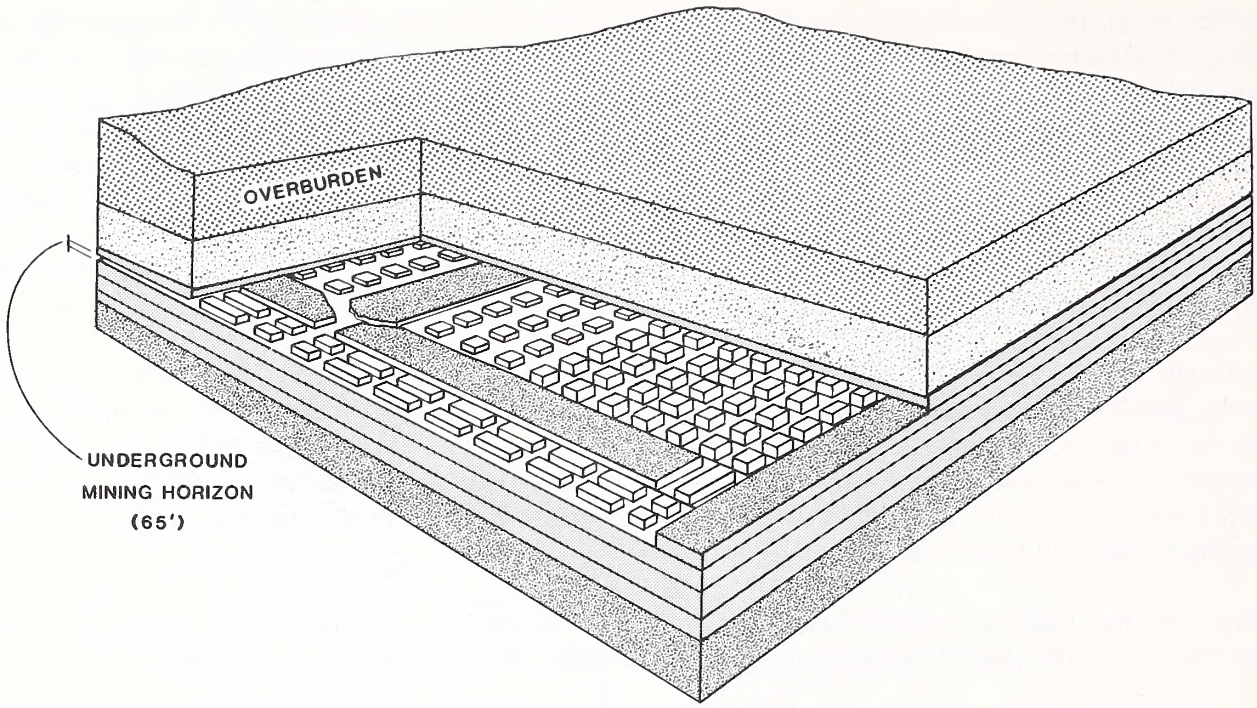
Feed Preparation and Handling

The mined oil shale would be crushed within the mine to a coarse size and would then be transported by conveyor to either the stockpile or the feed preparation plant. A reclaim conveyor would move ore from the stockpile to the feed preparation plant. The ore stockpile would contain approximately 2,000,000 tons, and would be used to compensate for an imbalance between the mine and retort operation. At the feed preparation plant, secondary crushing would occur and fines less than 1/8 inch in size would be separated. The sized ore would then be conveyed to the storage silos serving each Union B retort. The fine ore (<1/8 inch) would be tranported to the fines stockpile. Ore below the economic cut-off grade that is produced from development operations outside the Mahogany Zone would be removed to the waste disposal area. In the event that retorting of fines proves to be technically and economically feasible, the likely choice of retorting method for processing of fines would be the Lurgi technology. Because of the uncertainty of the feasibility of fines retorting, it is not a part of the proposed action. The Lurgi process is evaluated as an alternative in Section 2.4.

Retorting

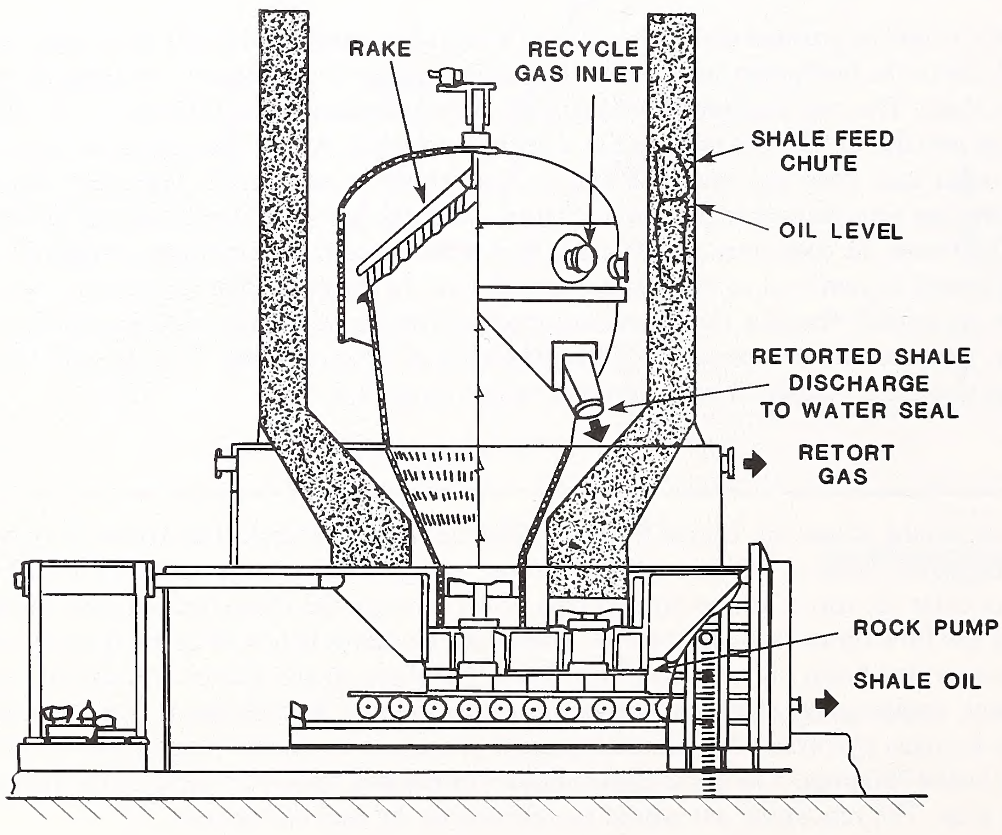
Retorting facilities would utilize the Union B retorts and the VMIS process. The Union B retort process is a continuous process where shale is fed through the bottom of the inverted cone vessel by a rock pump (Figure 2.3-23). Hot gases enter the top of the retort and pass down through the rising bed, causing kerogen pyrolysis. The shale oil and gas flow down through the bed. The oil accumulates in a pool at the bottom, which seals the retort and acts as a settling basin for entrained shale fines. The shale oil and gas are withdrawn from the bottom and top of the pool, respectively. The gases are split into two streams. Recycle gas is reheated and reinjected to induce additional kerogen pyrolysis. The remaining gas is processed to recover liquid hydrocarbons and reduce sulfur content to below 100 ppm. The gas is then suitable for use as a fuel, with most of the fuel gas being used within the retort area. The remaining gas would be released to the fuel gas system.

The raw shale oil would have approximately 2 percent by weight nitrogen and and 0.8 percent by weight sulfur. The material balance for the Union B retorting process is shown in Figure 2.3-24.



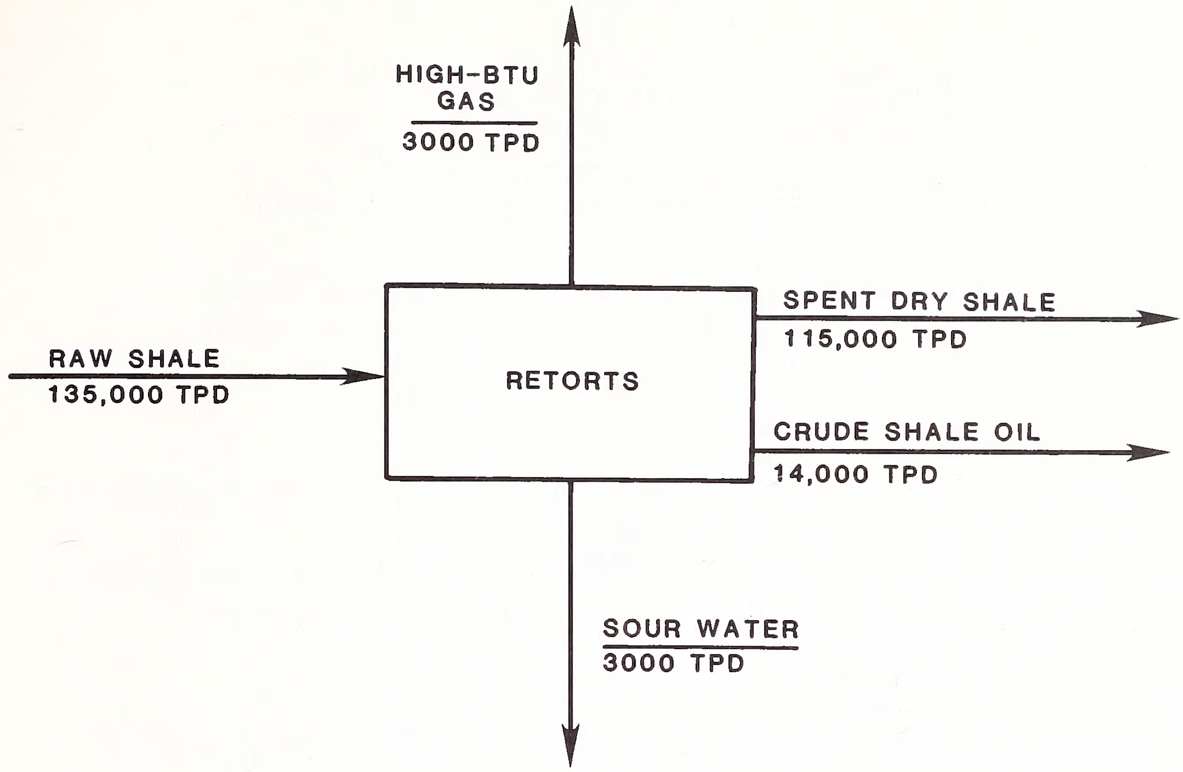
Source: Adapted from BLM (1983a).

Figure 2.3-22 Conceptual Diagram of Underground Mining, Cities Service Shale Oil Project.



Source: Cities Service (1983b).

Figure 2.3-23 Conceptual Diagram of the Union Oil "B" Retorting System.



Source: Cities Service (1983b).

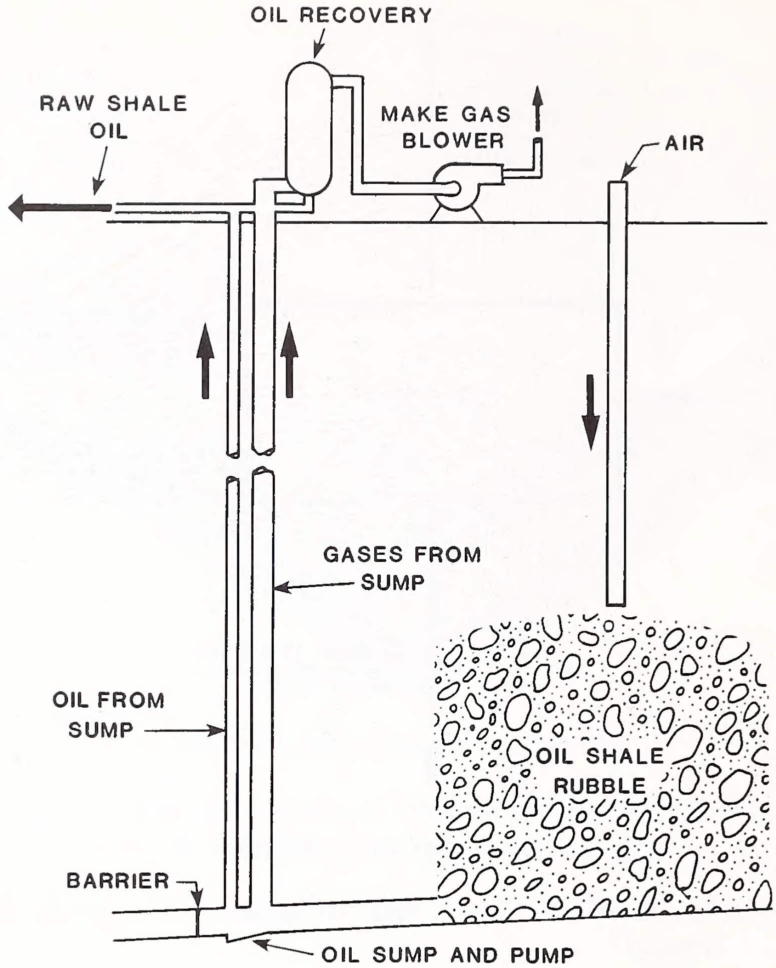
Figure 2.3-24 Union Oil "B" Retort Material Balance, Cities Service Shale Oil Project.

Emissions of primary pollutants for the above-ground retorting portion of the project are shown in Table 4.3-7. The combustion source emissions for sulfur dioxide, nitrogen dioxide, carbon monoxide, nonmethane hydrocarbons, and particulates are based on information provided by Union Oil Company and, in general, are based on the best available control technology. All other regulated pollutants are either not emitted from the retort process or are estimated to be below EPA regulated levels. Additional information on above-ground retort waste streams is provided in Section 2.3.2.2.3.

The VMIS process consists of retorting a rubblized column of broken shale that has been formed by expansion of the oil shale into a previously mined-out void volume (Figure 2.3-25). This is accomplished in three steps. First, approximately 20 percent of the retort volume is mined and taken to the surface for retorting. Second, vertical holes are drilled from the mined-out rooms into the shale column to be rubblized. The holes are then loaded with explosives and detonated with appropriate time delays. The resulting broken shale would fill both the volume of the previously mined-out void and the volume of the shale column. Finally, prior to retorting, connections would be made at the top for air addition, and bottom for oil and gas withdrawal. At this stage, the oil shale is ready for in-situ retorting.

Retorting would be initiated by heating the top of the rubblized shale column with hot inert gas followed by admitting air to initiate combustion. Several hours after commencement, the inert gas flow is stopped and the air flow is maintained utilizing the carbonaceous residue in the retorted shale as fuel. In this vertical retorting process, the hot gases from the combustion zone move downward to pyrolyze the kerogen in the shale below and produce gases, and water vapor and shale oil mist, which condense at the bottom of the rubblized column. The raw shale oil would have approximately 1.5 percent by weight nitrogen and 0.7 percent by weight sulfur. The material balance for the VMIS process are shown in Figure 2.3-26.

The expected emissions for all primary pollutants from the VMIS retorting process are given in Table 4.3-7. In addition to the primary air pollutants, there may be other criteria pollutants emitted from the VMIS retorts.



Source: Cities (1984b).

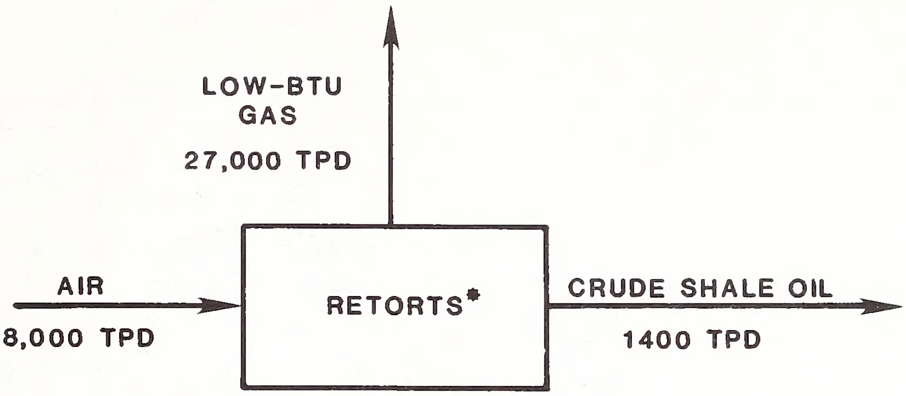
Figure 2.3-25 Conceptual Diagram of the VMIS Retort Process, Cities Service Shale Oil Project.

Cathedral Bluffs Shale Oil Company has estimated the maximum emission rates for these pollutants from the VMIS retort, and most are below the regulated rates. Table 4.3-18 lists these rates, along with de minimis values. Some criteria pollutants, such as asbestos, beryllium, and vinyl chloride have neither been found in the core samples taken from Tract C-b, nor are they formed during oil shale processing. Nonvolatile pollutants are emitted as the constituents of the raw and processed shale particulates, and the control of these particulates also provides the control of such pollutants. The mobilization of volatile pollutants, such as mercury, is temperature dependent. Since the waste streams released from the plant would be below the boiling point of mercury, release of mercury vapors is not anticipated. Any released mercury would be as a nonvolatile constituent of the particulates (EPA 1983).

Upgrading

Upgrading facilities would be located on the Roan Plateau, and would occupy approximately 30 acres (Figure 2.3-20). The retort and upgrading plants would be connected by a pipeline running through the middle of the site.

The upgrading process takes blended and filtered raw shale oil from both the Union B retorts and the VMIS processes, and catalytically hydrotreats it to remove nitrogen, sulfur, and metal compounds. The nitrogen content would be reduced to approximately 1,000 ppm and sulfur content to approximately 10 ppm. Natural gas would be used as the feedstock to a steam-methane reforming unit to produce hydrogen required for hydrotreating. A flow diagram of the upgrading process is shown in Figure 2.3-27. On-site storage would include 500,000 barrels for raw shale oil, and 750,000 barrels for synthetic crude oil.



* INCLUDES APROXIMATELY 18 RETORTS WITH ASSOCIATED OIL SHALE.

NOTE: ORGANIC MATTER IN INDIVIDUAL RETORT (180 FT x 180 FT x 280 FT) CONSUMED IN 260 DAYS.

Source: Cities Service (1983b).

Figure 2.3-26 VMIS Retort Material Balance, Cities Service Shale Oil Project.

Off-gas and sour water from the hydrotreaters would be sent to gas cleaning and sour water treatment, respectively. Hydrogen required for hydrotreating is furnished from the hydrogen plant by steam reforming natural gas followed by hydrogen purification. The gas cleaning plant recovers oil, removes acid gas for sulfur recovery, and provides treated fuel gas. Acid gas would be treated in the Unisulf unit to recover elemental sulfur. Additional information on waste streams from upgrading are presented in Section 2.3.2.2.3.

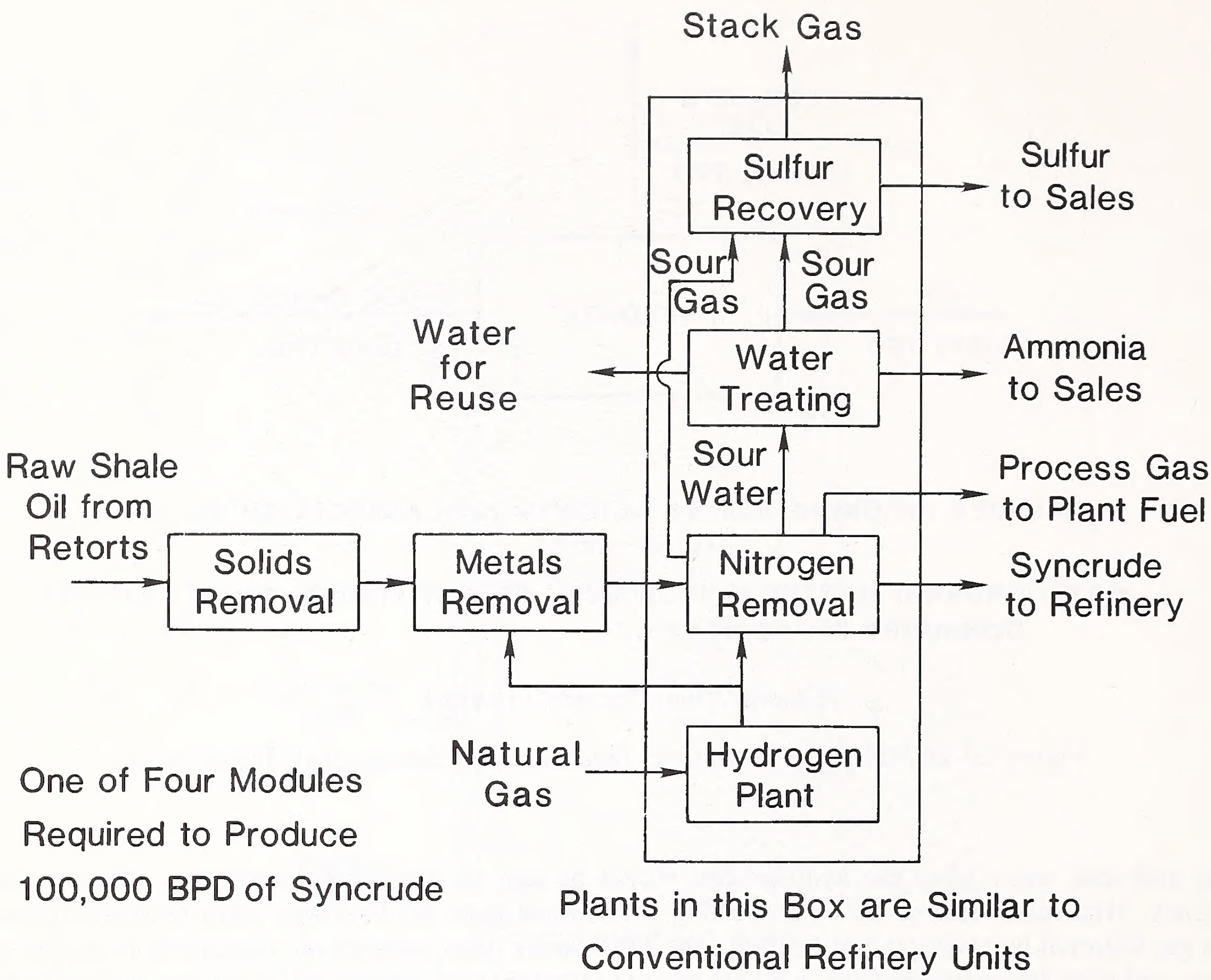
Approximately 300 tpd of ammonia and 200 tpd of liquid sulfur would be recovered in the sour water and sulfur recovery plants, respectively. Approximately 10 days of on-site storage would be provided. Both by-products would be trucked to a terminal at De Beque for rail transport to market. The total amount of truck traffic is approximately 15 round trips per day.

Spent Shale and Waste Rock Disposal

At the ultimate production rate of 100,000 bpd, approximately 115,000 tpd of spent shale would be generated (dry weight basis). The total amount of spent shale generated for the project life would be disposed of in Cascade and Conn Creek canyons (Figure 2.3-19). Prior to the disposal of shale in these areas, topsoil would be removed and stockpiled. Deposition of the shale would begin in the lower portion of Conn Creek, and proceed in a northerly direction as indicated in Figure 2.3-28. Considering various engineering data, this is the most suitable method of progression.

The proposed construction of the spent shale pile involves the construction of a layered fill made entirely of retorted shale. Past investigations indicate that this technique provides a disposal pile that is economically and environmentally sound (Gerhart and Holtz 1981; UOC 1982b). A cross-section of the spent shale disposal pile is shown in Figure 2.3-29.

Prior to the disposal of the shale, topsoil would be removed and stockpiled. Most of the retorted shale would be dumped in thick, uncompacted lifts. However, prior to and concurrent with placement of the dumped retorted shale, a compacted retorted shale lining would be placed over the ground surface. The primary purpose of the compacted lining would be to control and collect runoff from the shale pile during its construction. Runoff from precipitation on as yet unreclaimed areas of the retorted shale pile could be routed to and collected on that lining



Source: Cities Service (1983b).

Figure 2.3-27 Flow Diagram of the Upgrading Process, Cities Service Shale Oil Project.

with a system of ditches and low dikes. Any runoff water would be collected in a dam below the toe of the pile and evaporated or be used for dust and moisture control within the pile. Surface water stream flows from Conn and Cascade creeks would be diverted around the pile in lined culverts used during pile development and after completion. Peak streamflow during flooding would be contained in an upstream header dam. An underdrain system below and above the shale liner could be utilized to collect any leachate. While these methods are felt to be best at this time, specific drainage methodologies would be addressed in the applicable mining and reclamation permits.

Any other runoff from natural areas around the planned pile location and from as yet undisturbed natural areas would be routed around the retorted shale with a similar system of ditches and dikes. Water collected from the shale pile would be evaporated or used to facilitate retorted shale compaction and to reduce dusting. The compacted lining would have a relatively low coefficient of permeability to lower the risk of temporarily ponded water seeping through the pile and into the underlying natural ground. Water from undisturbed natural areas would be directed to a sediment pond where the water would have an adequate residence time to settle out any sediment. The water remaining in these ponds could be used in commercial oil shale operations or may be discharged to natural drainages.

A similar compacted retorted shale layer, which would be connected to the compacted retorted shale beneath the pile, would be placed over the pile end slopes and top. The purpose of that compacted zone would be to reduce moisture infiltration into the pile while vegetation on the overlying reclamation zone becomes established.

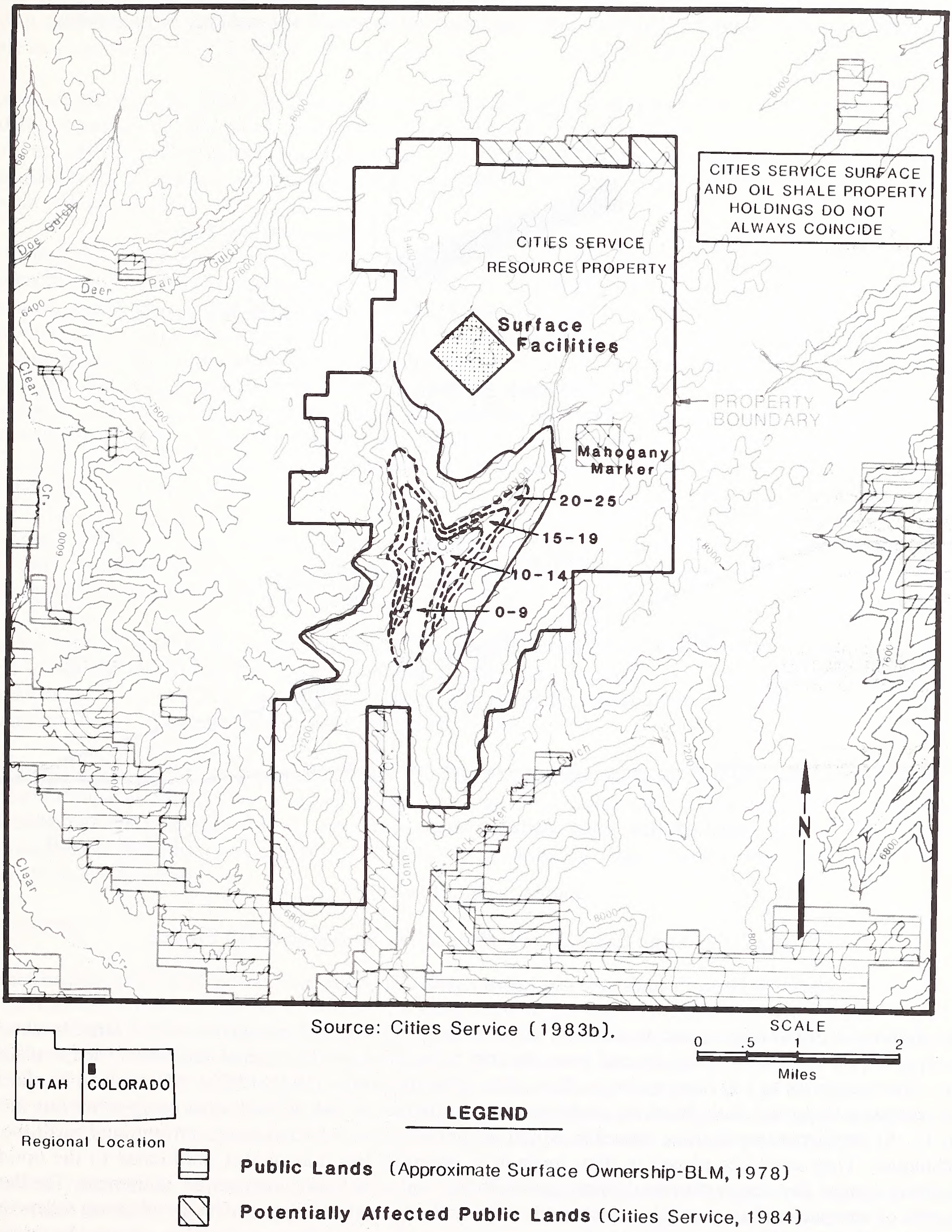
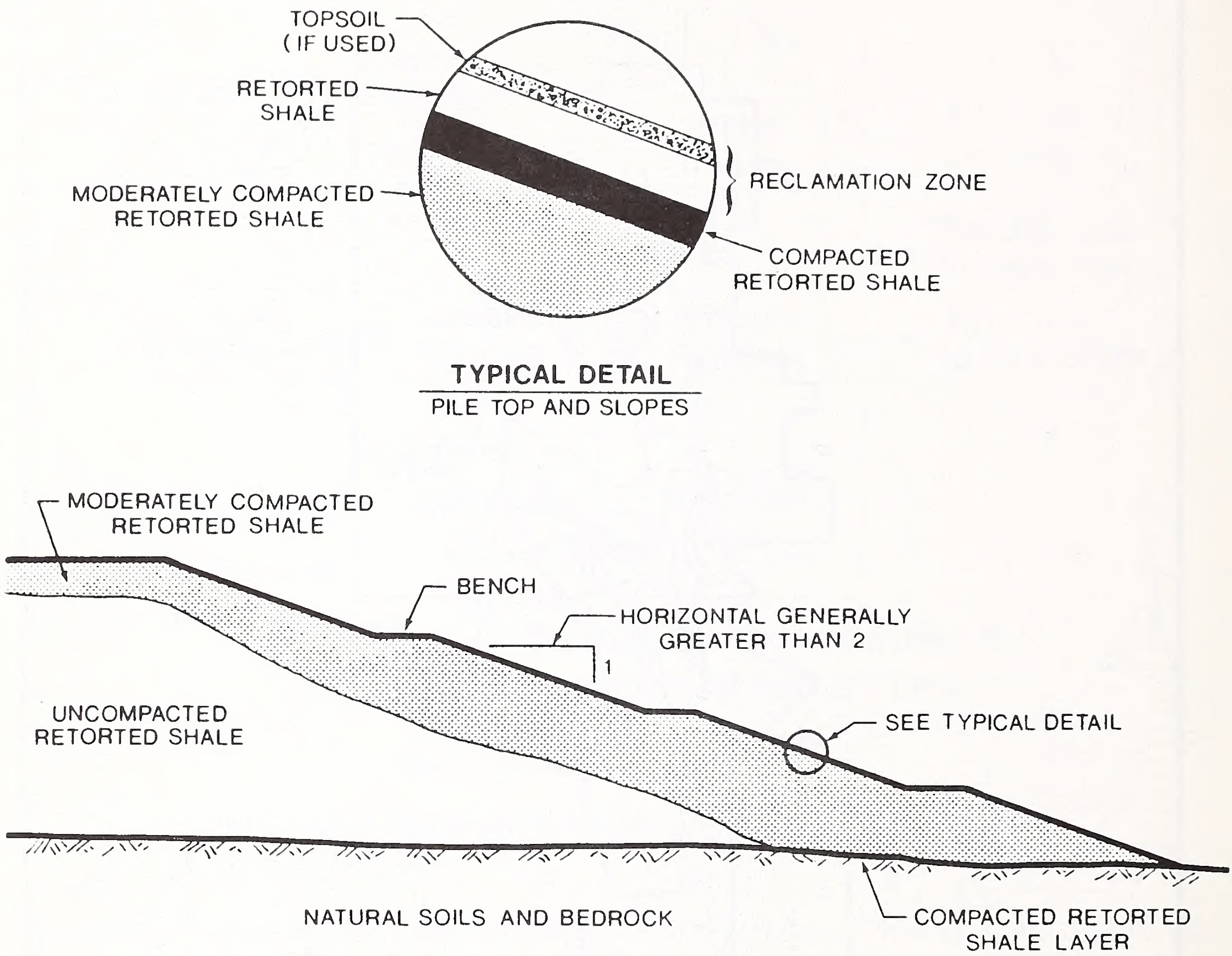


Figure 2.3-28 Spent Shale Disposal Progression (years), Cities Service Shale Oil Project.

Most of the retorted shale placed in the disposal pile would be deposited in thick, uncompacted loose lifts. Compacting the retorted shale blanket over such loose materials would be difficult. To facilitate that compaction, a layer of moderately compacted retorted shale could be located at the pile end slopes directly beneath the compacted blanket. That moderately compacted layer would also enhance slope stability.



Source: In-Situ (1984).

Figure 2.3-29 Spent Shale Cross-section, Cities Service Shale Oil Project.

The dumped retorted shale could be transported to disposal areas using conveyors and/or large trucks. The thickness of the dumped lifts will depend upon the area being filled and the type of equipment used to place the lifts. Thicknesses up to 150 feet have been planned by other operations (UOC 1982b). Materials to be placed in the compacted retorted shale blankets could also be transported to the disposal area using conveyors and/or trucks. At the disposal area those materials would be spread and compacted using conventional earth moving techniques. They would be placed in thin, loose lifts, generally less than 1 foot, moistened to the optimum moisture content for compaction and compacted with conventional heavy compaction equipment. The desired degrees of compaction can probably be achieved with 6 to 8 passes of conventional heavy vibrating rollers or the equivalent (UOC 1982b; Holtz 1983). Moderately compacted retorted shale zones could be achieved by spreading the materials in relatively thin lifts (less than 5 feet) and compacting them by selective routing of hauling equipment over the lifts surfaces.

Retorted Shale Properties

Some physical properties of Union B spent shale have been reported by Union Oil Company of California in permit applications to the Colorado Mined Land Reclamation Board for their Phase I and II Parachute Creek shale oil projects (UOC 1979; 1982b). Those properties are summarized on Table 2.3-34 and are discussed below.

The maximum particle size of the Union B spent shale was 3 inches and the material contained between about 8 and 10 percent silt and clay sizes. Between about 62 and 66 percent gravel sizes and 26 and 28 percent sand sizes were reported. Specific gravities ranged between 2.52 and 2.59. The retorted shale was non-plastic, and would be classified as poorly graded, slightly silty, sandy gravels (GP-GM) in accordance with Unified Soil Classification System (ASTM D 2487).

Gradation tests were performed (In-Situ 1984) to evaluate particle breakdown under standard and modified compactive efforts (ASTM D 698 and ASTM D 1557, respectively). Considerable breakdown of the materials occurred, particularly in the gravel size particles. Those tests, which were performed on the minus ¾-inch fraction of the as-received shale material indicated that gravel sizes (plus No. 4 sieve) changed from 44 percent of the samples tested prior to compaction to only 21 and 15 percent after compaction. Similarly, silt and clay sizes (minus No. 200 sieve) increased from 31 percent before compaction to 48 and 54 percent after compaction. The increase in smaller particle sizes would result in compacted Union B spent shale being less permeable than uncompacted retorted shale. A maximum dry density of 99.4 pounds per cubic foot (pcf) at an optimum moisture content of 20.5 percent was obtained for the modified compaction test, and 93.9 pcf and 22.1 percent for the standard compaction test.

Two permeability tests were reported, each for samples compacted to densities near the maximum obtained for the modified compaction test. Those tests showed coefficients of permeability of 4.6 feet per year, or less, at confining pressures of 50, 100, and 200 psi.

Triaxial strength tests on the Union B spent shale samples compacted to ASTM D 698 conditions showed an angle of internal friction of 36.1° and a cohesion of 630 psf was reported from centrifuge tests and materials compacted to ½ ASTM D 698 and ASTM D 698 conditions for confining pressures of between 0 and 80 psi. For pressures between 70 and 300 psi, an angle of internal friction of 35.4° and a cohesion of 2350 psf was indicated.

Except for having a slightly lower specific gravity, the physical properties of the Union B spent shale discussed in the permit applications are similar to and within the range of properties typical of a slightly silty, sandy gravel soil. Low to high strengths, low to moderate compressibilities under applied loads, and moderate to high resistance to seepage flows would be exhibited by the retorted shale in disposal areas, depending on the densities to which it is compacted.

Pile Stability

Pile settlement and the long-term stability of pile slopes affect retorted shale disposal pile stability. Settlement (consolidation) of natural soils beneath a retorted shale disposal pile and of previously placed retorted shale will occur as additional lifts of retorted shale are placed on the pile. The amount of settlement and the time period during which it occurs is dependent upon many factors. Settlement of natural materials beneath the pile depends upon applied loads (the height of pile), soil moisture conditions, horizontal and vertical variations in the soil profile and the depth to bedrock. The time rate of settlement depends upon the rate of load application, the time involved for structural readjustment of the soil particles under those loads, and soil permeability.

It has been estimated by Union Oil Company that a 1,000-foot-high pile placed in the East Fork Parachute Creek would cause the underlying natural soils (approximately 100 feet thick) to settle from 5 to 15 feet (UOC 1982b). Because the natural soils are essentially granular materials (sands and gravels) that settle relatively quickly after application of load, the settlement of those soils should be essentially complete at the end of construction of the retorted shale disposal pile.

Table 2.3-34 PHYSICAL PROPERTIES OF UNION B RETORTED SHALE[a]

Item/Condition	Maximum Particle Size (in.)	Gradation %			Compaction			Coefficient of Permeability			Triaxial Shear Strength		Remarks
		Silt[b] & Silt Sizes	Sand[c]	Gravel[d]	Specific Gravity (apparent)	Optimum Moisture Content (%)	Dry Dens. (pcf)	Load 50 psi	Load 100 psi	Load 200 psi	Angle of Internal Friction (degrees)	Cohesion (psf)	
As Received													Classified as poorly graded, slightly silty, sandy gravels (GP-GM) in accordance with Unified Soil Classification System (ASTM D 2487)
1978 data	1-1/2	10	28	62									
1979 data	3	8	26	66									
Compacted to ASTM D 1557					2.56	20.5	99.4						
Before Compaction	3/4	31	25	44									
After Compaction	3/4	54	31	15									
Compacted to ASTM D 698					2.56	22.1	93.9				36.1	1,300	
Before Compaction	3/4	31	25	44									
After Compaction	3/4	48	31	21									
96.6 pcf dry density, 23.6% moisture cont.								3.4	4.6	4.1			
99.4 pcf dry density, 20.5% moisture cont.								4.0	2.9	2.6			
Specific Gravity Range					2.52-2.59								
Confining Pressure													Values reported for Stress Path Analysis for tri-axial test on retorted shale compacted to ½ ASTM D 698 and ASTM D 698 conditions, and for centrifuge tests.
0-80 psi											38.4	630	
70-320 psi											35.4	2,350	

Source: UOC (1982b).

[a] Properties summarized from those reported in Colorado Mined Land Reclamation Board Permit Application, Phase II, Parachute Creek Shale Oil Program, Parachute, Colorado (UOC 1982b) and Long Ridge Experimental Shale Oil Plant Mined Land Reclamation Permit Application (UOC 1979); both by Union Oil Company of California.

[b] Smaller than No. 200 sieve.

[c] No. 4 to No. 200 sieve.

[d] + No. 4 sieve.

Settlement of retorted shale within a pile depends upon the gradation of the retorted shale materials, strength of the individual particles and groups of particles, pile height, moisture conditions and placement methods and the resulting initial placement densities. Preliminary estimates of total pile settlement for a 1,000-foot high retorted shale pile constructed of Union B process retorted shale placed in thick and uncompacted loose lifts indicate that as much as 80 to 100 feet of movement may occur (UOC 1982b). However, it is estimated that because Union B process retorted shales are granular materials, most of the settlement should occur as the pile is being constructed. The total downward movement of the pile between the time of its completion and the time of ultimate pile settlement should only be a fraction of the anticipated total settlement.

The settlement of retorted shale pile for the Cities Service project would be on the order of, or less than that estimated by Union Oil Company for retorted shale disposal piles in the East Fork Parachute Creek. If the piles are located atop the ridges where the depth to bedrock is shallow, considerably less settlement should occur.

Because expected pile settlements due to the underlying natural soils and material within the pile are expected to occur essentially during construction, such settlement should not detrimentally affect long-term pile stability.

As currently planned, a compacted retorted shale lining will be placed over the natural ground surface prior to, and concurrent with, the placement of other retorted shale over it. The lining will assist in controlling and collecting runoff from the retorted shale disposal pile during construction. In addition, the pile slopes and top will be covered with a compacted, retorted shale blanket. The blanket will underlie the reclamation zone and will reduce moisture infiltration into the pile while vegetation becomes established in the reclamation zone. However, infiltration of moisture into and through the retorted shale disposal pile, including the compacted retorted shale blanket encapsulating the pile, would eventually occur.

Tests have shown that when the moisture content of retorted shale reaches a level called field capacity, which is below saturation conditions, no more water can be held by the material. Any water entering the material will then be passed through to underlying materials. Therefore, an entire pile could eventually reach field capacity conditions. The field capacity of retorted shale depends upon its density and other physical properties. Higher values of field capacity are expected for retorted shale materials deeper in a pile that have become densified due to the placement of overlying materials, and for compacted retorted shale linings. However, those field capacity values should be, in general, below saturation conditions.

The currently planned disposal pile at the Cities Service property incorporates slopes of 3.5:1 (horizontal:vertical) for the embankment or toe section. Union Oil Company of California (UOC 1982b, Exhibit D) performed computerized theoretical stability analyses of models of their generalized embankment section constructed of Union B spent shale. The overall slopes of that model were also 3.5:1. A layered-pile section, as previously discussed, and material properties for Union B spent shale obtained from the laboratory tests were used in the analyses. Seismic parameters were included in the study. The resulting factors of safety for the ultimate 1,000-foot-high pile slope ranged from 2.2 to 3.0 and were considered to be well within the limits of standard engineering practices for the type of facility being planned. Their stability analysis assumed lower parts of slopes could not be saturated. However, it is anticipated that laboratory tests on saturated retorted Union B process shale samples will show nearly the same strength parameters as were assumed for the unsaturated condition stability analyses. Therefore, it is expected the overall stability of a pile with localized or broad saturated areas would be similar to that expected for an unsaturated pile.

As discussed previously, the physical properties reported for Union B processed retorted shales are within the range of those reported for naturally occurring soils whose classifications are the same as the retorted shale. No retorted shale pile of the height and volume of materials that is planned for this project has yet been constructed. However, numerous embankment fills, earth dams, and other similar structures have been constructed of naturally occurring soils. Many of those structures have overall pile slopes steeper than the planned 3.5:1 to be used for this project. Such structures have performed well, and it is felt that similar well-constructed stable embankment fills could be constructed of retorted shale.

Retorted Shale Disposal Pile Leachate and Runoff Potential

The leachate and runoff potential of the retorted shale disposal piles for Cities Service's project was estimated for two sets of conditions: (1) during pile construction, and (2) post-reclamation (In-Situ 1984). During construction of the retorted shale disposal pile, the overall goal is to minimize leachate potential. This is accomplished with a sufficient depth of retorted shale so that precipitation falling directly on the retorted shale disposal pile would be redistributed as the wetting front moves downward resulting in little or no leachate, given the water-holding characteristics of the in-place retorted shale. Post-reclamation has the general goal of minimizing leachate potential by establishing a revegetated surface and controlling the quantity of the precipitation infiltrating the pile by evapotranspiration from vegetation. Both of the above cases were analyzed using empirical equations and an analytical unsaturated flow model to calculate water movement downward through the retorted shale disposal pile. The analytical model utilized was one developed for use by Union Oil Company (UOC 1982b) and revised and updated by Kunkel and Murphy (1983).

The model utilizes a risk-based approach. In this approach, rainfall probabilities are assessed for input to the analytical unsaturated flow model. For this analysis, the probability of leachate and runoff potential for the wettest year in 2, 5, 10, 20, 50, and 100 years was estimated. The model then takes into account water movement under unsaturated conditions within the retorted shale disposal pile. The model can be utilized both for during-construction and post-reclamation cases by varying the impact data. It should be noted that the timing of leachate generation would not be concurrent with the annual precipitation event.

Within the model, the upper 6 feet of the retorted shale pile is conceptualized as a layered system. The upper 1 foot consists of soil or loose retorted shale. The lower 5 feet is moderately compacted retorted shale. Water movement into and out of this zone is calculated by the model using the water-balance equation. The water-balance equation consists of precipitation input and calculated runoff, change in storage of water ponded on the surface, evapotranspiration, drainage in soil moisture storage, and deep percolation below the root zone.

The model may be used both for construction and post-reclamation cases by changing the input data and characteristics of the reclamation zone. For the construction case, for the portion of the pile that has not been reclaimed, infiltrated water cannot be transpired because no vegetation would be growing on the surfaces. Therefore, the water which enters the pile would increase the in-place retorted shale moisture and/or move downward into the pile. In the model, evaporation is assumed to occur from the wet shale surface to a depth of approximately 6 inches. The post-reclamation analysis differs from the during-construction analysis in that evapotranspiration can remove water up to 6 feet below the shale pile surface.

Inputs to the analytical model include physical parameters of the retorted shale disposal pile such as initial or placement shale moisture content, field capacity, permanent wilting point percentage, saturated hydraulic conductivity, porosity, a curve of relative hydraulic conductivity versus saturation for the retorted shale, and Soil Conservation Service (SCS) hydrologic runoff curve number. Climatological-related inputs include precipitation and potential evaporation or evapotranspiration. Model outputs include the water content of each layer at each time step, along with periodic monthly and annual water-balance estimates, including precipitation, actual evapotranspiration or evaporation, change in shale moisture storage, total runoff, total change in "pond" surface storage, and total deep percolation. The primary interest in the assessment of leachate potential and the water-quality impacts associated with runoff and leachate involves the water-balance terms associated with deep percolation and runoff.

Retorted Shale Characteristics

Table 2.3-35 summarizes the retorted shale characteristics used in the during-construction and post-reclamation unsaturated flow modeling. These values typify the expected retorted shale characteristics for both the during-construction and post-reclamation cases (Woodward-Clyde 1984). Except for the top 1 foot of the pile, which represents either a loosely placed topsoil or retorted shale, the remainder of the upper 6 feet was assumed for the analyses to consist of retorted shale at a placement moisture of 16 percent by volume and a dry density of 88 lbs/cu-ft. The compactive effort required to obtain this dry density is that exerted by the equipment used to place the retorted shale (such as mobile conveyors and trucks). The saturated hydraulic profile of the retorted shale is based on laboratory tests performed on numerous samples of Union retorted shale (Woodward-Clyde 1984).

Results of the unsaturated flow modeling in terms of runoff and leachate potential, both during construction and post-reclamation, are summarized below and further discussed in Chapter 4.0 under the applicable disciplines.

Table 2.3-35 SUMMARY OF RECLAMATION ZONE RETORTED SHALE CHARACTERISTICS

	Reclamation Zone Depth[a]					
Characteristic	0-1 ft	1-2 ft	2-3 ft	3-4 ft	4-5 ft	5-6 ft
Dry Density (lb/ft^3)	70	88	88	88	88	88
Porosity (%)	56	44	44	44	44	44
Saturated Hydraulic Conductivity (ft/yr)	720	32	32	32	32	32
Field Capacity (% by volume)	28	22	22	22	22	22
Permanent Wilting Point (% by volume)	14	11	11	11	11	11
Placement Content (% by volume)	13	16	16	16	16	16

Source: Woodward-Clyde (1984).

[a] 0-1 ft layer loosely placed retorted shale or topsoil; other layers are *"wheel-rolled"* compacted retorted shale.

Pile Construction

At the Cities Service retorted shale disposal pile (elevation 7,000 feet above msl), during pile construction, runoff is estimated to range from about 2.2 inches for the 50 percent chance year to about 6.9 inches for the 1 percent chance year. Water infiltrating the Cities Service retorted shale disposal pile during construction would be zero for the 50 percent chance year increasing to approximately 2.65 inches for the 1 percent chance year.

The potential for infiltration to eventually appear at the bottom of the pile as leachate during construction is minimized by establishing a certain minimum laydown rate. If the laydown rate is increased above this minimum, then the pile will not reach saturated conditions and no leachate would leave the pile during construction. As summarized in Table 2.3-35, a majority of the disposed retorted shale would be placed at a density of 88 lbs/cu-ft with a placement moisture of 16 percent by volume. Water movement in the retorted shale is essentially zero at saturations less than 50 percent or approximately 22 percent by volume. Therefore, the additional available waterholding capacity of the retorted shale during construction is approximately 6 percent by volume (22 percent less 16 percent). Assuming a unit depth of retorted shale at an initial moisture content of 35 percent of saturation, 1 inch of infiltrated water could be stored in approximately 1.4 feet of retorted shale without raising the percent saturation above 50 percent. Based on this, the anticipated thickness of retorted shale, which could store 1 year's infiltration without releasing leachate, ranges from a lift thickness of 6 feet for the 50 percent chance year to about 10 feet for the 1 percent chance year. This analysis implies that additional lifts should be placed at least once per year to control leachate potential for the recurrence interval year desired.

The lift thicknesses indicated for the during-construction case do not include water which may be added to the retorted shale disposal pile for leaching of salts during reclamation or irrigation in excess of consumptive use during initial reclamation. However, the lift thicknesses may be increased to accommodate these inputs at a rate of about 1.4 feet of shale per inch of water added to the pile.

Post-Reclamation

Runoff potential for the post-reclamation case, based on the unsaturated flow model, are estimated to range from approximately 2.12 inches for the 50 percent chance year to 6.78 inches for the 1 percent chance year. Leachate from the retorted shale disposal pile after reclamation would be zero for all frequencies analyzed except the 2 percent and 1 percent chance years, which would generate about 0.4 and 1.0 inches of leachate, respectively, not considering channel seepage from reconstructed channels for Conn Creek and Cascade Canyon. If the line source reconstructed channels are considered, the leachate potential ranges from 4.68 inches for the 50 percent chance year to 5.70 inches for the 1 percent chance year (see Table 4.3-1).

Leachate generation from the Cities Service retorted shale disposal pile would be derived not only from infiltration of rainfall and snowmelt, but from the artificial alluvial channel constructed over the top of the pile at reclamation. The purpose of this channel would be to conduct flows primarily from Conn Creek, a perennial stream, along with occasional flows from Cascade Canyon. Based upon preliminary information, the alluvial channel is assumed to have about 12 feet of saturated sediments overlying a 10-foot-thick layer of compacted retorted shale having an estimated permeability of 3.6 feet per year. The area of the Conn Creek and Cascade Canyon alluvial channels on top of the retorted shale pile would be about 60 acres. Estimated leachate generated from a constant line source of water across the top of the pile would be about 260 acre-feet per year. Remaining areas of the retorted shale disposal pile would be subject to leachate from precipitation inputs only. The leachate potential would be about 0 acre-feet per year for the 50 percent and approximately 57 acre-feet per year for the 1 percent chance year. Therefore, the long-term leachate potential of the Cities Service retorted shale disposal pile would range from 260 to 317 acre-feet per year for the 50 percent and 1 percent chance years, respectively. An alternative action to constructing the alluvial channel would be to construct a rock drain system to direct the stream flows under the pile.

Reclamation

The reclamation activities for the proposed project can be categorized into two areas: (1) reclamation of the shale disposal site, and (2) reclamation of other disturbed areas.

Retorted Shale Disposal Area Reclamation. As previously described, retorted shale from the Union B process has properties of a slightly silty, sandy, gravel soil; is high in soluble salts; has a moderate pH; and is low in available phosphorus and nitrogen. Other mineral nutrients are low to adequate and within the range found in Colorado soils. The major problems encountered in establishing vegetation on retorted shale are the shale's low fertility, high sodium adsorption ratio, and high soluble salt content.

The amount of subsoil and topsoil to be placed will be precisely determined during preparation of the permit application for the Mined Land Reclamation permit for the Cities Service project. As parts of other testing programs, various researchers have successfully produced vegetative cover on various soil and subsoil combinations including growing plants directly on spent shale from a variety of retorting processes. Union Oil Company has conducted tests using 6 inches and 12 inches of soil coverage over retorted shale from the Union B process. The analysis, conducted over 6 years, indicated the highest plant cover values with the 6-inch soil cover. Although the soil-covered shale tests had better initial coverage, later stages of development of all tests were similar. The current plan for reclamation of the Cities Service property would involve covering spent shale with unretorted waste shale rock followed by soil, soil amendments, and seeding as necessary. The depths of these layers would be determined by further testing and by the appropriate permit requirements.

The spent shale disposal pile for Cities Service project would be confined within Conn and Cascade canyons. It would occupy the general area indicated in Figure 2.3-28. The disposal pile would be constructed in lifts of varying thickness to a final contour as follows. The top of the pile would be gradually sloped along the long axes of the canyons at about 7 percent and sloped downward toward the west across the canyons at about 4 percent.

The final cross-section of the spent shale disposal pile is shown in Figure 2.3-29. The faces of the pile would be formed in lifts of 50 feet with the final slope of these faces approximately 3.5:1. As final contours of the faces of the disposal pile are realized, these areas would receive the final reclamation treatment including grading, subsoil and topsoil cover, and seeding as necessary. This activity primarily would involve the benches constructed to form sequential lifts of spent shale. Active waste disposal areas would be minimized such that no more than 20 acres of unconsolidated material is exposed at any time, and additional interim reclamation procedures would be employed, as required, to control erosion. In the context of this FEIS, the unconsolidated portion of the pile surface means that surface which is used for material laydown prior to wetting and compaction.

Waste rock from mining operations will be disposed on the plateau. Fine ore from crushing operations, which is unsuitable for processing in the Union B retort, would be stockpiled on the plateau for future recovery. These piles would be designed and constructed in accordance with applicable regulatory standards. Reclamation measures would be implemented on the fines stockpile so that no more than 1 acre of unconsolidated material would be exposed at any one time. The ultimate areal extent of the disposal site would be approximately 73 acres.

Other Disturbed Areas Reclamation. Construction of the processing and support facilities for the Cities Service project would require local topographic modifications to provide level areas for construction. After decommissioning, those areas would be reclaimed according to the specific conditions of the Colorado Mined Land Reclamation permit. Although the exact conditions of this permit cannot be accurately predicted at this time the following procedures are anticipated. Surface disturbance areas would be graded and disced to break up the surface. Topsoil would be redistributed and appropriate seed mixtures and plantings would be placed. Monitoring plans are expected to evaluate the success of returning the various areas to a condition suitable for the planned post-mining land use.

Major pieces of equipment, structures, and foundations would be decommissioned per the requirements of the reclamation permit. Embankments, waste piles, and other disturbed areas would be reclaimed as described above.

Erosion control for the Cities Service project would be accomplished using the appropriate type of control method for the situation at hand. Depending on the material to be controlled and the time requirement associated with the control, physical and chemical barriers such as riprap, mulches, netting, coagulants, and emulsifiers could be used. More permanent control would be accomplished through soil preparation and revegetation efforts. Control of suspended solids resulting from erosion will be exercised by collection of runoff from eroding areas in sedimentation ponds.

Specific seed mixtures for short-term stabilization, long-term stabilization, and permanent revegetation efforts would be included in the specific reclamation procedures proposed as part of the reclamation permit application. The seed mixture presented in Table 2.3-36 is considered to be representative of the mixtures expected to accomplish reclamation goals. This mixture may be modified to reflect state-of-the-art reclamation knowledge, as well as specific site conditions.

2.3.2.2.3 Waste Streams. There are various waste streams associated with the production of shale oil. These streams can be generally classified into wastewaters, air emissions, and solid wastes. The waste streams (air, water, solid wastes) can be further subdivided into wastes resulting from mining, retorting, upgrading, and solid waste disposal. Each of these areas are discussed below.

Wastewater Streams

Oil shale retorting produces water, partly by combustion of hydrogen and oxygen, and partly by release of combined and free moisture in the shale. Most of this water leaves the retort in the vapor phase with the raw gas and is recovered as a condensate when the gas is cooled prior to treating. Constituents potentially within the gas condensate include dissolved ammonia, carbon dioxide and some hydrogen sulfide, some volatile organics as well as inorganic salts.

Table 2.3-36 CITIES SERVICE PROJECT PROPOSED SEED MIXTURE[a]

Scientific Name	Common Name	PLS/Acre[b]
XERIC SITE		
Agropyron inerme	Beardless bluebunch wheatgrass	1.0
Agropyron tricophorum	Pubescent wheatgrass	2.0
Elymus junceus	Russian wildrye	1.0
Agropyron riparium	Streambank wheatgrass	1.0
Agropyron smithii	Western wheatgrass	2.0
Agropyron desertorum	Crested wheatgrass	1.0
Festuca ovina	Hard fescue	2.0
Sporobolus airoides	Alkali sacaton	0.1
Sporobolus cryptandrus	Sand dropseed	0.1
Melilotus officinalis	Yellow sweet clover	0.5
Artemesia tridentata vaseyana	Mountain big sagebrush	0.1
Purshia tridentata	Bitterbrush	0.5
Hedysarum boreale	Utah sweetvetch	0.1
Kochia prostrata	Summer cypress	0.5
	TOTAL	11.9
SHRUB SEEDLING MIXTURE		Seedlings/Acre
Prunus virginiana	Chokecherry	100
Rosa woodsii	Woods Rose	50
Symphoricarpos oreophilus	Snowberry	150
Amelanchier alnifolia	Serviceberry	50
Quercus gambelii	Gambels Oak	100
	TOTAL	450

[a] Seed mixtures are those to be used for permanent reclamation.
[b] PLS = Pure Live Seed; 1.0 lb/acre is equivalent to 60 seeds/square foot.

Some water condenses with the raw shale oil and may contain some heavy oil and organics. Inorganic salts, particularly bicarbonates, may also be present in this wastewater if the water has been in contact with the inorganic matrix during retorting.

The wastewater treatment schemes of the Cities Service shale oil project involve removal of contaminants prior to deposition on the spent shale pile. Figure 2.3-30 presents the overall flow of wastewater generation and treatment. A summary of the processes is presented below.

The proposed wastewater treatment is based on state-of-the-art treatment technology. Water consumption figures are based on water recycle and reuse. It must be noted that no overall treatment scheme has yet been tested on oil shale process waters on a demonstration plant scale or, in some instances, even on a pilot scale. Thus, the treatment schemes and stream qualities must be viewed as preliminary and can be expected to change as the technology evolves. The major wastewater categories requiring treatment are described below.

- Sour water generated from the retorting and upgrading processes would be treated for oil separation prior to steam stripping for removal of hydrogen sulfide and ammonia. The resulting stream may be treated for biological oxidation of organics. At this time, the success of biological treatment of these waters has yet to be verified.

- Water streams from the utility systems and site runoff, together with any excess mine water, would be combined for removal of oil and solids, and may be further treated by biological oxidation.

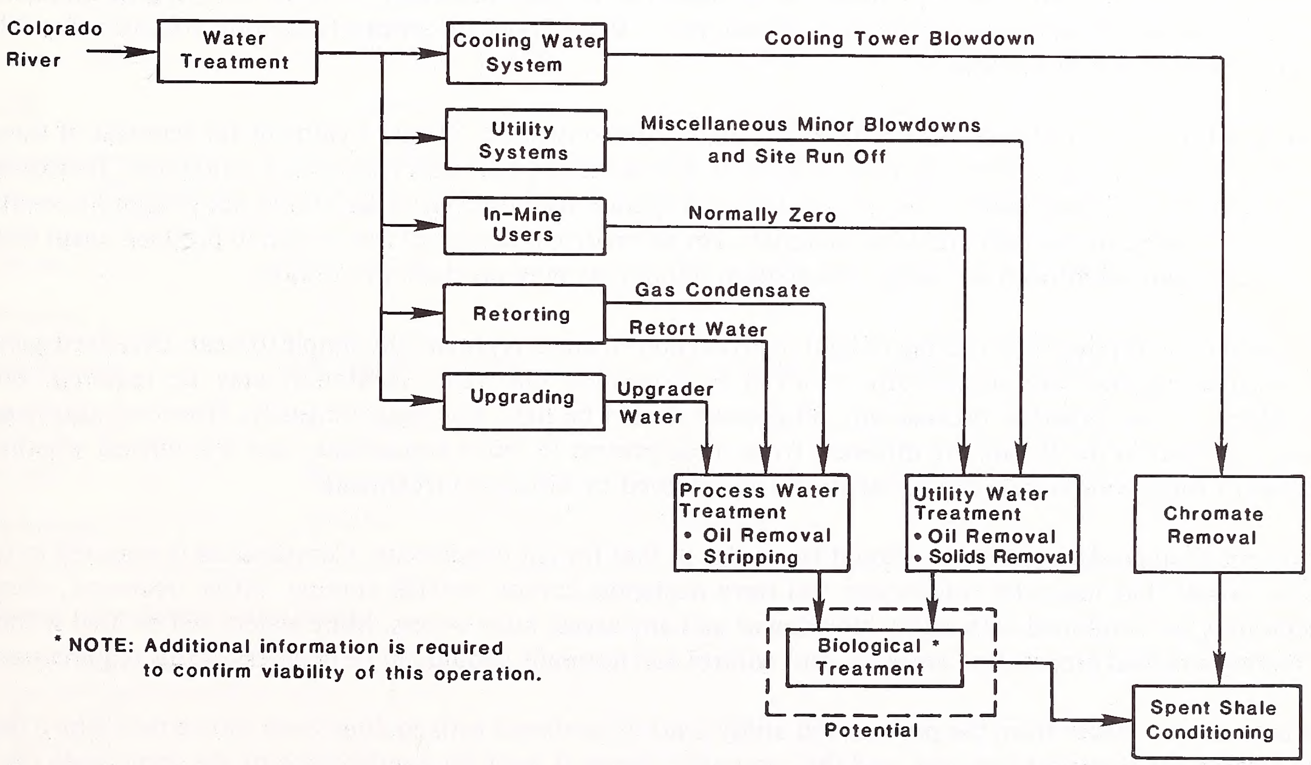
- Cooling tower blowdown water would be treated for the removal of chromates.
- Runoff impounded below the spent shale pile and from other runoff collection facilities would be reused in secondary crushing or in processed shale management.
- Sanitary wastewater from the plant and mine areas would be treated by conventional techniques.

Oil Shale Water Pollutants

Major types of waterborne contaminants found in oil shale facilities are summarized below.

Suspended solids contained in wastewater streams originate mainly from dust suppression operations in the material handling areas. In retorting where water contacts oil shale, some entrainment of fines will occur. The resulting level of solids is expected to be low and should be easy to treat. Cooling water blowdown will contain certain inorganic solid material.

Oil and grease will be present in retort waters. The amount of hydrocarbon contained in these waters depends upon the process conditions during retorting and retorted oil characteristics. Some of the oil forms an emulsion which may be difficult to break, and may require the use of de-emulsifiers. Raw shale oil from retorting is de-ashed by contacting with water. The retort water from this operation is expected to contain non-volatile hydrocarbons and shale fines. These hydrocarbons may be present in a water soluble form or as a residual emulsion. Retort condensate is generated in the gas cooling train. Water condensed in this stream will contain dissolved volatile organic materials. These constituents can be relatively easily removed by conventional separation techniques such as gravity separation.



Source: Cities Service/Getty (1984).

Figure 2.3-30 Wastewater Generation and Treatment Flow Diagram, Cities Service Shale Oil Project.

Dissolved gases are present in gas condensate wastewater from retorting and upgrading. These gases are primarily ammonia, carbon dioxide and hydrogen sulfide. They can be easily removed by stripping operations.

Dissolved inorganics are present in wastewater streams which contact oil shale. Mine drainage water and retort waters are the major sources of these chemicals.

Dissolved organics arise mainly from the organic species in raw shale oil which have been altered during pyrolysis. Retorting conditions such as temperature and the presence or lack of oxygen will affect the type and concentration of the compounds. Data on these organic compounds is very limited, but it is known that a wide range of compounds, particularly carboxylic acids and neutral compounds, can be expected. Many of these compounds should be biodegradable, but studies have shown that complete removal of the organic matter may require further processing in addition to conventional biological oxidation. This is attributed in part to the detrimental effect of certain compounds on the waste treatment bacteria.

Trace materials occur in wastewater from elements or metals leaching or from volatilization from oil shale during retorting operations, or from trace organics formed during pyrolysis. Information on these materials is very limited, and the issue is further complicated by the high variability in trace material concentration between locations in the Piceance Basin. Specialized operations such as ion exchange or membrane processing may be required to remove these materials.

Wastewater treatment. Wastewaters originate primarily from the cooling water system, retorting, and upgrading units as shown in Figure 2.3-30. In addition to these sources, wastewaters will be produced from utility operations, runoff and mine drainage.

Retort water is formed when water and oil vapors are condensed. The stream is contaminated with oil, dissolved gases, dissolved inorganics and dissolved organics. The wastewater is first treated in an oil/water separator, and emulsion breaking is applied as necessary. The resulting stream is then stripped to remove dissolved gases, including acid gases, and volatile organics. Lime addition may be necessary prior to stripping to minimize ammonia fixation and enhance precipitation of inorganics. Recovery of the stripped ammonia for sale is feasible by using the Phosam-W process.

Removal of dissolved organics has not been adequately demonstrated. Should treatment for removal of these materials be employed, options include biological treatment, carbon adsorption and oxidation. Biological treatment is the most adaptable to large scale, low cost operations; however, to date it has not proven successful due to the presence of resistant and toxic materials. An alternative is the use of this stream to produce steam with the contaminants withdrawn as sludge. Mechanical limitations may preclude this option.

Gas condensate, produced by cooling of light hydrocarbon streams, is potentially simple to treat. Dissolved gases and volatile organics are successfully removed by stripping. Oil/water separation may be required, but difficulties are not expected because any oil present should be light and separate easily. However, dissolved organics present in the stream are different from those present in retort condensate, and it is unclear whether removal of these compounds can be satisfactorily achieved by biological treatment.

Treatment of upgrader wastewater should be similar to that for gas condensate. Composition is expected to be similar except that upgrader wastewater will have negligible carbon dioxide content. After treatment, these wastewaters are combined with utility blowdowns and any excess mine waters. Mine waters will be used within the mining and feed preparation areas for dust control and normally should not be in excess of this requirement.

The treated wastewater from the process and utility units is combined with cooling tower blowdown, which has been treated for chromate removal, and the composite stream is used for conditioning of the spent shale pile.

Water Quality

The characteristics of wastewater produced in oil shale operations have not yet been clearly defined, as demonstrated by the wide variations in published information. These wastewaters can, however, be generally characterized in the form of water quality parameters. The presence and proportion of these constituents are the determining factors in the choice of treatment method.

Table 2.3-37 lists the range of retort water and gas condensate qualities measured by numerous investigators. Union has presented information on reclaimed process water for their Phase I Shale Oil facility. This information, based on pilot scale testing and engineering estimates, is presented in Table 2.3-37. Removal efficiencies can be estimated by comparing the untreated compositions presented in Table 2.3-37 with the treated compositions. Removal of ammonia is in excess of 90 percent. Substantial reductions in organic content occur.

Table 2.3-37 RETORT WASTEWATER QUALITY, CITIES SERVICE PROJECT (mg/l)

	Untreated Above-ground Retort (AGR) Water	Untreated AGR Gas Condensate	Untreated VMIS Retort Water	Untreated VMIS Gas Condensate	Untreated Hydrotreater Water	Treated Union B Spent Shale Wetting
Alkalinity	6,690 - 35,200	12,900 - 46,000	1,900 - 110,900	3,440	N/A[a]	2,000
BOD5	5,000 - 12,000	N/A	350 - 5,500	2,200	10,000	N/A
Carbon, bicarbonate	5,000 - 26,000	6,280 - 24,000	1,460 - 42,000	2,560 - 9,940	N/A	1,700
carbonate	2,000 - 24,000	22,000	440 - 7,500	880	N/A	400
inorganic	223 - 1,600	N/A	30 - 19,200	N/A	N/A	N/A
organic	3,910 - 29,000	11,760	152 - 19,000	537	N/A	1,350
COD	7,700 - 136,000	19,200	1,000 - 43,000	2,070	N/A	6,500
Nitrogen, ammonia	1,340 - 31,700	14,350 - 16,800	730 - 38,000	720	41,000	35
ammonium	16,800	13,540	930 - 24,450	N/A	N/A	N/A
organic	N/A	189	73 - 7,510	N/A	N/A	N/A
Oil and Grease	392 - 2,210	N/A	95 - 3,800	N/A	N/A	1,300
Phenols	8 - 50	1	2 - 169	4	N/A	125
Solids, total	1,856 - 160,000	429 - 15,528	1,002 - 121,000	1,520	N/A	3,100
Sulfur, sulfate	29 - 8,720	N/A	42 - 6,230	N/A	Low	1,500
Sodium	30 - 308	N/A	370 - 14,400	N/A	Low	1,500
References	b,e,g,j,k,l	b,e,g,k	b,c,d,e,f,g,h,i	b,e	e	k

Source: Cities Service/Getty (1984a).

[a] N/A - Not Available.
[b] Day and Rawlings (1981).
[c] Bates (1980).
[d] Bates (1983).
[e] OTA (1980).
[f] Sareen and Dickehuth (1982).
[g] Higgins et al. (1982).
[h] Sierka (1982).
[i] Torpy et al. (1982).
[j] Nowacki (1981).
[k] UOC (1982c).
[l] Goldstein et al. (1979).

Table 2.3-37 also lists typical hydrotreater condensate concentrations. Since shale oil produced by different retorts is not markedly different in nitrogen and sulfur contents, it is reasonable to assume that the wastewater will be similar.

As stated earlier, composition of upgrader wastewater is expected to be similar to retort gas condensate and treatment options should be similar. Furthermore, this stream will show many similarities to wastewater from refinery upgraders; thus, treatment options are expected to be within state-of-the-art.

Additional wastewater is generated from the arsenic removal unit. This unit removes arsenic from the shale oil prior to upgrading. No data are available on this stream; however, Union has provided arsenic concentration in the final effluent water shown in Table 2.3-41.

The composition of the cooling tower blowdown depends on the raw water quality to the plant. Table 2.3-38 shows the estimated quality of cooling water blowdown based on raw water supply from the Colorado River at Cameo (OTA 1980).

Table 2.3-38 COOLING WATER BLOWDOWN QUALITY

Chemical Component	mg/l
Calcium	215
Chloride	615
Fluoride	--
Magnesium	60
Sodium	460
Sulfate	840

Source: Cities Service/Getty (1984a).

Wastewater Quantity

Table 2.3-39 presents the principal process wastewater streams and their flow rates. These rates are based on previous designs for oil shale facilities (OTA 1980), but must be considered preliminary because the information is general and not based on site-specific project information. The numbers are based on data of the Union B, Tosco II and Paraho indirect processes. The "modified in-situ" plant is based on data from direct combustion retorting and Occidental's modified in-situ process.

Final effluent water quality from Cities Service's project can be estimated using the information presented above in conjunction with the removal efficiencies presented in Table 2.3-40. The final effluent streams have been calculated both with and without biological treatment. Currently it is unclear whether this operation will be included, because its merit has not been demonstrated. Table 2.3-41 presents the results together with Union published data (based on pilot data and engineering estimates). The reader is cautioned not to use the table beyond gaging general trends. This is because there is no commonality in data sources for the two columns and also because the stream qualities used for the Cities Service calculations are preliminary in nature. The treatment

Table 2.3-39 PRINCIPAL PROCESS WASTEWATER STREAMS AT 100,000-BPD PRODUCTION

	Quantity (gpm)	
Source	Above-ground Indirect Retorting	Modified In-Situ Retorting
Cooling Tower Blowdown	2,000	2,000
Retort Water	600	600
Gas Condensate	1,000	2,000
Upgrader Condensate	1,000	1,000

Source: Cities Service/Getty (1984a).

scheme for Union's effluent water quality does not include biological treatment and thus should only be compared to similar streams in the Cities Service project. Table 2.3-41 is based on the following assumptions and conditions.

- Where data are not available in Table 2.3-37, average values are substituted based on other wastewater streams.
- Hydrotreater wastewater is assumed to have the same composition as retort gas condensate wastewater in Table 2.3-37.
- Chemical components of cooling tower blowdown not presented in Table 2.3-38 are assumed to have zero value.
- Removal efficiencies are based on Table 2.3-40 and include a degree of conservatism to account for the very preliminary nature of the information and its limited data base. Table 2.3-42 summarizes the removal efficiencies used.

A comparison of the effluent water qualities presented in Table 2.3-41 with EPA Interim Drinking Water Standards and the EPA Agricultural Use Standards shows the effluent water to contain higher pollutant levels. However, the likelihood of the effluent water reaching drinking or agricultural water systems is very low due to the remoteness of the facility from these systems. Operating practices will comply with all appropriate regulations.

Gaseous Stream Emissions

Federal and state agencies have set regulatory standards to be met by new facilities. These standards control both ambient pollution levels downwind of a facility and the incremental volume of pollutants which can be added to the ambient air within certain designated sensitive areas. Oil shale development will need to comply with these regulatory standards by using Best Available Control Technology (BACT). The application of BACT to the proposed Cities oil shale project, emphasizing control of those pollutants regulated by ambient air quality standards, is discussed below. The pollutants addressed, known as criteria pollutants, are sulfur dioxide, nitrogen dioxide, ozone, non-methane hydrocarbons, carbon monoxide, total suspended particulates, and lead.

Table 2.3-40 STRIPPING OF MODIFIED IN-SITU RETORT WATER

Chemical Components	Raw (mg/l)	Stripped (mg/l)	Reduction (%)	Biologically Treated (mg/l)	Reduction (%)
Carbon, organic	2,800 - 3,300	2,200 - 3,300	26	220 - 370	90
COD	8,400 - 9,100	7,000 - 7,200	19	580 - 980	91
Nitrogen, ammonia	1,100 - 1,250	7 - 40	98	10 - 21	99
ammonium	N/A[a]	N/A	--	N/A	--
organic	34	21	38	9 - 16	63
Phenols	45	18 - 24	53	<1	99

Source: Torpy et al. (1982).

[a] N/A = Not Available.

Table 2.3-41 FINAL EFFLUENT WATER QUALITY TO SPENT SHALE PILE

	Cities Service (90 % AGR[a]; 10% VMIS)	Union[b]
	With Biological Treatment (mg/l)	Without Biological Treatment (mg/l)
BOD5	1,600 - 2,000[c]	2,000
Carbon, organic	2,600 - 4,200[c]	N/A[d]
COD	4,400 - 5,000[c]	5,500
Nitrogen, ammonia	600 - 850	35
organic	50 - 100[c]	N/A
Oil and Grease	50	1,300
Phenols	0 - 1[e]	125
Solids, Total	450 - 9,600	3,100
Sulfur, Sulfate	600 - 2,400	500
Sodium	600 - 750	1,500
Arsenic	6.5[b,f]	6.5
Flow Rate (gpm)	4,700	--

Source: Cities Service/Getty (1984a).

[a] AGR - Above Ground Retorting.
[b] Engineering Science (1984).
[c] Numbers may increase by up to 100% if biological treatment is not included.
[d] N/A - Not Applicable.
[e] Numbers may increase by up to 1,000% if biological treatment is not included.
[f] It is assumed that biological treatment will have no effect on arsenic removal. No published data are available to confirm this assumption.

Table 2.3-42 REMOVAL EFFICIENCIES UTILIZED IN WASTEWATER STREAM ANALYSIS

	% Removal Efficiency[a]	
	From Table 2.3-40	Used for Table 2.3-41
BOD5	N/A[b]	50/10
COD	91/19	50/10
Carbon, organic	90/26	50/10
Nitrogen, ammonia	99/98	95/95
organic	63/38	50/10
Oil and Grease	N/A	90
Phenols	99/53	95/50
Solids, Total	N/A	0
Sulfur, Sulfate	N/A	0
Sodium	N/A	0

Source: Cities Service/Getty (1984a).

[a] With/without biological treatment (i.e., BOD5 removal is 50% with biological treatment and 10% without biological treatment).
[b] N/A = Not Available.

Air Pollution Sources. All the major processes associated with the production of shale oil are potential sources of air pollution. Each is categorically discussed below.

Oil shale *mining* activities, which include excavation, blasting, crushing, and transportation, generate air pollution. While particulate matter is the major emission from mining operations, most of the other criteria pollutants are also generated. Explosives can produce carbon monoxide, nitrogen oxides and hydrocarbons, while possibly releasing some trace materials from the rock. Mining equipment will produce carbon monoxide, nitrogen oxides, sulfur dioxide and hydrocarbons.

The primary pollutant from *feed preparation* is fugitive dust generated during material handling operations. In this operation, a run of mine material is crushed, conveyed to the plant site and processed to final feed specifications prior to above-ground retorting.

Gaseous emissions from *retorting and upgrading* include sulfur dioxide, hydrogen sulfide, particulates, nitrogen oxides, hydrocarbons, carbon monoxide and trace metals. Sulfur emission control from retorting and upgrading has received considerable attention, with selection of appropriate sulfur control technology being a major factor in project development. Currently, BACT can remove in excess of 90 percent of the sulfur from gaseous streams.

Raw shale contains up to 3 percent sulfur with a typical shale in the Green River Formation containing about 0.7 percent sulfur. About one-third of the sulfur is present as organic species and the remainder inorganic. During pyrolysis, the organic fraction undergoes reaction with about 40 percent being released in the form of hydrogen sulfide. The remaining 60 percent stays in the shale oil product as heavier sulfur-containing compounds. About 2 pounds of sulfur per ton of oil shale is available for reaction. Assuming a Fischer assay of 25 gpt and a 100,000 bpd operation, about 150 tpd of sulfur could be emitted in an uncontrolled release. This sulfur is released as compounds including sulfur dioxide, hydrogen sulfide, and small amounts of carbon disulfide and carbonyl sulfide.

In addition to sulfur emissions, retorting may release other particulates, nitrogen oxides and hydrocarbons. Particulates may be released from the oil shale during retorting. Nitrogen oxides are released during combustion of fuel to support the retorting and processing operations. Hydrocarbons are present in the retorting gas stream and have the potential of ultimately being released to the atmosphere.

Air Pollution Control Technologies. Various technologies have proven effective in controlling air pollution associated with industrial operations. These are briefly summarized below.

Particulate Control. Particulate control can be achieved by using techniques such as water sprays, cyclones, scrubbers and filters.

- Water sprays are used to control dust from such facilities as roadways, storage piles and mining and material handling operations.

- Cyclones are used primarily to clean retort off-gases and possibly for primary dust control at the crushing operation.

- Scrubbers use water to remove dust entrained in gas streams. They have the same general application as cyclones, but have a higher removal efficiency at a cost of increased energy requirements.

- Baghouse filters are used for dust control in the feed preparation system such as crushing operations and feed shale conveying. Should further dust removal be required, then high efficiency electrostatic precipitators can be employed.

Nitrogen Oxides Control. Nitrogen oxides are produced during the combustion of hydrocarbons. In oil shale processes, nitrogen oxides are formed during two operations the combustion of gaseous or liquid products, and the combustion of process heater fuels. Nitrogen oxides control can be achieved by adjusting combustion conditions to minimize formation. Stack gas clean-up techniques are being developed; however, they are not yet commercially demonstrated.

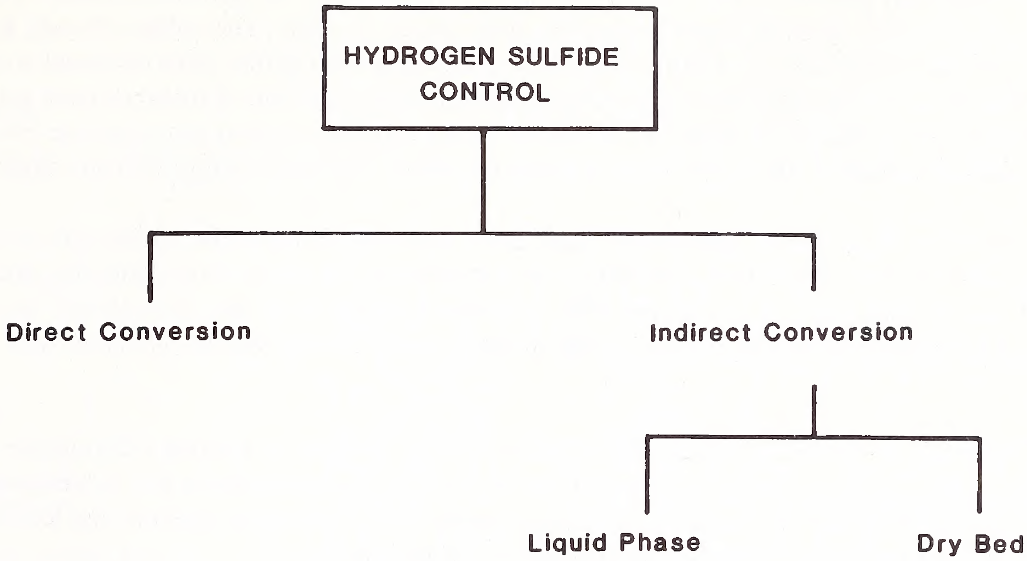
Hydrocarbon and Carbon Monoxide Control. These materials occur primarily in emissions from process heaters under conditions of incomplete combustion. State-of-the-art combustion technology will be used to minimize formations. Small amounts of hydrocarbons are also emitted to the atmosphere through leaks in processing or storage equipment. These will be controlled by use of state-of-the-art sealing of process and storage equipment. Hydrocarbons are also present in retort gas streams prior to sulfur removal, and operating conditions will be adjusted to ensure hydrocarbon condensation prior to treatment.

Sulfur Control. Sulfur may be removed from oil shale operations in the form of hydrogen sulfide or as sulfur dioxide. Numerous processes are available for removal of these species, and the general approaches for removal are shown in Figures 2.3-31 and 2.3-32.

The hydrogen sulfide removal processes use either direct or indirect conversion (Figure 2.3-31). In the direct conversion process, sulfur compounds are directly oxidized to elemental sulfur. In the indirect conversion process, the hydrogen sulfide is separated from the feed gas and recovered separately.

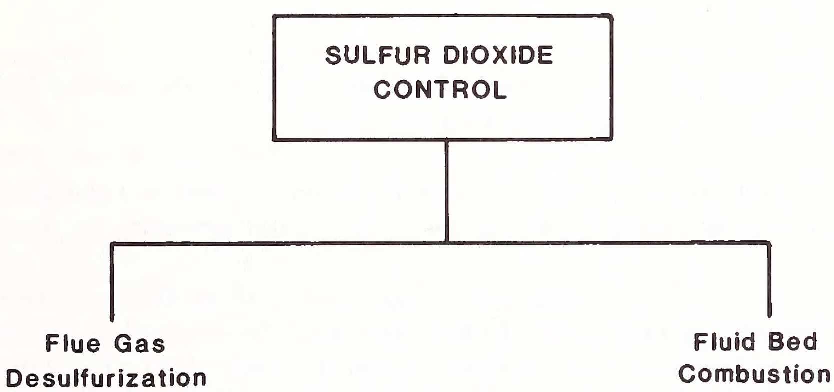
Direct conversion processes are best suited for treatment of gases containing low concentrations of hydrogen sulfide. In these processes, hydrogen sulfide is directly oxidized to elemental sulfur. However, any sulfur in a form other than hydrogen sulfide, such as carbonyl sulfide or carbon disulfide, is only partially removed. The Stretford and Unisulf processes are examples of the direct converstion process.

Indirect conversion removes sulfur by either chemical conversion of the hydrogen sulfide to another compound, absorption into a liquid or adsorption onto a solid. Chemical conversion appears to be the most practical option for oil shale desulfurization. Absorption processing requires higher pressures than practical for oil shale gas streams, and adsorption processing is not applicable because of bed fouling problems from high contaminant loadings. As with direct conversion processes, sulfur present in forms other than hydrogen sulfide is only partially removed.



Source: Cities Service/Getty (1984b).

Figure 2.3-31 Technology Options for Hydrogen Sulfide Control, Cities Service Shale Oil Project.



Source: Cities Service/ Getty (1984b).

Figure 2.3-32 Technology Options for Sulfur Dioxide Control, Cities Service Shale Oil Project.

In the chemical conversion process, hydrogen sulfide is removed by reacting with an amine solution. The hydrogen sulfide is released in a concentrated stream from the amine in a stripping step and subsequently processed in a Claus sulfur recovery plant to produce elemental sulfur. The tail gas from the Claus plant may require further treatment. This process combination is best suited to off-gas streams from indirect retorting since concentrations of hydrogen sulfide from direct retorting operations are too low for practical operation of the Claus process.

Sulfur dioxide removal processes include flue gas desulfurization and fluid bed combustion. These technologies are used either for final capture of sulfur from Claus plant tail gas, or removal of the bulk of the sulfur where concentrations are too low for other techniques. The flue gas desulfurization process is normally used for these applications.

Flue gas desulfurization processes may be of two types, regenerable or non-regenerable. The regenerable processes involve reaction of an inorganic chemical with sulfur dioxide. The sulfur dioxide is subsequently removed as a concentrated stream for further processing and sale, while the inorganic chemical is regenerated for further sulfur dioxide removal. The non-regenerable process involves reaction of sulfur dioxide with limestone to produce a non-hazardous sludge for disposal. While the sulfur dioxide removal processes are less effective than the hydrogen sulfide processes, they represent the state-of-the-art for sulfur removal from dilute gas streams.

Fluid bed combustion of process off-gas and oil shale fines, a potential alternative to flue gas desulfurization, is currently being evaluated by researchers. The off-gas is burned in the presence of oil shale fines and the inorganic component of the oil shale fines acts as a captor for the sulfur species in the gas. This option has the synergistic features of simultaneously desulfurizing the off-gas together with processing the oil shale fines in a beneficial manner.

Technological Status. As previously discussed, there are a wide variety of control technologies that could be applied to oil shale processes. The selection of suitable technologies for a given facility is based on a number of factors, including the nature of the ore body, the characteristics of the emission streams, the technological status of the control technology, and the applicable environmental regulations.

Currently, research is proceeding and technology is evolving in most areas of oil shale processing and pollution control. Because results from commercial experience are not available, streams from pilot oil shale facilities together with commercial applications in analogous services are used to predict efficiencies of pollution control technologies. It is, however, desirable to maintain maximum flexibility in the planning stage to accommodate future process improvements.

Table 2.3-43 summarizes the technological status of the major control technologies, along with the proposed action for Cities Service.

Proposed Action Pollution Control. Cities Service's proposed action includes control technologies that will achieve the appropriate level of control. These are described below.

Figure 2.3-33 is a process block diagram for Cities Service's sulfur control systems. Table 2.3-44 shows the BACT removal efficiencies for this system. Table 2.3-45 lists the sulfur dioxide emissions for the proposed project.

The gas product from the Union retorts is primarily a light hydrocarbon stream containing 3 to 4 percent hydrogen sulfide. This stream is desulfurized in a Unisulf unit, a process licensed by Union Oil, converting in excess of 99.9 percent of the hydrogen sulfide in the gas to elemental sulfur. Union has stated (UOC 1984) that, under normal operating conditions, concentrations of hydrogen sulfide in the desulfurized gas should not exceed 10 ppmv and concentrations of trace organics should not exceed 50 ppmv.

The Unisulf process is less effective in removing trace organics than removing hydrogen sulfide. The feed concentration level of these trace organics has not yet been defined. Researchers have developed data (Table 2.3-46) which can be used to establish a preliminary range. However, recent information from the EPA, also shown in Table 2.3-46, indicates signifi cantly higher trace organics levels. Depending on the concentration of these materials and the removal efficiency of the control process, additional specialized sulfur removal steps may be necessary to convert the organic materials to hydrogen sulfide.

The product gas from upgrading is a sour hydrocarbon stream containing hydrogen sulfide and potential trace organic sulfur species. These materials are removed by amine treating and combined with hydrogen sulfide produced from stripping of sour process waters. The desulfurized gas, containing a maximum concentration of 100 ppmv of sulfur species is used for fuel. Depending upon the specific amine selected, it may be necessary to provide additional treatment of the type described above for removal of the trace sulfur species. The composite sour gas stream is then processed in a Claus plant to produce elemental sulfur. Tail gas from the Claus plant, containing residual sulfur dioxide, is treated as necessary for final removal of sulfur. Tail gas concentration of hydrogen sulfide, trace organic materials and any residual sulfur dioxide is predicted to total 100 ppmv.

Table 2.3-43 STATE OF DEVELOPMENT OF AIR POLLUTION CONTROL TECHNIQUES

Control Techniques	Development Status[a]	Cities Service Proposed Action	Comments
Particulates			
Water Sprays	High	Yes	
Cyclones	High	Yes	
Scrubbers	High	Yes	
Filters	Medium	Yes	Further testing required, especially for high efficiency electrostatic precipitators
Nitrogen Oxides			
Combustion Control	High	Yes	
Chemical Conversion	Low	No	Substantial testwork required
Hydrocarbons and Carbon Monoxide			
Combustion Control	High	Yes	
Sulfur Control			
Hydrogen sulfide			
Direct conversion (e.g., Stretford)	Medium	Yes	
Indirect conversion (e.g., Amine/Claus)	High	Yes	
Sulfur Dioxide			
Flue Gas Desulfurization	Medium	No	Improvements in control efficiency may be necessary
Fluid Bed Combustion	Low	No	Substantial testwork required

Source: Cities Service/Getty (1984b).

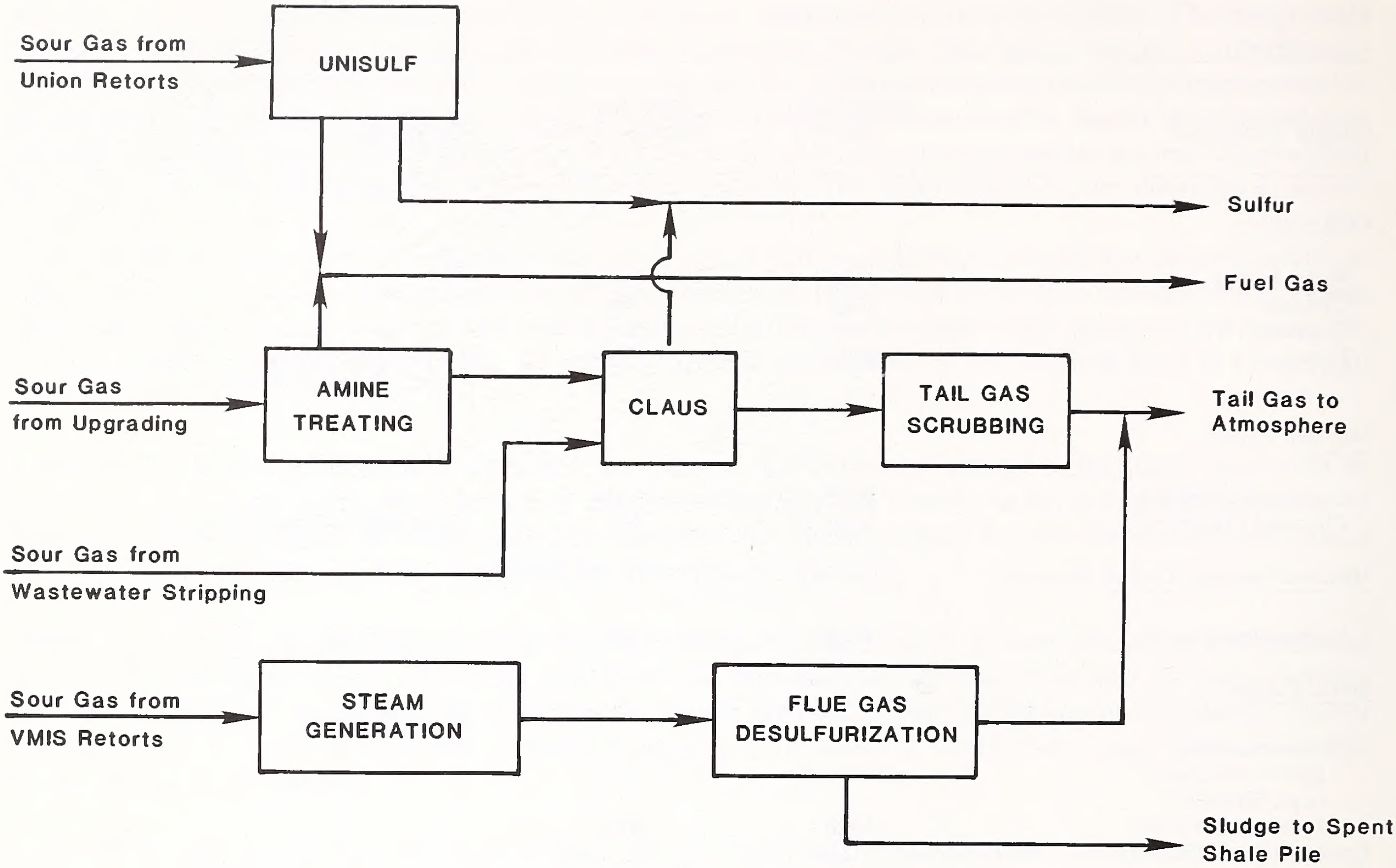
[a] High - Well developed; technology in current use.
Medium - Some technical improvements are needed for commercial oil shale applications.
Low - Substantial work required prior to commercial demonstration on oil shale.

Table 2.3-44 SUMMARY OF BEST AVAILABLE CONTROL TECHNOLOGY (BACT) FOR SULFUR

Source	Proposed Action	BACT[a]
Sour Gas from Union Retorts	Unisulf	100 ppmv[b]
Sour Gas from Upgrading	Amine Treating	100 ppmv
	Claus	> 95% H_2S Removal
	Tail Gas Scrubbing	100 ppmv
Sour Gas from Wastewater Stripping	Claus	> 95% H_2S Removal
	Tail Gas Scrubbing	50 ppmv
Sour Gas from VMIS Retorts	Flue Gas Desulfurization	40 ppmv

Source: Cities Service/Getty (1984b).

[a] Total of H_2S, SO_2, trace organics.
[b] Units are parts per million by volume (ppmv).



Source: Cities Service/Getty (1984a).

Figure 2.3-33 Sulfur Control Systems, Cities Service Shale Oil Project.

The off gas from VMIS retorting is a low BTU gas containing less than 1 percent hydrogen sulfide, together with trace organic sulfur species. This stream is pretreated to remove ammonia (to minimize formation of NO_x) and light hydrocarbons, and is then used as boiler fuel. The sulfur species are converted to sulfur dioxide which is removed via flue gas desulfurization, probably using a wet scrubbing technique such as the double alkali process. The scrubbed flue gas is predicted to contain 27 ppm sulfur dioxide. State-of-the-art control technology can achieve 40 ppmv. Further development work may be necessary to achieve 27 ppmv.

There are additional releases of sulfur dioxide from process heating, utility heating and material handling operations. The major releases occur from process and utility heating and are based upon BACT for combustion sources operating on sweet fuel gas. Mining and spent shale disposal operations will contribute small amounts of sulfur dioxide from mobile equipment exhausts.

There are other criteria pollutants that will be subject to various control mechanisms. Table 2.3-47 summarizes those pollutants and control technologies.

Particulates, nitrogen oxides, carbon monoxide and hydrocarbons in addition to sulfur species are emitted from the recycle gas heater and oil stripper reboiler, steam boiler, utility and upgrading heaters, and tail gas incinerator. State-of-the-art combustion technology will be employed, as discussed earlier. All sources, with the exception of the steam boiler utilize a desulfurized high BTU fuel gas. The steam boiler will burn sour low BTU fuel gas from VMIS operations, and the combustion products from this operation will be desulfurized by flue gas desulfurization. The tail gas incinerator will combust the treated gas stream from the tail gas unit.

Table 2.3-45 SUMMARY OF PREDICTED CITIES SERVICE PROJECT SULFUR DIOXIDE ATMOSPHERIC EMISSIONS

	Emission Source	Emission Level	Emission (g/sec)
Retorting			
- Recycle Gas Heater (Union)	Fuel Gas		26
- Oil Stripper Reboiler	Fuel Gas	a	2
- Flue Gas Desulfurization (VMIS)	Off Gas	27 ppmv SO_2	35
Upgrading			
- Auxiliary Boiler	Fuel Gas	a	<1
- Reformer Heater	Fuel Gas	a	1
- Whole Oil Heater	Fuel Gas	a	21
- Naphtha Heater	Fuel Gas	a	2
- Tail Gas Incinerator	Fuel Gas	a	2
Mining and Material Handling			
- Mining Equipment	Diesel Fuel	b	2
- Spent Shale Haulage Equipment	Diesel Fuel	b	2
- Miscellaneous			≤1
			93

Source: Cities Service/Getty (1984b).

[a] 100 ppmv (parts per million volume) H_2S, SO_2, trace organics.
[b] Varies by equipment type and size.

Table 2.3-46 TRACE ORGANIC CONCENTRATION IN RETORT GAS STREAM[a]

	Indirect Above Ground Retorting[b]		VMIS Retorting	
	Research[c] Testing	USEPA[d]	Research[c] Testing	USEPA[d]
Carbonyl Sulfide	135 - 550	100 - 1000	0 - 40	100 - 500
Carbon Disulfide	0 - 20	100 - 1000	N/A[e]	100 - 500
Methyl Mercaptan	35 - 165	50 - 500	N/A	50 - 250

Source: Cities Service/Getty (1984b).

[a] Units in ppmv.
[b] See definition in Glossary.
[c] Enviroscience (1982).
[d] Bates (1984).
[e] N/A = Not Available.

Table 2.3-47 SUMMARY OF NON-SULFUR EMISSIONS, CITIES SERVICE SHALE OIL PROJECT

Source	Pollutant	Emission Factor	Control	Emission (g/sec)
Retorting				
Recycle Gas Heater	TSP	1 lb/10^6 ft^3	None	<1
	CO	40 lb/10^6 ft^3	None	10
	HC	1.4 lb/10^6 ft^3	None	<1
	NO_x	550 lb/10^6 ft^3	None	139
Oil Stripper Reboiler	TSP	1 lb/10^6 ft^3	None	<1
	CO	35 lb/10^6 ft^3	None	3
	HC	2.8 lb/10^6 ft^3	None	1
	NO_x	140 lb/10^6 ft^3	None	<1
Steam Boiler	TSP	1 lb/10^6 ft^3	None	<1
	CO	40 lb/10^6 ft^3	None	12
	HC	1.4 lb/10^6 ft^3	None	<1
	NO_x	0.5 lb/mm Btu	None	143
Auxiliary Boiler	TSP	1 lb/10^6 ft^3	None	<1
	CO	35 lb/10^6 ft^3	None	1
	HC	2.8 lb/10^6 ft^3	None	<1
	NO_x	140 lb/10^6 ft^3	Low NO_x Burners	6
Reformer Heater	TSP	1 lb/10^6 ft^3	None	<1
	CO	40 lb/10^6 ft^3	None	9
	HC	1.4 lb/10^6 ft^3	None	<1
	NO_x	550 lb/10^6 ft^3	Low NO_x Burners	126
Whole Oil Heater	TSP	1 lb/10^6 ft^3	None	<1
	CO	35 lb/10^6 ft^3	None	2
	HC	2.8 lb/10^6 ft^3	None	<1
	NO_x	140 lb/10^6 ft^3	Low NO_x Burners	9
Naphtha Heater	TSP	1 lb/10^6 ft^3	None	<1
	CO	35 lb/10^6 ft^3	None	<1
	HC	2.8 lb/10^6 ft^3	None	<1
	NO_x	140 lb/10^6 ft^3	Low NO_x Burners	1
Tail Gas Incinerator	TSP	1 lb/10^6 ft^3	None	0
	CO	35 lb/10^6 ft^3	None	<1
	HC	2.8 lb/10^6 ft^3	None	<1
	NO_x	140 lb/10^6 ft^3	Low NO_x Burners	<1
Mining and Material Handling				
Mining (Blasting)	TSP	0.01 lb/ton shale	Wet Suppression (98.5%)	<1
	CO	0.0211 lb/lb ANFO	None	28
	NO_x	0.0016 lb/lb ANFO	None	2
Mining	TSP	0.009 lb/ton shale	Wet Suppression (98.5%)	<1
Mining (crushing)	TSP	0.02 lb/ton shale	Wet Suppression (98.5%)	<1
Mining (conveying)	TSP	0.004 lb/ton shale - transfer point	Wet Suppression (98.5%)	3
Mining (mobile equipment)	TSP	0.76 g/hp-hr	None	1
	CO	0.89 g/hp-hr	None	5
	HC	0.90 g/hp-hr	None	2
	NO_x	12.87 g/hp-hr	None	23
Surface Material Handling				
Belt Transfers	TSP	0.004 lb/ton-transfer pt.	Baghouse (99.5%)	2

Table 2.3-47 SUMMARY OF NON-SULFUR EMISSIONS, CITIES SERVICE SHALE OIL PROJECT (concluded)

Source	Pollutant	Emission Factor	Control	Emission (g/sec)
Surface Material Handling (cont.)				
Crushing	TSP	0.6 lb/ton	Baghouse (99.5%)	3
Feed Stockpile	TSP	0.02 lb/ton-yr maint. 0.018 lb/ton-yr wind erosion	None	1
Disposal Reclamation				
Spent Shale Placement and Compaction	TSP	0.81 g/hp-hr	None	1
	CO	2.62 g/hp-hr	None	5
	HC	0.89 g/hp-hr	None	2
	NO_x	11.20 g/hp-hr	None	20
Spent Shale Pile	TSP	0.004 lb/ton	Wet Suppression (90%)	23
Waste Rock Pile	TSP	0.004 lb/ton	Wet Suppression (90%)	1
Fines Pile	TSP	0.004 lb/ton	Wet Suppression (90%)	7
Fines and Waste Rock Pile Equipment	TSP	0.81 g/hp-hr	Wet Suppression (90%)	<1
	CO	2.62 g/hp-hr	Wet Suppression (90%)	<1
	HC	0.89 g/hp-hr	Wet Suppression (90%)	<1
	NO_x	11.20 g/hp-hr	Wet Suppression (90%)	2

Source: Cities Service/Getty (1984b); UOC (1982b).

The principal emission from mining and materials handling operations would be suspended particulate matter. This material would consist largely of raw or spent shale fines from the proposed facilities. Activities that produce fugitive particles include blasting; loading, haulage, crushing and stockpiling of raw and retorted shale; and disposal pile development. Dust is also produced by vehicular traffic on access roads. Appropriate dust suppression facilities, of the type discussed earlier, will be included.

Combustion emissions are produced from blasting operations, and from vehicular traffic. Hydrocarbon emissions will be produced from product storage tanks. As appropriate, a vapor collection system will be installed to minimize these emissions.

Solid Waste Emissions

Solid wastes include large amounts of spent shale, some quantities of raw shale fines, waste rock, and other non-hazardous materials, and small amounts of hazardous materials.

Table 2.3-48 lists the probable wastes from the Cities Service shale oil facility, and also presents the proposed action. The disposal techniques and destinations for these wastes are discussed elsewhere. Characteristics of the wastes are briefly described below.

Table 2.3-48 SUMMARY OF SOLID WASTE MATERIALS AND SOURCES, CITIES SERVICE SHALE OIL PROJECT

Source	Classification[a]	Disposal Method	Quantity
Spent Shale	NH	Spent Shale Pile	115,000 TPD (dry)
Raw Shale Fines	NH	Fines Pile	10,000 TPD
Waste Rock	NH	Waste Rock Pile	6MMT (total)
Upgrading Catalysts			
- Hydrogen Plant	H	Off-site	Ni 37,000 lb/yr (approx.) Fe-CR 170,000 lb/yr (approx.) ZnO 100,000 lb/yr (approx.) Co-Mo 22,000 lb/yr (approx.)
- Hydrotreating	H	Off-site	Al_2O_3 155,000 lb/yr (approx.) Ni-Mo 1,555,000 lb/yr (approx.)
- Sulfur Recovery	H	Off-site	Al_2O_3 14,000 lb/yr (approx.) Activated Alum. 100,000 lb/yr (approx.) Co-Mo 12,000 lb/yr (approx.)
Water Treatment			
- Sludges, Floats	NH	Spent Shale Pile	1,000 TPD (dry)
- Biological Sludges	NH	Soil Conditioning	100 TPD (dry)
Flue Gas Desulfurization			
- Sludge	NH	Spent Shale Pile	1,500 TPD
Miscellaneous			
- Wood, concrete, etc.	NH	Spent Shale Pile	Variable

Source: Cities Service/Getty (1984b).

[a] NH = Non-Hazardous
H = Hazardous

Representative information on Union B processed shale is available and is presented in Table 2.3-49. The Cities Service shale oil project will also produce approximately 35,000 tpd of spent shale from VMIS retorting. This spent shale remains in place after processing. Discussion elsewhere describes the impacts of spent shale disposal operations.

Raw shale fines are produced from crushing and screening the mined shale. This material, less than 1/8 inch in size, cannot be processed in the Union B retorts. Characteristics are generally similar to raw shale.

Waste rock is low grade oil shale produced during mine development operations that cannot be economically processed.

Catalysts are utilized in shale oil upgrading operations to produce refinery quality feedstock. These catalysts become progressively deactivated and require periodic changeouts. In addition to the materials listed in Table 2.3-48, the hydrotreating catalyst contains quantities of arsenic and heavy metals adsorbed from the shale oil. The spent catalysts are classified as hazardous materials and would be transported to off-site disposal or reprocessing facilities. The method of transport has not been selected at this time, and would depend on the disposal site location and facilities available at the disposal site.

Sludges and floats from feedwater treatment consist mainly of non-hazardous silty material removed from the water supply. Biological sludges may be produced from wastewater processing and may be used as a soil conditioner in revegetation operations.

The flue gas desulfurization system will produce sludge which consists mainly of calcium sulfite and calcium sulfate. This sludge, containing approximately 50 percent solids, will be disposed of in the spent shale pile.

2.3.2.2.4 Support Facilities. During construction and operation of the project, provisions must be made for the supply of personnel, equipment, water, natural gas, and electricity to the site, as well as provision for the removal of shale oil, by-products, and waste. The various corridors and support facilities are located as shown in Figure 2.3-19.

Transportation Systems

Cities Service's plan for transporting workers, major materials, and by-products is based on utilization of buses and trucks. The workers and major equipment would utilize the existing transportation system for access to De Beque. Facilities would be constructed near De Beque to allow transfer of workers and equipment to buses and trucks, respectively. Buses would transport workers to the project site via the new highway corridor identified in Figure 2.3-19. By-products from the project would be trucked from the plant site to De Beque for transfer to railroad cars and/or directly to the final by-product destination. Table 2.3-50 summarizes the transportation requirements. The general location of the transfer facilities was shown previously on Figure 2.3-19.

Access to the site would be limited at Cities Service's southern property boundary by a security gate and guard. Only authorized personnel would have access to the site.

Road access to the plateau would be along the existing Roan Creek road, up Conn Creek, and above the west side of the spent shale disposal area (Figure 2.3-19). The Conn Creek road would be upgraded to a two-lane paved road, and designed to provide a safe traveling surface. The road grade would be limited to a maximum of 8 percent. The total length of the route from De Beque to the plant site would be approximately 20 miles.

Water Sources and Supply Systems

The primary source of water would be the Colorado River near De Beque. Cities owns water rights sufficient to support a 100,000-bpd shale oil facility. These rights are indicated in Table 2.3-51. Getty, Cities Service, and Chevron Shale Oil Company have formed the GCC Joint Venture. Its purpose is to develop a common water

Table 2.3-49 UNION B RETORTED SHALE CHEMICAL COMPOSITION (Representative Sample)

Chemical Component	Percent by Weight
SiO_2	31.5
CaO	19.6
MgO	5.7
Al_2O_3	6.9
Fe_2O_3	2.8
Na_2O	2.2
K_2O	1.6
SO_3	1.9
P_2O_5	0.4
Mineral CO_2	22.9
Organic C	4.3
Trace Elements	<0.15
Nitrogen	0.2
	100.00

Source: Cities Service/Getty (1984b).

Table 2.3-50 TRANSPORTATION REQUIREMENTS, CITIES SERVICE SHALE OIL PROJECT

Transportation Item	Number or Quantity	Mode	Required No. of Round Trips/Day[a]
Work Force	5,328 people[b,c]	Buses	122
	3,368 people[c,d]	Buses	68
Catalysts	2,000 tons/year (delivered and waste)	Truck	0.3
Explosives[e]	75 tons/day	Truck	7
Byproducts			
Ammonia	300 tons/day	Truck	12
Sulfur	200 tons/day	Truck	8
Diesel Fuel	17,000 gal/day	Truck	2
Chemicals, Solids, and Wastes	60 tons/day	Truck	3

Source: Cities Service/Getty (1984b).

[a] Approximately 40 miles per round trip. Assume 42 minutes for each one-way trip.
[b] Peak bus transportation requirement is expected to occur in 2004. Construction and operations shifts will be staggered to minimize the number of buses required.
[c] Numbers based on Table 2.3-29, less 80 percent of administrative and management personnel who do not regularly commute to the project area.
[d] Bus transportation requirement for only operating personnel is expected to peak in 2011.
[d] Explosive ingredients (dry ammonia nitrate) would be delivered to the plant site by truck. Final explosive preparation would be done on-site. Shipment to the site would not be an explosive hazard.

Table 2.3-51 WATER RIGHTS CONTROLLED BY CITIES SERVICE THAT MAY BE UTILIZED TO FULFILL WATER REQUIREMENTS FOR THE CITIES SERVICE PROJECT

Name of Structure	Source	Amount	Appropriation Date	Basin Rank	Court Action
Cities Service Pipeline	Colorado River	100 cfs	Aug. 2, 1951	4187	6404 W2969
Cascade Canyon Pipeline	Cascade Creek	10 cfs	Aug. 25, 1966	5120	6404
Cascade Canyon Reservoir	[a]	619.47 a.f.	Aug. 25, 1966	5120	6404
Conn Creek Pipeline	Conn Creek	10 cfs	Aug. 25, 1966	5120	6404
Conn Creek Reservoir	[b]	422.75 a.f.	Aug. 25, 1966	5120	6404

Source: Cities Service (1984c).

[a] Cascade Creek and alternate source of Colorado River per decree.
[b] Conn Creek and alternate source of Colorado River per decree.

supply system that will allow each participant to utilize its individual water rights for subsequent industrial use. A diversion structure is planned in the Colorado River, and a dam and reservoir near the confluence of Dry Fork and Roan Creeks. The intake structure is proposed to be located near the right bank of the Colorado River approximately 600 feet downstream of the confluence with Roan Creek. A system of low head pumps and short discharge lines would deliver water to adjacent sedimentation ponds. The ultimate withdrawal capacity of the GCC system from the river would be 442.25 cubic feet per second. The maximum withdrawal rate for Cities Service is 100 cubic feet per second. A 23,000-foot-long water pipeline, with a high head pumping plant, is planned along the Roan Creek valley floor, to the storage site. The length of the dam crest is expected to be about 4,000 feet with a maximum height of 225 feet. The area of the reservoir would be about 2,600 acres, with an ultimate capacity of 175,000 acre-feet. Cities Service would install separate facilities to withdraw its water from the reservoir and to pump the water up Conn Creek canyon to the plant site along the previously discussed corridor. These facilities would include a 24-inch (approximate diameter) pipeline and have a nominal operating capacity of 12,500 gpm.

Natural Gas

There is an existing natural gas pipeline adjacent to the Cities Service property. A connection would be established (via a 6-inch approximate diameter pipeline connection) to provide supplemental fuel to the project. Normal operating requirements would be 86,000,000 standard cubic feet per day.

Transmission Lines

The power requirements for the project are presented in Table 2.3-31. A transmission loop is planned that would extend from De Beque, up Roan and Conn creeks, over to Parachute Creek, down the valley to the town of Parachute, and back to De Beque. This transmission line loop would be designed to provide reliable service.

Capacity of the proposed transmission line that would support the Cities Service project is likely to be 345 kV. This same line would serve the Getty project. Depending on the ultimate power requirements of the projects and the ultimate number of other project loads in the area, more than one line may be required. A right-of-way for a single 345-kV transmission line would be 100 feet wide.

The type of structure that would be utilized will depend on the conductor size and terrain limitations. Wood H-frame design, lattice steel towers, and steel poles are all possible alternatives. The wood H-frame structure requires more structures per mile of line, as compared to steel towers or poles, but the latter types usually require more land disturbance during construction of each structure.

Product Pipeline

The syncrude pipeline would connect to the La Sal pipeline, originally planned to transport syncrude from the Colony Oil Shale Project to existing refineries. Although the construction of the La Sal pipeline has been delayed, it would remain a viable link for product transport. The Cities Service connecting pipeline would be approximately 16 inches in diameter and would have a nominal operating capacity of 100,000 bpd.

Waste Disposal

At this time, mining wastes are not classified as hazardous. However, some wastes could be generated by the retorting and upgrading processes that may be classified as hazardous waste types and estimated quantities were previously presented in Section 2.3.2.2.3. Any hazardous waste would be handled by a qualified and licensed contractor, and disposed of off-site in a licensed facility. If on-site disposal is utilized, a waste disposal management plan would be developed and filed with the appropriate agencies.

Non-hazardous waste generated by the proposed project would include paper and metal wastes, plastic products, and miscellaneous items (wood, concrete, etc.). The proposed plan is to dispose of these wastes in the spent shale pile. If another on-site or off-site location is utilized, a waste management plan would be developed and filed with the appropriate agencies.

2.3.2.2.5 Committed Mitigation Measures - Proposed Action. Mitigation involves avoiding, minimizing, compensating, reducing, or eliminating an adverse environmental impact (CEQ 1978). Mitigation measures committed to by Cities Service are presented, by discipline, in Table 2.3-52. These committed mitigation measures will be based on best available technology at the time of construction and will be implemented to the extent that they are technically and economically reasonable, feasible, and practical. The mitigation measures presented assume, as applicable, that reclamation of disturbed lands would occur according to current state and federal requirements. Correspondingly, all other environmental performance standards currently in place are assumed to remain.

These mitigation measures were taken into account when analyzing environmental impacts. This consideration is reflected, as appropriate, in Section 2.4 and Chapter 4.0.

2.3.2.3 Alternatives to the Proposed Action

2.3.2.3.1 Alternatives Considered for Detailed Discussion. This section describes alternatives to the various components of the Cities Service proposed action. A wide range of options were investigated. Table 2.2-2 (Section 2.2.3) presents the alternative categories which have been considered and the various options in each category. Each alternative selected for detailed discussion is described below. For some categories, there were no alternatives included for detailed discussion; these include upgrading, water source, product transport methods, retort sites, upgrading site, supplemental energy systems, underground mine technology, and transmission routes. Table 2.2-2 may be reviewed concerning reasons for elimination from detailed study for these alternatives.

Production Rate

The alternative to the proposed 100,000-bpd production rate addressed is the 50,000-bpd rate. This alternative would still utilize room-and-pillar underground mining and surface retorting, but at a reduced level. The project life would be doubled. The amount of VMIS retorting would be the same as in the 100,000-bpd alternative because it represents the minimum commercial size. The net consumption per year of water and power would be less than the 100,000-bpd alternative. Air emissions and water discharges would also be less on an annual basis, but not over the life of the project. Overall process efficiency is expected to be less because of the loss of the economy of scale.

Mining Method

Only room-and-pillar mining (no VMIS) was considered as an alternative. Resource recovery for this alternative would not be as efficient as the underground/VMIS combination.

Retort Type

An alternative to the combination of surface and VMIS retorting is to use surface retorting only. Using surface retort technology only will result in loss of shale oil resource.

Surface Retort Technology and Pile Stability

The Lurgi retorting process was the only alternative to the Union B process that was considered. Other processes were rejected based on their developmental status.

The key elements of the Lurgi retort process are illustrated in Figure 2.3-34. Shale fines are fed to a horizontal mechanical screw mixer where heating is accomplished by mixing with recycled shale. The retort oil is discharged from the mixer with the gas. The gas is quenched in a heavy oil scrubber which is designed to contain most of the dust in the heavy oil fraction. The lighter oils are further quenched and water is separated. The heavy oil is dedusted by a dilution centrifuge process which returns the spent shale to the retort collection bin. Heat is supplied to the process by combusting the carbon on a mixture of recycled and freshly-processed shale in a

Table 2.3-52 LIST OF COMMITTED MITIGATION FOR THE CITIES SERVICE PROJECT[a]

Project Feature/Discipline	Mitigation Measure
Project Design and Operation	• Cities Service will implement control measures in the use of oil, grease, and diesel fuel.
	• Cities Service will develop pipeline break and accidental spill prevention and control plans.
	• Cities Service will develop operating procedures to comply with appropriate regulations to ensure that emissions are minimized from unplanned conditions during startup and other intermittent events.
Surface Water	• Cities Service agrees to route surface flows from spring discharges around disturbed areas.
	• Cities Service will utilize in its process poor quality runoff as collected in sedimentation ponds.
	• If spent shale pile underdrains are used, Cities Service will commit to use engineering practices to prevent clogging.
	• Cities Service will utilize proper routing or containment of underdrain discharge if it is a poorer quality than receiving waters.
	• Cities Service will control drainage from, near, or around spent shale piles and other processing facilities to avoid contamination of nearby surface runoff.
	• Cities Service will use engineering practices to avoid introduction of high TSS/TDS water into reservoirs and receiving streams and to ensure minimal watershed disruption and damage.
	• Cities Service will monitor water quantity and quality changes immediately downstream of dams.
	• Cities Service will develop procedures intended to prevent spillage of oils, fuels, and other hazardous materials from construction vehicles.
	• Cities Service will not allow debris to remain on floodplain surfaces and roads for any undue length of time.
	• Cities Service will utilize erosion and sedimentation control plans.
	• Cities Service will utilize vegetative buffer zones between roads and streams to minimize high TSS runoff.
	• Cities Service recognizes the possibility that its project could impact the flow of water in Conn Creek. Cities Service also recognizes that state law protects downstream senior appropriators' water supply if adversely affected by project activities. Cities Service will augment the flow to the affected user to the extent necessary or required.
Ground Water	• Cities Service agrees to design, construct, and maintain drainage control systems where needed.
	• Cities Service will utilize leachate collection systems which may include underdrains beneath the spent shale disposal areas.
	• Cities Service agrees to install liners and/or barriers for all ponds and disposal areas.
	• Cities Service will monitor for leachate leakage immediately downstream of its spent shale pile and take appropriate measures should leakage be detected.
	• Cities Service will utilize optimal siting of potential impact causing facilities.
	• Cities Service agrees to conduct an additional site-specific geotechnical analysis of Mahogany Zone and overlying strata to generate mining plans which minimize subsidence, and optimize worker health and safety as well as resource recovery.

Table 2.3-52 LIST OF COMMITTED MITIGATION FOR THE CITIES SERVICE PROJECT[a] (continued)

Project Feature/Discipline	Mitigation Measure
Aquatic Ecology[b]	• Cities Service commits to installation of a passive intake structure for the GCC water system on the Colorado River as described in the Public Notice 8157-FEIS at the front of this FEIS.
	• Cities Service agrees to conduct activities causing major surface disturbances during periods of low flow and precipitation to reduce impacts related to runoff.
	• Cities Service will use containment techniques on spent shale disposal areas to reduce leachate contamination of streams.
Soils	• Cities Service will comply with the conceptual reclamation plans outlined in Section 2.3.2 of the EIS.
	• Cities Service will perform slope revegetation and wind and water control measures on non-shale disposal areas such as plant sites and pipeline and road corridors.
	• Cities Service will minimize topsoil stockpiling to the extent possible through direct replacement of topsoil.
Vegetation[b]	• In consultation with state agencies, Cities Service will use appropriate plant materials and topsoil to revegetate disturbed areas consistent with future land use plans.
	• Cities Service will commit to use state-of-the-art practices for spent shale revegetation.
	• Cities Service will attempt to maintain surface water flows in cliff areas which support candidate endangered plant populations.
	• Cities Service will avoid talus slopes and cliff habitat where possible.
	• Cities Service will overlap corridors to minimize disturbances.
	• Cities Service will limit mechanical disturbance of vegetation during construction of transmission lines, pipelines, and roadways.
Wildlife[b]	• Cities Service will avoid all Category 1 habitats.
	• Cities Service recognizes that its project may impact Category 2 and Category 3 habitats/ranges. The USFWS mitigation policy directs that mitigation of such impacts to Category 2 and Category 3 habitats/ranges be accomplished so that no net loss of wildlife habitat value is realized. Although no commitment to specific mitigation acreage is presented here, Cities Service recognizes that some acres may need to be enhanced to offset project impacts. Cities Service, during construction and operation, agrees to enhance other acres, using enhancement technology in effect at the time, so there is no net loss of in-kind habitat value.
	• Cities Service agrees to work closely with the USFWS and CDOW to determine appropriate buffer zones for sage grouse leks and federal and state-protected raptor nest sites. In addition, Cities Service will work with these agencies in making any needed further assessments to identify problem locations and any conflict resolution where needed.
	• Cities Service will coordinate construction to avoid critical nesting (sage grouse and raptor) and concentration (big game) periods.
	• Cities Service will not take any federal or state protected raptors or federal or state protected nests unless specifically permitted by USFWS and CDOW under regulations in place at the time.
	• At the time a final decision is made to move forward with the project, Cities Service, in consultation with CDOW and USFWS, will develop and implement an in-house monitoring program to monitor wildlife activities on its property.
	• Cities Service will install electrocution-proof transmission lines.

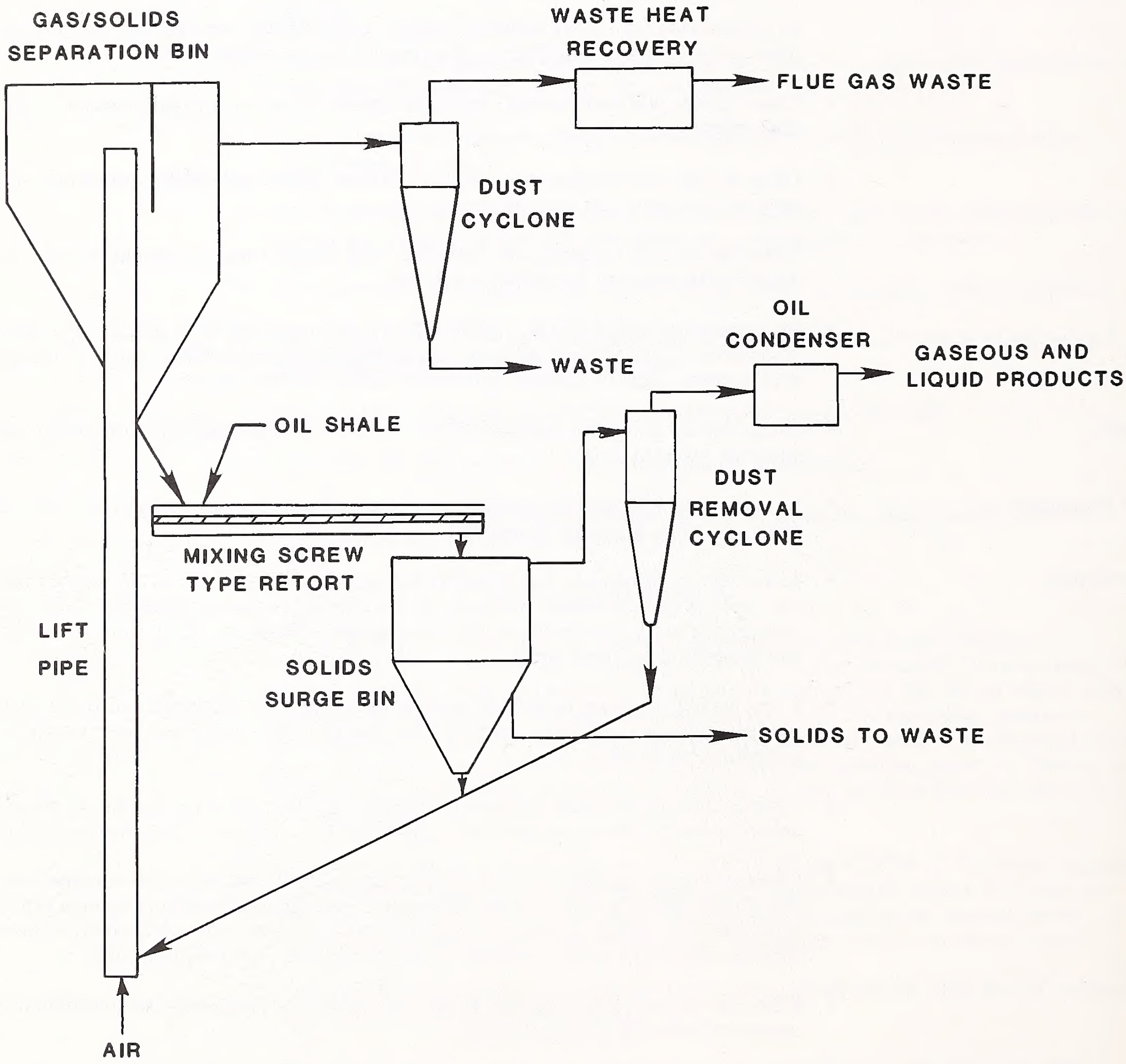
Table 2.3-52 LIST OF COMMITTED MITIGATION FOR THE CITIES SERVICE PROJECT[a] (continued)

Project Feature/Discipline	Mitigation Measure
Wildlife[b] (cont.)	• Cities Service agrees that fencing should be minimized and should not exclude wildlife except from hazardous areas.
	• Cities Service agrees to implement appropriate means to minimize big game road kills if kill frequencies exceed 10 per mile per year. This may include underpasses, one-way deer gates and fencing or other measures such as reflectors.
	• Cities Service agrees to reseed roadway shoulders and borrow ditches with unpalatable vegetation.
	• Cities Service will utilize reasonable methods to minimize wildlife access to the various project-related water retention reservoirs.
	• In conjunction with other shale developers, Cities Service will consider the possibility of mass transportation of workers at the time of project development.
	• Cities Service will enforce strict vehicular speeds on project-related property controlled by the company.
	• Cities Service will implement a company firearm policy and wildlife protection education program for use on its shale property.
	• Cities Service will revegetate all disturbed lands except roadway shoulders and borrow ditches with mixtures favorable to wildlife.
	• In cooperation with CDOW, USFWS, BLM, other appropriate agencies, and other oil shale companies, Cities Service will assist in the organization and development of regional wildlife management plans to address cumulative wildlife impact issues.
Air Quality	• Mitigation of air quality impacts will be achieved by implementation of control measures, as specified by regulations.
Cultural Resources	• Cities Service will conduct additional cultural resource surveys and will provide mitigation prior to surface disturbance activities.
Socioeconomics	• Cities Service recognizes that demands for increased human and social services will precede the onset of project-related revenues. At the time of project-development, Cities Service proposes to work cooperatively with government officials to seek means of providing front-end funds to meet these needs.
	• Cities Service proposes to provide local governments with technical assistance, as required, to identify impacts resulting from its shale venture and develop possible approaches to mitigate these impacts.
	• Cities Service proposes to encourage employees to locate in areas having the best capacity to absorb growth without overwhelming their infrastructure and public service facilities.
	• Cities Service recognizes that in order for housing and commercial development to precede new Cities Service's shale venture employees, local financial institutions may need some capital inflows. Cities Service proposes to work cooperatively with local government and financial sectors to assist in seeking means to provide such needed capital.
	• Cities Service will cooperate with local governments in monitoring socioeconomic factors associated with the proposed project.
	• Cities Service will maintain contact with appropriate local officials to provide them with updated employment estimates and scheduling information as necessary to meet mitigation objectives.

Table 2.3-52 LIST OF COMMITTED MITIGATION FOR THE CITIES SERVICE PROJECT[a] (continued)

Project Feature/Discipline	Mitigation Measure
Transportation	• At the time of project development, Cities, in cooperation with appropriate state and county agencies and other oil shale companies, will consider financial assistance to upgrade the Roan Valley Road from De Beque to county and state standards.

[a] Cities Service committed mitigation measures will be based on best available technology at the time of construction and will be implemented to the extent that they are technically and economically reasonable, feasible, and practical.
[b] See Appendix D for additional committed mitigation.



Source: Cities Service (1983b).

Figure 2.3-34 Lurgi-Ruhrgas Retort Process, Cities Service Shale Oil Project.

fluidized bed lift pipe which discharges to a collection bin. The flue gas from the combustor passes through a heat exchanger to preheat combustion air and to generate steam. A high-Btu gas byproduct is produced. Substantial quantities of flue gas dust must be collected and disposed of with the spent shale.

Some physical properties of Lurgi process retorted shale have been summarized by the U.S. Environmental Protection Agency (1983), as shown on Table 2.3-53. The Lurgi process retorted shale tested was a fine material with a maximum size of 3/8 inch and between 64 and 67 percent minus the No. 200 sieve size. It would be classified as a sandy silt (ML) in accordance with the Unified Soil Classification System. A specific gravity of 2.83 was reported.

Compaction permeability, triaxial, and unconfined shear strength test results for three levels of compactive effort were reported. A maximum dry density of 85.6 pcf at an optimum moisture content of 30.3 percent, coefficients of permeability of 0.002 and 0.003 ft/yr, an angle of internal friction of 34.5° and moist and saturated cohesions of 22.2 and 7.6 psi, respectively, were reported for retorted shale compacted with 6300 ft-lbs of energy per cubic foot of sample (½ ASTM D 698). Samples compacted to ASTM D 698 standards (12,375 ft-lbs) showed a maximum dry density and optimum moisture content of 88.2 pcf and 28.5 percent, respectively, coefficients of permeability of 0.003 and 0.005 ft/yr, a friction angle of 32° and moist and saturated cohesions of 33.3 and 13.9 psi. A maximum dry density of 96.8 pcf at an optimum moisture content of 23.2 percent, coefficients of permeability of 0.001 ft/yr, friction angle of 38.5° and moist and saturated cohesions of 41.0 and 27.8 psi, respectively, were reported for samples compacted at a high compactive energy (56,250 ft-lbs, ASTM D 1557). About 3 to 8 percent breakdown of particle sizes was experienced when the samples were compacted. About 6 to 11 percent particle size breakdown was reported when the samples were tested in triaxial shear.

The Lurgi process retorted shale exhibited cementitious properties when wetted and compacted. The degree of cementation can be measured by unconfined compressive strength tests. Unconfined compressive strengths of between 28.8 and 1222 psi were reported, depending upon the degree of compaction and the number of days the samples were cured.

The test results reported for the Lurgi process retorted shale are similar to those discussed by others (Gerhart and Holtz 1981) for high temperature retorted shales. Except for the strength properties, those properties are also within the range of physical properties typical of sand silt soils. The measured strengths of the retorted shale were considerably higher than would be expected for a "typical" silt soil, and are the result of cementitious processes that occur between particles when they are moistened. The degree of strength gain is likely dependent on several factors, including the quality and quantity of the water used, the degree to which the retorted shale is compacted and the time between wetting and compaction. The high strengths that result are due to the cementitious effects. The Lurgi process retorted shale exhibits properties that indicate that such materials could be designed and constructed into stable disposal piles.

Since Lurgi process retorted shale is a finer material than Union B process retorted shale, somewhat more settlement might be anticipated for a Lurgi process retorted shale disposal pile. However, the cementitious properties of the Lurgi process shale could result in less settlement as much of the pile could be bonded into a single mass. The physical properties reported for the Lurgi processed retorted shale are within the range of those reported for naturally occurring soils whose classifications are the same as the retorted shales. The strengths of the Lurgi process retorted shale could be higher than for similar natural soils due to its cementitious properties.

The thermal efficiency of the Union B process could be improved by utilizing the energy remaining in the spent shale. The Union Oil Company (UOC 1982a) is currently developing a process known as Unishale C that would use a spent shale combustor to gasify the residual coke and supply energy for process heating. Cities Service plans to monitor development of this technology and evaluate its use when available.

Unishale C technology has not yet been commercialized, however, certain test data have been published by Union (Duir et al. 1977). For Colorado oil shale having a Fischer Assay of 34 gal/ton, Union reports that products have the following energy distribution: oil - 75 percent, gas - 12 percent, carbonaceous material on spent shale - 13 percent. This compares well with the reported 13 percent increase in overall thermal efficiency when the

Table 2.3-53 PHYSICAL PROPERTIES OF LURGI RETORTED SHALE

		Gradation (%)					Compaction			Permeability ft/yr			Shear Strength: Triaxial Shear				Shear Strength: Unconfined	
Test Condition	Max. Part. Size (in.)	Clay[a]	Silt[b]	Sand[c]	Gravel[d]	Remarks	Spec. Grav.	% Opt. Moist.	Max. Dens. (pcf)	Load, 50 psi	Load, 100 psi	Load, 200 psi	Fric. Coef. Tan Ø	Intern. Angle of Fric.	Cohes. psi	Satur. Cohes. psi	Days Cured at 120 °F	Uncon-fined Comp. psi
As Received	3/8	17.1	47.8	33.4	1.7		2.83											
	3/8	15.3	46.4	36.6	1.7		2.84											
Compacted	--	16.2	48.2	35.6	0.0	Initial		30.3	85.6	0.002	0.003	--	0.69	34.5	22.2	7.6	0	28.8
1/2 D 698	--	17.6	44.2	38.2	0.0	After Compaction											0	33.1
(6,200 ft-lbs)	--	15.5	37.9	46.6	0.0	After Triaxial											7	590.7
		15.5	37.9	46.6	0.0	Shear Test											7	785.9
																	14	575.0
																	14	682.4
																	28	--
																	28	--
Compacted	--	16.2	48.2	35.6	0.0	Initial		28.5	88.2	0.003	0.005	--	0.62	32.0	33.3	13.9	0	38.5
D 698	--	18.8	44.2	37.0	0.0	After Compaction											0	42.5
(12,375 ft-lbs)	--	8.8	42.5	48.7	0.0	After Triaxial											7	874.5
						Shear Test											7	865.5
																	14	940.8
																	14	912.1
																	28	1,222.2
																	28	1,222.1
Compacted	--	16.2	48.2	35.6	0.0	Initial		23.2	96.8	0.001	0.001	--	0.80	38.5	41.0	27.8	0	378.5
D 1557	--	0.1	56.3	43.6	0.0	After Compaction											0	350.8
(56,250 ft-lbs)	--	12.8	45.9	41.3	0.0	After Triaxial											7	971.1
						Shear Test											7	1,182.6
																	14	986.5
																	14	1,081.0
																	28	--
																	28	--

Source: USEPA (1983).

[a] 0.005 mm
[b] −200 mesh to 0.005 mm
[c] 4 to 200 mesh
[d] +4 mesh

spent shale combustion step is added to the Union B process. Union reports that this combustion mode operation does not consume any of the net product oil or fuel gas, and produces energy to supply most of the plant power requirements. Product oil and gas compositions are unchanged.

Spent shale properties are different for the two operating modes. As shown on Table 2.3-54, these differences are primarily in organic carbon and mineral CO_2 content (CSM 1975). The Union B retorted shale contains about 4 percent of organic carbon. As a result of the relatively low (950-1000°F) retorting temperature, only a small fraction of carbonate minerals in the raw shale feed decomposes. In the case of the Unishale C shale, combustion of the spent shale is nearly complete and the carbonates are largely decomposed at the maximum temperature (1,500-1,600°F) of the combustor.

The Unishale C spent shale has a pH of 12.5 and is considerably more alkaline than the Union B spent shale which has a pH of 8.7. This higher pH is an indication of partial decomposition of carbonates into oxides which are hydrolyzed to form alkalis.

Physical properties of Union B and Unishale C spent shales have been measured relative to their potential for being successfully vegetated. Table 2.3-55 shows the results of these tests. Compared to Union B spent shale, decarbonized shale will likely require a reduction in alkalinity to enhance revegetation, require a greater amount of moistening, and will exhibit improved cementing properties. Due to its higher porosity from undergoing decomposition of most of its mineral carbonates, decarbonized shale has a compacted dry bulk of only about 70 pcf in contrast to about 90 pcf for Union B spent shale. Also, due to this porosity, held moisture of decarbonized shale should be considerably higher than 21-23 weight percent reported for compacted retorted shale. The 361 psi compressive strength reported for the decarbonized shale indicates that this material has a significant amount of natural cementing activity, which will be an important factor in its disposal.

Table 2.3-54 COMPOSITION OF UNION B AND UNISHALE C RETORTED SHALE

Component	Union B Retorted Shale (% by weight)	Unishale C Decarbonized Shale (% by weight)
SiO_2	31.5	39.2
CaO	19.6	27.3
MgO	5.7	8.2
Al_2O_3	6.9	8.9
Fe_2O_3	2.8	3.8
Na_2O	2.2	3.7
K_2O	1.6	2.7
SO_3	1.9	1.4
P_2O_5	0.4	0.5
Mineral CO_2	22.9	3.1
Organic C	4.3	0.3
Trace Elements	$<$ 0.15	0.9
Nitrogen	0.2	--
	100.0	100.0

Source: CSM (1975).

Power Source

Cities Service may install an on-site cogeneration plant as an alternative to ensure reliability of power supply. The capacity of the plant would be determined based upon critical loads, steam requirements, and the availability of fuel. The output of a cogeneration plant is electricity and process steam, and the ratio of the two products varies with plant design. The assumed fuel for cogeneration is low-Btu gas. It is estimated that a maximum of 1.8 mm scf per hour of natural gas may be required additionally to supplement the fuel balance.

Table 2.3-55 PROPERTIES OF UNION B AND UNISHALE C RETORTED SHALE AFFECTING REVEGETATION

	Union B		Unishale C	
	Initial Compaction	Compaction to 12,375 psf	Initial Compaction	Compaction to 12,375 psf
Particle Size (%):				
1-6 in.	--	--	--	--
4.8 mm - 1 in.	74	37	75	53
0.07 mm - 1 in.	16	39	16	14
0.005 mm - 0.07 mm	9	17	5	33
0.0-0.005 mm	1	7	4	
Soil Grouping[a]	GP-GM		GM	
Texture	Silty Gravel		Silty Gravel	
Color	Black		Buff	
Solid Density (g/cc)	2.59		2.69	
Dry Bulk Density (pcf)	61	90.4		68.5
Unconfined compressive strength after 28 days cure at 125°F		13		361
Field moisture, wt% of dry solids	16	21-23		

Source: Allred (1983).

[a] GP = Poorly graded gravel
GM = Gravel with appreciable amounts of fines
GP-GM = Combination of GP and GM

Railroad Transportation

A railroad may be used to transport workers to the Cities Service property in the Conn Creek valley. This rail transportation would be utilized by workers from De Beque to an unloading/parking area located east of the GCC Reservoir site near the access road. From the unloading/parking area, workers would be transported by buses to the main plant site area on the plateau. Materials, fuel, and supplies would be transported by truck from De Beque or their origin, to the property. Likewise, by-products would be transported by truck from the project site to their destination or a secondary transportation system. Table 2.3-56 summarizes the transportation requirements under the railroad alternative.

Table 2.3-56 TRANSPORTATION REQUIREMENTS, RAILROAD ALTERNATIVE CITIES SERVICE SHALE OIL PROJECT

Transportation Item	Number or Quantity	Mode	Required No. of Round Trips/Day[a]
Work Force	5,328 people[b,c]	Train (53 cars)	3
	3,368 people[c,d]	Train (34 cars)	3
Catalysts	2,000 tons/year (delivered and waste)	Truck	0.3
Explosives[e]	75 tons/day	Truck	7
Byproducts			
Ammonia	300 tons/day	Truck	12
Sulfur	200 tons/day	Truck	8
Diesel Fuel	17,000 gal/day	Truck	2
Chemicals, Solids, and Wastes	60 tons/day	Truck	3

Source: Cities Service (1983b).

[a] Train round trip from De Beque to the unloading/parking area is approximately 11 miles. Truck round trip from the unloading/parking area in Conn Creek canyon to the plant is approximately 9 miles. Railroad will only go as far as the confluence of Roan and Conn creeks. From this point, buses will transport workers. The approximate number of buses will be as indicated in Table 2.3-50.
[b] Peak construction (combined with operation) transportation requirements occur in the year 2004.
[c] Numbers based on Table 2.3-39, less 80% of administrative and management personnel who do not regularly commute to the project area.
[d] Peak operating transportation requirements occur in the year 2011.
[e] Explosive ingredients (dry ammonia nitrate) would be delivered to the plant site by truck. Final explosive preparation would be done on-site (i.e., mixing ammonia nitrate with fuel oil). Shipments to the site would not be an explosive hazard.

Product Pipeline Route

The Rangely product pipeline alternative occupies the same corridor as described in the CCSOP EIS (BLM 1983a). It would connect to an existing pipeline in Rangely, supplying crude oil to Salt Lake City refineries. However, the pipeline has insufficient capacity for 100,000 bpd, and excess refining capacity in Salt Lake City is also inadequate to handle an additional 100,000 bpd.

The North product pipeline and power corridor is also a desirable alternative. It would be the shortest distance from Cities Service property to the La Sal corridor, but would generate increased construction impacts compared to the proposed action since it crosses several drainages enroute to Parachute Creek. This corridor is also less desirable from the standpoint of the opportunity for joint usage with others, such as the Getty project.

Spent Shale Disposal Sites

Alternative spent shale disposal areas within Cities Service property boundaries include upper Cascade Canyon in conjunction with plateau property above this canyon, all within the Cascade Creek drainage area.

If the Lurgi retort is utilized, the resulting spent shale would be deposited in the same areas, utilizing the same methods as in the proposed action and alternatives described herein.

Water Supply System

Cities Service's proposed water supply system would be the GCC Joint Venture. An alternative would be the development of a water withdrawal system at the Larkin Ditch Diversion, just east of De Beque, which would pump water to the GCC Roan Creek reservoir for eventual use on the Conn Creek property. Cities Service has filed in Water Court for a Change Order to utilize the Larkin Ditch headgate as an alternate point of diversion. No other Water Court filings are felt to be necessary.

The Larkin Ditch is an existing, permitted structure which currently supplies water for agricultural purposes. The intake for the Larkin Ditch is located on the south bank of the Colorado River about 1,000 feet upstream of the De Beque highway bridge. The water in the ditch then flows generally in a southward direction.

Cities Service's alternate action is to install a low head pumping station at the point shown on Figure 2.3-19, which would remove water from the ditch and pump it to a sedimentation pond located on the south side of the river. The pump station and sedimentation pond would be designed to withstand a 100-year flood.

The water from the sedimentation pond would be pumped to storage via the GCC corridor. The pipeline from the sedimentation pond to the GCC corridor would be routed via the De Beque highway bridge, and then parallel to the railroad track on the north side of the river. Storage would be at the proposed GCC reservoir site.

Other alternative water supplies have been eliminated due to technical and economic reasons (see Table 2.2-1).

Fines Processing

Presently Cities Service's preferred option regarding fines is to store them in an environmentally acceptable manner, rather than attempting to process them. Processing of the fines for oil extraction is an alternative and would utilize the Lurgi technology.

2.3.2.3.2 Alternative Mitigation Measures. This section presents mitigation measures (Table 2.3-57) that may be considered in addition to those being proposed by Cities Service in Section 2.3.2.2. The mitigation measures presented in Table 2.3-57 would be applied to features of the proposed action or to the alternatives presented in this section.

2.3.2.4 Preferred Alternative - Cities Service

For regulatory permit actions, the Corps takes an impartial position whether to issue or deny a particular application until the public interest review is complete. At no time is the Corps a proponent of any action. It simply determines whether or not certain actions proposed by applicants are in the public interest and under what circumstances such proposals, if modified, would be in the public interest. The Corps' actual decision that is made by the final decision maker will be stated in the Record of Decision. This does not negate the requirement under 40 CFR 1505.2(b) for the district engineer to objectively state the *"environmentally preferred alternative"*.

2.3.2.5 No Action Alternative - Cities Service

Consideration of the No Action alternative is required in any EIS, in accordance with regulations issued by the Council on Environmental Quality (1978), and under provisions of the National Environmental Policy Act of 1969. Under the No Action alternative, the construction of the shale oil facility would not take place. No action would occur, due to (1) the denial of the 404 Permit by the Corps, or (2) a decision by Cities Service not to proceed with the project. The impacts of the No Action alternative for Cities Service are described and compared in Section 2.4.3.2.11.

Table 2.3-57 POTENTIAL ADDITIONAL MITIGATION MEASURES FOR THE CITIES SERVICE PROJECT

Project Feature/Discipline	Mitigation Measure
Topography/Geology/Paleontology	• Avoidance of paleontological resources and, if necessary, extraction and preservation of scientifically important fossils
Noise	• Proper equipment selection, design, and operation schedules
	• Increased noise absorbers or deflectors
Cultural Resources	• Conduct of cultural resources and paleontological surveys and appropriate mitigation measures on significant sites on private lands
Land Use, Recreation, and Wilderness	• Development of alternate rangeland areas and livestock drive trails
	• Operator would assist in development of land use planning and control
Transportation	• Shift scheduling
	• Mass transit systems
Energy	• Energy conservation measures

2.4 Comparison of Alternatives Including the Proposed Action(s)

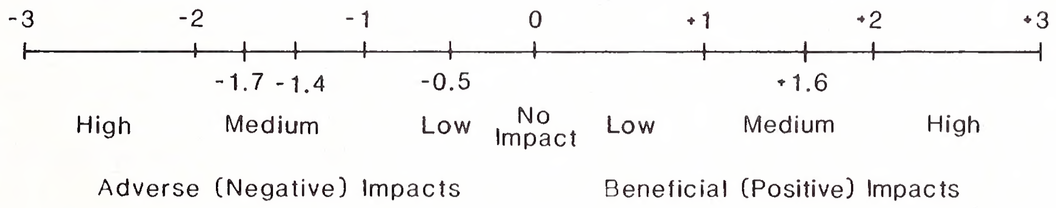
2.4.1 Introduction

The impacts of the proposed action(s) and alternatives for each of the Getty and Cities Service shale oil projects on specific segments of the environment (e.g., air, wildlife, ground water resources) are presented, compared, and contrasted in this section. These summaries and comparisons are derived from the detailed impact assessments in Section 4.0.

2.4.2 Methodology

Project alternatives were analyzed in consideration of their impacts to appropriate disciplines (i.e., specific segments of the environment). For example, an alternative oil shale retorting technology may not have wildlife impact differences, but usually will have varying air quality impacts. Conversely, an alternative corridor route usually has wildlife implications, but may show negligible impact differences concerning air quality.

Results of the impact assessments for each alternative on a discipline-specific basis were summarized and documented in project files on impact analysis matrix forms, and rated on a numerical scale of +3 to −3. Impact ratings are graduated to tenths, and were determined based upon the diagram shown below.



As an example, one pipeline corridor might rate −1.4 for wildlife, while another might compare at −1.7. Both would be considered to have medium adverse impacts, with one corridor rated slightly more adverse than the other.

It is important to note that these numerical impact ratings are subjective and based on best professional judgment. They are presented here to display the relative impacts between various alternative project components. The numbers presented in each table should not be construed as having any statistical significance.

Because of the complexity of the socioeconomic impacts, the numerical impact rating approach could not be used. Rather, socioeconomic impacts are presented in detail in tables of absolute numbers (e.g., population, employment, income) in Sections 4.2.13 and 4.3.13.

The wildlife impact ratings shown in the following sections were based on a worst case analysis of the effects of project components on key wildlife features. Getty's and Cities Service's committed mitigation plans will significantly reduce the effects of the proposed actions on wildlife. Specific mitigation measures are listed in Section 2.3.1.2.5 (Getty) and 2.3.2.2.5 (Cities Service). It is expected that acreage figures reflecting maximum loss or disturbance of habitat shown in the following sections and denoted with an asterisk (*) will be mitigated to an acceptable level.

2.4.3 Impact Comparisons

2.4.3.1 Getty

The proposed action for the Getty project for which impact assessment was undertaken includes the following major project components.

- **Underground room-and-pillar mine** (capacity of 150,000 tpd to produce 100,000 bpd of shale oil)
- **Twelve Union B retorts**
- **Four shale oil upgrading modules**
- **Mine bench with mine portals** at the 2 retort sites
- **Associated surface facilities**
- **Disposal of 130,000 tpd spent shale** from the Union B process, including co-disposal of shale fines, in Wiesse Gulch
- **A water supply system** consisting of the GCC Joint Venture (intake on Colorado River, storage reservoir in Roan Creek, and associated facilities), plus pumping plants, pipelines, and regulation reservoirs at the Roan Creek/Clear Creek confluence and in Tom Gulch, with a pipeline to the mesa plant site up Buck Gulch. (Note: The GCC Joint Venture Roan Creek reservoir is addressed in the CCSOP EIS - BLM 1983a.)
- **Purchased power** from off-site sources
- **Tom Gulch road corridor**
- **Buck Gulch water and power corridor**
- **Mesa-top multi-use corridors**
- **Common corridor (with Cities Service);** north from the additional retort site to the La Sal pipeline connection
- **La Sal power and syncrude corridor** (previously addressed in the CCSOP EIS - BLM 1983a)
- **Roan Creek/Clear Creek (Tom Gulch to De Beque) multi-use corridor** (previously addressed in the CCSOP EIS - BLM 1983a)

Alternatives to Getty's proposed action for which impact comparisons are made are as follows:

- Production rate
    - **50,000 bpd** (only one plant site to be developed)
- Retort technology
    - **Lurgi**
- Spent shale disposal sites
    - **Tom Gulch**
    - **Buck Gulch/Doe Gulch**
    - **Underground mine/Buck and Doe Gulch combination**

- Spent shale disposal type
  - **Lurgi**
- Shale fines
  - **Processing on-site**
- Corridors
  - **Rangely product pipeline** (addressed in the CCSOP EIS - BLM 1983a)
  - **Big Salt Wash transmission line** (addressed in the CCSOP EIS - BLM 1983a)
- Power generation
  - **Cogeneration** on-site
- Water supply
  - **West Fork Parachute Creek Reservoir,** pumping plant, and pipeline added to proposed action to provide supplementary water to additional retort site

Maps and detailed discussions of the above proposed action and alternative components are given in Section 2.3.1.

2.4.3.1.1 Production Rate. As noted above, one Getty alternative is to produce shale oil at the rate of 50,000 bpd. It is assumed that approximately 75,000 tpd of oil shale would be mined, with spent shale disposal at the rate of 65,000 tpd. Mine life would be approximately doubled (to 60 years) with total mining and disposal volumes approximately the same over a longer period.

Appropriate impact comparisons by discipline are shown in Table 2.4-1, with brief written explanations given below.

Topography. The proposed 100,000-bpd production rate would result in a greater adverse impact to topography than the alternative production rate of 50,000 bpd due to the construction of an additional retort and upgrading facility. The reduced production rate (50,000 bpd) would result in the reduction of the area to be disturbed.

Geology. No significant differences in the potential impacts to geological resources are expected as a result of the proposed or alternative actions. Both production rates and associated underground mines could result in the subsidence of the land surface, and both would utilize the same eventual volume of oil shale resource.

Paleontology. The 50,000-bpd alternative would reduce the proportion of the project area to be disturbed. This reduction in the proportion of disturbed area would result in reduced potential impacts to paleontological resources in the project area.

Surface Water. Compared to the 100,000-bpd production rate, production at 50,000 bpd would produce smaller amounts of spent shale on a daily basis. Surface water disturbances over the short-term would, therefore, be less for 50,000 bpd than the proposed action due to the reduction in the spent shale. Therefore, the 50,000-bpd production rate would have less adverse impacts on the surface water system.

Ground Water. Impacts to ground water would include potential dewatering of bedrock aquifers and discharge of mine inflows to the hydrologic system. Neither of these impacts are anticipated to be significant due to the fact that large mine inflows are not expected; data suggest that the mining interval may not be connected to overlying water-bearing strata. Prudent operation of a discharge handling system should mitigate potential impacts associated with encountered inflows. Impacts associated with the 50,000-bpd alternative would be similar, but on a reduced scale.

Table 2.4-1 IMPACT COMPARISONS FOR PRODUCTION RATE ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	100,000 bpd (Proposed Action)	50,000 bpd (Alternative)
Topography	−0.3	−0.1
Geology	−0.3	−0.3
Paleontology	−0.3	−0.1
Surface Water	−1.0	−0.5
Ground Water	−0.8	−0.4
Soils	−1.3	−1.2
Aquatic Ecology	−0.1	−0.1
Vegetation	−2.2	−2.0
Wildlife	−1.6[b]	−1.5[b]
Air Quality	−2.0	−1.2
Noise	−0.6	−0.5
Cultural Resources	−0.5	−0.3
Land Use	−1.2	−1.0
Recreation	−1.0	−0.7
Wilderness	−1.0	−0.8
Visual Resources	−1.2	−1.0
Socioeconomics[c]	--	--
Transportation	−1.7	−1.1
Energy	+2.0	+1.7

[a] Only pertinent disciplines for impact assessment are shown.
[b] See Section 2.4.2.
[c] Socioeconomic impacts are not rated numerically. See the socioeconomics noted in Methodology, Section 2.4.2.

Soils. The moderate adverse soils impacts resulting from the 100,000-bpd production rate are slightly greater than the 50,000-bpd rate. This is largely a result of the surface disturbance for the proposed action being larger than the alternative: 6,333 versus 6,097 acres (assuming the additional retorts and mine portals are the only difference). Incremental soil losses (the difference in soil loss between undisturbed and disturbed land conditions over a 30-year project life) for the 100,000- and 50,000-bpd production rates would be 234,040 tons and 223,490 tons, respectively. Prime farmland loss for both production rates would be the same (1,324 acres). Incremental soil loss would be 49 and 48 percent greater than naturally occurring soil in the proposed action and alternative, respectively.

Aquatic Ecology. The development of the Getty project and production at 100,000 bpd would have a slight negative impact on aquatic ecology. (The impact rating does not include impacts previously addressed in the CCSOP EIS, including development of the GCC Joint Venture Roan Creek reservoir and water withdrawal from the Colorado River.) There would be a loss of intermittent stream reaches due to physical covering, a risk of introduction of toxic substances to the surface water from the shale stockpile and accidental spillage along the corridors, and possible pipeline breakages. The proposed reservoirs, however, would offset some of these negative impacts by providing a net increase in aquatic habitat. The ratings for the 100,000-bpd and 50,000-bpd alternatives are based on the same water withdrawal and storage facilities. All other facility sitings are the same regardless of production rate. Therefore, there would be no difference between the proposed and alternative production rates.

Vegetation. The 100,000-bpd project would have slightly higher adverse impacts (both are high adverse) on vegetation than the 50,000-bpd alternative. This is due primarily to increased acreages that would be affected by the additional retort facilities and larger spent shale pile necessary for the 100,000-bpd alternative. Indirect impacts to vegetation resulting from increased urbanization would be similar among alternatives. Impacts on special interest plants (threatened or candidate plant species) would be similar for both production alternatives. These impacts would result from direct disturbance to known plant populations or their habitat. These disturbance areas would occur on private land owned by the Operator.

Wildlife. The types of wildlife impacts associated with each of the production rate alternatives are expected to be similar (i.e., there would be loss or disturbance of wildlife habitats and individuals in the affected areas). However, in comparison with the proposed action, approximately 230(*) fewer acres of habitats on the plateau would be affected under the 50,000 bpd alternative. This difference in acreage is attributed to the elimination of the additional retort site. No difference in anticipated impacts to sensitive wildlife habitats is expected. The medium adverse indirect impacts of the production alternatives to wildlife are also expected to be similar. See Section 2.4.2.

Air Quality/Meteorology. See the discussion of the various alternatives under Retort Technology, Section 2.4.3.1.2.

Noise. The variation between Getty's production rate alternatives regarding noise levels would be minimal. The full production alternatives would have the most adverse impacts, but these are only slightly higher than the reduced production alternatives. Transportation alternatives noise impacts would vary insignificantly between production alternatives.

Cultural Resources. Potential impacts on cultural resources (given the existing federal and state cultural resource regulations) would be insignificant. Surface disturbances related to the construction of the 100,000-bpd action would be relatively greater (in a low adverse context) than the 50,000 bpd alternative. Areas previously unsurveyed will be subject to study. Actual determination of impacts and mitigation measures will be developed according to agency requirements.

Land Use. Construction and operation of the mine, retorts, and ancillary facilities would significantly impact existing land uses on the site and have secondary effects on land uses off-site. Lands which are now utilized as agricultural land or rangeland would become predominately industrial, commercial, and residential. Direct impacts are slightly higher (relatively) in an adverse sense for the 100,000-bpd alternative than for the 50,000-bpd alternative due to slightly more total disturbance to rangeland for the proposed action. Implementation of the Getty project would result in the potential use of approximately 2,600 acres of public land. Of this total, approximately 500 acres (21 percent) would be affected by the construction of transportation, transmission line, and pipeline corridors, and the GCC reservoir (see Table 2.3-2). Impacts to the public Lands are the same for both production rate alternatives.

Recreation. Indirect and adverse impacts to recreational facilities and opportunities in the region could occur due to an increase in human population during the construction phase of the project. Slightly beneficial impacts could be expected during the operational and residual phases, because new recreational facilities would be built during construction, providing more facilities during operation and post-operation phases for the reduced number of workers.

Wilderness. Low adverse impacts to wilderness could occur due to increased demand for wilderness use. Impacts could be relatively higher (yet still low adverse) during the construction phase of the 100,000-bpd project, when more workers would be involved.

Visual Resources. Due to the reduced size of facilities required for a 50,000-bpd alternative, a 50,000-bpd alternative would have less visual impacts than a 100,000-bpd alternative. However, since a 50,000-bpd alternative would require many of the same types of surface facilities and corridors, overall impacts for both alternatives would remain low to medium adverse.

Socioeconomics. The 100,000-bpd production rate has two distinct 5-year construction cycles, peaking at 5,000 construction workers in 1991 and again in 1995. Once the second cycle is complete, long-term operations employment stabilizes at 2,900. The 50,000-bpd alternative would duplicate the first construction cycle described above, but operations employment would then stabilize at 1,600 workers and there would be no further construction. Thus, the peak impact of the two production scenarios which occur during construction are very similar, except that they are repeated in the 100,000-bpd scenario. In the long-term, however, because most of the socioeconomic impacts are proportioned to employment, the impacts of a 50,000-bpd production level would only be about one-half the impact of the 100,000-bpd scenario. See the detailed impact analysis in Section 4.2.13, and the note on socioeconomic impact comparisons in Methodology, Section 2.4.2.

Transportation. Transportation impacts throughout the construction, operations, and residual phases would be greater for the 100,000-bpd production rate than for the 50,000-bpd alternative, due to the greater need for worker, material, and product transport. At the 100,000-bpd production rate, greatest adverse impacts would occur to the roadway systems. Depending on the timing of the proposed project's construction, traffic slowdowns could occur on roadways within the area. Airports and railroads could experience minor adverse impacts from the 50,000- and 100,000-bpd production rates. Overall pipeline capacity would be increased under both alternatives, thereby creating a low beneficial impact following project shutdown.

Energy. Energy use during construction would constitute a low adverse impact. During project operation, however, a moderate net beneficial impact would result due to the production of shale oil. The 100,000-bpd production rate would, on the basis of output/input ratio, have a slightly greater beneficial impact.

2.4.3.1.2 Retort Technology. This alternative would employ the Lurgi technology (as previously described in Section 2.3.1) instead of the Union B retorts for surface retorting of the oil shale at 100,000 bpd. Appropriate impact comparisons by discipline are shown in Table 2.4-2, with brief written explanations given below.

Surface Water. The alternative Lurgi retort would process finer raw shale and, therefore, generate smaller particle size spent shale material compared to the proposed Union retort technology. Surface water impacts would be relatively greater using Lurgi retort due to (1) higher water consumption for spent shale moistening, and (2) more sour water generation.

Ground Water. Impacts could occur to ground water from the production of retort wastewater and spent shale. Disposal of these by-products could result in the generation of leachate containing organic and inorganic components. Additionally, the Union B process cannot process raw shale fines, necessitating their disposal with the retort by-products (spent shale). Utilization of the Lurgi retorts would allow processing of the fines, negating disposal-related impacts. However, design and installation of the drainage system is necessary to restrict runoff waters from contacting/saturating any temporary storage piles for the Lurgi technology.

Air Quality. The full production Lurgi alternative is predicted to have the highest (relative adverse) impact rating for air quality due to TSP and NO_2. Impacts, when added to background, are estimated at 79 percent and 76 percent of the national standard and present a potential for visibility impairment in the Flat Tops on seven days during the visitor season. The 50,000-bpd Lurgi alternative has less impact than the full production alternative because the TSP impacts are predicted to be 66 percent of the 24-hr TSP national ambient standard. This alternative consumes the TSP 24-hr Class II increment by more than one and one-half times. Also, the Level 2 visibility screening analysis indicates seven potential days of significant visibility impact in the Flat Tops Wilderness for the reduced Lurgi alternative. The proposed action is slightly less adverse, because the highest air quality impact when added to background predicted is 73 percent of the NO_2 standard. Also, the 24-hr SO_2 PSD Class I increment in the Flat Tops Wilderness is predicted to be 80 percent consumed. Modeling indicates that the proposed action is predicted to consume the allowable PSD Class II increment for 24-hr TSP by 1 $\mu g/m^3$ in a small area near the property line. The impact rating for the 50,000-bpd Union B alternative is most favorable of the process technology alternatives. Predicted TSP annual 24-hr concentrations are only 37 percent of the national ambient standard.

Noise. The variation between Getty process technologies concerning noise impacts would be minimal. Transportation alternative noise impacts would also vary insignificantly between process technologies.

Energy. The energy impacts of the proposed Union B and alternative Lurgi surface retort technologies would be moderately beneficial. The processing of the oil shale would require consumption of energy, but the shale oil produced would more than offset the energy consumption. There is a difference in energy efficiencies between the Union B and Lurgi retorting technologies. The Lurgi technology utilizes raw shale fines and the carbon on the spent shale is burned to produce energy. Therefore, the Lurgi technology is rated as being more beneficial to the overall energy balance.

Table 2.4-2 IMPACT COMPARISONS FOR RETORT TECHNOLOGY ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	Union B (Proposed Action)	Lurgi (Alternative)
Surface Water	−0.3	−0.5
Ground Water	−0.8	−0.6
Air Quality	−2.0 (−1.2)[b]	−2.5 (−2.2)[b]
Noise	−0.6 (−0.5)[b]	−0.6 (−0.5)[b]
Energy	+1.2	+1.4

[a] Only pertinent disciplines for impact assessment are shown.
[b] Ratings in parentheses refer to the 50,000 bpd alternative.

2.4.3.1.3 Spent Shale Disposal Sites. As alternatives to the Wiesse Gulch disposal site (proposed action), Getty would dispose of spent shale in either (1) Tom, Buck, and Doe gulches, or (2) underground in the mine and in Buck/Doe gulches. The underground disposal is an alternative because less material could be disposed underground, future resource recovery is precluded, materials handling is increased, and environmental and engineering difficulties exist. However, it is evaluated as an alternative rather than as the proposed action for EIS purposes below. Use of Tom Gulch would not allow for a regulation reservoir there, as shown for the proposed action under water supply for Getty (see Section 2.4.3.1.6). Impact comparisons for the spent shale sites (proposed action and alternatives) are described below and presented in Table 2.4-3.

Table 2.4-3 IMPACT COMPARISONS FOR SPENT SHALE DISPOSAL SITE ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	Wiesse Gulch (Proposed Action)	Tom/ Buck/Doe Gulches (Alternative)	Underground/ Buck-Doe Combination (Alternative)
Topography	−0.5	−0.8	−0.3
Geology	−0.3	−0.5	−0.1
Paleontology	−0.2	−0.2	−0.1
Surface Water	−1.0	−1.7	−0.7
Ground Water	−1.5	−2.0	−1.0
Aquatic Ecology	−0.3	−0.3	−0.2
Soils	−0.1	−0.3	−0.3
Vegetation	−1.5	−1.3	−1.3
Wildlife	−1.0[b]	−2.5[b]	−2.5[b]
Air Quality	−1.5	−0.9	−0.9
Noise	−0.3	−0.4	−0.3
Cultural Resources	−0.5	−0.2	−0.3
Land Use	−1.0	−1.0	−0.5
Visual Resources	−1.1	−1.5	−1.0
Transportation	−0.1	−0.2	−0.1
Energy	−0.2	−0.3	−0.4

[a] Only pertinent disciplines for impact assessment are shown.
[b] See Section 2.4.2.

Topography. The proposed action of placing spent shale in Wiesse Gulch (located on the plateau), would have relatively less adverse impacts on topography than the alternative site in Tom, Buck, and Doe gulches. The alternative with the least topographic impacts would be the combined disposal of spent shale underground and in Buck/Doe gulches, since it would decrease the volume of material to be placed on the surface.

Geology. The principal impact on geological resources as a result of the disposal of spent shale on the surface is the potential for geologic hazards. The disposal of spent shale at the surface could result in its exposure to weathering and erosional processes. Proper construction, maintenance, and reclamation would be required to limit the instability of the piles. Disposal in flatter areas (e.g., Wiesse Gulch) would have fewer adverse impacts (all are low adverse) than steep slopes.

Paleontology. The disposal of spent shale on the surface could bury potential paleontological resources and limit access to collection sites. The combined surface/underground mine disposal of spent shale would have the least impact to paleontological resources, since the potential for sites to be buried would be slightly less due to reduced volumes.

Surface Water. The alternative spent shale disposal site in Tom, Buck, and Doe gulches would have the greatest relative surface water impacts (medium adverse) compared to surface/underground mine combination and proposed action (Wiesse Gulch) disposal due to the proximity of Buck and Doe gulches to the Clear Creek drainage. Disposal of approximately one-half of the spent shale in the underground mine would have the least relative impacts due to reduction of surface area disturbance.

Ground Water. Impacts of spent shale disposal could be the most critical effects to ground water from the proposed development. Most important is the potential degradation of ground water resources due to leachate migration. The magnitude of such potential impacts is dependent upon the effectiveness of spent shale disposal pile design and construction, and the proximity of the disposal area to important sources of ground water. The proposed Wiesse Gulch site provides the best (i.e., topographically, the flattest) site for liner construction and is also the furthest from alluvial aquifers. The Tom, Buck, and Doe gulch areas, however, are typified by steep valley sides which would create difficult liner construction conditions, and are situated adjacent to the Clear Creek alluvial aquifer. As such, they pose a higher relative potential for ground water contamination. The combined underground/surface disposal would potentially result in the fewest ground water impacts because underground dipsosal presents the least opportunity for leachate migration to either alluvial or bedrock aquifers.

Aquatic Ecology. The proposed and alternative spent shale disposal sites would be located in intermittent tributaries of Clear Creek. The construction and operational impacts would be low adverse for all actions. The potential impacts include elimination of intermittent drainages, increased sedimentation in Clear Creek, and addition of toxic substances to Clear Creek via spent shale leachates. The surface/underground mine combination, which would have less surface disposal volume, would involve slightly less adverse impacts.

Soils. All three spent shale disposal scenarios would have low adverse impacts. The proposed action (Wiesse Gulch) is estimated to have the least, and Tom/Buck/Doe gulches and underground/Buck-Doe gulch combination the greatest relative impacts. There would be no prime farmland losses in any localities and calculated incremental soil losses are (−) 1,210, 45,540; and 29,470 for Wiesse Gulch, Tom/Buck/Doe gulches, and underground/Buck-Doe gulches, respectively. Assuming reclamation goals would be achieved, these range from a 1 percent decrease to a 139 percent increase over naturally occurring soil loss for the least adverse and most adverse scenarios, respectively. These impact ratings do not reflect the eventual soil erosion rates which would occur when topsoil is eroded away, which could be 5 to 10 times the disturbed erosion rates shown previously. See Table 4.2-1 in Section 4.2.5 of the DEIS.

Vegetation. All alternative spent shale disposal sites would have medium adverse impacts on vegetation. In terms of affected acreage, disposal of spent shale in Wiesse Gulch would have the greatest adverse impact on vegetation. However, Wiesse Gulch disposal would affect fewer plant populations of special interest than disposal in Tom Creek canyon, Buck Gulch, and Doe Gulch.

Wildlife. Of the disposal alternatives considered, the Wiesse Creek Gulch disposal area would have the lowest adverse impact to wildlife. The disposal of spent shale in Tom or Buck/Doe gulches would have high adverse impacts because of the expected loss of not only elk winter range, winter concentration area, and critical habitat, but also observed nest sites for Cooper's hawk in Buck/Doe gulches, and for buteos and golden eagles in the Tom Creek canyon. The impacts of combined surface/underground mine disposal are expected to be similar in nature, but reduced in extent (Tom Gulch would not be affected) compared with impacts which could occur under the Tom and Buck/Doe gulch disposal alternatives. Because of the types of wildlife features affected by the Tom and Buck/Doe gulch alternatives and the combination underground mine/surface disposal alternative, these alternatives were considered to have equally high adverse impacts to wildlife. See Section 2.4.2.

Air Quality. Impact analyses for spent shale alternatives involved previous modeling and professional judgment. The air quality impact differences among the alternatives are minor compared to the maximum concentrations from the retorting and upgrading processes. Wiesse Gulch rates higher relative (medium) adverse impacts than the alternative disposal sites.

Noise. Daily minor changes to the acoustic environment would result from the spent shale alternatives for the Getty project. Use of Doe or Buck Gulch, however, could result in elevated noise levels at sensitive receptors in the Clear Creek canyon.

Cultural Resources. Potential impacts on cultural resources (given the existing federal and state cultural resource regulations) would be insignificant. Given the areal extent and diverse topography of the Wiesse Creek gulch area, there is a relatively higher potential to impact cultural resources here than with any of the alternative areas. The underground alternative would certainly lessen the potential for impacts in the Wiesse Creek area, while the Tom gulch alternative and Buck/Doe alternatives are rated as having even less potential for impact due to the presence of steep-walled canyons. Areas previously unsurveyed will be subject to study. Actual determination of impacts and mitigation measures will be developed according to agency requirements.

Land Use. Low to medium adverse impacts to land use would occur from construction of all spent shale disposal alternatives. Rangeland would be lost as a result of all alternatives. The Wiesse Gulch spent shale pile would affect the greatest amount of rangeland among all alternatives. The Tom Gulch canyon disposal site would be the only alternative to affect agricultural land. No public lands would be affected.

Visual Resources. Disposal of spent shale in Wiesse Creek gulch would have less relative adverse impacts than disposal in either Tom Gulch or Buck/Doe gulches. The Wiesse Creek site is on the plateau and in an area of moderate scenic quality. Disposal of spent shale in either of the gulches would impact areas of high scenic quality. Return of some spent shale to the underground mine would reduce overall visual impacts compared to all surface disposal. Since some disposal would be required on the surface, adverse impacts would remain for all alternatives until final reclamation.

Transportation. Spent shale disposal at any of the alternative sites would have minimal impacts to the transportation system, since conveyors and/or haul roads would be used. A very low adverse impact was assessed for spent shale disposal since some ancillary transportation (e.g., materials or equipment) could be needed to support the shale disposal process.

Energy. Disposal of spent shale in either the Wiesse Creek (proposed action) or alternate shale disposal sites would result in minimal energy consumption because of the proximity of the retorts. Use of underground disposal (in conjunction with surface disposal) may result in slightly higher relative adverse impacts, due to the dual nature of the disposal areas.

2.4.3.1.4 Spent Shale Disposal Types. Some impact differences would also occur as a result of the type of spent shale disposed — whether it be from the Union B or Lurgi retort technology. Each has some different characteristics, as explained below by pertinent discipline and shown in Table 2.4-4. It is assumed that the spent shale types are disposed in identical sites.

Table 2.4-4 IMPACT COMPARISONS FOR SPENT SHALE DISPOSAL TYPE ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	Union B Retorted Spent Shale (Proposed Action)	Lurgi Retorted Spent Shale (Alternative)
Geology	−1.5	−1.0
Surface Water	−0.3	−0.5
Ground Water	−1.8	−1.5
Soils	NA[b]	NA[b]
Air Quality	−1.5	−1.4

[a] Only pertinent disciplines for impact comparisons are shown.
[b] See soils note in text for justification of non-applicability.

Geology. The type of spent shale produced by the proposed (Union B) and alternative (Lurgi) retort could impact existing site geology as a geologic hazard. The spent shale particles produced by Lurgi retorting are known to cement together more easily when compared to the spent shale produced by the Union B retorts. The increased potential for cementation of the Lurgi-produced particles should increase the stability of the spent shale fines and reduce erosion of the pile by sheet wash.

Surface Water. The alternative Lurgi retort process would generate smaller particle size spent shale material, compared to the Union B retort technology. Surface water impacts would be relatively greater using Lurgi, due to (1) higher water consumption for spent shale moistening, and (2) more sour water generation.

Ground Water. Disposal of spent shale generated by the Lurgi process could result in less ground water impacts than would be associated with Union B retorts. Reduced impacts could occur if the disposal pile were to become cemented or solidified upon application of moisture as existing data indicate (Bates 1983). This phenomenon could be enhanced due to the fine particle size of retorted shale associated with the Lurgi process when compared to the Union B process. If additional structural stability is achieved by this cementing, the potential for erosion and concomitant leachate generation would be reduced.

Soils. The impacts resulting from disposal of either type of spent shale are the same because the type of spent shale deposited would not affect the soil resource. The impacts result from the spent shale disposal sites rather than from the type of spent shale deposited. If water erosion occurs from the spent shale pile prior to overburden and topsoil replacement, spent shale would be lost, not soil. It is expected that the sedimentation basin would capture this eroded spent shale. Upon completing overburden and topsoil replacement activities on the spent shale piles, water and wind erosion would undoubtedly occur. Whether the pile is Lurgi or Union B spent shale beneath the topsoil would not affect the topsoil erosion rate.

Air Quality. The air quality impacts were analyzed with different process stack emission rates but no differences in spent shale disposal emission rates between Union B and Lurgi retorting alternatives. However, the spent shale emission for Lurgi would be less due to the propensity of this Lurgi material to solidify. Both spent shale alternatives rate a medium adverse impact.

2.4.3.1.5 Shale Fines. The oil shale fines (pieces less than 1/8 inch in diameter after crushing) could be disposed of with the spent shale (proposed action) or, as an alternative, stockpiled and processed on-site for additional shale oil extraction. The impacts of these two options are compared below and in Table 2.4-5 for appropriate disciplines.

Table 2.4-5 IMPACT COMPARISONS FOR SHALE FINES ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	On-site Disposal with Spent Shale (Proposed Action)	Processed On-site (Alternative)
Surface Water	−0.5	−1.0
Ground Water	−0.8	−0.7
Air Quality	−1.5	−1.6
Visual Resources	−0.9	−0.7
Energy	−0.3	+0.3

[a] Only pertinent disciplines for impact comparisons are shown.

Surface Water. Low to medium adverse impacts to surface water would be associated with each alternative. On-site disposal could cause surface runoff and erosion from the stockpile, and migration of leachate to surface drainages. Retorting on-site would have slightly higher relative adverse impacts since some stockpiling is assumed and processed shale fines could contain residues of reagents from retorting which could contaminate surface water.

Ground Water. Low adverse ground water impacts are anticipated from either scheme for raw shale fines. The proposed disposal of fines with the spent shale would allow for longer term exposure to drainage waters, whereas processing in the alternative Lurgi retort, with continual accumulation/removal, would decrease this exposure time. Conversely, disposal with the spent shale would allow for timely reclamation by revegetation, thereby decreasing the opportunity for infiltration of precipitation. In either case, design and operation of proper handling and drainage control plans can reduce any hydrologic impacts.

Air Quality. Shale fines processing as opposed to disposal with the spent shale would probably have similar TSP impacts. Air quality impacts would be slightly increased by screening, crushing, and processing of the fines.

Visual Resources. Disposal of shale fines would have an adverse visual impact until processing and/or reclamation of the spent shale/shale fines area. Processing without storage would eliminate the storage area impact; an additional impact would occur, however, due to the need for additional process facilities.

Energy. Disposal of shale fines on-site (proposed action) would result in low adverse impacts because of the energy consumed in the transport of shale fines and the energy lost by non-recovery of the shale oil within these fines. Conversely, the alternative of retorting these fines would have a net low beneficial impact, due to the recovery of the additional shale oil.

2.4.3.1.6 Corridors. Alternatives to the La Sal corridor (proposed action) for product pipelines and transmission lines include (1) Rangely and (2) Big Salt Wash. All three alignments and their impacts have been previously addressed in the CCSOP EIS (BLM 1983a). Rangely B and Big Salt Wash (Echo Lake) are assumed for purposes here, and the numerical impact analyses from the CCSOP EIS are reprinted in Table 2.4-6. Summaries of the CCSOP EIS impact comparison discussions are presented below. The Roan Creek multi-use corridor was previously addressed in detail in the CCSOP EIS and is not reassessed here, but is briefly recalled in the text.

Topography. The potential impacts to topography by the proposed action (La Sal) and the alternatives (Rangely and Big Salt Wash) are not significantly different. All are rated low average surficial disturbances caused by construction of the pipeline and could be reduced with proper reclamation.

Table 2.4-6 IMPACT COMPARISONS FOR CORRIDOR ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	La Sal[b,c] (Proposed Action)	Rangely B[b] (Alternative)	Big Salt Wash[b] (Alternative)
Topography	−0.5	−0.5	−0.5
Geology	−0.2	−0.2	−0.8
Paleontology	−0.5	−1.1	−1.0
Surface Water	−0.8	−1.1	−1.5
Ground Water	−0.5	−0.5	−0.6
Aquatic Ecology	−0.8	−1.1	−1.2
Soils	−0.4	−0.7	−1.4
Vegetation	−0.8	−1.1	−1.0
Wildlife	−0.8	−1.0	−1.5
Cultural Resources	−0.2	−0.5	−0.3
Land Use	−0.3	−1.1	−0.2
Recreation	+1.0	+1.0	+1.2
Visual Resources	−0.5	−0.7	−0.7
Transportation	+0.8	+0.9	+0.6
Energy	−0.5	−0.6	−0.6

[a] Only pertinent disciplines for impact assessment are shown.
[b] Source of impact ratings is CCSOP EIS (BLM 1983a), except for land use.
[c] As discussed in the CCSOP EIS (BLM 1983a), the La Sal corridor assumes a loop system up Roan Creek to the Getty property east to Davis Point (La Sal connection), down Parachute Creek to Parachute, and down to the Colorado River to complete the loop at De Beque. The east and south portions of the loop have been assessed in other reports, and would potentially be used by multiple projects.

Geology. No significant impacts are anticipated for any of the alternatives. Longer alignments (Big Salt Wash) and their stream crossings, with potential impacts on sand and gravel resources, would have slightly higher relative adverse impacts. Both La Sal and Rangley B are rated very low adverse impacts to geology.

Paleontology. Excavations associated with the construction of the pipeline could destroy potential paleontological resources. There are some differences in the magnitude of potential impacts between the proposed and alternative actions with the differences dependent on alignment (potential resource areas crossed) and length. Rangley B and Big Salt are rated medium adverse with this sense, while La Sal rates the least (low adverse) impacts. Impacts to paleontological resources could be reduced as a result of the development and implementation of a mitigation program.

Surface Water. The alternative Rangely B and Big Salt Wash corridors would have slightly higher (medium adverse) relative surface water impacts compared to the proposed La Sal pipeline corridor. Impacts for the Rangely corridor would occur on the White River system, while the proposed La Sal corridor would have impacts on Roan Creek and Parachute Creek drainage systems. Big Salt Wash (in that drainage primarily) would have slighty higher relative adverse impacts (of medium magnitude) because of length and drainages crossed.

Ground Water. Impacts to ground water resulting from any of the alternative corridor construction activities are expected to be minor and limited to potential localized and temporary increases in dissolved solids associated with construction activities. Accidental spills of fuel or other contaminants may also occur during the construction phase. Adverse ground water impacts would be only slightly greater for the Big Salt Wash corridor than for the others, given the length of the former.

Aquatic Ecology. Potential impacts to aquatic ecology would be related to sedimentation during construction and water quality changes resulting from pipeline breaks or leaks. Impacts for all routes were considered low to medium adverse as directly related to pipeline length and proximity to surface waters. The Big Salt Wash corridor would have the highest (medium adverse) relative impacts of the corridors from the Getty site. Rangely B and La Sal would have slightly less adverse impacts, in descending order.

Soils. It is expected that medium adverse soils impacts would occur due to development of the Big Salt Wash alternative, and lower relative impacts would occur in the other two corridors. Because the disturbance area of the Big Salt Wash corridor is the largest, the soil loss is expected to be the greatest; about 78,000 tons versus 10,700 and 11,500 tons in the Rangely and La Sal corridors, respectively. Furthermore, the Big Salt Wash corridor would cause a loss of prime farmland (approximately 20 acres) while use of the others would not.

Vegetation. Construction of corridors would generally result in low to medium adverse impacts to vegetation and special interest plant species. Impacts to vegetation would depend on the length, revegetation potential affected agricultural productivity and unavoidable impacts to special interest plants. Using these criteria, La Sal is rated low adverse and Rangley B and Big Salt Wash are rated medium adverse.

Wildlife. Wildlife would be affected by both short- and long-term impacts to habitats associated with construction and operation of the corridors. The degree of impact would be directly related to the length of the corridor. The La Sal pipeline would have the lowest relative impact to wildlife and the Big Salt Wash the highest. In general, the three pipeline corridors would have low to medium adverse wildlife impacts (BLM 1983a).

Cultural Resources. Potential impacts of corridors on cultural resources (given the existing federal and state cultural resources regulations) would be insignificant. La Sal and Big Salt Wash alternatives especially are considered to have an insignificant impact on cultural resources. Rangely B is rated slightly higher adverse impacts, due to greater potential for inadvertent disturbance. Areas previously unsurveyed will be subject to study. Actual determination of impacts and mitigation measures will be developed according to agency requirements.

Land Use. Low adverse effects on land use can be expected from construction of the alternative corridors, except Rangely B. A small amount of rangeland would be lost for all alignments except for Rangely B, which would affect greater amounts of rangeland and some agricultural land along its alignment and is rated low to medium adverse. Land use impacts for the alternative corridors have been addressed in the CCSOP (BLM 1983), in Section 4.11.4.

Recreation. Beneficial impacts on recreation would probably occur due to development of corridors. Lands which are currently unavailable for recreational use would be opened for possible off-road vehicle use and hunting. Access would probably be controlled during the life of the project, so such recreational use would most likely follow project abandonment. Because of its length and location in lands, which are currently somewhat inaccessible, Big Salt Wash is rated slightly higher (medium beneficial) impacts.

Visual Resources. Use of either the Big Salt Wash or Rangely B corridor instead of La Sal would have relatively greater (low adverse) visual impacts, due to their greater lengths.

Transportation. Transportation impacts would be low, yet beneficial, because of either (1) improvements to the existing pipeline system, (2) transmission line system, or (3) construction of new systems available for further transport needs. The relative beneficial impacts were assessed based upon the length and potential availability of the networks to future users. As such, the Rangely B alternative would have slightly greater relative beneficial impacts of the three alternatives analyzed.

Energy. Energy impacts would be directly related to length and are, therefore, proportional to energy use. Longer corridors would result in higher adverse impacts due to the increased need for pumping. Impacts of product pipelines are all rated as low adverse impacts. The La Sal pipeline, because of its relatively shorter length, would have slightly lower adverse impacts when compared to the Rangely or Big Salt Wash alternatives.

2.4.3.1.7 Power Generation. An alternative to purchase of power from off-site sources is cogeneration of power on-site. Impact comparisons for pertinent disciplines concerning cogeneration versus off-site purchase of power are given below and in Table 2.4-7. In general, cogeneration of power would cause more site-specific environmental impacts.

Table 2.4-7 IMPACT COMPARISONS FOR POWER GENERATION ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	Purchase Off-Site (Proposed Action)	Cogeneration On-Site (Alternative)
Surface Water	-0-	−0.5
Air Quality	-0-	−0.3
Noise	-0-	−0.2
Visual Resources	-0-	−0.5
Energy	−0.8	+0.6

[a] Only pertinent disciplines for impact assessment are shown.

Surface Water. The cogeneration of power would introduce additional surface watershed disturbance and water consumption. Surface water impacts would be slightly adverse compared to the proposed action (which has essentially no on-site impacts).

Air Quality. With cogeneration added to the project alternatives, the 24-hour TSP concentrations are predicted to consume or exceed the PSD Class II increment for the 100,000-bpd Union B and the 100,000- and 50,000-bpd Lurgi alternatives. The total concentration, when added to the background values, result in 50, 91, and 66 percent of the NAAQS of the respective alternatives. No other consumption or exceedance of the PSD increments or NAAQS occur. All SO_2 and TSP concentrations for the regulated averaging times in the Class I and Category I sensitive receptors are less than 1 $\mu g/m^3$. A Level I screening analysis of cogeneration with the proposed action indicates a dark plume against a bright sky caused by NO_x would be visible out to 40 miles from the facilities and a light plume against dark terrain caused by TSP would be visible out to 48 miles from the facility. The refined level 2 indicates a potential for visibility degradation in Flat Tops Wilderness on four days during the visitor season.

Noise. Cogeneration would add only slightly to the process facilities adverse noise impacts. The additional noise from cogeneration could be masked by the other facilities.

Visual Resources. The visual impacts of purchasing power would relate to the transmission line serving the project which would be required regardless of whether power is generated on-site or not. Power generation on-site (cogeneration) would contribute to the adverse impacts due to the need to expand facilities on site.

Energy. Purchase of power from an outside grid would place additional demands on that grid, and would have an adverse impact. The precise location of the power within the grid and associated environmental impact cannot be precisely determined at this time. Considering that the current power grid appears to be adequate for the anticipated project uses, the impact is rated as low. Cogeneration would be a beneficial impact in that it would create additional power for use within the facility, thereby reducing the demand for imported power.

2.4.3.1.8 Water Supply. The proposed action GCC Joint Venture/Roan Creek-Clear Creek regulation reservoir/Tom Creek reservoir system, with related facilities, could be supplemented (as an alternative) by addition of the West Fork Parachute Creek reservoir, pumping plant, and pipeline, primarily to provide supplementary water to the retort additions site. Comparisons of the proposed action and the addition of this alternative reservoir site, with related facilities, are discussed below and presented in Table 2.4-8. Impact ratings statements concerning the preferred alternative GCC reservoir site in Roan Creek valley (the Upper Dry Fork site) are also recalled.

Topography. Impacts to topography include the inundation of valley bottomlands and topographic disturbance as a result of the construction of the impoundment structures. These impacts are not considered significant in the long-term. Upper Dry Fork was rated medium adverse topographic impacts.

Table 2.4-8 IMPACT COMPARISONS FOR WATER SUPPLY ALTERNATIVES, GETTY SHALE OIL PROJECT

Discipline[a]	GCC Joint Venture[b] and Two Other Regulation Reservoirs (Proposed Action)	GCC Joint Venture[b] and Three Other Regulation Reservoirs Including West Fork Parachute Creek (Alternative)
Topography	−0.1	−0.2
Geology	−0.3	−0.4
Paleontology	−0.1	−0.2
Surface Water	−0.5	−0.7
Ground Water	-0-	-0-
Aquatic Ecology	+1.0	+1.4
Soils	−1.3	−1.3
Vegetation	−1.0	−1.3
Wildlife	−0.4[c]	−0.6[c]
Cultural Resources	−0.2	−0.2
Land Use	+0.4	+0.5
Visual Resources	−0.7	−0.9

[a] Only pertinent disciplines for impact assessment are shown.
[b] Upper Dry Fork Reservoir impacts have been previously analyzed. Impact ratings shown are for additional regulation reservoirs only, using the Lower Dry Fork reservoir site and its related system — BLM's preferred alternative — as a base. See Section 2.4.7 in the CCSOP DEIS (BLM 1983a). Further, Getty is responsible for a portion (nominally one-third) of the GCC Joint Venture System impacts as shown in the CCSOP EIS (BLM 1983a).
[c] See Section 2.4.2.

Geology. Impacts to the existing geology result from the construction of impoundment structures. These structures are considered potential geologic hazards. There is no significant difference in the potential impact of either the proposed or alternative actions, nor were there significant impact differences in Upper Dry Fork of the other Roan Creek reservoir sites geologically. Potential hazards could be reduced by the development and implementation of a detailed maintenance and inspection program.

Paleontology. Impacts to paleontological resources include the submersion of existing or potential fossil collecting sites. The alternative action would inundate a greater area, thus the higher relative (yet still low adverse) impact rating. All Roan Creek reservoir sites were rated the same (low adverse) impacts, as a base for comparison.

Surface Water. The alternative water supply system would affect stream flows of the West Fork Parachute Creek, in addition to those impacts for the proposed action water supply system. Both would be rated low adverse impacts. Upper Dry Fork was rated low to medium adverse considering flood hazards to De Beque, areas of inundation and potential water quality degradation.

Ground Water. Little or no ground water impacts would be anticipated for the proposed GCC Colorado River diversion schemes. Little net impact (beneficial or adverse) to ground water was likewise noted for any of the reservoir sites. Increases in downstream salinity resulting from diversion could slightly affect the alluvial ground water quality along the Colorado River as a result of recharge from river water of increased salinity. Depending on the relative quality of local alluvial ground water and the quality of diverted Colorado River water stored in the respective impoundments, there would be slight beneficial or adverse impacts associated with localized recharge to alluvial aquifers at proposed storage reservoirs in the Parachute Creek and Tom Gulch valleys.

Aquatic Ecology. The proposed action would result in increased sedimentation in Roan Creek below the diversion and reservoir during construction, and dewatering of lower Roan Creek during operation. The reservoir would result in a net gain of warm water fishery habitat, however. Upper Dry Fork was also rated one of the Roan Creek sites having least adverse impacts to aquatic biota. A reservoir in Tom Creek, an intermittent drainage, would also increase available habitat. The alternative action, which includes the addition of a reservoir in West Fork Parachute Creek, would be a greater beneficial impact than the proposed action since it would probably increase the useable habitat for the already existing brown trout population in that stream. Potential impacts regarding loss of fishery habitat and aquatic biota as a result of dewatering below the proposed West Fork Parachute Creek reservoir cannot be predicted at this time; however, they are not expected to be significant.

Soils. The moderate adverse soil impacts of the two water supply systems are expected to be the same. Largely because of the slightly smaller disturbance area of the proposed action, its impacts are about 7 percent less in terms of incremental soil loss. Calculated incremental soil loss of the proposed action and alternative are 112,400 and 115,800 tons, respectively. Both would disrupt about 635 acres of prime farmland. Permanent and temporary prime farmland impacts (inundation) would occur in the reservoir areas. Temporary impacts would also occur due to water pipeline construction. The Upper Dry Fork site was rated as having the least relative soils impacts of the Roan Creek reservoirs.

Vegetation. Aside from the GCC water storage and supply system analyzed previously (BLM 1983a), alternative reservoir sites would have low to medium adverse impacts on vegetation and special interest plant species. The reservoir in Tom Creek canyon could affect populations or habitats of four special interest plant species (see Section 4.2.6.1). The West Fork Parachute Creek reservoir would affect no known populations or potential habitat for special interest plants. Upper Dry Fork was rated significant, high adverse impacts to special interest plants — the most adverse rating of all the Roan Creek sites.

Wildlife. The construction and operation of either water supply alternative would have low adverse impacts to wildlife. The Tom Creek and Roan Creek reservoirs would inundate about 220(*) acres of wildlife habitat including winter range, winter concentration areas, and critical habitat for mule deer and elk. Although no known raptor nest locations would be directly lost, construction of the reservoirs would likely cause short-term disturbance to raptors which nest in relative close proximity. The addition of the West Fork Parachute Creek reservoir to the water supply system would cause further elimination of about 280(*) acres of habitat, most of which is composed of the aspen and riparian cover types. It is unknown whether or not the reservoir would eliminate or disturb any raptor nests. Upper Dry Fork, in the GCC water system used as a basis for this analysis, was rated medium to high adverse due to the critical mule deer winter range and other special interest species habitat displaced — the highest relative adverse impacts of all the Roan Creek sites. See Section 2.4.2.

Cultural Resources. Potential impacts on cultural resources (given the existing federal and state cultural resource regulations and the previous surveys undertaken, especially in the Roan Creek drainage) would be insignificant. Upper Dry Fork was rated equal to the other sites for this discipline. Areas previously unsurveyed will be subject to study. Actual determination of impacts and mitigation measures would be developed according to agency requirements. Mitigation measures would eliminate most if not all, adverse impacts to sites potentially eligible for the National Register of Historic Places.

Land Use. There would be a slight beneficial impact on land use values from development of the alternative reservoir sites. Development of reservoirs could result in opportunities for irrigation, other agricultural uses, or recreation following project decommissioning. The Upper Dry Fork reservoir site would affect approximately 390 acres of public lands, while the alternative sites analyzed here (Tom Creek, Roan/Clear Creek confluence, W. Fork Parachute Creek) would have no direct inundation effects, but probably some indirect effects on an undetermined, yet small, amount of public land acreage from construction, access roads, and pipelines.

Visual Resources. The proposed action system would have low to medium adverse impacts during construction and operation, followed by low to medium beneficial visual impacts after project shutdown. These are balanced in the ratings shown. The addition of the West Fork Parachute Creek reservoir would have a greater potential for initial adverse (and later beneficial) impacts due to the added facilities. Upper Dry Fork was rated low to medium adverse based upon distance from De Beque and visual sensitivity.

2.4.3.1.9 No Action Alternative. The No Action alternative for the Getty project is described in Section 2.3.1.6. For impact comparison purposes, the implications of the No Action alternative are many. These include the following:

- Non-development of the oil shale resource, increasing U.S. dependence on foreign energy.
- Elimination of the economic and social benefits of the project to Colorado's Western Slope.
- Non-use of the water, which would be put to beneficial industrial, commercial, and domestic uses before leaving Colorado if the project were developed.
- No adverse environmental impacts to the immediate area's and region's air, surface and ground water, wildlife, vegetation, soils, and aquatic resources; the social and economic environment; cultural resources, land use, recreation and wilderness values; visual resources and noise; and the area's topography, paleontological, and geological resources.
- No beneficial impacts to the above components of the environment (e.g., beneficial impacts to transportation and land use due to reservoir, road, and pipeline construction for the project).

These impacts or non-impacts compare to those related to project development depending upon individual values, national policy matters, agency missions, and many other factors.

2.4.3.2 Cities Service

The proposed action for the Cities Service shale oil project for which impact assessment was undertaken includes the following major project components.

- **Underground room-and-pillar/vertical modified in situ (VMIS) mine** (capacity of 135,000 tpd to produce 100,000 bpd of shale oil; surface retorts to produce 90,000 bpd of shale oil, VMIS retorts to produce 10,000 bpd)
- **Ten Union B retorts**
- **A total of 18 VMIS retorts** (180 feet square × 280 feet high)
- **Four shale oil upgrading modules,** one at 10,000 bpd and three at 30,000 bpd
- **One mine bench and mine portal**
- **Associated surface facilities, including shale fines storage on-site**
- **Disposal of 115,000 tpd of spent shale** from the Union B retorts in Conn and Cascade canyons
- **A water supply system** consisting of the GCC Joint Venture, with a connecting pipeline to the Cities Service property (GCC system addressed in the CCSOP EIS - BLM 1983a)
- **Purchased power** from off-site sources
- **Conn Creek multi-use corridor**
- **Mesa-top multi-use corridors**
- **Cities Service to Getty property power and transmission corridor** (to near the Getty additional retorts site)
- **Common corridor (with Getty)** north from near the additional Getty retorts site to the La Sal pipeline connection
- **La Sal power and syncrude corridor** (addressed in the CCSOP EIS-BLM 1983a)
- **Roan Creek (De Beque to Conn Creek confluence) multi-use corridor** (addressed in the CCSOP EIS-BLM 1983a)
- **Bus and Truck Transport** of workers and materials from De Beque up the Conn Creek road to the plateau

Alternatives to the Cities Service proposed action for which impact comparisons are made are as follows.

- Production rate
    - **50,000 bpd** (reduced production to 40,000 bpd from room-and-pillar mine, 10,000 bpd VMIS)
- Retort technology
    - **Lurgi**

- Mine type
  - **All underground room-and-pillar mine** (no VMIS retorts)
- Shale fines
  - **Processing on-site**
- Spent shale disposal site
  - **Upper Cascade Canyon/plateau combination**
- Spent shale disposal type
  - **Lurgi**
- Corridors
  - **Rangely product pipeline** (addressed in CCSOP EIS-BLM 1983a)
  - **North product pipeline and transmission line** (directly north of Cities property on BLM and private lands to tie in with La Sal)
- Water supply
  - **Larkin Ditch** (existing intake on south side of Colorado River near De Beque, existing ditch, new sedimentation reservoir and pipeline across river to GCC property)
- Power Generation
  - **Cogeneration** of power on-site
- Transport
  - **Rail and truck transport** of workers and materials

Maps and detailed discussions of the above proposed action and alternatives are given in Section 2.3.2.

2.4.3.2.1 Production Rate. As noted above, one Cities Service alternative is to produce shale oil at a rate of 50,000 bpd. Approximately 68,000 tpd of oil shale would be mined, with spent shale disposal of approximately 58,000 tpd. The mine life would be approximately doubled, with ultimate disposal volumes approximately the same as at the 100,000-bpd rate. Short-term impacts would be less, and long-term impacts approximately the same. Appropriate impact comparisons by discipline are summarized in Table 2.4-9. Brief written descriptions of impacts follow.

Topography. Impacts to topography include general surficial disturbance as a result of the construction of mine facilities. There are no significant impact differences to topography by utilization of the proposed or alternative action.

Geology. No significant differences in the potential impacts to geological resources are expected as a result of the proposed or alternative actions. Both production rates and associated underground mines could result in the subsidence of the land surface, and both would utilize the same eventual volume of oil shale resource.

Paleontology. There are no significant impact differences to paleontological resources as the result of the proposed or alternative actions. Minor adverse impacts for both alternatives would be experienced as a result of disturbance or covering of potential fossil collection sites.

Table 2.4-9 IMPACT COMPARISONS FOR PRODUCTION RATE ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	100,000 bpd (Proposed Action)	50,000 bpd (Alternative)
Topography	−0.3	−0.3
Geology	−0.3	−0.3
Paleontology	−0.3	−0.3
Surface Water	−1.0	−0.8
Ground Water	−1.2	−1.0
Soils	−1.4	−1.3
Aquatic Ecology	−0.3	−0.3
Vegetation	−2.2	−2.0
Wildlife	−2.5[b]	−2.5[b]
Air Quality	−2.3	−1.7
Noise	−0.6	−0.5
Cultural Resources	−0.3	−0.2
Land Use	−2.0	−1.5
Recreation	−1.0	−0.7
Wilderness	−1.0	−0.8
Visual Resources	−1.2	−1.0
Socioeconomics[c]	--	--
Transportation	−1.2	−0.9
Energy	+2.0	+1.7

[a] Only pertinent disciplines for impact comparisons are shown.
[b] See Section 2.4.2.
[c] Socioeconomic impacts are not rated numerically. See the socioeconomics discussion in Section 2.4.2.

Surface Water. Compared to the proposed production rate, the 50,000-bpd production rate would produce smaller amounts of waste rock, shale fines, and spent shale on a daily basis. However, the final dimensions of the retorted shale disposal pile would be approximately the same as the proposed action. Surface water disturbances over the short-term would be less for 50,000 bpd than for the proposed action, due to the reduction of storage areas for waste rock, shale fines, and spent shale. Therefore, the 50,000-bpd production rate would have less adverse impacts on the surface water system over the short-term, but essentially the same as the proposed action over the life of the project.

Ground Water. Impacts associated with ground water for both production rates would include potential dewatering of bedrock aquifers and discharge of mine inflows to the hydrologic system. The magnitude of these impacts would be dependent upon the degree of increased rock fracturing or production of high TDS waters from the VMIS process, an integral component of both actions. Existing data indicate that prudent use of the VMIS process and associated water handling (or treatment if necessary) should keep impacts in the low to medium adverse range, with a slightly lower relative rating for the 50,000-bpd alternative.

Soils. The moderate adverse soil impacts are slightly higher for the 100,000-bpd rate. This is a result of slightly greater surface disturbance for the proposed action than the alternative. The erosion rate (averaged for wind and water) for both scenarios is about 5.88 tons per acre annually, a five-fold increase over naturally occurring erosion losses. About 1,300 acres in prime farmland losses are associated with either of the production rate scenarios.

Aquatic Ecology. The development of the Cities Service project at a production rate of 100,000 bpd would have a low adverse negative impact on aquatic ecology. (The impact rating does not include impacts previously addressed in the CCSOP EIS including development of the GCC Joint Venture Roan Creek reservoir and water withdrawal from the Colorado River.) These impacts include a loss of intermittent stream reaches due to physical covering, a risk of introduction of toxic substances to the surface water from spent shale stockpile and accidental spillage along corridors, and possible pipeline breakages. The ratings for the 100,000-bpd and 50,000-bpd alternatives are based on the same water withdrawal and storage facilities. All other facility sitings are the same regardless of production rate. Therefore, there would be no impact differences between the proposed and alternative production rates.

Vegetation. The proposed action would have slightly higher adverse impacts (both alternatives are rated high adverse) on vegetation resource values than the 50,000-bpd alternative. This is due primarily to the additional acreages that would be affected by the expanded retort facilities necessary for the 100,000-bpd alternative. Indirect impacts to vegetation resulting from increased urbanization (housing and support facilities for project workers) would be similar among alternatives. Impacts on special interest plants (threatened or candidate plant species) would be similar for both alternatives; however, no threatened or endangered plants are known to occur on Cities Service's land. These impacts would result from direct disturbance to known plant populations or their habitat. These disturbance areas would occur on private land owned by the Operator.

Wildlife. The types of impacts associated with each of the production rate alternatives are expected to be similar (i.e., there will be loss or disturbance of wildlife habitats and individuals in the affected areas, as well as significant and adverse effects). Big game ranges, raptor nest sites, and sensitive habitats would all be affected. A comparable amount of wildlife habitat would eventually be disturbed under the 50,000-bpd alternative. The extent of these changes is unknown. Indirect impacts of the production alternatives are expected to be similar. Both alternatives are rated high adverse wildlife impacts. See Section 2.4.2.

Air Quality. See the discussion in Section 2.4.3.2.2 (Retort Technology Alternatives).

Noise. The generation of noise for both alternatives would be similar. The full production alternatives would have the most adverse impact, but is only slightly higher than the reduced production alternatives. Transportation alternatives noise impacts would also vary insignificantly between the production rate alternatives.

Cultural Resources. Potential impacts on cultural resources (given the existing federal and state cultural resource regulations) would be insignificant. Surface disturbances related to the construction of the 100,000-bpd action would be relatively greater (in a low adverse sense) than the 50,000-bpd alternative. Areas previously unsurveyed will be subject to study. Actual determination of impacts and mitigation measures will be developed according to agency requirements.

Land Use. Construction and operation of the mine, retorts, and ancillary facilities would significantly impact existing land uses on the site and have significant secondary impacts on land uses off-site. Lands which are now utilized as agricultural land and rangeland would become predominately industrial, commercial, and residential. Direct impacts are slightly higher (relatively) in an adverse sense for the proposed action than for the 50,000-bpd alternative due to slightly more total disturbance to rangeland for the proposed action. Development of the Cities Service project would result in potential impacts to 5,037 acres of public lands. Of this total, 565 acres (11 percent) would be affected by the construction of transportation, transmission line, and pipeline corridors in Roan Creek valley and Conn Creek canyon. On the Roan Plateau, development of the underground mine, syncrude pipeline, and transmission line would also affect public lands.

Recreation. Indirect and adverse impacts to recreational facilities and opportunities would occur due to an increase in human population during the construction phase of the project. Slightly beneficial impacts could be expected during the operational and residual phases, because new recreational facilities would be built during construction, providing more recreational facilities during operation and post-operation phases for the reduced number of workers.

Wilderness. Low adverse impacts to recreation could occur due to increased demand for wilderness use. Impacts could be relatively higher (yet still low to medium adverse) during the construction-phase of the 100,000 bpd level, when more workers would be involved with the project.

Visual Resources. Due to the reduced size of facilities required for a 50,000-bpd alternative, it would have less visual impacts than a 100,000-bpd alternative. However, since the 50,000-bpd alternative would require many of the same types of surface facilities and corridors as the proposed action, impacts of both alternatives would remain low to medium adverse.

Socioeconomics. The 100,000-bpd proposal by Cities Service has four distinct construction cycles, each of approximately 6 years duration. After the first two cycles are completed in 1998, operations employment would be 1,800 and production would be approximately 40,000 to 50,000 bpd (a nominal 50,000-bpd alternative). Thus, the impact analyses through 1998 are appropriate to either the 50,000-bpd or the 100,000-bpd scenarios. Subsequent to 1998, under the 50,000 bpd alternative, impacts would stabilize at levels similar to those of 1998. Under the 100,000-bpd scenario, impacts continue to increase in each subsequent construction cycle because similar construction forces are added to progressively larger numbers of operating workers. See the details concerning absolute numbers in Section 4.3.13, and the note on impact ratings for socioeconomics in Section 2.4.2.

Transportation. Transportation impacts throughout the construction, operation, and residual phases would be greater for the 100,000-bpd production rate than for the 50,000-bpd rate due to the greater need for worker, material, and product transport. However, the duration of the impacts from the 50,000-bpd alternative would be doubled. At the 100,000-bpd production rate, the highest relative adverse impacts would occur to the roadway systems. Depending on the timing of the proposed action construction, traffic slowdowns could occur on roadways within the area. Airports and railroads may experience low to medium adverse impacts from both the 50,000- and 100,000-bpd production rates. Overall regional pipeline capacity would be increased under both alternatives, causing low beneficial impacts.

Energy. Energy use during construction would constitute a low adverse impact. During project operation, a net beneficial impact would result due to the production of shale oil. The 100,000 bpd production rate would, on the basis of output/input ratio, have a slightly greater (medium to high) beneficial impact.

2.4.3.2.2 Retort Technology. This alternative would use the Lurgi technology (as previously described in Section 2.3.2) instead of the Union B retort for surface retorting of the oil shale. Appropriate impact comparisons by discipline are shown in Table 2.4-10, with brief written explanations given below. The 100,000-bpd proposed action production rate (90,000-bpd surface retort, 10,000-bpd VMIS) is assumed except as indicated. Other alternatives as modeled for air quality are discussed in that section.

Surface Water. The alternative Lurgi retort would process finer raw shale and, therefore, generate smaller particle size spent shale material compared to the proposed Union B retort technology. Surface water impacts could be increased due to: (1) higher water consumption for spent shale moistening, and (2) more sour water generation.

Ground Water. Impacts could occur from the production of retort wastewater and spent shale. Disposal of these by-products could result in the generation of leachate high in dissolved solids, selected trace metals, and organic contaminants. Additionally, the Union B process cannot process raw shale fines, necessitating their storage separately on the mesa. Utilization of the Lurgi retorts would allow processing of the fines negating disposal-related impacts. However, careful design and installation of a water management system would be necessary to restrict runoff waters from contacting and infiltrating any temporary storage piles.

Air Quality. The air quality discussion presents only the most adverse or limiting values for health impacts. Additional detail is presented in Section 4.3.8. The most adverse air quality impacts would come from the full production alternatives for the proposed action and the Union B retorts. Both would consume 80 percent of the 24-hour National Ambient Air Quality Standards (NAAQS) for total suspended particulates (TSP). Additionally, the project would require some redesign or additional land acquisition (approximately 0.1 square miles) to avoid violating Prevention of Significant Deterioration (PSD) Class II increments. The land area of potential violation is near the shale fines storage area on the western property boundary. This violation could be removed by a minor shift in the location of the raw shale fines pile, or by acquiring some minor additional land to move the property boundary. Additionally, a Level 2 visibility analysis indicates the potential for significant visibility impacts on 5 days during the visitor season in the Flat Tops Wilderness. Of the other alternatives analyzed for the EIS, the 90,000-bpd Lurgi/10,000-bpd VMIS would consume, when added to background, approximately 65 percent of the 24-hour TSP NAAQS, primarily due to shale disposal. This alternative and the proposed action would consume 60 percent of the 24-hour SO_2 Class I increment in Flat Tops Wilderness Area. A potential violation of the Class II 24-hour TSP increment could also occur with the 90,000-bpd Lurgi/10,000-bpd VMIS alternative. Refined analyses could prove that this would not occur. These analyses would be required for air quality permits prior to construction.

For the 100,000-bpd all Union B retorts alternative, the 24-hour TSP off-property concentration would cause one of the highest air quality impacts of all Cities Service's proposed alternatives, consuming 2.3 times the Class II increment. When added to the background concentration, the total impact represents 80 percent of the NAAQS. Forty percent of the SO_2 24-hour Class I increment would be consumed in the Flat Tops wilderness. When added to background concentrations, the total annual TSP and NO_x concentrations would represent about 30 percent of the applicable limiting NAAQS. The Level 2 visibility analysis indicates a potential for significant impact in the Flat Tops on four days during the visitor season. This impact is rated moderate to high adverse.

For the 100,000-bpd all Lurgi retorts alternative, the off-property PSD Class II 24-hour TSP concentration is predicted to be exceeded by 72 percent. The total 24-hour TSP concentration would represent 65 percent of the limiting NAAQS. Forty percent of the 24-hour TSP Class I increment would be consumed in Flat Tops and 40 percent of the 3-hour SO_2 Class I increments in the Flat Tops would be consumed. Additionally, the refined visibility analysis indicates seven visitor days of potential visibility impacts in the the Flat Tops Wilderness.

The full production 90,000-bpd Union B/10,000-bpd VMIS alternative, with an additional Lurgi retort to process fines, replaces the fines stockpile with an additional retort. The 24-hour TSP Class II concentration would exceed the PSD increment by 22 percent. When added to the background levels, this results in a total concentration which would be 52 percent of the federal standard. The 3-hour SO_2 concentration in the Flat Tops Wilderness would be 40 percent of the PSD Class I increment. Seven days of potentially significant impact to visibility in the Flat Tops were also predicted.

The 40,000-bpd Union B/10,000-bpd VMIS alternative would consume approximately 59 percent of the 24-hour TSP NAAQS. This impact is primarily due to the shale fines storage and spent shale disposal. Also, 1 day of visibility impairment during the visitor season in the Flat Tops cannot be ruled out.

For the Union B reduced production alternative, the PSD Class II 24-hour TSP increment would be exceeded by 16 percent. The total off-property TSP 24-hour concentration would be 50 percent of the NAAQS. No other increments are predicted to be exceeded. Also, no days of potential visibility impact were predicted in the Flat Tops during the user season.

For the 50,000-bpd, all Lurgi retorts alternative, no PSD Class I or Class II increments would be consumed. When added to the background concentrations, they would represent 44 percent of the 24-hour TSP NAAQS and 33 percent of the annual TSP NAAQS. However, the refined PLUVUE analysis indicates a potential for 7 days of visibility impacts during the visitor season in the Flat Tops.

The 40,000-bpd Lurgi/10,000-bpd VMIS alternative would also have its major adverse impacts from TSP. It is predicted to consume approximately 44 percent and 31 percent of the 24-hour and annual TSP NAAQS, respectively. The refined PLUVUE analysis indicates a potential for seven days of visibility impacts during the visitor season in the Flat Tops.

The 40,000-bpd Union B retorts/10,000-bpd VMIS alternative, with an additional Lurgi retort for fines, replaces the fines stockpile with an additional retort at a reduced production rate. No TSP or SO_2 Class I, Class II, or Category I increments are fully consumed, nor are the NAAQS exceeded. When added to the background concentrations, the 24-hour off-property TSP total concentration represents 38 percent of the NAAQS. The PLUVUE analysis indicates a potential to affect visibility to the Flat Tops on 5 days during the visitor season.

The 24-hour TSP concentrations are predicted to consume or exceed the PSD Class II increment for all full-production (Union B/VMIS) alternatives and for the reduced production split and all Union B retorts. These impacts would all occur in the same location as the original alternatives without cogeneration. When added to the background concentrations, the percent contribution of the 24-hour TSP NAAQS and impact ratings are identical to those listed for the proposed alternatives without cogeneration. All other total concentrations would be well below 30 percent of the NAAQS.

A more complete description of the air quality impacts is contained in Appendix A and Sections 4.1.8 and 4.3.8.

Table 2.4-10 IMPACT COMPARISONS FOR RETORT TECHNOLOGY ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	Union B (Proposed Action)	Lurgi (Alternative)
Surface Water	−0.3	−0.5
Ground Water	−0.8	−0.6
Air Quality	−2.5 (−1.8)[b]	−2.2 (−1.7)[b]
Noise	−0.6 (−0.5)[b]	−0.6 (−0.5)[b]
Energy	+1.2	+1.4

[a] Only pertinent disciplines for impact comparisons are shown.
[b] Rating in parentheses is for the 50,000-bpd alternative, using the indicated technology at 40,000 bpd plus 10,000 bpd VMIS.

Noise. The variation between the Cities Service process technologies concerning noise impacts would be minimal. The full production alternatives would have the most adverse impacts, but are only slightly higher than the reduced production alternatives. Noise impacts of the transportation alternatives would also vary insignificantly between process technologies.

Energy. The energy impacts of the proposed Union B surface retort technology are medium beneficial. Processing of the oil shale would require consumption of energy, but the shale oil produced would more than offset the energy consumption. There is a difference in energy efficiency between the Union B and Lurgi retorting technologies. The Lurgi technology utilizes raw shale fines and the carbon on the spent shale is burned to produce energy. Therefore, the Lurgi technology is rated as being more beneficial to the overall energy balance.

2.4.3.2.3 Mine Type. The combination underground room-and-pillar mine/VMIS process could be replaced by an all room-and-pillar underground mine alternative. Union B retorts and 100,000-bpd production rates are assumed. Appropriate impact comparisons by discipline are shown in Table 2.4-11, with brief interpretations given below.

Topography. The underground mining of oil shale could result in the subsidence of the land surface. Underground disturbances associated with the VMIS process, including blasting and increased excavation, would increase the potential for subsidence. Impacts from the proposed action, therefore, could be higher in magnitude.

Geology. Geologic impacts include the possibility of land subsidence. Underground disturbances associated with the VMIS process, including blasting and increased excavation from the proposed action could be higher in magnitude than those from the alternative.

Table 2.4-11 IMPACT COMPARISONS FOR MINE TYPE ALTERNATIVES (WITH UNION B RETORTS), CITIES SERVICE SHALE OIL PROJECT

	100,000 bpd	
Discipline[a]	90,000 room-and-pillar; 10,000 VMIS (Proposed Action)	All Underground room-and-pillar (Alternative)
Topography	−0.5	−0.2
Geology	−0.5	−0.3
Surface Water	−0.4	−0.4
Ground Water	−1.8	−0.8
Soils	−0.1	−0.1
Wildlife	−0.3[b]	−0.1[b]
Air Quality	−2.3 (−1.7)[c]	−2.3 (−1.6)[c]
Noise	−0.6 (−0.5)[c]	−0.6 (−0.5)[c]
Visual Resources	−0.9	−0.8
Energy	−0.7	−0.9

[a] Only pertinent disciplines for impact comparisons are shown.
[b] See Section 2.4.2.
[c] Impact rating in parentheses is for 50,000-bpd alternatives.

Surface Water. The alternative all room-and-pillar mine type would have essentially the same surface water impacts as the proposed action, because overall mining areas are the same and volumes of spent shale piles would be essentially equal.

Ground Water. Adverse ground water impacts resulting from the alternative all room-and-pillar mine without VMIS retorting should be less than for the proposed action. The increase in impact magnitude for the proposed action is due to the potential for dewatering of overlying aquifers, ground water contamination via contact with VMIS retort *"rubble,"* and increased opportunity for mine inflows during this VMIS process.

Soils. Impacts associated with either of the two different mine types are low and adverse. The underground versus the VMIS method would probably disturb the same surface acreage in generally the same locations. Therefore, incremental soil loss would be approximately the same. There are no prime farmland impacts associated with either of the two alternatives.

Wildlife. The effects of the two mining alternatives on wildlife would be low adverse. The impacts would also be similar since the location and amount of surface disturbance associated with each are comparable. The VMIS alternative could have slightly greater adverse direct and indirect impacts on wildlife than the proposed action because of increased potential for subsidence and air quality impacts. See Section 2.4.2.

Air Quality. See discussion in Section 2.4.3.2.2 (Retort Technology Alternatives).

Noise. See discussion in Section 2.4.3.2.2. (Retort Technology Alternatives).

Visual Resources. The combination underground mine/VMIS would have slightly higher relative adverse visual impacts than underground mining alone. The greater impact is related to the surface facilities (oil recovery units and pipes) of the VMIS process. The visual impact of the underground mine would result from surface facilities at the mine adit.

Energy. Mining of oil shale would have a low adverse energy impact due to the energy consumed in the extraction, crushing, and transport of oil shale. The combination of underground mining and VMIS would have relatively greater beneficial energy impacts because the combined method gives the best site-specific resource recovery.

2.4.3.2.4 Shale Fines. The oil shale fines (pieces less than 1/8 inch in diameter after crushing) could be stockpiled on-site (as in the proposed action) or, as an alternative, processed on-site for additional shale oil extraction. The impacts of these two options are compared below and in Table 2.4-12 for appropriate disciplines.

Surface Water. Low to medium adverse impacts to surface water would be associated with each alternative. On-site storage could cause surface runoff and erosion from the stockpile, and migration of leachate to surface drainages. Retorting of shale fines on-site would have slightly higher adverse impacts since the wastewater generated by the retorting process could potentially contaminate surface water.

Ground Water. Low adverse ground water impacts are anticipated from either scheme for raw shale fines. The proposed storage of fines in stockpiles would allow for longer term exposure to drainage waters, whereas processing in the alternative Lurgi retort, with continual accumulation/removal, would decrease this exposure time. Conversely, storage would allow for timely reclamation by revegetation, thereby decreasing the opportunity for infiltration of precipitation. In either case, design and operation of proper handling and drainage control plans can reduce any significant hydrologic impacts.

Air Quality. Shale fines processing as opposed to storage (both on-site) would reduce TSP impacts slightly. Reduced storage requirements would be offset by increased screening and crushing operations if processing occurred. Storing the shale fines on-site, as in the proposed action, would consume approximately 75 percent of the 24-hour TSP NAAQS, while processing these fines using the Lurgi alternatives would reduce the impact to approximately 60 percent of the same standard.

Visual Resources. Storage of shale fines would have an adverse visual impact until processing and/or reclamation of the storage area. Processing, without storage, would eliminate most of this adverse impact. The impact would be offset due to the additional processing facilities required.

Energy. Storage of shale fines on-site (proposed action) would result in low adverse impacts because of the energy consumed in the transport of shale fines and the energy lost by non-recovery of the shale oil within these fines. Conversely, the alternative of retorting these fines would have a net low beneficial impact, due to the recovery of the additional shale oil.

2.4.3.2.5 Spent Shale Disposal Sites. As an alternative to the Conn Creek/Cascade Canyon site in the proposed action, Cities Service has determined that an alternative involving a combination site in Upper Cascade Canyon and a nearby location on the plateau would be feasible. These impact comparisons are given below and in Table 2.4-13. The 100,000-bpd production rate is assumed.

Topography. The disposal of spent shale in Conn Creek and Cascade Canyon would result in greater relative adverse impacts to topography than the combined disposal of spent shale on the plateau and in upper Cascade Canyon. The impact of spent shale disposal on topography is considered low adverse for both actions, with the alternative action having the lower impact, due to less relief changes.

Geology. Impacts to geology include the creation of potential geological hazards as a result of the construction of the spent shale piles. The alternative action is preferred due to the location of the spent shale on the plateau where gentler slopes, forming the foundation and sides of the pile, predominate. Furthermore, since the alternative spent shale disposal area consists of two smaller piles rather than one large one, the amount of material that could affect valley bottomland activities, should there be a slope failure, would be less.

Table 2.4-12 IMPACT COMPARISONS FOR SHALE FINES ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	Disposal On-site (Proposed Action)	Processed On-site (Alternative)
Surface Water	−0.5	−1.0
Ground Water	−0.8	−0.7
Air Quality	−2.1	−1.7
Visual Resources	−0.9	−0.5
Energy	−0.3	+0.3

[a] Only pertinent disciplines for impact comparisons are shown.

Table 2.4-13 IMPACT COMPARISONS FOR SPENT SHALE DISPOSAL SITE ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	Conn Creek/Cascade Canyon (Proposed Action)	Upper Cascade Canyon/Mesa (Alternative)
Topography	−1.0	−0.6
Geology	−0.8	−0.5
Paleontology	−0.2	−0.2
Surface Water	−1.0	−1.5
Ground Water	−2.0	−1.8
Soils	−0.6	−0.5
Aquatic Ecology	−0.5	−0.2
Vegetation	−2.2	−2.3
Wildlife	−1.1[b]	−2.3[b]
Air Quality	−1.5	−2.6
Noise	−0.3	−0.3
Cultural Resources	−0.1	−0.1
Land Use	−1.0	−1.5
Visual Resources	−1.5	−1.4
Transportation	−0.1	−0.2
Energy	−0.2	−0.2

[a] Only pertinent disciplines for impact comparisons are shown.
[b] See Section 2.4.2.

Paleontology. As a result of the construction of the spent shale disposal piles, potential paleontological resources would be buried and access restricted. Very low adverse impacts are expected. Neither action is preferred with regard to paleontological resources.

Surface Water. The alternative spent shale disposal area using upper Cascade Canyon and the plateau site would disturb more surface drainage area than the proposed action, including several springs which contribute to the stream flow of Conn Creek. In addition, spent shale disposal piles and embankments on the plateau are more susceptible to water erosion and potential leaching as a result of the two separate disposal areas. This alternative disposal site would have greater relative impacts (both are medium adverse) compared to the proposed action disposal site.

Ground Water. Potential ground water impacts from spent shale disposal could be significant, involving leachate generation and migration. The magnitude of these impacts is dependent upon both the effectiveness of the liner containment system and on the proximity to ground water aquifers. The proposed disposal area is situated largely within steep-walled canyons at the head of the Conn Creek alluvial valley, whereas more than half of the alternative site occurs on flatter, upland areas further removed from alluvial aquifers. These factors indicate that the potential for contamination of important ground water sources could be greater for the proposed action site than for the alternative sites.

Soils. The proposed action is expected to have low adverse impacts on soils, but a relatively greater adverse impact than the alternative. The incremental soil loss for the proposed action is about 64,200 tons, as compared to 50,600 tons for the alternative. No prime farmland loss is expected for either. If revegetation of the spent shale pile slopes is successful, permanent erosion rates could be lower than predisturbance rates. The impact analyses do not reflect the eventual soil erosion rates which would occur when the topsoil material is eroded away. They could easily be 5 to 10 times the disturbance rates shown in Table 4.3-1, which is reprinted in Section 5.3.9.

Aquatic Ecology. Neither the proposed action nor the alternative sites would have significant impacts to aquatic ecology. There would be a slightly lower adverse impact associated with the alternative action since only one intermittent stream bed would be eliminated. The plateau site would have little or no adverse impacts.

Vegetation. The alternative spent shale disposal sites would have similar, high adverse impacts on vegetation. Disposal in Conn Creek and Cascade Canyon would affect significantly more special interest plant populations and habitat than disposal on the plateau and in upper Cascade Canyon. However, affected plant productivity is higher in the plateau/Cascade Canyon alternative than in the Conn Creek/Cascade Canyon proposed action.

Wildlife. The proposed and alternative shale disposal sites would have, respectively, low to moderate adverse impacts to wildlife and habitats. Over 700(*) acres of wildlife habitat would be inundated if shale were disposed of in Cascade and Conn Creek canyons. Major impacts would be known to raptor nests locations and big game ranges. The disposal of shale in the alternative location would have a significant long-term impact on wildlife since over 1,500(*) acres of habitat would be eliminated, including raptor nest locations and sensitive habitats (aspen, Douglas-fir, riparian, and cliffs). See Section 2.4.2.

Air Quality. A moderate to high adverse impact rating is predicted for all of the 100,000-bpd alternatives at the alternative spent shale disposal site. The proposed action site shows medium adverse impacts from the modeling analyses.

Noise. Daily minor changes to the acoustic environment would result from both spent shale disposal alternatives. Noise adverse impacts would be low adverse and about equal.

Cultural Resources. Due to the steep canyon walls and narrow canyon bottom associated with these sites, potential impacts to cultural resources would be minimal. Areas previously unsurveyed would be subject to study. Actual determination of impacts and mitigation measures would be developed according to agency requirements. Mitigation measures would eliminate most, if not all, adverse impacts to sites potentially eligible for the National Register of Historic Places.

Land Use. Low to medium adverse impacts to land use would occur from construction of either spent shale disposal site. Rangeland would be lost as a result of both alternatives. The plateau/canyon spent shale pile would affect the greatest amount of rangeland and productivity among alternatives. No public lands would be affected.

Visual Resources. Spent shale disposal within Conn Creek and Cascade Canyon would have a medium adverse impact since an area of high scenic quality would be impacted. Disposal on the plateau and in the canyon would have a slightly less relative impact since a smaller area of high scenic quality would be affected.

Transportation. Spent shale disposal at either of the alternative sites would have minimal impacts to the regional transportation systems since private conveyors and/or haul roads would be used. A very low adverse impact was assessed for spent shale disposal since some ancillary transportation (e.g., materials) may be needed to support the shale disposal procedures.

Energy. Disposal of spent shale in either the Conn/Cascade Creeks location or the Mesa/Canyon alternative location would result in low adverse impacts. Only a minimal amount of energy would be consumed because of the proximity of these sites to the retorts.

2.4.3.2.6 Spent Shale Disposal Types. The Union B and Lurgi processes would produce spent shale with differing properties. These differences are discussed below and shown in Table 2.4-14.

Geology. The Union B spent shale and alternative (Lurgi) retorts could impact existing site geology as a geologic hazard. The spent shale particles produced by Lurgi retorting are known to cement together more easily when compared to the spent shale produced by the Union B retorts. The increased potential for cementation of the Lurgi-produced particles should increase the stability of the spent shale pile and reduce erosion of the pile by sheet wash.

Surface Water. The alternative Lurgi retort process would generate smaller particle size spent shale material, compared to the Union B retort technology. Surface water impacts would be relatively greater using Lurgi, due to (1) higher water consumption for spent shale moistening because of the smaller particle size, and (2) more sour water generation.

Ground Water. Disposal of spent shale generated by the Lurgi process could result in less adverse ground water impacts than would be associated with the Union B retorts. Reduced impacts could occur if the disposal pile were to become cemented or solidified upon application of moisture as existing data indicate (Bates 1983). If additional structural stability is achieved by this cementing, the potential for erosion and leachate generation would be reduced.

Soils. The impacts resulting from disposal of either type of spent shale would be the same because the type of spent shale deposited would not affect the soil resource. Hence, the impact rating reflects the spent shale disposal site rather than the type of spent shale deposited. If water erosion occurs from the spent shale pile prior to overburden and topsoil replacement, spent shale would be lost, not soil. It is expected that the sedimentation basin system would capture this eroded spent shale. Upon completing overburden and topsoil replacement activities on the spent shale piles, water and wind erosion would undoubtedly occur. The type of spent shale beneath the topsoil will not affect the topsoil erosion rate.

Air Quality. The maximum air quality impacts would result from the process stack releases. Nevertheless, TSP impacts, which fully consume the PSD Class II increment for 24-hr TSP, are predicted to occur along the west property line next to the spent shale disposal area. This rates a low to moderate adverse impact. The maximum emissions for the Lurgi disposal areas are 10 to 20 percent lower than the Union B spent shale disposal emissions.

2.4.3.2.7 Corridors. Alternative corridors for the Cities Service project are discussed below for product transport and transmission lines. These are the North corridor, directly north of the Cities property using BLM/private lands (but not using the Getty property), and the route northwest to Rangely. The Rangely route is described in the CCSOP EIS (BLM 1983a). The route designated Rangely B is assumed for purposes here, and its impact ratings in the CCSOP EIS are presented in Table 2.4-15 and briefly recalled in the text below. This table also presents impact comparisons of the proposed action (Cities to common corridor with Getty to La Sal connection) and the North corridor alternative. Brief written interpretations for appropriate disciplines are presented.

Topography. Topographic impacts would be the result of surficial disturbance due to excavation and construction. There is no significant difference in the potential impacts to topography as a result of the proposed or the alternative actions. In general, impacts to topography would be reduced by reclamation efforts. Rangely B is rated low adverse in terms of its length and existing topography to be crossed.

Table 2.4-14 IMPACT COMPARISONS FOR SPENT SHALE DISPOSAL TYPE ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	Union B Retorted Spent Shale (Proposed Action)	Lurgi Retorted Spent Shale (Alternative)
Geology	−1.5	−1.0
Surface Water	−0.3	−0.5
Ground Water	−1.9	−1.6
Soils	NA[b]	NA[b]
Air Quality	−1.1	−1.0

[a] Only pertinent disciplines for impact comparisons are shown.
[b] See soils note in text for justification of non-applicability.

Table 2.4-15 IMPACT COMPARISONS FOR CORRIDOR ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	Cities Service to Common Corridor With Getty to La Sal Connection (Proposed Action)	Rangely B (Alternative)[b]	North Corridor to La Sal (Alternative)
Topography	−0.5	−0.5	−0.5
Geology	−0.2	−0.2	−0.2
Paleontology	−0.2	−1.1	−0.5
Surface Water	−0.3	−1.1	−0.5
Ground Water	−0.5	−0.5	−0.5
Soils	−0.1	−0.7	−0.2
Aquatic Ecology	-0-	−1.1	−0.5
Vegetation	−0.8	−1.1	−0.8
Wildlife	−0.8[c]	−1.0	−0.2[c]
Cultural Resources	−0.2	−0.5	−0.2
Land Use	−0.3	−1.1	−0.5
Recreation	+1.0	+1.0	+1.0
Visual Resources	−0.1	−0.7	−0.1
Transportation	+0.2	+0.9	+0.5
Energy	+0.3	−0.6	+0.3

[a] Only pertinent disciplines for impact comparisons are shown.
[b] Rating shown is from CCSOP EIS (BLM 1983a), except for land use.
[c] See Section 2.4.2.

Geology. No significant impacts are anticipated for any of the alternatives. Given the relatively similar length and character of the corridors, both the proposed action and each alternative are rated very low adverse impacts to geology.

Paleontology. There is no significant difference in the potential impacts to paleontological resources as a result of the proposed common corridor or the alternative North corridor. Rangely B is rated as having moderate adverse impacts because of potential paleontological resource sites traversed.

Surface Water. The Rangely pipeline corridor would have similar surface water impacts compared to the proposed La Sal pipeline corridor. Impacts of these two corridors, assessed in BLM (1983a), would occur on different drainage systems. The North syncrude pipeline corridor would have greater impacts than the Cities-to-Getty common pipeline corridor because it crosses several additional drainages enroute to Parachute Creek.

Ground Water. The La Sal and Rangely corridors addressed in the CCSOP EIS (BLM 1983a) would have low adverse impacts to ground water. Similarly, the North corridor alternative is rated as low adverse. The North corridor is largely on upland areas, with exposure only to a narrow reach of West Fork Parachute Creek, where saturated alluvial deposits should be minimal.

Soils. It is expected that the North corridor alternative would have low adverse soils impacts, but the relative highest impacts of the three pipeline routes. Incremental soil loss is calculated at about 21,400 11,500, and 10,700 tons for the North, La Sal, and Rangely corridors, respectively. No loss or disruption of prime farmland is expected.

Aquatic Ecology. The Cities Service to Getty common corridor would have no aquatic ecology impacts, because it crosses no permanent water. The North corridor crosses several minor drainages, and is expected to have low adverse impacts. Rangely B is rated medium adverse due to its length, potential sedimentation to streams during construction, and potential water quality changes to small surface drainages resulting from pipeline breaks or leaks.

Vegetation. Low adverse impacts to vegetation would occur as a result of the Cities-to-Getty common power and syncrude corridor. A minimal amount of vegetation and plant productivity would be lost. No known populations of or favorable habitat for special interest plant species will be affected. The remainder of the La Sal pipeline route is addressed in BLM (1983a). The North corridor is also expected to have low adverse impacts. Rangely B is rated medium adverse based on length and revegetation potential.

Wildlife. The Cities-to-Getty power and syncrude corridor would have low adverse impacts to wildlife and wildlife habitat. A few known raptor nests (which occur in close proximity to the corridor) could be temporarily disturbed during construction. Almost 80(*) acres of aspen cover type would also be eliminated or disrupted by construction of this corridor. The North corridor would create similar impacts to wildlife including potential disturbance of raptor nesting locations and 147(*) acres of aspen habitat. The corridor would also intersect and cause short-term disturbance of about 50(*) acres of riparian habitat. The rating for the North corridor is the best estimate available; no site-specific surveys have been conducted along this route. The Rangely B pipeline would have a low to medium adverse impact to wildlife, primarily related to short-term construction. See Section 2.4.2.

Cultural Resources. Potential impacts on cultural resources (given the existing federal and state cultural resources regulations) would be low adverse. The Rangely corridor would have slightly more potential for disturbance of cultural resources, given existing studies. Areas previously unsurveyed will be subject to study. Actual determination of impacts and mitigation measures will be developed according to agency requirements.

Land Use. Low adverse impacts to land use can be expected from construction of the North corridor and the Cities-to-Getty common power and syncrude corridor. An insignificant amount of range would be lost. No agricultural lands would be affected. Approximately 52 acres of public surface or mineral holdings could be affected by the North corridor. Rangely B corridor, because of its length and rangeland traversed, could have medium adverse impacts, especially during construction.

Recreation. Low-to-medium beneficial impacts on recreation would probably occur due to development of all corridors. Lands which are currently unavailable for recreational use would be opened for possible off-road vehicle use and hunting. Access would be controlled during the life of the project; thus, such recreational use would probably follow project abandonment. Rangely B is rated equal to the others for this purpose.

Visual Resources. The Cities-to-Getty common corridor to La Sal, and the North pipeline alternatives would have similar, very low adverse visual impacts. Both of these corridors would be on the Roan Plateau. The Rangely corridor would have a greater adverse visual impact due to greater length and visibility of the corridor to the general public in the vicinity of Rangely.

Transportation. Transportation impacts of the pipeline corridors would be low, yet beneficial, because of improvements to the existing pipeline system and because new systems would be available to transport other commodities. The relative beneficial impacts were assessed based upon the length and potential availability of the pipeline network to future users. As such, the Rangely product pipeline would have slightly greater beneficial impacts of the alternatives analyzed.

Energy. Energy impacts for the pipeline corridors would be directly related to length and therefore proportional to energy use. Longer corridors would result in higher adverse impacts due to the increased need for pumping. Impacts of product pipelines are rated as low adverse impacts. The La Sal pipeline, because of its relatively shorter length, would have slightly lower adverse impacts when compared to the Rangely alternative. The corridors constructed for power transmission (i.e., North corridor and the Cities-to-Getty corridor) are assessed as having overall low beneficial impacts due to expansion of the power distribution system.

2.4.3.2.8 Water Supply. The alternative to the GCC Joint Venture system (which is addressed in the CCSOP EIS - BLM 1983a) is the Larkin Ditch system. Larkin Ditch consists of a previously established (and permitted by the Corps) intake structure on the south side of the Colorado River near De Beque, with an existing irrigation ditch. Cities Service would construct a sedimentation pond and a pumping facility and pipeline across the river (a hanging pipeline on the De Beque highway bridge is assumed) should this alternative be constructed. The pipeline would then follow the GCC corridor and utilize the GCC reservoir site for storage. Therefore, the only difference between the preferred and alternative actions is the withdrawal point, sedimentation pond, and pipeline to the GCC reservoir. The total amount of water withdrawn by Cities Service would not increase. As a result, Table 2.4-16 shows only the increment of additional adverse impacts attributed to the necessary additional construction, operation, and use of the Larkin Ditch components in a separate location on the river. The CCSOP EIS (BLM 1983a) ratings for the GCC Joint Venture system (notably the Upper Dry Fork reservoir - BLM's preferred alternative) are also recalled, and both alternatives are discussed below.

Topography. The alternative action (Larkin Ditch) would cause slightly greater adverse impacts to topography over and above the proposed action, because of additional disturbance due to Larkin Ditch activities (even though specific acreage disturbances will be offset by a reduced size GCC system, according to Cities Service). The Upper Dry Fork reservoir site was rated medium adverse due to topographic changes during construction.

Geology. The alternative action would result in similar (low adverse) impacts to existing geology when compared with the proposed action.

Paleontology. The inundation of a portion of Roan Creek valley by the Upper Dry Fork reservoir could restrict the access to potential paleontological resource sites. The alternative would result in similar impacts to paleontological resources, generally of a low adverse magnitude. The excavation and construction of a water pipeline in the Roan Creek valley could also impact potential paleontological resources.

Surface Water. While the alternative Larkin Ditch diversion could cause stream flow disruption at another point on the Colorado River compared to the proposed GCC diversion, the same total amount would be withdrawn for each. In addition, a sedimentation basin to be located within the floodplain of the Colorado River could restrict some degree of flow conveyance during flood flow events. Present agricultural water uses could be displaced by industrial water use for project purposes.

Soils. The very low adverse soil impacts of the Larkin Ditch water supply system add slightly to those of the proposed action, largely because they cause an additional loss of about 20 acres of prime farmland. The incremental soil loss is also slightly greater (690 tons) for the alternative as compared to the proposed action. Upper Dry Fork reservoir was rated to have the least adverse effects of the reservoir sites, primarily due to incremental soil losses during construction.

Table 2.4-16 IMPACT COMPARISONS FOR WATER SUPPLY ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	GCC Joint Venture System (Proposed Action)[b]	Larkin Ditch System (Alternative)[c]
Topography	−1.0	−0.1
Geology	−0.8	−0.1
Paleontology	−0.5	−0.1
Surface Water	−1.5	−0.5
Soils	−1.6	−0.1
Aquatic Ecology	−1.2	--[d]
Vegetation	−3.0[e,f]	−0.5[f]
Wildlife	−2.1	−0.1[f]
Cultural Resources	−0.4	−0.1
Land Use	+0.4	−0.5
Visual Resources	−0.9	−0.1

[a] Only pertinent disciplines for impact assessment are shown.
[b] Rating is shown from CCSOP EIS (BLM 1983a) for Upper Dry Fork reservoir site (BLM's final preferred alternative). Cities Service is only responsible for a portion (nominally one-third) of the GCC Joint Venture System impacts.
[c] Only the additional incremental impacts attributed to the Larkin Ditch components are shown.
[d] Aquatic ecology impacts of the Larkin Ditch alternative regarding the Colorado River have been primarily assessed in the 404 permit for that intake facility. These impacts will be reassessed in the future if construction activities cause an amended permit application to be filed. Additional diversion beyond that previously addressed for the GCC Joint Venture (see CCSOP EIS - BLM 1983a) will not occur as a result of the Larkin Ditch alternative.
[e] This rating considers impacts to threatened and endangered plant species. Mitigation of impacts has received commitment from the GCC (BLM 1983a). The biological assessments and opinions rendered for this project (see Section 1.3.1) further define committed mitigation for threatened and endangered vegetation species.
[f] See Section 2.4.2.

Aquatic Ecology. Aquatic ecology impacts of the Larkin Ditch alternative on the Colorado River were assessed in the 404 permit for that intake facility. These impacts will be reassessed in the future if construction activities cause an amended permit application to be filed. Additional diversion beyond that previously addressed for the GCC Joint Venture (BLM 1983a) would not occur as a result of this alternative. Upper Dry Fork was rated to have the least adverse effects to aquatic biota of the Roan Creek reservoir sites.

Vegetation. The GCC water storage and supply alternative described in BLM (1983a) would have high adverse impacts to vegetation and special interest plant species. Upper Dry Fork would have the highest adverse impacts of all the Roan Creek reservoir sites, based on location of populations of these special interest species. Additional disturbances associated with Larkin Ditch are expected to have low adverse impacts to vegetation.

Wildlife. The Larkin Ditch alternative would have slightly higher adverse impacts to wildlife when added to those of the GCC system. The GCC system would eliminate about 140 acres of riparian habitat and 1,700 acres of mule deer winter range, winter concentration areas, and critical habitat (BLM 1983a). Upper Dry Fork has the highest relative adverse impacts to wildlife habitat of all the Roan Creek sites. By comparison, the Larkin Ditch system would affect about 10(*) acres of riparian habitat. See Section 2.4.2.

Cultural Resources. Potential impact on cultural resources (given the existing federal and state cultural resources regulations) would be insignificant. The GCC Joint Venture system impacts are addressed in BLM (1983). All Roan Creek reservoir sites are rated similar low adverse impacts. Impacts of the Larkin Ditch alternative appear to be insignificant due to the existing impacts to the area. Areas previously unsurveyed will be subject to study. Actual determination of impacts and mitigation measures will be developed according to agency requirements. Mitigation measures would eliminate most, if not all, adverse impacts to sites potentially eligible for the National Register of Historic Places.

Land Use. The Larkin Ditch water supply alternative would have low adverse impacts, compared to slightly beneficial impacts for the GCC water supply system (including Upper Dry Fork reservoir) as presented in BLM (1983a). Construction of a sedimentation pond for the Larkin Ditch alternative would affect a cattle feed lot and an existing gravel pit. It is not expected that the GCC system would be appreciably reduced in size by construction of the Larkin Ditch alternative, and would not thereby offset the impacts. No public lands would be affected.

Visual Resources. The proposed action water supply system presented in BLM (1983a) would have a low adverse to low beneficial impact, depending on operational characteristics. The Upper Dry Fork site is rated low adverse, assuming major fluctuations in water level during operations. The Larkin Ditch alternative, although in an area already impacted, would add a similar low adverse visual impact due to its proximity to the I-70 corridor and the location of its pipeline.

2.4.3.2.9 Power Generation. An alternative to the purchase of power from off-site sources is cogeneration of power on-site. Impact comparisons for pertinent disciplines concerning cogeneration versus off-site purchase of power are given below and in Table 2.4-17. In general, cogeneration of power would cause more site-specific environmental impacts. Off-site impacts of power purchase were not assessed except for energy.

Surface Water. The cogeneration of power would introduce additional surface watershed disturbance and water consumption. Surface water impacts would be slightly adverse compared to the proposed action (which has essentially no on-site impacts).

Air Quality. With cogeneration added to the project alternatives, the 24-hour TSP concentrations are predicted to consume or exceed the PSD Class II increment for all alternatives except the 50,000 bpd (40,000 Union B/10,000 VMIS), 50,000-bpd all Lurgi, and the additional retort at 50,000 bpd. No other consumption or exceedance of the PSD increments or NAAQS would occur. All SO_2 and TSP concentrations for the regulated averaging times in the Class I and Category I sensitive receptors are less than 1 $\mu g/m^3$. A Level I visibility screening analysis of cogeneration with the proposed action indicates an NO_x-caused dark plume against a bright sky would be visible out to 40 miles from the facilities and a light plume against dark terrain caused by TSP would be visible out to 48 miles from the facility. A refined Level 2 analysis indicates a potential for visibility degradation in the Flat Tops Wilderness on 7 days during the visitor season.

Noise. Cogeneration would add only slightly to the process facilities adverse noise impacts. The additional noise from cogeneration could be masked by the other facilities.

Visual Resources. The visual impacts of purchasing power would relate to the transmission line serving the project, which would be required regardless of whether or not power is generated on-site. Power generation on-site (cogeneration) would contribute to the adverse impacts due to the need to expand facilities on-site.

Table 2.4-17 IMPACT COMPARISONS FOR POWER GENERATION ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	Purchase Off-Site (Proposed Action)	Cogeneration On-Site (Alternative)
Surface Water	-0-	−0.5
Air Quality	-0-	−0.4
Noise	-0-	−0.2
Visual Resources	-0-	−0.5
Energy	−0.8	−0.6

[a] Only pertinent disciplines for impact assessment are shown.

Energy. Purchasing power from an outside grid would place additional demands on that grid, and would have an adverse impact. The precise location of the power within the grid and associated environmental impacts cannot be precisely determined at this time. Considering that the current power grid appears to be adequate for the anticipated project uses, the impact is rated as low. Cogeneration would be a beneficial impact in that it would create additional power for use within the facility, thereby reducing the demand for imported power.

2.4.3.2.10 Transport of Workers and Materials. As an alternative to the transport of workers and materials by vehicles (buses and trucks from De Beque up the Conn Creek road to the base of the mesa), Cities Service has considered rail transport for workers to a point near the Conn Creek/Roan Creek confluence as an alternative. Impact comparisons for appropriate disciplines are shown in Table 2.4-18 and described below.

Wildlife. The use of rail instead of buses to transport workers would result in relatively lower adverse impacts to wildlife, since a significant reduction in the number of round-trips is expected. The nearly 200 bus round-trips per day would cause medium adverse impacts to wildlife, primarily as a result of roadkills and noise. The incidence of roadkills would diminish significantly if workers were transported by rail, since the number of required round-trips per day would be about six. Noise effects on wildlife would likely remain the same as the proposed action. Noise intensity from the rail system would probably be greater than that expected from buses; however, the incidence and duration should be considerably less. See Section 2.4.2.

Air Quality. Significant air emissions and, thus, air quality impacts are not expected from either of these transportation alternatives. Both rate very low adverse impacts.

Noise. Bus and truck noise for the Cities Service project could be perceptible to residents along this road segment. This rates a low adverse impact. Railroad noise, however, would be perceptible to residents along this corridor. Due to the low frequency, penetrating rumble characteristic of trains, the noise levels may be objectionable to some of these individuals. This rates a higher relative (yet still low adverse) impact.

Visual Resources. The visual impact of trucking supplies to the project site from a De Beque railhead would result from the roadway previously addressed. Therefore, no additional impact would be expected. A railhead at the Conn Creek confluence would require construction of a railroad line up Roan Creek valley. A minor linear and form impact would result from construction of this line.

Transportation. Use of either the vehicular transportation system or the rail system would not significantly affect the overall transportation characteristics of the area. The vehicular transportation system is rated as a very low adverse impact because it could cause some traffic congestion and subsequent traffic problems (e.g., accidents). This adverse aspect of the vehicular transportation system is somewhat offset by the improved transportation network up the Roan Creek valley. The rail system is rated as a very low beneficial impact because of the improved transportation system. Problems of traffic congestion are not anticipated with the rail system.

Energy. Both alternatives are rated as low adverse impacts because of the consumption of energy to operate the transportation systems. Rail transportation is more efficient than vehicular transportation and is rated a lower relative adverse impact.

2.4.3.2.11 No Action Alternative. The No Action alternative for the Cities Service project was described in Section 2.3.2.5. For impact comparison purposes, implications of the No Action alternative are many. These include the following:

- Non-development of the oil shale resource, increasing U.S. dependence on foreign energy sources.
- Elimination of the economic and social benefits of the project to Colorado's Western Slope.
- Non-use of the water, which would be put to beneficial industrial, commercial, and domestic uses before leaving Colorado if the project were developed.

- No adverse environmental impacts to the immediate area's and region's air, surface and ground water, wildlife, vegetation, soils, and aquatic resources; the social and economic environment; cultural resources, land use, recreation and wilderness values; visual resources and noise; and the area's topography, paleontology, and geology.

- No beneficial impacts to the above components of the environment (e.g., beneficial impacts to transportation and land use due to reservoir, road, and pipeline construction for the project).

These impacts or non-impacts compare to those related to project development depending upon individual values, national policy matters, agency missions, and many other factors.

Table 2.4-18 IMPACT COMPARISONS FOR TRANSPORTATION ALTERNATIVES, CITIES SERVICE SHALE OIL PROJECT

Discipline[a]	Bus and Truck Transport (Proposed Action)	Rail Transport (Alternative)
Wildlife	−1.5[b]	−0.7[b]
Air Quality	−0.3	−0.1
Noise	−0.2	−0.5
Visual Resources	−0.1	−0.5
Transportation	−0.1	+0.1
Energy	−0.4	−0.1

[a] Only pertinent disciplines for impact assessment are shown.
[b] See Section 2.4.2.

3.0

Affected Environment

3.1.3 Ground Water

3.1.3.1 Regional Setting

Ground Water Occurrence

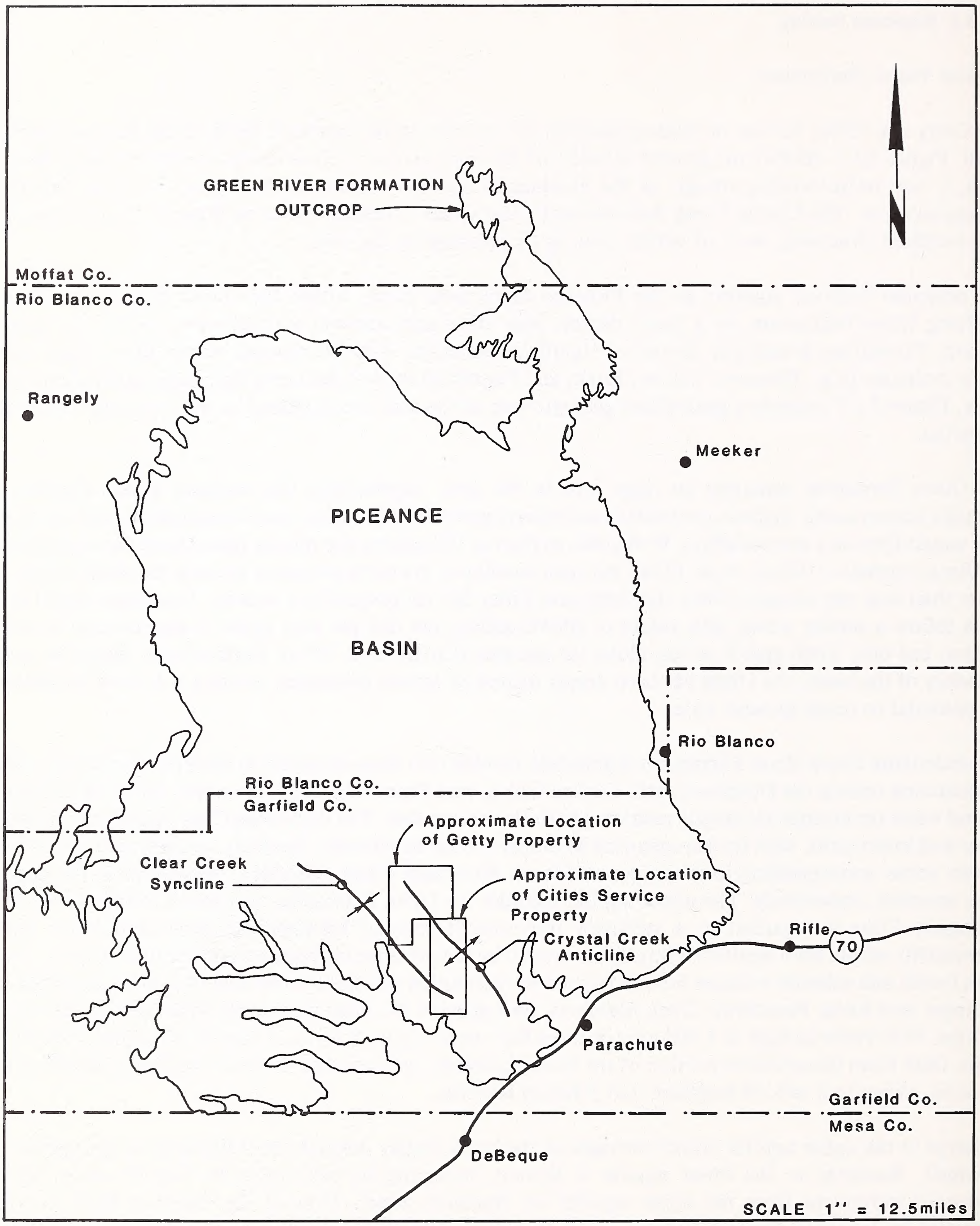
The Getty and Cities Service oil shale properties are located on the southern flank of the Piceance Structural Basin. Figure 3.1-1 exhibits the general location of the respective properties relative to the Piceance Basin. The basin, a northwest-trending trough, is the dominant structural feature of the region, although faulting and folding do occur. The Crystal Creek Anticline and Clear Creek Syncline, shown on Figure 3.1-1, are examples of such localized structures, both of which occur at or proximal to the sites.

The principal bedrock aquifers in the Piceance Basin area occur within the Green River Formation. The overlying Uinta Formation, to a lesser degree, may store and transmit ground water, while the underlying Wasatch Formation is typically devoid of significant aquifers. Alluvial deposits within the stream valleys of major drainages (e.g., Piceance, Yellow, Roan, and Parachute creeks) also carry significant quantities of ground water. Figure 3.1-2 presents a generalized geologic map of the area encompassed by the Getty and Cities Service properties.

The Uinta Formation outcrops on ridge tops in the area, representing the youngest strata. Ground water generally occurs under fracture-controlled (secondary) permeability, rather than interstitial porous spaces of the rock matrix (primary permeability). Well yields as high as 100 gallons per minute (gpm) have been reported from the Uinta Formation (Weeks et al. 1974), but such conditions are more prevalent towards the center of the basin, rather than near the margins where the Getty and Cities Service projects are located. Transmissivities for Uinta strata follow a similar trend, with values of 20,000 gallons per day per foot (gpd/ft) encountered in the basin interior, but only 3,000 gpd/ft or less along the margins (Coffin et al. 1971). Furthermore, along the southern boundary of the basin, the Uinta has been deeply incised by stream drainages, creating a drained condition with less potential to retain ground water.

The underlying Green River Formation is generally divided into three members in the Piceance Basin. These are (in ascending order): the Douglas Creek, Garden Gulch, and Parachute Creek members. Oil shale horizons and ground water occurrence are largely restricted to the latter member. The Parachute Creek Member is divided into upper and lower units, with the kerogen-rich Mahogany Zone in between. Similarly, ground water occurs in two distinct zones corresponding to the upper and lower Parachute Creek Members, referred to as the upper and lower aquifers, respectively. The upper aquifer includes the Uinta Formation over much of the region, and the Mahogany Zone is regarded as a relatively impermeable barrier between the upper and lower aquifers. Permeability within both aquifers is largely controlled by the presence of fractures and solution cavities. Leached zones (voids and solution collapse breccia formed by dissolution of soluble minerals) have been identified within the upper and lower Parachute Creek Members, and provide the most permeable zones within the respective aquifers. Well yields as high as 1,000 gpm or more have been reported for each aquifer throughout the Piceance Basin. Data from the southern portion of the basin, however, indicate that the lower aquifer is largely absent in this area, owing to a lack of fractures and solution features.

Recharge to the upper aquifer occurs throughout the basin largely through the infiltration of precipitation and snowmelt. Recharge to the lower aquifer is limited, occurring by infiltration in outcrop areas and some downward movement from the upper aquifer via fractured zones. Flow in the Piceance Basin is typically controlled by localized fracture systems or, in the case of the lower aquifer, by dissolution zones. Regional ground water flow is generally downward and towards the basin center, although local variations on this trend occur, particularly along basin margins (Coffin et al. 1971). In general, bedrock aquifers beneath the Getty and Cities Service properties are hydrogeologically isolated from the remainder of the basin. The general hydrogeologic characteristics of the specific Getty and Cities Service properties are discussed in Sections 3.2.3 and 3.3.3 of this FEIS, respectively. More detailed site-specific data to be collected during mine permitting studies will allow further delineation of hydrogeologic conditions, including potentiometric surfaces and their relationship to regional trends.



Source: RMAG (1974).

Figure 3.1-1 Geologic Location Map of the Getty and Cities Service Properties.

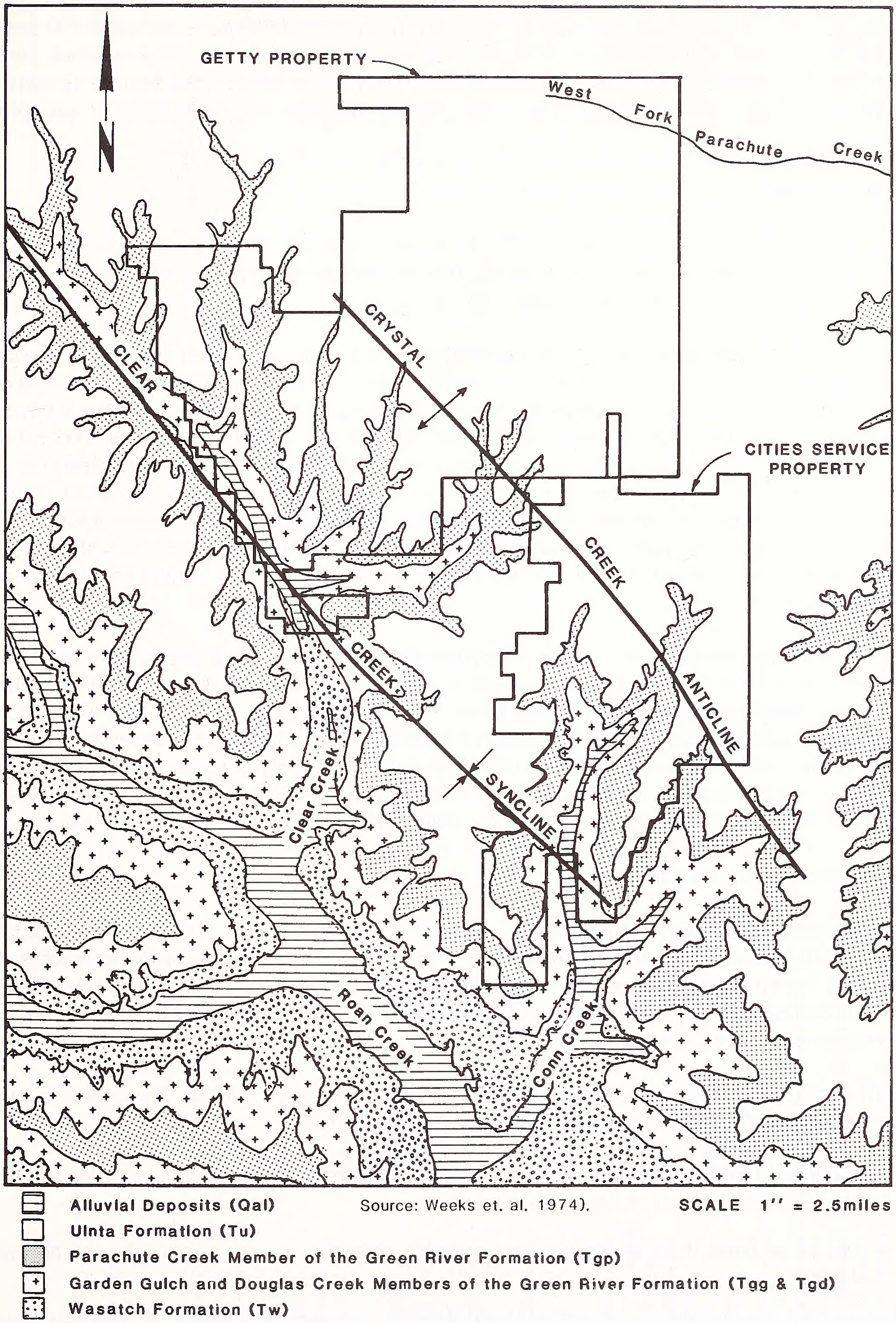


Figure 3.1-2 Generalized Geologic Map of the Getty and Cities Service Properties.

Alluvial aquifers beneath principal stream valleys of the Piceance Basin are generally less than 0.5 mile in width, and range in thickness from 0 to 140 feet (Coffin et al. 1971). Saturated thicknesses as high as 100 feet have been reported for the Piceance Creek drainage. Well yields as high as 2,000 gpm have been reported, but long-term maintenance of these rates may be restricted by the limited lateral extent of the valley bottom deposits. Recharge to the alluvial aquifers occurs via discharge from bedrock aquifers and infiltration of precipitation and streamflow.

Ground Water Quality

The water quality of alluvial and bedrock aquifers is quite variable. Water quality in bedrock aquifers is dependent on lithology, depth, and location within the Piceance Basin, whereas water quality of the alluvial aquifer is largely a function of the lithochemistry of the deposits.

Concentrations of total dissolved solids (TDS) exhibit a general increase with depth and with increasing distance from recharge areas. As a result, higher TDS values are typically associated with the lower aquifer (as opposed to the upper aquifer), and occur more towards the center of the basin. TDS concentrations range from 250 mg/l to about 2,500 mg/l in the upper aquifer, with typical value in the range of 800 to 1,800 mg/l. TDS concentrations in the lower aquifer are as high as 50,000 mg/l or more, specifically near the basin center (Coffin et al. 1971). The high concentrations of dissolved solids in water bearing intervals below the Mahogany zone result from the dissolution of highly mineralized zones, including nahcolite, in these strata. Bedrock ground water is generally a sodium bicarbonate type, although appreciable concentrations of calcium, magnesium, chloride, and sulfate may also occur. High concentrations of chloride, fluoride, boron, lithium, and barium have also been reported for the lower aquifer.

Water quality in the alluvial aquifers is similarly variable with general down-gradient increases in TDS (Weeks et al. 1974). TDS values range from 250 mg/l to as high as 25,000 mg/l. The latter concentration typically occurs in lower reaches of drainages where strata of lower Green River or Wasatch Formations are exposed (Coffin et al. 1971). In general, the alluvial water quality is largely a function of the dissolution of minerals within the alluvial deposits, recharge conditions associated with streamflow or adjacent bedrock strata, and irrigation return flow. Alluvial ground water ranges in water type from calcium/magnesium-bicarbonate to sodium-bi-carbonate. Table 3.1-1 provides water quality data for monitor wells in the southern Piceance Basin area.

3.1.3.2 Common Project Facilities

The proposed common corridor within the Getty property crosses upland and valley areas. The upland areas are underlain by Uinta and Green River Formation strata, whereas valley areas include the upper reaches of the West Fork (and Wet Fork tributary) Parachute Creek. Hydrostratigraphic units in these environments, therefore, include fractured/leached marlstones of the upper Parachute Creek Member of the Green River Formation, and alluvial deposits within the drainage valleys.

Site-specific data are limited to a survey of springs in the corridor area (Getty 1983a). These data are suggestive of several probable characteristics of the hydrogeologic environment:

- Uinta and Upper Parachute Creek strata are at least partially saturated, with various points of spring discharge at or near their contact.
- Discharge from these bedrock strata probably provides for some saturation of alluvial deposits.
- Based on topographic and surficial geologic data, the alluvial deposits are likely thin and unstratified, and do not represent a significant aquifer.
- Based on limited conductivity and pH data, the water quality of discharging springs appears to be typically good.

Table 3.1-1 AVERAGE GROUND WATER QUALITY IN THE SOUTHERN PICEANCE BASIN AREA[a]

Property	Well No.	Completion Interval	TDS	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Carbonate	Sulfate	Chloride	Iron	Boron	pH (Std. Units)
Pacific[b]	DH-1L	UPCM[c]	360	27	6.4	93	2.8	327	0	55	4	2.8	<0.1	7.4
	DH-2L	UPCM	400	65	25	42	0.9	320	0	66	18	0.54	<0.1	7.3
	DH-5L	UPCM	467	54	22	102	4.3	427	0	94	6.3	3.0	<0.1	7.8
	DH-10	Uinta	933	287	0.5	57	24.0	0	62	25	19	44.0	<0.1	11.1
	DH-20	Uinta	1,750	578	0.5	72	61.0	0	82	7	12	1.3	0.1	11.8
	DH-50	Uinta	380	48	21	76	2.6	282	27	91	4	0.97	<0.1	9.3
	VB-4B	Alluvium[d]	596	73	47	121	5.2	465	0	150	11	10.4	0.2	7.7
	VB-5B	Alluvium[e]	1,200	96	102	163	3.6	598	0	555	12	0.84	0.3	7.1
	VB-6B	Alluvium[d]	613	161	61	78	4.9	490	0	155	15	27.0	0.4	7.4
Chevron[f]	CC-A	UPCM	550	23	21	160	2.0	390	0	85	6	0.06	0.3	7.5
	CC-4(A)	UPCM	540	58	34	96	0.3	400	0	81	2	0.5	0.1	7.0
	CC-6(A)	UPCM	540	55	41	82	0.6	390	0	40	2	0.1	0.2	7.0
	CC-B	LPCM[g]	680	6	11	250	0.8	600	0	6	0	0.2	0.3	8.0
	CC-4(B)	LPCM	3,000	12	17	1,100	0.6	2,800	0	40	2	0.23	0.4	7.5
	CC-L4	LPCM	23,500	5	4	9,300	60.0	11,000	0	2	6,000	1.0	9.0	8.2
	CC-7(B)	LPCM	540	12	18	180	0.2	470	0	25	0	0.15	0.3	7.4
	CC-ALL-4	Alluvium[d]	600	70	45	75	2.2	360	0	140	12	0.1	0.3	6.8
	CC-ALL-8	Alluvium[d]	1,700	130	125	230	3.9	540	0	750	23	0.6	0.4	6.9
	CC-ALL-12	Alluvium[d]	550	53	41	92	4.0	380	0	130	10	0.04	0.5	7.0
Union[h]	OM-1-82H	UPCM	460	47	32	96	1.4	300	106	106	12	17.0	0.5	7.9
	OM-1A-82H	UPCM	505	72	38	64	5.2	305	143	143	5	0.43	0.2	8.0
	OM-2-82H	UPCM	325	39	10	60	0.8	213	54	54	2	1.52	0.1	8.2
	OM-3-82H	UPCM	275	27	6	69	1.8	180	76	76	2	3.52	0.1	8.3
	PW-1	Alluvium[i]	442	63	40	47	2.9	357	0.5	119	15.3	ND[j]	ND	7.6
	PW-2	Alluvium[k]	557	64	49	86	2.6	371	1.8	213	15.2	ND	ND	7.8
	PW-3	Alluvium[d]	725	80	61	101	3.5	372	3.9	140	96.3	ND	ND	7.7

[a] All concentrations reported in mg/l unless otherwise noted.
[b] Source: CDM (1983e).
[c] UPCM = Upper Parachute Creek Member of the Green River Formation.
[d] Alluvial deposits of Clear Creek.
[e] Alluvial deposits of Conn Creek.
[f] Source: BLM (1983a).
[g] LPCM = Lower Parachute Creek Member of the Green River Formation.
[h] Source: UOC (1984).
[i] Alluvial deposits of the East Fork Parachute Creek.
[j] ND = No Data Available.
[k] Alluvial deposits of the West Fork Parachute Creek.

All of the springs emanating from bedrock strata along or near the corridor discharge into the Wet Fork of the West Fork Parachute Creek. In this manner, bedrock aquifers serve as a recharge mechanism for alluvial deposits in the West Fork, as well as potential contributors to base stream flow in that drainage. Further discussion of spring discharge is provided in Sections 3.2.3 and 3.3.3.

Ground water characteristics of the Roan Creek reservoir site are addressed in BLM (1983a). To summarize, the Roan Creek water supply reservoir and associated corridor is underlain by alluvial and other unconsolidated deposits. The deposits, in turn, are underlain by bedrock strata of the Wasatch Formation. Bedrock of the Wasatch Formation is generally not considered a significant source of ground water, although some lenticular sandstone aquifers may occur in the Shire Member. The Roan Creek valley contains alluvial deposits that can be classified as an aquifer. No site-specific data are available on this aquifer, but existing water use, including nine wells in the vicinity (BLM 1983a), indicates that at least some of the sediments are sufficiently permeable and saturated so as to allow ground water extraction for domestic, stock, and irrigation use.

3.2.3 Ground Water

Ground Water Occurrence

The hydrogeologic environment of the Getty resource property is dominated by sandstone and marlstone strata of the Uinta Formation at the surface, and the underlying marlstones of the upper Parachute Creek Member of the Green River Formation. A geologic map showing the Getty property is provided in Figure 3.1-2. The spent shale disposal area, syncrude corridor, and additional retort facilities are underlain by the Uinta Formation, whereas the initial retort and upgrading facilities in Short Gulch are underlain by the Upper Parachute Creek Member. The water and power corridor would traverse alluvial deposits in the valleys of Clear Creek and Buck Gulch before crossing Uinta and upper Parachute Creek strata atop the Roan Cliffs. Site-specific information for these hydrostratigraphic units are lacking, but their probable characteristics can be inferred from data available from adjacent oil shale properties.

The Uinta Formation in this sector of the Piceance Basin is typified by interbedded sandstones and marlstones. Bedding is often discontinuous and lenticular and not traceable for any distance. Permeability conditions are controlled by primary (interstitial openings in the rock matrix) and secondary (fracture) systems. Data from the Pacific property to the south indicate that primary and secondary permeability decreases with depth (CDM 1983e). The occurrence of ground water within the Uinta Formation is highly variable. Information from the Chevron property indicates the Uinta Formation is well drained and largely unsaturated (BLM 1983a). Drill hole/monitor well data and spring discharges on the Pacific property are indicative of at least partially saturated conditions (CDM 1983e). Similarly, exploratory drill holes on the Getty property encountered cascading water from the Uinta interval, suggesting saturated zones are present (Getty 1983a). The occurrence of numerous springs throughout the Getty property, emanating from at or near the Uinta/Upper Parachute Creek contact confirms the probability of partially saturated conditions within Uinta strata. Based on single well test data from the Pacific property, the hydraulic conductivity of Uinta Formation ranges from 5.4×10^{-4} to 2.4×10^{-2} feet/day (CDM 1983e). This variability is due to the lateral and vertical differences in lithology and fracture intensity.

Ground water also occurs in strata of the underlying Parachute Creek Member. Flow beneath the Chevron property is confined to thin, sandy siltstone layers above and below the Mahogany Oil Shale Zone, known as the A and B grooves, respectively. The predominant water-bearing interval beneath the Pacific property, however, is a zone of fractured and leached marlstones above (and hydraulically isolated from) the A groove. The occurrence of this water-bearing leached zone within the Upper Parachute Creek Member is more typical within the Piceance Basin, than is its absence on the Chevron property (Coffin et al. 1971; Weeks et al. 1974). Testing data from the Pacific property show the leach zone to be more permeable than the Uinta Formation, with hydraulic conductivities ranging form 4.0×10^{-2} to 1.7×10^{-1} feet/day (CDM 1983e). Hydraulic conductivities for the A and B grooves on the Chevron property had ranges of 2.0×10^{-2} to 5.5×10^{-2} feet/day and 8.0×10^{-4} to 3.0×10^{-2} feet/day, respectively (BLM 1983a).

The leach zone on the Pacific property is bounded above and below by relatively impermeable (unfractured) marlstones, although the intertonguing of Uinta/Upper Parachute Creek strata at the northern end of the Pacific property and onto the Getty property (Hail 1978; Verbeek and Grout 1983) may allow for some downward ground water flow. On all properties, declining head with depth was observed, indicating potential for some downward flow.

The Mahogany Zone is not considered a significant water-bearing interval beneath the Getty property (Getty 1983a), nor any of the adjacent oil shale properties. Data from the adjacent Pacific property, including rock cores and hydraulic testing, show the Mahogany Zone to be relatively unfractured and flow permeability a hydraulic conductivity of less than 0.020 feet/day (7×10^{-6} cm/sec; CDM 1983e). Furthermore, with the exception of the B groove, no strata below the Mahogany Zone are considered significant sources of ground water (Getty 1983a; CDM 1983e; BLM 1983a).

Existing data do not allow precise determination of the direction of ground water flow within these bedrock strata. A potentiometric map, however, constructed for the Getty property (Getty 1983a) based on composite head in open drill holes exhibits an estimated flow gradient to the southwest, corresponding to the structural dip of the Crystal Creek Anticline. A similar southwesterly ground water flow direction was apparent for the leach zone interval beneath the Pacific property, whereas flow in the Uinta Formation roughly corresponded to the topographic surface (i.e., away from topographic highs). The preponderance of springs discharging to plateau drainages from near the Uinta/Upper Parachute Creek geologic contact suggests that these characteristics may also be indigenous to the Getty property, with some modification of geologic structure. The location of springs on the Getty property are shown on Figure 3.2-1. Although ground water flow direction on the Getty property and adjacent areas is dissimilar to that described elsewhere in the Piceance Basin, such a variance can be explained by the location of these sites on the margin of the basin.

Alluvial aquifers within the boundaries of the Getty property include valley fill deposits along Clear Creek and in Tom, Buck, and Doe gulches. The alluvial aquifer in Clear Creek has been addressed in BLM (1983a), and is presently being evaluated as a result of Chevron's proposed augmentation plan (5th District Water Court). Little or no data are available as to the extent, lithologic character, and degree of saturation in the latter three gulches. Based on their topographic expression, and data available for Deer Park Gulch on the Pacific property to the south, several general conditions can be inferred:

- Ground water probably occurs under unconfined conditions within the colluvial and alluvial sediments of the valley bottom
- Ground water levels may fluctuate seasonally
- The valley bottom aquifers are recharged by infiltrating streamflow and by springs discharging from bedrock strata along and atop the Roan Cliffs
- Ground water flow probably parallels surface topography (i.e., down gulch to Clear Creek canyon)

Based on available data, unconsolidated deposits in drainages on the plateau, including Wiesse and Short gulches, appear to be too thin and laterally restricted to be considered significant sources of ground water.

Water Quality

The water quality of the bedrock aquifers is generally good, based on spring discharge data on the Getty property and additional ground water quality data from the adjacent Chevron, Pacific, and Cities Service properties. Discharge and water quality data for springs on the Getty property are presented in Table 3.2-1. TDS values for all springs and upper Parachute Creek wells are uniformly in the range of 400 to 800 mg/l (Getty 1983a). Sodium bicarbonate waters predominate, although locally high calcium and sulfate concentrations occur. Based on data from the Pacific property, however, the Uinta Formation displays greater variability in water chemistry, particularly in the northern sector adjacent to the Getty property. High concentrations of calcium (greater than 500 mg/l in several instances) were observed, with TDS values as high as 1,800 mg/l (CDM 1983e). Little or no bicarbonate was encountered, owing to pH values in excess of 10.3. It is important to note that spring discharges from the Uinta Formation and Upper Parachute Creek Member on the Getty property and from the Uinta Formation on the Pacific property are low in dissolved solids, with TDS values consistently below 500 mg/l. The difference between dissolved solids from Uinta wells and springs suggests that groundwater flow to the springs may be a near-surface phenomenon and not associated with deeper bedrock flow (CDM 1983e). Fracture controlled permeability in near-surface areas allow discharge quantities as high as 240 gpm on the Getty property, whereas the low hydraulic conductivities discussed previously suggest a longer residence time for the "interior", unweathered strata.

Alluvial water quality is generally good, based on data from the adjacent Chevron and Pacific properties. Ranges in TDS concentrations are 550 to 730 mg/l and 310 to 570 mg/l for Clear Creek and Deer Park Gulch, respectively (CDM 1983e; BLM 1983a). Water type is generally mixed cation and anion, with variable concentrations of sodium, calcium, bicarbonate, and sulfate.

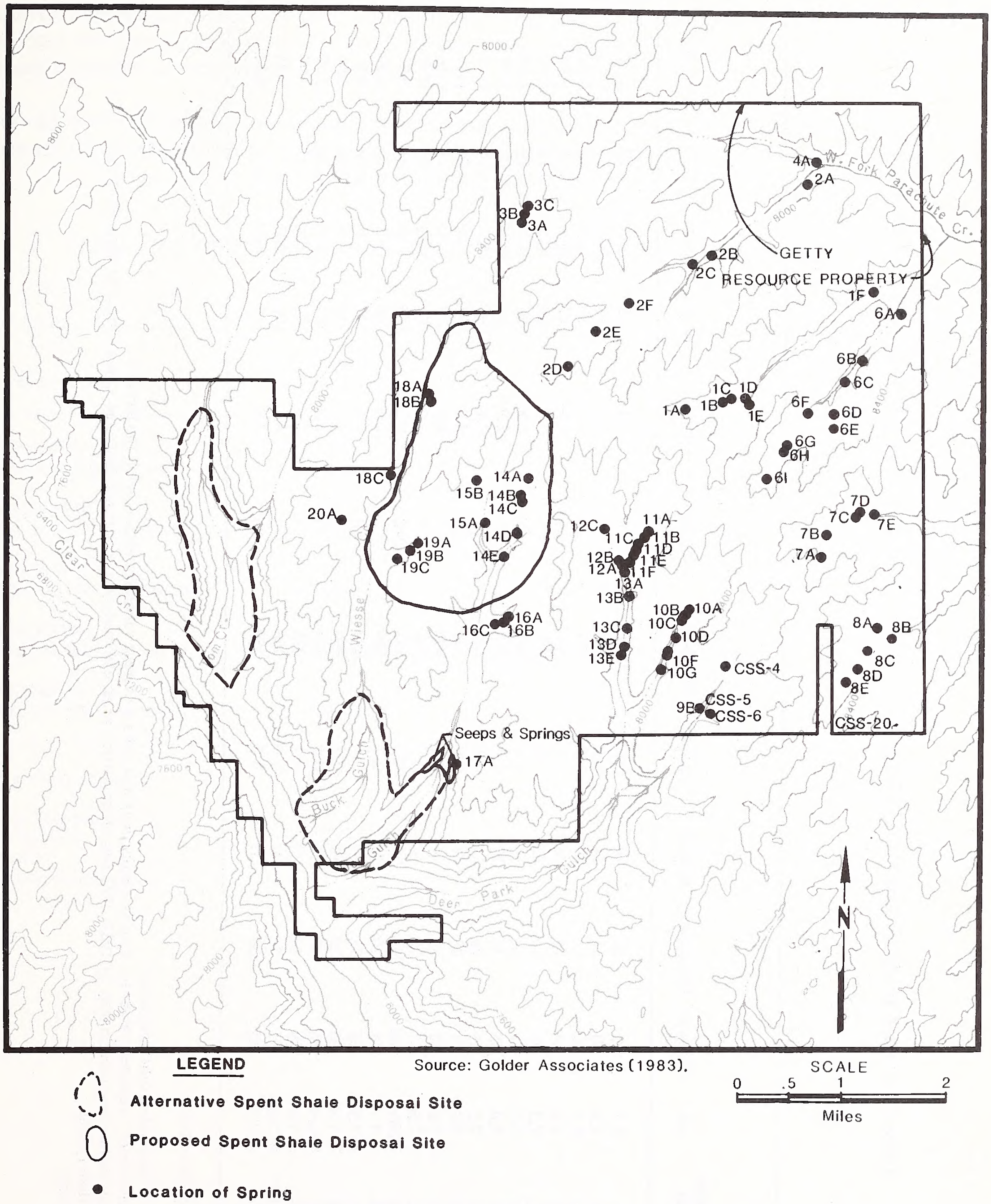


Figure 3.2-1 Location of Springs Relative to Spent Shale Disposal Sites, Getty Shale Oil Project.

Table 3.2-1 DISCHARGE AND WATER QUALITY DATA FOR SPRINGS ON THE GETTY PROPERTY[a]

Spring Number[b]	Discharge[c] (GPM)	pH	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Carbonate	Chloride	Sulfate	Iron	Boron	Strontium	Total Dissolved Solids (TDS)
1	130	7.1	52	15	28	0.7	264	<1	3.1	35	0.19	0.10	0.62	310
2	256	7.4	50	21	34	0.7	278	<1	2.1	42	0.05	0.12	0.83	326
3	319	7.1	53	17	27	0.7	270	<1	1.8	26	0.24	0.14	0.56	286
4	120	7.1	49	19	36	0.4	261	<1	4.0	47	0.09	0.15	0.60	326
6	241	7.3	61	24	42	0.9	277	<1	2.5	96	0.08	0.14	0.90	416
7	95	7.7	61	23	33	0.4	292	<1	2.8	86	0.10	0.10	0.59	395
8	88	7.4	65	26	32	0.4	286	<1	2.9	83	0.09	0.09	0.77	402
9	258	7.3	65	29	38	0.3	321	<1	3.4	95	0.11	0.11	0.78	412
10	395	7.6	57	28	37	0.5	340	<1	3.1	57	0.10	0.08	0.99	375
11	183	7.6	58	26	44	0.6	300	<1	4.4	77	0.15	0.11	0.86	385
12	65	7.6	53	25	42	0.7	306	<1	3.0	60	0.28	0.04	0.79	353
13	10	ND[d]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14	109	7.7	51	20	39	0.7	290	<1	2.6	46	0.12	0.06	0.80	307
15	92	7.5	52	22	37	0.7	298	<1	2.6	47	0.20	0.06	0.67	335
16	58	7.8	60	30	45	0.5	340	<1	4.9	76	0.14	0.04	0.91	406
17	32	6.9	66	47	55	0.4	414	<1	6.3	121	0.25	0.21	0.89	531
18	316	7.0	49	19	33	0.7	273	<1	2.4	37	0.10	0.12	0.77	312
19	50	7.0	73	34	45	0.6	358	<1	4.1	100	0.55	0.15	0.84	476
20	30	7.2	65	34	51	0.7	350	<1	3.1	115	0.24	0.14	0.83	488

Source: Golder Associates (1983).

[a] All concentrations in mg/l unless otherwise noted.
[b] Where multiple sources occur, reported values for specific conductivity and pH are average values for all sources at the location.
[c] Discharge values reported as measured in July of 1983; 1983 was characterized as an extremely wet year hence discharge values should be considered as appreciably higher than typical.
[d] ND - No data available.

Ground Water Use

An inventory of existing water rights indicates that no registered ground water wells occur on the Getty resource property. Five registered wells for stock, domestic, and irrigation use are situated within 3 miles of the property boundary. Well depths range from 4 to 350 feet, with yields ranging from 5 to 50 gpm (Getty 1983a). Table 3.2-2 presents available information for these five wells.

Four appropriated springs occur on the Getty property, and three more within 1 mile of the property boundary. These are tabulated in Table 3.2-3. Appropriated flows range from 0.05 to 0.5 cfs (0.4 to 3.7 gpm; Getty 1983a).

Table 3.2-2 GETTY RESOURCE PROPERTY PERMITTED OR DECREED WELLS

Well Location	Permit or Court No.	Use[a]	Depth (ft)	Well Yield (gpm)
T4S/R97W NW 1/4, NE 1/4, Sec 21	W-2590	3	4	10
T4S/R97 W SW 1/4, SW 1/4, Sec 29	W-2578	2	80	5
T4S/R98W NE 1/4, NW 1/4, Sec 25	025815	2	83	20
T5S/R98W SW 1/4, NE 1/4, Sec 10	76489	2	350	5
T6S/R97W NE 1/4, NW 1/4, Sec 22	013813-R	1	20	50

Source: Getty (1983a).

[a] Usage Classification
1. Irrigation
2. Stock
3. Domestic and Stock

Table 3.2-3 GETTY RESOURCE PROPERTY AND VICINITY APPROPRIATED SPRINGS

Well Location	Identification	Appropriation Date	Flow (cfs)
T4S/R97W NE 1/4, SW 1/4, Sec 33	Howell #2[a]	02-01-55	0.25
T4S/R97W SE 1/4, SW 1/4, Sec 33	Howell #1[a]	06-01-55	0.25
T4S/R97W SW 1/4, SW 1/4, Sec 33	Filener #1[a]	06-01-55	0.25
T5S/R97W NW 1/4, NW 1/4, Sec 4	Filener #2[b]	06-01-55	0.5
T5S/R97W SE 1/4, SE 1/4, Sec 1	Oldland #1[b]	08-15-73	0.05
T5S/R97W SE 1/4, NE 1/4, Sec 2	Oldland #2[b]	06-15-55	0.02
T5S/R97W NE 1/4, SE 1/4, Sec 2	Summers Spring[b]	06-01-51	0.03

Source: Getty (1983a).

[a] Springs located within the Getty resource property boundaries.
[b] Springs located within 1 mile of the Getty resource property.

3.3.3 Ground Water

Ground Water Occurrence

The hydrogeologic environment of the Cities Service resource property is dominated by sandstone and marlstone strata of the Uinta Formation at the surface, and underlying marlstones of the Upper Parachute Creek Member of the Green River Formation. A geologic map of the Cities property is provided in Figure 3.1-3.

Proposed retort and upgrading facilities, waste rock pile, and majority of shale fines pile would be situated on the Uinta Formation, whereas, the spent shale disposal area would be located in Conn Creek and Cascade Canyon, incised into Green River Formation strata. The alternative spent shale disposal areas would encompass areas underlain by Uinta and Upper Parachute Creek strata on the plateau. The water and power corridor would traverse alluvial deposits of Conn Creek, as well as the aforementioned bedrock units on and above the Roan Cliffs. Detailed site-specific information for these hydrostratigraphic units is somewhat limited. However, their probable characteristics can be inferred from limited data for the Cities property and from additional information available from adjacent oil shale properties.

The Uinta Formation in this sector of the Piceance Basin is typified by interbedded sandstones and marlstones. Bedding is often discontinuous and lenticular, such that no one strata can be correlated for any distance. Permeability conditions are controlled by primary (interstitial openings in the rock matrix) and secondary (fracture) systems. Data from the Pacific property to the west indicate that primary and secondary permeability decreases with depth (CDM 1983e). Ground water conditions resulting from this lithology are similarly variable. Whereas data from the Chevron property indicate the Uinta Formation to be well drained and unsaturated (BLM 1983a), drill hole/monitor well data and spring discharge on the Cities Service and Pacific properties are indicative of at least partially saturated conditions (CDM 1983e).

The occurrence of numerous springs throughout the Cities Service property, emanating at or below the Uinta/Upper Parachute Creek contact, confirms the probablility of partially saturated conditions within Uinta strata. Based on single well test data from the Cities Service and Pacific properties, the hydraulic conductivity of Uinta Formation ranges from 5.4×10^{-4} to 2.4×10^{-2} feet/day (CDM 1983e). This variability is undoubtedly due to the lateral and vertical differences in lithology and fracture conditions.

Ground water also occurs in strata of the underlying Parachute Creek Member. Flow beneath the Chevron property is confined to thin, sandy siltstone layers above and below the Mahogany Oil Shale Zone known as the A and B grooves, respectively. The predominant water-bearing interval beneath the Pacific and Cities Service properties, however, is a zone of fractured and leached marlstones above (and hydraulically isolated from) the A groove. The occurrence of this water-bearing leached zone within the upper Parachute Creek member is more typical within the Piceance Basin than is its absence on the Chevron property (Coffin et al. 1971; Weeks et al. 1974). Testing data from the Pacific and Cities Service properties show the leach zone to be more permeable than the Uinta Formation, with hydraulic conductivities ranging from 4.0×10^{-2} to 1.7×10^{-1} ft/day (CDM 1983e). Hydraulic conductivities for the A and B grooves on the Chevron property had ranges of 2.0×10^{-2} to 5.5×10^{-2} feet/day and 8.0×10^{-4} to 3.0×10^{-2} feet/day, respectively (BLM 1983a).

The leach zone on the Pacific and Cities Service properties is bounded above and below by relatively impermeable (unfractured) marlstones, although the intertonguing of Uinta/Upper Parachute Creek Strata at the northern end of the Pacific property and onto the Cities Service property (Hail 1978; Verbeek and Grout 1983) may allow for some downward ground water flow. Declining head with depth has been encountered on the Pacific, Chevron, Getty, and Cities Service properties, allowing the downward flow gradient, provided that vertical fracture conduits exist. Data from the Pacific property indicate that such fractures are confined to the aforementioned areas, where Uinta and Upper Parachute Creek strata are interbedded.

As shown on Figure 3.3-1, spring discharge has been documented from 40 locations on and immediately adjacent to the Cities Service property (Cities Service 1983a). These springs emanate from just above or below the contact between Uinta and Upper Parachute Creek strata. As such, they are indicative of infiltrating ground water that

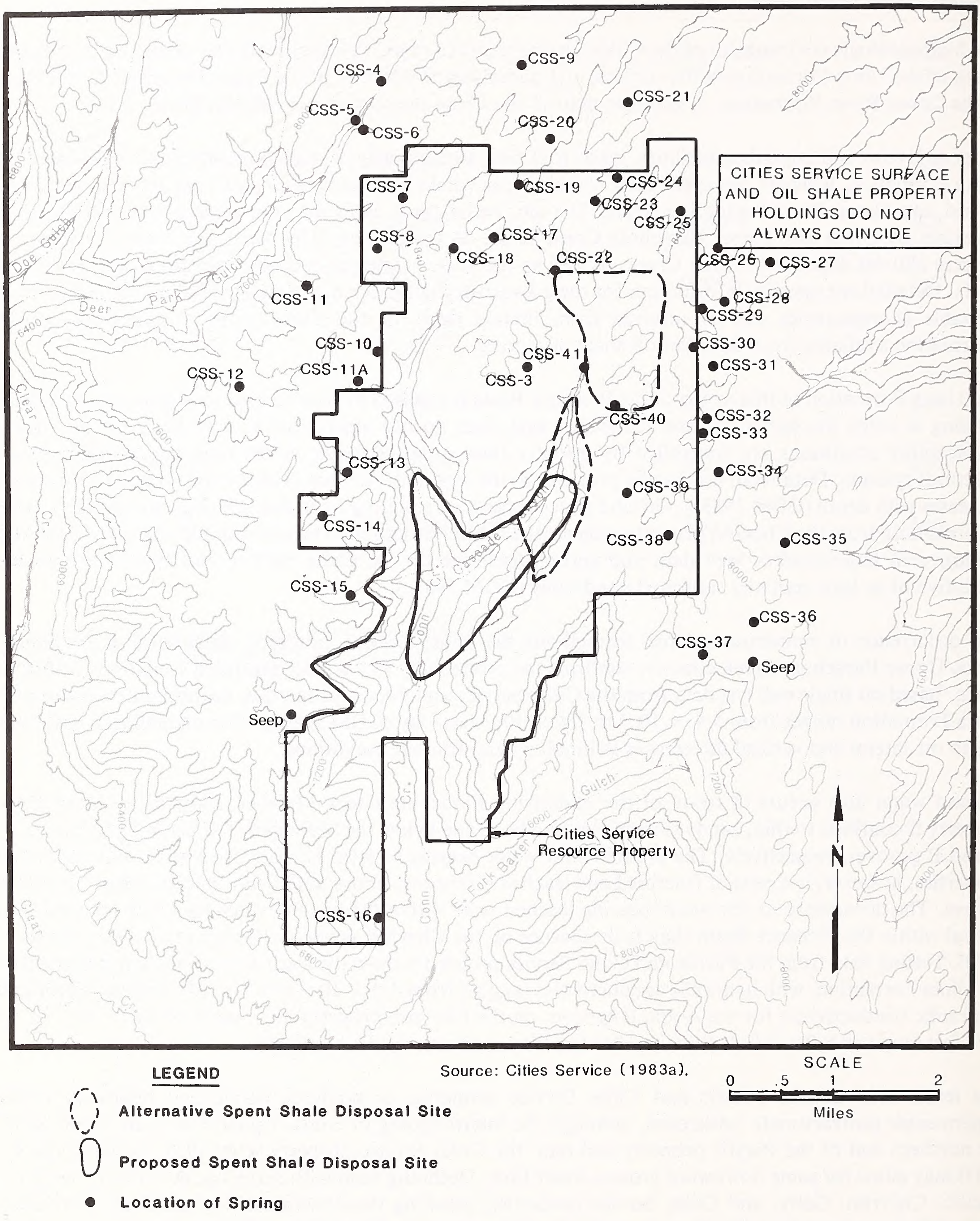


Figure 3.3-1 Location of Springs Relative to Spent Shale Disposal Sites, Cities Service Shale Oil Project.

moves downward through the Uinta Formation, discharging at the base of this unit or upper sections of the Upper Parachute Creek member. These discharge points are typically near the heads of the numerous ephemeral/intermittent streams drawing from the plateau, where erosion has allowed incision through the overlying bedrock strata. Total spring discharge, as shown in Table 3.3-1, was 1.2 cfs (536 gpm) during July of 1983, following abnormally wet winter and spring seasons.

The Mahogany Zone is not considered a significant water-bearing interval beneath the Cities Service property (Cities Service 1983a), nor any of the other adjacent oil shale properties. Data from the adjacent Pacific property, including rock cores and hydraulic testing, show the Mahogany Zone to be relatively unfractured and of low permeability, with a hydraulic conductivity of less than 0.020 ft/day (7×10^{-6} cm/sec; CDM 1982e). Similarly, core data from exploratory drill holes on the Cities Service property show the Mahogany zone to be relatively competent. Furthermore, with the exception of the B groove, no strata below the Mahogany Zone are considered significant sources of ground water (Cities Service 1983a; CDM 1983e; BLM 1983a). A single spring (CCS-16 on Table 3.3-1) emanates from the contact between the Douglas Creek Member of the Green River Formation and the underlying Wasatch Formation. This spring is located at the extreme southern end of the Cities Service property, with a measured discharge of less than 3 gpm (Cities Service 1983a). No other seeps or springs have been observed emanating from, at, or below the Mahogany Zone on the Cities Service or any of the adjacent properties (Cities Service 1983a; BLM 1983a; Chevron 1983).

Existing data do not allow a precise determination of the direction of ground water flow within the bedrock aquifers. Based on well and springs data from the Cities Service, Pacific, and Getty properties, flow in the Uinta Formation appears to be from topographically high areas to points of spring discharge in the drainage bottoms along the periphery of the mesa. As noted previously, some water may percolate downward through the Uinta and into the Upper Parachute Creek Member below. Data from the Pacific and Getty properties indicate a general southwesterly ground water gradient for the Upper Parachute Creek Member. Existing data, including topographic and stratigraphic/structural information, suggest that such a trend can be inferred for the southwestern portion of the Cities Service property as well, whereas a northeasterly gradient may occur on the northeastern sector of the property (Cameron Engineers 1974).

Valley fill deposits along Conn Creek in the extreme southern sector of the Cities Service property represent the only significant alluvial aquifer. Unconsolidated deposits of alluvial and colluvial origin occur in the upland reaches of Conn Creek and Cascade Canyon atop the plateau. Both are generally narrow and shallow in extent, based on topographic evidence. They may, however, provide a recharge mechanism for the lower valley fill on Conn Creek by the transmission of water discharged from bedrock springs. A single alluvial monitor well at the southern property boundary exhibited 50 feet of valley fill alluvium adjacent to Conn Creek. Thirty-nine feet of saturated thickness was encountered. Although no data are available, it is reasonable to assume that ground water flow in the Conn Creek alluvial aquifer likely parallels surface flow.

Water Quality

Based on spring (Table 3.3-1) and well (Table 3.1-1) data from the Cities Service and adjacent properties, the water quality of the bedrock aquifers is generally good. TDS values for all springs and wells completed in Upper Parachute Creek strata are uniformly in the 300 to 800 mg/l range. Spring discharge on the Cities Service property is comparable to that on the Pacific property (CDM 1983e), but slightly lower in TDS concentrations than exhibited on the Getty property (Getty 1983a). Sodium bicarbonate waters predominate, although locally high calcium and sulfate concentrations occur. Calcium often occurs as the dominant cation in Cities Service springs where TDS concentrations are low (in the 300 mg/l range; Cities Service 1983a). Springs and upper Parachute Creek wells typically have pH values in the 6.9 to 8.4 range.

Based on monitor well data on the Cities Service and Pacific properties, significant variation in water chemistry may occur within the Uinta Formation. TDS values as high as 1,800 mg/l were encountered in two wells (1 Cities Service, 1 Pacific; CDM 1983e). Little or no bicarbonate was encountered, owing to pH values above 10.3. Given the relatively good quality of identified Uinta spring discharge, it is apparent that isolated high TDS zones exist within the Uinta strata. Fracture controlled permeabilities in the near-surface areas allow spring discharge as high as 35 gpm with good quality water, whereas the low hydraulic conductivities observed at well locations may allow for greater dissolution of calcium carbonate strata, with little opportunity for movement or discharge from these more isolated zones.

Table 3.3-1 DISCHARGE AND FIELD WATER QUALITY MEASUREMENTS FOR SPRINGS ON CITIES SERVICE PROPERTY

Spring	Discharge[a] (gpm)	Conductivity (umhos/cm)	pH (Std. Units)	Geologic Formation
CCS-3	4	493	7.6	UPC[b]
CCS-4	13	572	7.7	UPC
CCS-5	13	581	7.7	UPC
CCS-6	20	662	7.8	UPC
CCS-7	35	681	7.0	UPC
CCS-8	-	647	7.7	UPC
CCS-9	6	562	7.8	UPC
CCS-10	8	533	8.1	UPC
CCS-11	26	598	7.9	UPC
CCS-11A	5	520	8.1	UPC
CCS-12	4	588	8.0	UPC
CCS-13	10	580	8.0	UPC
CCS-14	30	529	7.8	UPC
CCS-15	12	678	8.1	UPC
CCS-16	2.5	4,451	8.4	W/DC[c]
CCS-17	15	705	6.9	U[d]
CCS-18	15	705	8.0	U
CCS-19	4	608	7.2	UPC
CCS-20	15	698	7.8	UPC
CCS-21	24	705	7.8	UPC
CCS-22	15	642	7.9	UPC
CCS-23	-	-	-	U
CCS-24	22	508	7.9	UPC
CCS-25	16	420	8.2	UPC
CCS-26	6	420	8.2	UPC
CCS-27	3	540	7.6	U
CCS-28	8	598	7.9	UPC
CCS-29	20	576	8.0	UPC
CCS-30	13	454	8.1	UPC
CCS-31	5	472	8.0	UPC
CCS-32	15	566	8.0	UPC
CCS-33	20	599	7.9	UPC
CCS-34	24	643	8.3	UPC
CCS-35	13	492	8.1	UPC
CCS-36	21	563	8.0	UPC
CCS-37	8	474	8.9	UPC
CCS-38	20	526	8.1	UPC
CCS-39	30	655	7.9	UPC
CCS-40	8	670	7.4	UPC
CCS-41	10	652	7.9	UPC
Total	538.5 gpm			
Mean Values	13.5	582	7.9	

Source: Cities Service (1983a).

[a] Discharge measurements taken July 19 and 20, 1983, following winter snowfall and spring rain appreciably above normal. Therefore, discharge values should be considered higher than would be expected to typically occur.
[b] UPC = Upper Parachute Creek Member of the Green River Formation.
[c] W/DC = Wasatch or Douglas Creek strata.
[d] U = Uinta Formation.

Based on data from a single monitor well, TDS concentrations in the Conn Creek alluvial aquifer are noticeably higher than other valley systems such as Clear Creek. TDS values of 1,200 mg/l were recorded during all four quarters of a sampling program conducted during 1982-1983 (CDM 1983e). Ground water was of a sodium bicarbonate type, with appreciable concentrations of calcium, magnesium, and particularly sulfate as well. Similar water quality was apparent from an adjacent well, completed in the underlying Wasatch Formation (CDM 1983e), indicating that highly mineralized zones within these bedrock strata may contribute to the high dissolved solids concentration in the alluvial aquifer. The presence of a high TDS (greater than 4,000 mg/l) spring emanating from the Douglas Creek Member/Wasatch interface about 1.8 miles from the above noted wells appears to confirm this theory (Cities Service 1983a).

Ground Water Use

No registered wells or appropriated springs occur within 2 miles of the Cities Service property (Cities Service 1983a), indicating negligible ground water use. The nearest registered springs occur on the Getty property to the northwest, and the nearest ground water well occurs in the lower reaches of Conn Creek. This well is 100 feet deep, and is registered for domestic supply use (Cities Service 1983a). Additional registered wells are located in the alluvial deposits of the Roan and Parachute Creek Valleys. These wells, including use, depth, and approximate yield, are tabulated in Tables 3.3-2 and 3.3-3, respectively.

Table 3.3-2 REGISTERED WELLS IN THE ROAN CREEK VALLEY BETWEEN CONFLUENCE WITH CLEAR AND DRY FORK CREEKS

Location[a]	Permit No.	Use[b]	Depth (ft)	Yield (gpm)
7S/98W-4aa	019455	1	59	20
-10ca	006050-F	6	73	1,600
-14ac	W637	3	100	45
-14ca	W636	6	80	45
-25ad	W639	3	80	45
-30da	W1207	3,6	75	224
-31cb	W1206	6	60	224[c]
8S/97W-6bb	W1209	3,5,6	100	2,694[c]
-7ab	W1208	6	70	224[c]

Source: Colorado Division of Water Resources (1978).

[a] USGS location system.
[b] 1. Domestic
2. Stock
3. Domestic and stock
4. Commercial
5. Industrial
6. Irrigation
7. Stock and irrigation
8. Municipal
9. Other
[c] Conditional decree; all others absolute.

Table 3.3-3 REGISTERED WELLS IN THE PARACHUTE CREEK VALLEY - MAINSTEM TO CONFLUENCE WITH THE COLORADO RIVER

Location[a]	Permit No.	Use[b]	Depth (ft)	Yield (gpm)
5S/96W-36aa	6045-F	5	57	236
6S/96W-17aa	013814-R	6	20	50
-35ba	W1611[c]	1	86	20
-35bd	W1611	2	80	10
-35bd	017376	2	86	20
-35cd	W1611	1	64	6
7S/96W-2ba	W1611	1	55	25
-1cc	047306	1	60	12
-2bb	047731	1	60	12
-2bb	047732	1	50	15
-13ba	047733	1	30	15

Source: Colorado Division of Water Resources (1978).

[a] USGS Location system
[b] 1. Domestic
2. Stock
3. Domestic and stock
4. Commercial
5. Industrial
6. Irrigation
7. Stock and irrigation
8. Municipal
9. Other
[c] W - Water case

4.0

Environmental Consequences

Getty

Cities Service

4.0 Environmental Consequences

4.1 Common Impacts

4.1.2 Surface Water

4.1.2.1 General Impacts

General surface water impacts resulting from oil shale development would include watershed disturbance, stream flow and water quality changes, and surface water uses. Construction of power and syncrude lines could temporarily disturb surface water drainages, and cause increases in total suspended and dissolved solids and stream sedimentation. In addition, accidental spills and leakage from the syncrude pipeline could affect the West Fork Parachute Creek including a stock pond located in proximity to the syncrude pipeline. Runoff and sedimentation reservoirs could reduce stream flows, especially during low flow periods. Construction of the access road, retort, upgrading facilities, and other site development activities could disturb the watershed causing potential increases in soil erosion and flood flows. However, these impacts should be minimized with proper design and construction practices.

Spent shale disposal for both projects could cause potential water quality impacts to Roan Creek and the Colorado River due to leachates and surface runoff from the spent shale piles. The potential impact from the spent shale pile disposal areas would be due to the loading of inorganic and organic chemical constituents to the hydrologic system. This loading could be generated through both leaching and runoff from the retorted shale disposal pile. However, these impacts should be minimized with proper design and construction practices. In order to assess the water quality of the runoff and leachate, a fairly detailed study was conducted by In-Situ (1984). The results of this study are discussed below.

A number of complex physical, chemical, and biological processes are involved in the generation of leachate and runoff water quality. Some of the more important process-related and environmental factors affecting the water quality are provided in Table 4.1-1. These factors include retorted shale particle size, hydraulic conductivity, solid-to-liquid ratio, and redox potential (Fox 1983). All of these aspects directly affect the physical, chemical, and biological interactions between water and retorted shale.

The evaluation of potential leachate and runoff generation from retorted shale disposal piles for this FEIS did not include characterizing the chemistry of wastewater streams that potentially will come in contact with the disposal pile (In-Situ 1984). Rather, during the evaluation greater emphasis was given to the results of the column tests and test plots on retorted shales. However, many of the column tests were conducted using retorted shale wetted with water other than quench water from wastewater streams which are planned to be used to cool and moisturize the shale.

The general approach to In-Situ's (1984) assessment was to, (1) conduct a review of the relevant literature, (2) derive ranges of concentrations for selected constituents, and then (3) consider these concentrations in conjunction with estimates of average leachate and runoff quantity. Based upon information from a number of literature sources, the general characterization of leachate and runoff quality are provided in Table 4.1-2. This table provides a distinction between long-term and short-term effects of pile-generated leachate and runoff.

The spent shale leachate assessment resulted in a loading prediction for key surface water locations on Roan Creek downstream from the Getty and Cities Service properties, as well as along the Colorado River at Cameo, Cisco, Lee Ferry, and above Imperial Dam. The selection of impact-analyses locations was influenced by the availability of streamflow records and recent water-quality reported by the U.S. Geological Survey (USGS).

Water quality characteristics of runoff and leachate for spent shale disposal piles were developed by using results of the water-balance modeling analyses for disposal piles. The mass-balance modeling results were based on several assumptions regarding exposed shale area, evaporation versus evapotranspiration losses, and leachate potential. In addition, resultant loadings were compiled for operations and post-reclamation periods. This distinction allows for the different sets of conditions which exist during these periods.

Table 4.1-1 FACTORS AFFECTING LEACHATE AND RUNOFF FROM RETORTED SHALE DISPOSAL PILES AND ASSOCIATED CHEMICAL CHARACTERIZATION

Retort/Upgrade Conditions

- Raw shale composition
- Atmosphere (pressure, temperature)
- Char-gasification technology
- Retort and upgrade processes

Co-mingling of Retorted Shale with Wastewater Streams Used for Quenching

- Quantities and chemical composition of comingled solids and liquids used to cool and moisturize shale

Climate

- Ambient temperature
- Wind speed and direction
- Freeze-thaw cycles
- Wet-dry cycles
- Precipitation volume, intensity, and timing
- Snow depths, duration of snow pack
- Chemical quality of precipitation
- Pile elevation

Pile Design

- Compactive effort
- Lift depths and timing
- Face and top slopes
- Drainage control system
- Erosion control measures
- Control of subsurface flows along pile-ground interface
- Control of flows from upstream contributing drainages
- Pile-surface ponding

Reclamation Procedures

- Plant life-form
- Plant cover
- Soil type and depth
- Depth-of-root zone
- Irrigation and/or leaching
- Salt-tolerant, drought-resistant plant species
- Water balance in reclamation zone
- Crop growth stage coefficients

Source: Adapted from Fox (1983).

Through utilization of the water-balance data, the mass-balance loadings for seven selected chemical constituents were computed for Roan Creek and the selected sites along the Colorado River. The results of water balance and quality impacts on Roan Creek and the Colorado River are provided in Sections 4.2.2 and 4.3.2 for the Getty and Cities Service projects, respectively. The results of water quality impacts presented for Roan Creek and the Colorado River are judged to represent "worse-than-real world" assumptions. Leachate within the shale pile itself may undergo a number of chemical changes associated with solution/precipitation, adsorption/desorption, and ion exchange processes, among other reactions and factors. Some of these changes are induced by changes in pressure, temperature, and pH. Net reductions in concentrations of solutes in water percolating through the retorted shale may well occur (Fox et al. 1980).

Once leachate and runoff streams leave the pile, dilution with ambient surface and ground waters generally will occur, and physical and chemical changes with sediment and stream channels and biological activities may effect changes in these pile-generated waste streams. In many cases, this has the net result of reducing or attenuating chemical concentrations. Such factors and processes have not been incorporated into the above-described impact analyses.

Table 4.1-2 PRELIMINARY CHARACTERIZATION FOR SELECTED CHEMICAL CONSTITUENTS IN LEACHATE AND RUNOFF FROM RETORTED SHALE DISPOSAL PILES

Indicator Variable	Infiltration[a]	Runoff[a]
Construction (short-term, 1-30 years)		
Specific Conductance (SC) (micromhos/cm at 25 °C)	15,000 - 35,000	1,500 - 3,000
Dissolved Solids (DS) (mg/l)	10,000 - 25,000	1,000 - 2,000
Sodium (Na) (mg/l)	3,500 - 8,000	350 - 700
Sulfate (SO_4) (mg/l)	7,500 - 17,000	750 - 1,500
pH (std. units)	6 - 9	6 - 9
Total Organic Carbon (TOC) (mg/l)	5 - 50[b]	1 - 10[b]
Arsenic (As) (μg/l)	4 - 20[b]	10[d]
Boron (B) (mg/l)	0.2 - 20[b]	5[d]
Fluoride (F) (mg/l)	5 - 15[b]	2[d]
Selenium (Se) (μg/l)	5 - 20[c]	5[d]
Post-Reclamation (long-term, > 30 years)		
Specific Conductance (SC) (micromhos/cm @ 25 °C)	3,000 - 7,000	300 - 600
Dissolved Solids (DS) (mg/l)	2,000 - 5,000	200 - 400
Sodium (Na) (mg/l)	700 - 1,600	70 - 140
Sulfate (SO_4) (mg/l)	1,500 - 3,500	150 - 300
pH (std. units)	6 - 9	6 - 9
Total Organic Carbon (TOC) (mg/l)	10[c]	5[c]
Arsenic (As) (μg/l)	10[c]	5[c]
Boron (B) (mg/l)	5[c]	0.5[c]
Fluoride (F) (mg/l)	10[c]	1[c]
Selenium (Se) (μg/l)	10[c]	2[c]

Source: In-Situ (1984).

[a] When range is given, upper value of range was used in water quality impact analysis.
[b] Limited data.
[c] Estimated, based upon quite limited data.

4.1.2.2 Common Project Facilities

The facilities that could be used by both projects include the GCC water supply system and reservoir on Roan Creek, intake facilities at the Colorado River, a water pipeline along Roan Creek, and the La Sal corridor for power and syncrude lines. Surface water impacts associated with those facilities have been addressed in the CCSOP EIS (BLM 1983a). The only other common facility for the Getty and Cities Service projects is a short (approximately 3 miles) power and syncrude corridor on the Getty Property to the proposed LaSal corridor. This corridor transects the headwaters of the West Fork Parachute Creek. Construction of this corridor could temporarily disturb the stream, and cause increases in total suspended and dissolved solids and channel sedimentation.

Water quality of the proposed GCC Roan Creek reservoir was evaluated (Terra Therma 1984) according to the proposed reservoir operations of Getty (1983f), Cities Service (1983e), and Chevron (1983b). The reservoir water quality would be a function of the quantity and quality of the runoff from Roan Creek into the reservoir, and the quantity and quality of Colorado River water pumped to the reservoir. The reservoir water quality analysis was performed for three annual flow scenarios for Roan Creek; average inflow, low inflow, and a year of high inflow from Roan Creek. The inflow from the Colorado River for each of these years was from the proposed operation plans (Getty 1983b; Cities Service 1983b; Chevron 1983b). Empirical techniques and comparison with another regionally similar existing reservoir were used to evaluate the reservoir water quality regarding temperature stratification, nutrient loading, dissolved oxygen, and total dissolved solids.

Tendency for thermal stratification was estimated by empirical techniques, and by comparison of the proposed Roan Creek reservoir with the temperature regime of Chatfield Reservoir on the South Platte River near Denver. Two techniques were used to estimate the tendency for thermal stratification. It was estimated that the densimetric Froude Number for the Roan Creek reservoir would be in the range of 0.003 to 0.007. A densimetric Froude Number much less than 0.32 indicates a reservoir with a strong tendency toward stratification. The calculated flushing rate of 1.527 is less than 10.0, which indicates that the reservoir will stratify in a stabilized manner. Studies of Chatfield Reservoir indicate that the reservoir is isothermal from late November through May, temperature gradients develop in June, and stratification is established during mid-July to August and persists through early fall. This comparison supports the empirical analyses, and indicates that the Roan Creek reservoir will probably undergo thermal stratification from midsummer through early fall.

Nutrient mass balance modeling was performed to evaluate the probable trophic status of the reservoir. It is estimated that the total phosphorus concentration in the reservoir will range from 13 to 16 ug/l. These total phosphorus concentrations are within the mesotrophic range of 10 to 20 ug/l. It is estimated that the total nitrogen concentration in the reservoir will range from 370 to 858 ug/l. These total nitrogen concentrations are within the mesotrophic range of 361 to 1,387 ug/l. It is estimated that chlorophyll a concentrations will range from 6.0 to 8.1 ug/l. These chlorophyll a concentrations are within the mesotrophic range of 3 to 10 ug/l.

Algal dominance and water clarity as measured by Secchi depth were estimated. Secchi depth, being a measure of quantity of algae, was estimated to range from 1.9 meters for a low inflow year to 2.3 meters for a high inflow year. The Secchi depth for mesotrophic conditions is 2 to 8 meters and for eutrophic conditions is 1 to 7 meters. Blue-green algae is not expected to predominate in the reservoir.

The result of the thermal stratification analysis and chlorophyll a analysis was used to estimate the dissolved oxygen depletion. A worst-case analysis of oxygen depletion based on chlorophyll a of 6.7 ug/l produces 115 grams of carbon per square meter. Oxidation of 20 percent of this carbon produces an oxygen demand of 2.0 mg/l. Using a dissolved oxygen of 8.0 mg/l at the initiation of stratification results in a final dissolved oxygen of 6.0 mg/l at the time of fall turnover of thermal stratification. This analysis of oxygen demand related to the trophic status of the reservoir indicates that, in the worst-case during summer stratification of the reservoir, the dissolved oxygen concentration in the hypolimnion will be greater than 5.0 mg/l.

Calculations of total dissolved solids concentration indicate that the concentration will normally be about 640 mg/l, with an expected range of about 514 to 688 mg/l. This is an improvement in total dissolved solids of Roan Creek, due mainly to dilution from Colorado River water which will be pumped into the resevoir. Subsequently, releases of water from the reservoir into Roan Creek will have reduced total dissolved solids as compared with concentrations without the reservoir.

A summary of water quality characteristics for the GCC Roan Creek reservoir for average, low, and high flows in Roan Creek is shown in Table 4.1-3. These characteristics indicate that the risk of eutrophication is low, and

Table 4.1-3 ESTIMATED WATER QUALITY CHARACTERISTICS AND RESERVOIR CLASSIFICATION PARAMETERS FOR THE GCC ROAN CREEK RESERVOIR FOR CONDITIONS OF AVERAGE, LOW, AND HIGH RUNOFF FROM ROAN CREEK INTO THE RESERVOIR

Water Quality Characteristics and Parameters	Average Flow	Low Flow	High Flow
Total Phosphorus, in μg/l	14	16	13
Total Nitrogen, in μg/l	578	858	370
Chlorophyll _a_, in μg/l	6.7	8.1	6.0
Secci Depth, in meters	2.1	1.9	2.3
Dissolved Oxygen in Hypolimnion, in mg/l	6.0	6.5	5.5
Total Dissolved Solids in Outflow, in mg/l	667	514	688
Densimetric Froude Number	0.004	0.003	0.007
Probability of Non-Blue-Green Algal Dominance	0.65	0.71	0.59
Risk of Eutrophy, in percent	28	36	24

Source: Terra Therma, Inc. (1984).

the probability of non-blue-green algal dominance is greater than the probability of blue-green algal dominance. The reservoir under these characteristics will probably be mesotrophic.

The average annual sediment load into Roan Creek reservoir has been estimated (Stone and Webster 1982) based on measured sediment concentrations for Roan Creek and a sediment rating curve. The average annual reservoir sediment deposition is estimated to be 70 acre-feet per year. The resulting sediment deposition and loss of storage capacity is very small relative to the total storage volume of the reservoir.

4.1.3 Ground Water

Impacts to regional ground water systems associated with oil shale development on the southern edge of the Piceance Basin could include removal and/or dewatering of aquifers within or proximal to the underground mines, local modification of ground water flow, and potential subsidence and fracturing of strata overlying the underground mines. In general, these adverse impacts could be of medium magnitude in terms of the local environment, but low with respect to the region. This projected lower regional impact is predicted on the apparent relative hydrogeologic isolation of these project sites from the majority of the Piceance Basin. Discussions of local ground water impacts associated with the individual Getty and Cities Service properties are provided in Sections 4.2.3 and 4.3.3, respectively. These sections provide impact analyses for the potential adjacent alluvial aquifers. Cumulative impacts to the region from these properties and others are discussed in Section 4.4.

Impacts to ground water resulting from common facilities would be limited. The Roan Creek reservoir and associated water transmission/road corridors are addressed in the CCSOP EIS (BLM 1983a). To recall, net ground water impacts would be negligible from the Roan Creek reservoir, and potential impacts along the Roan

Creek road corridor would be largely restricted to uncontrolled spills or leaks from the transport of hazardous contaminants. Similarly, the common transport corridor on the Getty property should have low adverse impacts, given the upland terrain; impacts would be limited to accidental spills resulting from pipeline breakage. The national average annual accident rate associated with pipeline breakage is about 0.001 accidents per year per mile of pipeline (BLM 1981). Based on a common pipeline distance of approximately 8 miles, the average pipeline leakage frequency would be on the order of once every 125 years — negligible for these properties.

4.2 Getty Project Impacts

4.2.2 Surface Water

4.2.2.1 Proposed Action

Getty's proposed underground mine is not expected to affect the surface water regime. Surface facilities (including mine benches, primary crushers, mine portals, equipment repairs, and storage areas) could have impacts, however. The proposed bench and mine portal are to be located on the east wall of Tom Creek. Surface water impacts resulting from these facilities would be limited to minor runoff and sedimentation increases in Tom Creek during construction and operation stages.

The initial plant site would be located in Short Gulch and on Trail Ridge. The main process facilities at the initial surface plant site would include the ore stockpile, feed preparation plant, Union retorts, upgrading, gas and oil processing, wastewater treatment, utility, and other support facilities. Facilites at the additional plant site, to be located in the headwaters of West Fork Parachute Creek, would not include the upgrading and the gas and oil processing. Construction of the processing and support facilities (earthworks and site grading) would disturb the surface drainage basin and contribute higher sediment load in the streams. During operations, runoff water from the plant site could have high concentrations of calcium, bicarbonate, and sulfate (BLM 1983a) causing water quality impacts on the receiving streams. However, these impacts should be minimized with proper water management practices.

The impacts on the stream water quality would be minimal provided that appropriate runoff diversion and sediment control plans are developed for areas around the two plant sites. Wastewater generated from the process plants would be treated in a wastewater treatment system only if, and as necessary, to be suitable for reuse for spent shale conditioning. Potential surface water impacts could result from the accidental spills of wastewater from the storage pond. Appropriate spill prevention and mitigation measures should minimize the impacts.

Spent shale and shale fines from the feed preparation plant would be disposed of in Wiesse Creek and Short Gulch watersheds as shown in Figure 2.3-3. Shale fines would be retorted if generated in sufficient quantity to economically justify the retort. The project would generate approximately 1,300 million tons of spent shale, plus a relatively small quantity of shale fines. The disposal site would cover a total area of approximately 2,310 acres. The design of the spent shale pile includes plans to control erosion, surface runoff, and slope stability. Revegetation plans would be implemented such that approximately 200 acres of retorted material could be exposed at one time. Retention dams would be located on the south end of Wiesse Creek and Short Gulch basins, downstream of the disposal area. The retained water would be utilized in the shale disposal operation. Potential impacts on watershed drainages prior to revegetation would include soil erosion and degradation of water quality due to surface runoff from the spent shale pile.

The potential quantity of construction and post-reclamation runoff and leachate for the Getty retorted shale disposal pile is summarized in Table 4.2-1. The leachate potential is for precipitation falling directly on the retorted shale disposal piles and does not include external sources of water such as springs. It is understood that an underdrain system will be used to control springs discharging from the valley sides and conduct them beneath or away from the retorted shale disposal pile.

Runoff from the Getty spent shale pile during construction ranges from approxiately 5.4 inches for the 50-percent chance year to over 11 inches for the 1 percent chance year. Water infiltrating the retorted shale disposal pile from precipitation during construction (Table 4.2-1) would range from approximately 2.6 inches for the 50-percent chance year to about 5.7 inches for the 1 percent chance year. Water management would include the control of runoff and infiltration. Runoff and leachate potential for the post-reclamation case, based on the water balance model, are also summarized in Table 4.2-1. Post-reclamation runoff at the Getty pile may range from about 5.4 inches for the 50-percent chance year to over 11 inches for the 1-percent chance year. Leachate from the retorted shale disposal pile at the Getty site would range from approximately 2.2 inches for the 50 percent chance year to about 6.6 inches for the 1-percent chance year.

Table 4.2-1 WATER BALANCE OF SPENT SHALE DISPOSAL PILE, GETTY SHALE OIL PROJECT

	Percent of Chance Year for Annual Precipitation					
Variable	50	20	10	5	2	1
Construction						
Precipitation (in.)	27.70	31.10	33.05	34.73	36.70	38.09
Evaporation (in.)	14.87	15.28	15.54	15.81	15.96	16.00
Runoff (in.)	5.45	7.23	8.31	9.29	10.48	11.34
Moisture retention (in.)	4.81	4.96	4.97	4.97	4.97	4.97
Infiltration (in.)	2.57	3.63	4.23	4.66	5.30	5.78
(ac-ft)[a]	64	91	106	116	132	144
Post-Reclamation						
Precipitation (in.)[b]	25.2	28.61	30.55	32.23	34.20	35.57
Evapotranspiration (in.)	12.69	12.69	12.69	12.69	12.77	12.85
Runoff (in.)	5.35	7.11	8.18	9.15	10.32	11.15
Moisture retention (in.)	4.97	4.97	4.97	4.97	4.97	4.97
Leachate (in.)	2.19	3.84	4.71	5.42	6.14	6.56
(ac-ft)[c]	365	640	785	903	1,023	1,094

Source: In-Situ (1984).

[a] Assumes 300 acres of uncovered pile surface during spent shale disposal operation.
[b] Excludes 2.5 in. of precipitation that is assumed to be lost through sublimation and evaporation from snowpack during the months of January through March, November, and December.
[c] Assumes 2,000 acres of final reclaimed spent shale surface.

Using results of the water-balance modeling analyses (Table 4.2-1), water-quality characteristics of leachate and runoff were determined using the preliminary estimates in Table 4.1-2, and mass-balance loads for the seven selected chemical constituents were computed (Table 4.2-2). The resultant loads were made in a probablistic sense to parallel the leachate/runoff modeling analysis for construction and post-reclamation conditions. Table 4.2-1 reflects underlying assumptions regarding exposed shale area and evaporation versus evapotranspiration losses.

The short-term construction impacts are judged to be considerably less, due to water-management controls in place during project operation. Also, a significant part of the water infiltrating the pile during construction will be retained in the pile.

Relative water-quality impacts on Roan Creek near De Beque for the proposed spent-shale pile are given in Table 4.2-3. Impacts of the spent shale pile on Roan Creek water quality would be measurable. The long-term concern in constituent loading for the average year (50 percent chance) shows greater than 10 percent increases in sulfate, boron, and fluoride. Water quality impacts are also evaluated at 5 locations along the Colorado River. This analysis utilized data available for the period 1980, 1981, and 1982 water years. Also no attenuation or other physical or chemical processes affecting the generated leachate and runoff loadings were assumed. The worst-case 1 percent chance loading inputs are summarized for the Getty spent-shale pile in Table 4.2-4.

Comparing modeling with currently applicable water quality standards (Table 4.2-5), the maximum anticipated boron concentration due to a combined effect of leachate and runoff (associated with the 1 in 100 chance annual precipitation) is about 0.39 mg/l compared to an ambient level of 0.20 mg/l in Parachute Creek and a stream standard of 0.75 mg/l for boron.

In using stream standards that apply to Roan Creek upstream from Clear Creek for the selected constituents (arsenic, boron, and selenium), the results of this analysis indicate that no standard applied to the lower reach of

Table 4.2-2 ESTIMATED CHEMICAL LOADS, GETTY RETORTED SHALE DISPOSAL PILE INFILTRATION OR LEACHATE AND RUNOFF[a]

Percent Chance[b]	Constituent (units)													
	Dissolved Solids (tpd)		Sulfate (tpd)		Total Organic Carbon (tpd)		Arsenic (lb/d)		Boron (tpd)		Fluoride (tpd)		Selenium (lb/d)	
Construction (Short-Term)														
	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff
50	6.05	1.02	4.12	0.77	0.0121	0.0051	0.0097	0.0102	0.00484	0.00256	0.00363	0.00051	0.00968	0.00511
20	8.74	1.34	5.94	1.01	0.0175	0.0067	0.0140	0.0134	0.00699	0.00336	0.00525	0.00134	0.01399	0.00672
10	10.09	1.56	6.86	1.17	0.0202	0.0078	0.0161	0.0156	0.00807	0.00390	0.00605	0.00156	0.01614	0.00780
5	10.76	1.72	7.32	1.29	0.0215	0.0086	0.0172	0.0172	0.00861	0.00430	0.00646	0.00172	0.01722	0.00861
2	12.10	1.94	8.23	1.45	0.0242	0.0097	0.0194	0.0194	0.00968	0.00484	0.00726	0.00194	0.01937	0.00968
1	13.45	2.10	9.15	1.57	0.0269	0.0105	0.0215	0.0210	0.01076	0.00525	0.00807	0.00210	0.02152	0.01049
Post-Reclamation (Long-term)[c]														
	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff
50	6.86	1.32	4.80	0.99	0.0137	0.0165	0.0274	0.0331	0.00686	0.00165	0.01372	0.00331	0.02744	0.01323
20	11.97	1.76	8.38	1.32	0.0239	0.0221	0.0479	0.0441	0.01197	0.00221	0.02394	0.00441	0.04788	0.01765
10	14.66	2.03	10.26	1.52	0.0293	0.0254	0.0586	0.0508	0.01466	0.00254	0.02932	0.00508	0.05864	0.02034
5	16.81	2.27	11.76	1.70	0.0336	0.0284	0.0672	0.0568	0.01681	0.00284	0.03362	0.00568	0.06725	0.02270
2	19.10	2.56	13.37	1.92	0.0382	0.0320	0.0762	0.0640	0.01910	0.00320	0.03820	0.00640	0.07640	0.02561
1	20.31	2.77	14.22	2.07	0.0406	0.0346	0.0812	0.0691	0.02031	0.00346	0.04062	0.00691	0.08124	0.02765

Source: In-Situ (1984).

[a] Indicated loads are unrounded, and do not reflect inherent uncertainties in estimates.

[b] 50 = 2-year recurrence; 20 = 5-year recurrence; 10 = 10-year recurrence; 5 = 20-year recurrence; 2 = 50-year recurrence; 1 = 100-year recurrence.

[c] Leachate from precipitation falling directly on pile is 0.0 cfs (0 acre-feet) for all but the 50-year and 100-year recurrence annual precipitation, which were estimated to be 0.03 cfs (21 acre-feet) and 0.08 cfs (57 acre-feet), respectively. The balance of leachate indicated would be due to seepage from a line source from a channel constructed on top of the pile to convey streamflows from upstream contributing areas of the Conn Creek and Cascade Gulch watersheds.

Table 4.2-3 POST RECLAMATION ESTIMATED WATER-QUALITY IMPACTS ON ROAN CREEK, GETTY RETORTED SHALE DISPOSAL PILE LEACHATE AND RUNOFF

	Constituent						
Description	DS	SO_4	TOC	As	B	F	Se
Ambient mean annual concentration of Roan Creek[a]	850 mg/l	323 mg/l	20 mg/l	4.5 μg/l	0.2 mg/l	0.6 mg/l	3.5 μg/l
Ambient mean annual loading of Roan Creek[b] (2-year recurrence interval)	97 tpd	37 tpd	2.3 tpd	1.0 lb/d	0.02 tpd	0.07 tpd	0.8 lb/d
Ambient extreme-year loading of Roan Creek[c] (100 year recurrence interval) (units)	345 tpd	131 tpd	8.1 tpd	3.7 lb/d	0.08 tpd	0.24 tpd	2.8 lb/d
	Percent Chance						
Long-term load increase, runoff only[d]							
2-year runoff	0.3	0.8	0.2	0.9	2.1	1.4	0.5
100-year runoff	0.8	1.6	0.4	1.9	4.3	2.9	1.0
Long-term load increase, leachate only[e]							
2-year leachate	7.1	13.0	0.6	2.7	30.0	20.0	3.4
100-year leachate	22.0	38.0	1.8	8.1	88.0	60.0	10.0
Long-term load increase, leachate and runoff[e]							
2-year leachate and runoff	8.4	16.0	1.3	6.1	37.0	22.0	5.1
100-year leachate and runoff	24.0	44.0	3.3	15.0	103.0	70.0	14.0

Source: In-Situ (1984).

[a] Average concentrations are time-weighted, not discharge weighted, based upon 1980-81 water year data for USGS station 09095000. Hence, computed loads may be high.
[b] Based upon mean annual (approximately 2-year recurrence) Q of 42.3 cfs (using 22 years of historical records at USGS site 09095000.
[c] Based upon 100-year recurrence annual Q of 151 cfs (using 22 years of historical records at USGS site 09095000).
[d] Relation to extreme-year load (100-year recurrence interval, 1 percent chance).
[e] Relation to mean-year load (2-year recurrence interval, 50 percent chance).

Roan Creek would be exceeded. Under the worst-case assumptions (1 percent chance associated with annual precipitation input to pile), dissolved solids concentrations in lower Roan Creek might increase 24 percent (from 850 to 1,050 mg/l), and sulfate concentrations might increase 44 percent (from 323 to 466 mg/l). Both of these constituents have no state standard for the Roan Creek stream segment.

The comparisons with currently applicable state standards for the Colorado River in Colorado and ambient concentrations for the selected constituents show a minimal impact on concentrations (Table 4.2-5). For example, under worst-case assumptions, sulfate concentrations in the Colorado River near Cameo might increase by 1 mg/l, from 125 to 126 mg/l, which is still about one-half the CDH water supply classification for this stream segment.

Long-term surface water impacts would include potential water quality degradation due to leachate from the spent shale pile, sediment deposition and salt loading contributed by surface runoff from the spent shale pile, and stream flow reduction of Wiesse Creek due to interruption of several major springs in the Wiesse Creek basin.

Various corridors are proposed for the project development in the Roan Creek and Parachute Creek basins. These corridors would contain access roads, railroad spurs, transmission lines, and water and syncrude pipelines. Surface drainages that would be disturbed by these corridors either during construction or operations include

Table 4.2-4 ESTIMATED WATER-QUALITY IMPACTS IN THE COLORADO RIVER, GETTY RETORTED SHALE DISPOSAL PILE LEACHATE AND RUNOFF (LONG-TERM, POST RECLAMATION, 1 PERCENT CHANCE)

	Ambient Water-Quality Load[a]						
Location[b]	DS (tpd)	SO_4 (tpd)	TOC (tpd)	As (lb/d)	B (tpd)	F (tpd)	Se (lb/d)
Colorado River at Cameo, CO (USGS 0909500, 8,050 sq mi)	4,115[c]	1,260	NA[d]	61	0.41[e]	3.05	20.3
Percent Change	0.6	1.3	--	0.2	5.8	1.6	0.5
Colorado River at CO-UT State Line (USGS 09163500, 17,843 sq mi)	9,860	4,430	247	62	NA	4.63	250
Percent Change	0.2	0.4	0.03	0.2	--	1.0	0.04
Colorado River at Cisco, UT (USGS 09180550, 24,100 sq mi)	11,020[c]	5,300	222	202	1.61[e]	6.13	121
Percent Change	0.2	0.3	0.03	0.07	1.5	0.8	0.09
Colorado River at Lee's Ferry, AZ (USGS 09380000, 111,800 sq mi)	21,140[c]	7,730	144	131	3.11	9.82	229
Percent Change	0.1	0.2	0.05	0.1	0.8	0.5	0.05
Colorado River above Imperial Dam AZ (USGS 09429490, 188,500 sq mi)	23,520[c]	9,110	188	235	5.29	14.7	117
Percent Change	0.1	0.2	0.04	0.06	0.4	0.3	0.09
Long-Term Loads (100-year recurrence leachate and runoff)	23	16	0.08	0.15	0.024	0.048	0.11

Source: In-Situ (1984).

[a] See Table 4.2-2 for estimated pile generated leachate and runoff loads (assumes no attenuation or reduction of loads by physical, chemical, or biological processes).
[b] USGS gage number and size of drainage are shown at each location.
[c] Based upon discharge-weighted concentrations for more accurate estimate of loads.
[d] Stream ambient data not available at this location.
[e] Based upon historical ambient data (Iorns et al. 1965). Percentage and long-term pile loads are rounded.

Roan Creek, Clear Creek, Tom Creek, Buck Gulch, Short Gulch, and West Fork Parachute Creek. Surface water impacts of soil erosion/sedimentation and stream flow disruption would be expected during the construction stage, especially at the intersections of corridor crossings and stream drainageways. In addition, accidental spills from the syncrude pipeline could affect waters in the West Fork Parachute Creek.

Water supply for the Getty shale oil development would come from the GCC Roan Creek reservoir. Pipelines would be required to deliver water from the Roan Creek reservoir to the plant site. The water supply system would include a pumping plant at the Roan Creek reservoir, a small regulation reservoir and pumping plant near the confluence of Roan and Clear creeks, a regulation reservoir and pumping plant on Tom Creek, and a water pipeline up Buck Gulch connecting those reservoirs to the plant sites. Construction of these two regulation reservoirs could interrupt streamflows in Tom, Clear, and Roan creeks. Minor stream channel configuration changes could also occur upstream and downstream of the reservoir sites.

Table 4.2-5 COMPARISON OF STREAM STANDARDS AND AMBIENT AND IMPACTED CONCENTRATIONS, ROAN CREEK AND COLORADO RIVER IN COLORADO, GETTY RETORTED SHALE DISPOSAL PILE[a]

Constituent		Segment 15 Roan Creek above Clear Creek (42.3 cfs)[b]	Segment 2 Colorado River near Cameo (3,780 cfs)	Segment 3 Colorado River at CO-UT State line (5,740 cfs)
Dissolved Solids (mg/l)	Standard:	--[c]	--[c]	--[c]
	Ambient Concentrations:	850	405	639
	Impacted Concentrations:	1,050	407	640
Sulfate (mg/l)	Standard:	--[c]	250	--[c]
	Ambient Concentrations:	323	124	287
	Impacted Concentrations:	466	125	288
Arsenic (μg/l)	Standard:	100	50	50
	Ambient Concentrations:	4.5	3	2
	Impacted Concentrations:	5.0	3	2
Boron (mg/l)	Standard:	0.75	0.75	0.75
	Ambient Concentrations:	0.20	0.04	--[d]
	Impacted Concentrations:	0.39	0.04	--[d]
Selenium (μg/l)	Standard:	20	10	20
	Ambient Concentrations:	3.5	1	8
	Impacted Concentrations:	4.0	1	8

[a] Reference for standards: Colorado Department of Health (1983). Based upon the leachate of 1 percent chance for assumed annual precipitation impacting on associated streamflows.
[b] Impact is below this segment in Roan Creek.
[c] No state stream standard is applicable.
[d] Ambient data are not available.

4.2.2.2 Alternatives

The 50,000-bpd production rate alternative would produce a smaller daily amount of waste rock, shale fines, and spent shale. Therefore, surface water disturbance would be less in the short-term than the proposed 100,000-bpd production rate due to the reduction of storage areas for waste rock and spent shale. Total project water requirements would also be reduced; however, the water consumption rate for per barrel shale oil production would be higher. Except for the syncrude pipeline, no impacts on West Fork Parachute Creek are anticipated due to the elimination of the retort additions site.

Three alternative spent shale disposal sites (Tom Creek; Buck and Doe gulches; and underground mine/Buck and Doe gulch combination) have been evaluated. Watershed disturbances for these alternatives would generally be reduced due to the decrease in affected drainage area. However, the Tom Creek disposal site would eliminate the water supply regulation reservoir on Tom Creek. Potential water quality impacts for this alternative on Clear Creek and Tom Creek are much greater than the Wiesse Gulch spent shale disposal site. The alternative Buck and Doe gulch disposal sites are also close to the Clear Creek drainage. Leachate and surface runoff from this spent shale pile could directly impact the Clear Creek drainage. Disposal of approximately one-half of the spent shale in the underground mine would reduce surface water impacts, due to less surface disturbance and least total volume of spent shale on the surface to contribute to potential shale leaching impacts.

The Rangely alternative product pipeline corridor is discussed in the CCSOP EIS (BLM 1983a). Surface water impacts of the alternative would be similar to the proposed La Sal pipeline corridor, but would occur on different drainages. The alternative Big Salt Wash transmission line corridor is also addressed in BLM (1983a). Surface water impacts for this alternative corridor would be slightly greater than the proposed De Beque transmission loop, due to its longer route and its crossing of more surface drainages.

The West Fork Parachute Creek alternative reservoir would have similar impacts as the proposed project, but would affect stream flows of West Fork Parachute Creek.

The Lurgi alternative process technology would generate spent shale of a smaller particle size compared to the proposed Union retort technology. It would therefore require more water to wet the surface of the particle for compaction due to more surface area per unit weight of spent shale. In addition, more sour water would be produced by Lurgi process compared to the Union retort process (Getty 1983b). Surface drainages downstream of the spent shale and plant site could be subject to slightly higher water quality impacts resulting from the potential leachate of this sour water.

4.2.2.3 Solid/Hazardous Wastes Disposal

All nonhazardous solid waste would be disposed of in the spent shale disposal area. No additional surface water impacts are anticipated beyond those previously mentioned. Some hazardous waste could be generated by the retorting and upgrading process. Hazardous waste disposal would be off-site in a licensed facility. There would be no surface water impacts in the vicinity of the Getty property, but cumulative impacts could occur elsewhere (see Section 4.4).

4.2.2.4 Secondary Impacts

Secondary impacts to surface water would result from increased population in the region. These impacts could include increased water consumption, potential water contamination from wastewater and solid wastes, and increased suspended solids in streams due to development activities adjacent to the streams.

4.2.3 Ground Water

4.2.3.1 Proposed Action

Underground mining on the Getty property would remove a 60-foot thick horizon within the Mahogany Zone. Direct disturbance of the subsurface associated with oil shale extraction would be limited to this zone and immediate over- and underlying strata. As discussed in Section 3.2.3, water-bearing intervals identified beneath the Getty property occur above this mining interval. The potential for ground water inflow into the mine workings is, therefore, predicted on the degree of interconnected fractures between the oil shale horizon and overlying leached interval in the Upper Parachute Creek Member of the Green River Formation.

Existing data are not adequate to precisely evaluate the potential for this interconnection. Data from the adjacent Chevron property, however, indicate that relatively minor inflows can be anticipated during mining from strata immediately adjacent to the mine interval. Total inflows estimated for the underground portion of the Chevron property are in the range of 100 to 1,500 gpm (BLM 1983a). Data from the Pacific and Cities properties to the south and east indicate the apparent presence of a thick zone of relatively impermeable strata separating the mining zone from the Upper Parachute Creek/Uinta aquifer. If this intervening zone remains relatively unfractured beneath the proposed mine area, inflows from overlying strata should be minimal. Similarly, limited inflows would reduce the potential for potentiometric impacts (i.e., lowering or aquifer water levels) resulting from the underground mine. The low hydraulic conductivities for the Mahogany and the Upper Parachute Creek zones would restrict the potential for any decline in potentiometric levels from propagating outside the property boundaries, where existing ground water use has been identified.

The effect of ground water flow from underground mining should also be minor. Vertical gradients have been identified on most adjacent properties. Such a gradient may be steepened if fracturing allows inflow from the overlying aquifer. Flow within the Uinta Formation and appurtenant spring discharge points should not be significantly affected by the proposed underground mine.

Further fracturing of overlying strata could occur if subsidence results from the eventual abandonment of underground workings. Such potential subsidence was estimated to be only 1 foot over a 10-year period (BLM 1983a). Given the relative similarity in both mining zone and overburden thickness between the Getty and Chevron sites, such an estimate should be considered generally reliable for the Getty property. If subsidence fractures intersect the overlying Upper Parachute Creek aquifer, increased inflows to the underground workings could occur. The magnitude and duration of any potential increase in flows cannot be predicted accurately.

Water quality impacts associated with the underground mine should similarly be minor. The quality of existing ground water in the Mahogany Zone and Upper Parachute Creek Members is generally good. Ground water inflow to the mine would be collected in mine sumps and discharged in a manner to minimize contact with soluble mined spent shale materials, restricting the potential for infiltration of higher TDS waters.

Impacts associated with process facilities — including the raw shale stockpile, secondary feed preparation, retorting and upgrading, and associated surface disturbances — should be minor. The stockpiling of raw shale could pose a ground water contamination potential. Such contamination would be minimized by two factors: (1) storage would include a continual removal and addition of materials; consequently, the limited exposure of raw shale involved with stockpiling and conveyance to feed preparation should restrict generation of leachate; and (2) drainage design around the stockpiles could minimize the potential for infiltration or off-site migration of any leachate that might be generated.

Prudent operation and maintenance of the remaining facilities should restrict the potential for contamination by infiltration of accidental spills.

Disposal of spent shale in Wiesse Gulch drainage could potentially be a source of leachate which, in turn, could infiltrate into the ground water regime. Getty has designed the disposal process so as to minimize this potential. Integral parts of the design would involve construction of a compacted spent shale liner and efficient reclamation of the surface area. The primary purpose of the compacted lining would be to control and collect runoff from the shale pile during its construction (In-Situ 1984).

Generation of leachate within the disposal area would require moisture conditions within the spent shale to exceed specific retention from water sources such as surface water runoff, direct precipitation, or ground water via spring discharge. Surface water runoff during pile construction would be contained by retention dams within Wiesse Gulch below the disposal area. Whereas the runoff collection pond will be unlined, the leachate collection pond below the spent shale disposal pond would be sealed or lined so as to limit seepage into ground water. Retained water would be used for moisturizing spent shale prior to disposal. Direct infiltration of precipitation during construction will be minimized by construction of a compacted layer of spent shale 10-feet thick on top of the disposal area. This compacted layer would be advanced and reclamation would occur in a timely fashion, such that no more than approximately 200 acres of retorted shale are exposed at any one time. Despite these precautions, some infiltration of water into the spent shale could occur from accumulation of runoff/precipitation during periods when the pile is exposed. A liner of compacted shale 10-feet thick would be constructed on the ground surface (stripped of topsoil) beneath the disposal area to minimize the potential for leachate infiltration. The permeability of this underlining is not available, but typical values for hydraulic conductivity of the expected spent shale in uncompacted form are 7.1×10^{-3} to 1.3×10^{-2} feet/day (2.5×10^{-6} to 4.6×10^{-6} cm/sec; Getty 1983b).

Existing data indicate that 12 or more springs emanate within the proposed disposal area. These springs exhibit a total maximum discharge of about 200 gpm. Continued flow from these springs could jeopardize the long-term stability of the compacted shale underliner and pose a significant potential for leachate generation and off-site migration. For this reason, spring flows would be collected in pipes and/or a rock underdrain system and diverted to the make-up water systems by the operator. Getty's proposed action includes installation of a piezometer through the spent shale pile to monitor the effectiveness of the collection system. Furthermore, because the compacted shale underliner would encompass a sizeable portion of the apparent recharge area for these springs, it is probable that spring flow will decrease as construction of the disposal area proceeds.

The spent shale pile would be designed to minimize the potential for failure, thereby reducing the potential to endanger the stability of the under- or overliners. Design features would include interior and exterior slopes engineered to provide an adequate factor of safety. Additional design features, including maintenance after closure, are not presently available, but will be developed in detail during the permitting process.

Reducing the potential for leachate generation and migration would entail careful design of the liner and drain systems. Long-term weathering of the under- and overliners could result in leakage. If leaks develop, leachate could be transmitted (1) directly into the Uinta Formation via infiltration, (2) into the alluvial aquifer systems below the mesa via surface runoff, or (3) into the surface water system. A detailed analysis of the potential quantity and quality of leachate was provided in Section 4.2.2.1 of this document. As described therein, elevated concentrations of sulfate, boron, and fluoride due to spent shale pile leachate and runoff may be released to the surface water system. These represent an increase in baseline conditions in Roan Creek, assuming that long-term seepage of leachate through the compacted shale liner will occur. Other published sources (EPA 1983) indicate that high concentrations of selenium, molybdenum, arsenic, copper, zinc, manganese, and iron may occur in retorted shale. Additional organic compounds may also be present from the co-disposal of wastewater from the upgrading plant. Existing data are not adequate to predict potential concentrations of additional leachate constituents from such co-disposal activities. As discussed in Section 2.3.1.2.3, potential retort waste water quality reflects high concentrations of a variety of organic and inorganic constituents. Treatment of waste streams (including biological oxidation of organics as applicable) prior to disposal will ameliorate potential impacts. Permitting under applicable RCRA and TSCA standards may be necessary; at such time, more detailed analyses of geochemical reactions, and potential impacts thereof, would be required.

The impact of increased chemical concentrations in the alluvial aquifers of the Clear and Roan Creek valleys cannot be evaluated quantitatively based on existing data. Estimated chemical loadings to the respective streams (see Tables 4.2-2 and 4.2-3), provide a good indication of similar effects to alluvial ground water. Ground water impacts are anticipated to be slightly less than those of surface water due to a number of chemical changes including the adsorptive capabilities, ion exchange, solution/precipitation of the alluvial sediments.

No significant ground water impacts are anticipated to occur from the construction of product transport, utility, road, railroad, and water corridors. Increases in TDS concentrations could occur during construction via infiltration of waters draining the distrubed areas. Such infiltration would be more prevalent along the Roan/Clear Creek alluvial areas than on upland areas (e.g., syncrude pipeline, access roads) underlain by bedrock. Any increase in TDS concentrations so occurring, however, would be short-term in nature.

4.2.3.2 Alternatives

Ground water impacts associated with a 50,000-bpd production rate would be essentially the same as those described for the 100,000-bpd proposed action. Surface and underground disturbance would occur at a reduced rate, however, thereby potentially decreasing the magnitude of any impacts.

Impacts associated with process facilities integral to the Lurgi process would be the same as those discussed for the proposed project. However, spent shale disposal from the Lurgi process may result in slightly less potential for leachate generation/migration than for the Union B process. The tendency of Lurgi spent shale to solidify upon moisturizing may reduce the erosion potential and leaching (Bates 1983). This lesser potential is necessarily predicated on effective, timely revegetation of Lurgi-derived spent shale piles.

Disposal of spent shale in Tom, Buck, and Doe gulches would require the same engineering/construction precautions as described for the proposed action (Wiesse Gulch). Disposal in Tom Gulch would require reevaluation of the project water supply, given that this site is a component (regulation reservoir) of the proposed and alternative water supply systems. Data provided in the In-Situ report (1984) indicate that the generation of leachate is a function of elevation, precipitation, evaporation and evapotranspiration. For these reasons, the total volume of leachate potentially generated within the pile would be less for the alternative site than for the proposed action.

From a design perspective, liner construction (and therefore reliability) could be more difficult in the alternative gulches. Alluvial deposits are apparently broader and thicker than in Wiesse Gulch, providing a foundation which is not as stable as Uinta strata underlying much of the Wiesse Gulch area.

Proper project operation during construction of the liner would result in minimal impacts to the ground water regime. As described previously, failure of the liner system during the construction period could result in release of leachate to the ground and surface water environments. Contrary to mesa top disposal, where numerous springs emanate in the proposed disposal area, underdrains are not as critical to inhibiting leachate generation in the alternative site. Conversely, however, routing of surface flows from the plateau may be problematic, particularly in the long-term. Maintenance of a non-erosive channel around and/or over the shale disposal pile may not be possible subsequent to site closure for the alternative disposal area. The potential for contamination of bedrock aquifers (e.g., the Uinta/Upper Parachute Creek Member) from the proposed action is significantly less than for the Wiesse Gulch site. Conversely, leachate leakage in these alternative sites would allow direct infiltration into the valley bottom alluvial aquifers of each gulch. If such occurred, there would be potential for more rapid migration (as compared to the proposed disposal on the mesa) into either the alluvial aquifer or surface drainage of Clear Creek.

In summary, although leachate volume may be less for the alternative site, engineering difficulties in ensuring the long-term reliability of mitigative measures would suggest that the proposed disposal site poses less potential for contamination of ground water. No significant ground water impacts are anticipated for the Rangely and Big Salt Wash corridors described in BLM (1983a). As described for the proposed project, potential increases in ground water TDS concentrations resulting from drainage (and infiltration) of disturbed areas should be short-term in duration and minor in magnitude.

No significant ground water impacts are anticipated from the co-generation of power on site.

Development of an alternative water supply which includes a regulation reservoir on the West Fork Parachute Creek should have no significant ground water impacts. Reservoir construction on West Fork Parachute Creek would alter the recharge/discharge relationship at this location; two springs discharging from the Upper Parachute Creek Member would be inundated. Any such alteration should not be considered adverse.

4.2.3.3 Solid/Hazardous Wastes and Toxic Pollutants

Nonhazardous wastes would be disposed of in the spent shale disposal area. As such, no impacts to the ground water regime are anticipated provided that the integrity of the liner material is not endangered. Hazardous waste would be disposed of in a presently unspecified, off-site, licensed facility; no ground water impacts are anticipated.

Toxic pollutants could be generated during the Union B retort processes. It is assumed that retort waters could be utilized to provide remoisturization of the spent shale, thereby introducing such trace metals as arsenic and lithium and various organic constituents. Impacts associated with this disposal would, therefore, be predicated on the effectiveness of the liner system to prevent production and migration of leachate. Leakage from the spent shale disposal pile could allow contamination of ground water below Wiesse Gulch. Additionally, airborne pollutants may settle in the area soils, also providing potential ground water contamination if leached and transported by infiltrating precipitation. Further discussion of potential airborne contaminants is provided in Section 4.2.8.

4.2.3.4 Secondary Impacts

Secondary impacts associated with population growth should be limited to: (1) depletion of ground water resources if such a source is required for domestic/municipal supply, and (2) short-term increases in dissolved solids concentration if runoff from disturbed areas (e.g., housing construction) is allowed to infiltrate. Although no ground water use is proposed for the Getty Project itself, concomitant industrial development could create such a demand. Furthermore, waste disposal areas required to support population increases could create localized ground water contamination if they are not properly designed, constructed, and maintained.

4.2.7 Wildlife

This section of the EIS serves in part, as a Technical Assistance Report to address the concerns of the U.S. Fish and Wildlife Service (USFWS) and Colorado Division of Wildlife (CDOW) under the Fish and Wildlife Coordination Act of 1958. The USFWS believes that the intent and implementation of these measures will assure compliance with the provisions of the Fish and Wildlife Coordination Act (USFWS 1984d).

Following is a description of direct impacts of the Getty proposed action and alternatives on wildlife. This discussion is based on the results of a wildlife impact analysis performed by the USFWS and CDOW. Sources of information for the analysis included the baseline report for the Getty project (Getty 1983a) and wildlife data in the USFWS/CDOW computer data base. Project impact analyses were accomplished by use of a modified USFWS Geographic Information System (GIS; Porter et al. 1979; USFWS and CDOW 1983). GIS is a computer-based overlay system designed to provide a relately rapid impact evaluation capability. Wildlife values (wildlife range or habitat acreage weighted by species abundance, sensitivity, or other critical limiting factors) were compared with project development acreage (weighted by intensity and type of potential disturbances). The results of this analysis are given in Appendix C (Tables C-1, C-3, and C-5) and summarized in this report. The habitat acreages and wildlife values shown in these tables and discussed in the following sections were generated for the DEIS, represent a worst-case analysis, and are intended for comparative purposes only.

Included in the discussions that follow are commitments made by Getty to specific mitigation measures since the release of the DEIS. The magnitude and probability of these impacts will be significantly reduced by the planned mitigation program. Therefore, it is expected that acreage figures reflecting maximum loss or disturbance of habitat as shown below and denoted with an asterisk(*) will be mitigated to an acceptable level.

Further details concerning the impact analysis methodology are provided in the Technical Assistance Report for the Clear Creek Shale Oil Project (USFWS and CDOW 1983).

4.2.7.1 Proposed Action

Construction and operation of the proposed action would directly affect about 4,100(*) acres of specific wildlife habitats. This figure does not take into consideration overlapping wildlife habitats. An additional 16,480(*) acres of specific wildlife habitats within 0.5 miles of the project features would be potentially disturbed (Table C-3, Appendix C). Similarly, this value may be somewhat inflated since it does not take overlapping habitats into consideration. Of these areas directly affected by the proposed action, an estimated 1,800(*) acres are big game winter range (WR), winter concentration area (WCA), and critical habitat (CH).

Getty will cooperate with USFWS and CDOW to avoid all Category 1 habitats (see Glossary) through proper siting. In addition, Getty recognizes that some acres may need to be enhanced to offset project impacts to Category 2 and 3 habitat/ranges. During construction and operation, Getty will enhance adjacent undisturbed habitat using enhancement technology in effect at the time, to offset disturbed habitat so that no net loss of in-kind habitat value is realized. Disturbed areas, except those adjacent to roadways, will be revegetated with vegetation mixtures favorable to wildlife, in cooperation with USFWS, CDOW, and MLRB permitting.

Active nest locations for Cooper's hawk and red-tailed hawk would be impacted as well as known cliff nesting sites (currently inactive) for the golden eagle. Getty will work closely with USFWS and CDOW to determine appropriate buffer zones for federal and state protected raptor nest sites and sage grouse leks. Getty will

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(*)Denotes maximum potential affected acreage. Mitigation should reduce figure to an acceptable level.

consider, as it is feasible, timing of construction activities to avoid critical raptor nesting and big game concentration periods. No taking of raptors or nests will occur unless specifically permitted by USFWS and CDOW.

Sensitive habitats affected by the proposed action include aspen woodland and riparian areas (Table C-3, Appendix C). Getty will work closely with USFWS and CDOW in minimizing impacts to riparian/wetland areas if they are encountered. Wildlife impacts associated with each project feature and alternatives are summarized below. It is expected that Getty's committed mitigation plan will significantly reduce these impacts.

Development and operation of the underground mine would have a low adverse effect on wildlife species or habitats in the project area. Disturbance of some cliff and plateau shrubland habitats could occur during construction of the two mine benches, portals, vents, and associated surface facilities.

The construction of processing facilities would directly affect plateau mixed shrubland habitat, the primary habitat on site. Some aspen stands would also be lost at the second retort addition. An active red-tailed hawk nest located in an aspen stand at the north end of the second retorting facility site may become disturbed or directly lost (see discussion above of mitigation measures for raptor nest sites).

The disposal of spent shale in Wiesse Gulch would cause the direct loss of plateau mixed shrubland, sagebrush, and aspen habitats. In addition, one active Cooper's hawk nest and one active red-tailed hawk nest would be eliminated through disposal activities. Three inactive nests — two buteo and one accipitrine — would also be directly lost (see discussion above pertaining to committed mitigation of raptor impacts).

The placement of a syncrude pipeline and transmission line across the Getty property would cause the short-term disturbance of plateau shrubland and aspen habitats which lie in the corridor. One known, active red-tailed hawk nest would probably be lost or disturbed. No raptor mortality due to contact with transmission lines is expected since only "electrocution-proof" lines will be installed.

The proposed utility and water corridor, which traverses Buck Gulch, would disturb dry slope shrubland and barren rock habitats of the gulch. This area has been classified by the CDOW (1983b) as a migration corridor for mule deer. Elk winter range, winter concentration area, and critical habitats would also be affected by this corridor (Table 4.2-6). However, disturbance of these big game areas should be short-term in duration.

The proposed access road from the Clear Creek road up Tom Gulch to the initial retorting and upgrading facilities would affect riparian, dry shrubland, cliff, conifer, and plateau shrubland habitats. In addition, the road corridor would traverse elk CH and a Tom Creek migration route. As a result, the incidence of big game roadkills, particularly elk, could increase due to increased vehicular traffic. Committed mitigation measures which will reduce this impact include (1) reseeding roadway shoulders, where possible, with vegetation unpalatable to wildlife; (2) implementing appropriate means to minimize big game road kills if kill frequencies exceed 10 per mile per year; (3) investigating in cooperation with other developers the use of mass transportation of workers to reduce big game road kills if kill frequency exceeds 10 per mile per year; and (4) enforcing reduced speed limits at key big game crossing areas. Although no known raptor nests lie in the road corridor, several buteo (active and inactive) and golden eagle (inactive) nests occur in relative close proximity. Construction and use of the road could cause these nests to become permanently abandoned. Committed mitigation measures should reduce these impacts to raptors (see Section 2.3.1.2.5).

The establishment of a reservoir in Tom Creek gulch would cause the inundation of riparian and valley shrubland habitats. Portions of WCA and CH for elk would be permanently lost (Table 4.2-6). Habitats for a variety of small game and nongame species would also be eliminated. The Roan Creek-Clear Creek reservoir would inundate valley riparian and shrubland habitats and affect portions of mule deer WCA and CH. The open water habitat created by the reservoirs could attract increased numbers of waterfowl and shorebirds to the project area during migration and winter periods. Fluctuating water levels in the reservoirs as a result of inflow and withdrawal could result in open, ice-free water throughout the winter. However, these positive aspects of the reservoirs are likely to be offset by the destruction of habitat and loss of individuals that are also expected to occur. Getty will develop appropriate reservoir management plans as long as such plans do not preclude the intended use.

The wildlife habitats affected by the proposed GCC settling pond are unknown but are most likely to be a combination of agricultural, valley grassland, and sagebrush types. Fifty-five(*) acres of mule deer WR, WCA, and CH would also be affected (Table 4.2-6).

Riparian communities potentially affected by construction and operation of the proposed action include those located in Tom Gulch and in the vicinity of the GCC settling pond. Approximately 20(*) acres of riparian habitat, including a 0.5 buffer, would be directly impacted at these localities (Table C-1, Appendix C). The effects on wildlife could include loss of breeding and nesting areas, escape cover, and preferred food and water sources, and are not deemed significant considering the total area involved. No threatened or endangered wildlife species would be affected by loss of riparian habitat at these locations. As stated previously in this section, Getty will work closely with USFWS and CDOW to minimize impacts to riparian/wetland habitats.

4.2.7.2 Alternatives

No significant difference in wildlife impacts is anticipated for the Lurgi alternative. About 230(*) fewer acres of wildlife habitat on the plateau would be disturbed under the 50,000-bpd alternative since the second retort addition site would be eliminated (see Key, Appendix C).

Disposal of spent shale in Tom, Buck, and Doe gulches would have a significant long-term effect on wildlife. Almost 640(*) fewer acres of wildlife habitat would be permanently lost compared with that expected under the proposed action. However, the disposal of spent shale at these alternate locations would inundate a relatively large area of cliff and dry shrubland habitat, thereby causing a long-term reduction in the availability of these habitats to cliff nesters (e.g., golden eagles), as well as to a variety of other wildlife species. A narrow band of riparian habitat in Tom Gulch would also be covered by spent shale. In addition, one active Cooper's hawk nest in Buck Gulch and several buteo and golden eagle nest sites (inactive) in Tom Gulch would be permanently lost. Almost 600(*) acres of Elk WCA and CH and over 1,500(*) acres of WR, which also occur in these gulches, would be directly lost through disposal activities (Table 4.2-6). Disposal of spent shale in the underground mine in combination with Buck and Doe gulches would result in wildlife impacts similar to those discussed above.

The addition of the West Fork Parachute Creek reservoir (plus a connecting pipeline) to the water supply system would entail the loss of additional riparian, aspen, and shrubland habitats on the plateau. Active red-tailed hawk and Cooper's hawk nests in the vicinity of the corridor and reservoir will likely be disturbed during construction activities. The impacts of the Big Salt Wash and Rangely corridors on wildlife and wildlife habitats were addressed in the CCSOP EIS (BLM 1983a).

Of the alternatives considered, the West Fork Parachute Creek reservoir and pipeline corridor is the only one which would adversely affect riparian habitat in the project area. Approximately 100(*) acres would be directly impacted, and an additional 66(*) acres of riparian habitat within 0.5 miles of the corridor could be disturbed (Table C-1, Appendix C). Impacts to terrestrial wildlife are expected to be similar to those which would result from disturbance of riparian habitat under the proposed action. No threatened or endangered wildlife species would be affected by disturbance or elimination of riparian habitat in the alternative reservoir and corridor location.

4.2.7.3 Solid/Hazardous Wastes and Toxic Pollutants

Getty has proposed to use engineering measures which should reduce the likelihood of surface and ground water contamination through contact with spent shale and upward migration of trace and toxic elements into the plant rooting zone. These preventive measures include use of an impermeable liner, capillary barrier, benching, adequate topsoiling, and revegetation of the pile (see Section 2.3.1). Therefore, spent shale disposal in Wiesse Creek should not result in uptake or bioaccumulation of toxic elements in plants and herbivores. Runoff retention reservoirs below the disposal area could contain elevated concentrations of heavy metals (see Surface Water, Section 4.2.2). Getty plans to pump the water in the retention reservoirs back to the shale disposal site. Hence, exposure of wildlife species to metals in the reservoirs should be minimal and short-term in duration. Additionally, Getty has committed to use fencing practices which will be directed to minimize wildlife impacts, exclude wildlife from hazardous areas, implement practices for oil and grease spills and proper storage of such chemicals and fuels, and develop emergency clean-up programs.

Table 4.2-6 SUMMARY OF ESTIMATED POTENTIALLY AFFECTED ACREAGES OF BIG GAME WINTER RANGE (WR), WINTER CONCENTRATION AREA (WCA), AND CRITICAL HABITAT (CH) FOR MAJOR FACILITIES ASSOCIATED WITH THE GETTY PROPOSED ACTION AND ALTERNATIVES

	Potentially Affected Acreages[a]					
	Mule Deer			Elk		
Alternative/Components	WR	WCA	CH	WR	WCA	CH
Proposed Action (100,000 bpd)						
Mine Bench and Plant Site	0.0	0.0	0.0	94.5	0.0	0.0
Additional Retort Site	0.0	0.0	0.0	0.0	0.0	0.0
Spent Shale Disposal	0.0	0.0	0.0	0.0	0.0	0.0
Corridors						
Power, Road, Syncrude, Water (Mesa)	0.0	0.0	0.0	0.0	0.0	0.0
Power and Water (Buck Gulch)	0.0	0.0	0.0	124.5	84.0	84.0
Road (Tom Gulch)	0.0	0.0	0.0	337.5	118.5	118.5
Power, Rail, Road, Water (Roan Creek, Clear Creek)	3,015.0	2,428.5	2,326.5	249.0	147.0	147.0
Water Supply						
GCC Joint Venture and Two Other Regulation Reservoirs	1,803.0	1,803.0	1,803.0	174.0	174.0	174.0
GCC Settling Pond	55.5	55.5	55.5	0.0	0.0	0.0
	4,873.5	4,287.0	4,185.0	979.5	523.5	523.5
Alternatives						
Proposed Action (50,000 bpd)	4,873.5	4,287.0	4,185.0	979.5	523.5	523.5
Spent Shale Disposal (Tom, Buck, Doe Gulches)	1.5	0.0	0.0	1,563.0	582.0	582.0
Corridors						
Rangely B	1,464.0	0.0	1,638.0	2,856.0	0.0	1,008.0
Big Salt Wash	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
West Fork Parachute Creek	0.0	0.0	0.0	0.0	0.0	0.0
Water Supply						
West Fork Parachute Creek Res., Tom Creek Res., Roan Creek/ Clear Creek Res., and GCC Joint Venture Facilities	1,803.0	1,803.0	1,803.0	174.0	174.0	174.0

Source: USFWS and CDOW (1983); See Appendix C, Table C-1.

[a] The acreages shown in the table for each big game species and range type are *not* mutually exclusive values (i.e., considerable overlap in ranges exists within *and* between each species).

4.2.7.4 Secondary Impacts

Indirect loss of wildlife and wildlife habitat would result from secondary impacts of the proposed project. A long-term reduction of wildlife densities from road kills and poaching could occur throughout the region. Direct loss of wildlife due to poaching could be locally significant, especially for deer and elk, where concentration areas are accessible. Direct regional impacts on wildlife habitat would result from housing and community infrastructure development. The magnitude of long-term reduction in the regional carrying capacity for many species would be minimized if such habitat losses are concentrated in areas of existing community development. Indirect impacts to wildlife would occur as a result of increased levels of noise, harassment by domestic pets, and human activity (including ORV use) in the area of secondary impact. A simultaneous increase in the demand for consumptive and nonconsumptive wildlife-related recreation would occur throughout the area.

To minimize these impacts, Getty is committed to (1) promote wildlife education as a part of employee orientation, (2) implement a company firearm policy to curb employee possession of weapons while at work and while commuting to the project site, and (3) work closely with USFWS and CDOW in implementing in-house wildlife monitoring programs on its properties. In addition, Getty will assist in the development of a regional wildlife management plan in cooperation with the CDOW, USFWS, other agencies, and other oil shale developers.

4.2.8 Air Quality/Meteorology

4.2.8.1 Proposed Action

This section considers the air quality impacts due to Getty's proposed action, including the mine, retorting and upgrading facilities located on the plateau above Doe and Buck gulches.

Emissions

The air quality impact analysis of the proposed Getty project considers stack and fugitive releases of SO_2, TSP, NO_x and CO in addition to emissions of other regulated and/or potentially hazardous pollutants. A 100,000-bpd production rate was utilized. TSP emissions anticipated from mining and shale handling activities include a wide variety of source types. The exact location of solids handling sources could move across wide areas in a month-to-month progression. The year 2010, or 21 to 25 years into the project, was chosen to define the area source locations of the rock storage and spent shale areas and the point source locations of the mine activities and processing plants. The year 2010 should represent maximum emission potentials due to full production.

The emission rates and stack height information associated with the retorting, upgrading, and mining facilities are presented in Table 4.2-7. Sources with identical stack parameters and in the same vicinity were grouped to form composite sources with combined emissions. These composite sources for the upgrading, retorting and mining facilities were assigned geographical coordinates corresponding to the geometric mid-point of the individual sources of each source sub-group. Constant year-round emissions corresponding to retorting for a 100,000-bpd oil shale facility were assumed for the modeling analysis. Further details of the modeling analysis are provided in Appendix A of the DEIS. The emission source modeling configuration was derived from the plot plans and emission rates detailed in the Getty project description (Getty 1983b).

Air Quality

Table 4.2-8 lists the predicted maximum air quality impacts of the plateau top facilities for the proposed action. The table lists each appropriate pollutant, averaging time, and receptor location for the predicted maximum concentrations in the PSD Class II areas, the PSD Class I areas (Flat Tops Wilderness, Arches National Monument, the Black Canyon of the Gunnison Wilderness, and West Elk Wilderness), the Colorado Category I areas (Colorado National Monument and Dinosaur National Monument) and the Mesa County TSP non-attainment area. All short-term values are the highest second-highest value predicted.

For the proposed action, the PSD Class II 24-hour TSP increment may be consumed or exceeded by 1 microgram per cubic meter ($\mu g/m^3$). This predicted impact is located along the west central property line and is largely due to the close proximity of the disposal area to this property line. No other Class II increments or NAAQS are predicted to be exceeded by the proposed action.

The 24-hour SO_2 impact at the southwest corner of the Flat Tops Wilderness boundary, which is about 42 miles away, is predicted to be 80 percent of the PSD Class I increment. Transport of significant quantities of SO_2 and TSP for the other regulated averaging times would not likely occur due to the distances to Flat Tops and other sensitive areas (about 87 miles to Arches National Monument, 76 miles to the Black Canyon of the Gunnison Wilderness, 71 miles to the West Elk Wilderness, 40 miles to the Colorado National Monument, and 58 miles to Dinosaur National Monument) and the low probability of occurrence of meteorological conditions that would effectively transport pollutants to these areas.

Table 4.2-7 MINING, RETORTING, AND UPGRADING STACK EMISSIONS AND STACK DATA, GETTY PROPOSED ACTION

Facility	Stack Height (m)	No. of Stacks	SO_2[a] (g/sec)	TSP[a] (g/sec)	NO_x[a] (g/sec)	CO[a] (g/sec)	HC[a] (g/sec)
Retorting and Upgrading Emissions							
Recycle Gas Heater	76	12	58	2	74	6	1
Reboiler	61	6	5	0	7	1	<1
Boiler	61	4	19	1	34	25	1
Reformer Heater	23	4	2	1	37	3	1
Hydrotreator	53	4	2	0	7	1	0
Tail Gas Incinerator	6	2	1	0	0	0	0
Mining and Material Handling Emissions							
Mining	NA[b]	NA	3	6	52	159	3
Raw Shale Handling	NA	NA	0	24	0	0	0
Spent Shale Handling	NA	NA	0	1	0	0	0
Disposal/Reclamation	NA	NA	1	7	17	3	1
Miscellaneous	NA	NA	0	0	0	0	20
TOTAL EMISSIONS			91	42	228	198	27

Source: Getty (1983b).

[a] Total for all stacks.
[b] NA - Not Applicable.

An analysis of ozone impacts from the Getty proposed action has been conducted. Since ozone is a regional pollutant, the analysis presented in the CCSOP EIS (BLM 1983a) should be representative of the Getty location. Optimum ozone production typically occurs when the ratio of HC to NO_x is between 7 to 1 and 12 to 1 (EPA 1977b). The ratio for the Getty proposed action is only 1 to 8. The Chevron study (BLM 1983a) indicates emissions of HC and NO_x from oil shale facilities at a ratio of 1 to 3 would have a minimal impact on ambient ozone concentration, with a range of predicted ozone concentrations for all scenarios less than 0.01 ppm. This would represent a concentration of less than 8 percent of the federal standard. The contribution from the Getty project would be within this range.

Visibility

An EPA Level-1 visibility screening analysis (Latimer and Ireson 1980) was performed to determine the possibility of any significant impacts occurring in the Class I and Colorado Category I areas. The Level-1 visibility screening analysis is a simple, straightforward calculation designed to identify those emission sources that have little potential of adversely affecting visibility. If a source passes this screening test, it would not likely cause significant visibility impairment, and further analysis of potential visibility impairment would not be necessary. The Level-1 analysis input requirements are the minimum distance of the emission source from the nearest Class I area boundary; total TSP, SO_2, and NO_x emission rates; and typical worst case meteorology. The

Table 4.2-8 MAXIMUM AIR QUALITY IMPACTS SUMMARY, GETTY PROPOSED ACTION

			Predicted PSD Class I[b] Concentrations ($\mu g/m^3$)				Category I[b] Conc. ($\mu g/m^3$)			Predicted Class II Conc. ($\mu g/m^3$)			Standards ($\mu g/m^3$)[b]			
Pollutant	Averaging Time	Background[a] Conc. ($\mu g/m^3$)	FLAT	ARCH	BACA	WELK	COLO	DINO	MESA	Receptor Location	Conc.	Total Conc.	Class I Incre.[c]	Class II Incre.	Limit. NAAQS	SIL
SO_2	Annual	<1	<1	<1	<1	<1	<1	<1		W-Cen Prop. Line	7	8	2	20	80	1
	24-Hour	14	4	1	1	<1	2	2		2.4 km off NW Cor.	29	43	5	91	365	5
	3-Hour	17	16	5	8	5	13	10		NW Cor. Prop. Line	88	105	25	512	1,300	25
TSP	Annual	15	<1	<1	<1	<1	<1	<1	<1	W-Cen Prop. Line	8	23	5	19	60	1
	24-Hour	34	<1	<1	<1	<1	<1	<1	<1	W-Cen Prop. Line	38[d]	72	10	37	150	5
NO_2	Annual	4								W-Cen Prop. Line	69	73			100	1
CO	8-Hour	2,500								W-Cen Prop. Line	1,981	4,481			10,000	500
	1-Hour	3,000								W-Cen Prop. Line	17,417	20,417			40,000	2,000

[a] Background concentrations are representative of facility area. The actual background concentration in other impact areas may be lower.
[b] FLAT = Flat Tops Wilderness west boundary; ARCH = Arches National Monument east boundary; BACA = Black Canyon of the Gunnison National Monument west boundary; WELK = West Elk Wilderness west boundary; COLO = Colorado National Monument north boundary; DINO = Dinosaur National Monument east boundary; MESA = Mesa County TSP Nonattainment Area; SIL = Significant Impact Level
[c] Colorado Category I increments are the same as PSD Class I increments for SO_2 only.
[d] Equal to or exceeds PSD increments.

meteorology used for this analysis is that suggested by Latimer and Ireson (1980) which is moderate atmospheric stability (F) and light winds. (These are the most stringent conditions for maximizing the conservative nature of the analysis.) This analysis indicates that significant impacts cannot be ruled out within 37 miles, where TSP-caused plume impact against dark terrain might occur. All of the above Class I and Category I areas are beyond 37 miles and therefore no visibility impacts are anticipated in these areas. A more sophisticated PLUVUE visibility impacts analysis verifies these results, with none of the 7 days analyzed showing significant impacts.

Atmospheric Deposition

Impacts caused by acid deposition is considered as one of the Air Quality Related Value (AQRVs) for federally designated Class I areas which are in close proximity to a facility. Acid deposition is a regional phenomenon generally associated with emissions generated by large cities and major industrial sources. Even so, it has been documented in a high-altitude Rocky Mountain setting where no direct connection has been made to major emissions sources (Lewis and Grant 1980). Additional studies and analyses have been done by Lewis and Grant of Colorado State University, Ft. Collins (see reference above), Turk of U.S. Geological Survey (Turk and Adams 1982), and Fox of the U.S. Forest Service (Fox et al. 1981). Most of these studies of western acid deposition indicate it is unlikely, but still unknown, whether significant contributions to adverse impacts are possible from an individual source.

Potential deposition of sulfur and nitrogen in Class I and Category I areas was modeled using the deposition results from the ISC long-term model and the annual meteorological data set collected at Chevron's Clear Creek mesa station. The analysis assumes the following:

- The estimated worst-case single concentration is representative of deposition to the entire wilderness area.

- All sulfur compounds were assumed to be SO_2 and nitrogen compounds were assumed to be NO_x.

- Dry deposition velocity of NO_x and SO_2 was assumed to be 1 centimeter per second (cm/sec).

- Complete mixing in lakes could occur due to snowmelt or runoff.

Wet deposition rates were estimated from precipitation statistics for the Class I and Category I areas. Assuming an annual average mixing depth of 8,300 to 8,500 feet (Holzworth 1972) and the complete removal of pollutants during the 1-hour precipitation event on each of the event days (U.S. Department of Commerce 1968), the effective annual-average wet deposition velocity of 0.8 cm/sec was calculated for Flat Tops, Black Canyon, and West Elk Wilderness areas, and 1.0 cm/sec for Arches, Colorado and Dinosaur National Monuments. Applying these values to the concentrations of SO_2 and NO_x in the wilderness area resulted in the prediction of wet deposition rates to be 80 and 100 percent of the dry deposition rates in these respective areas. Table 4.2-9 presents the annual dry and wet deposition rates resulting from Getty's proposed action. The total nitrogen and sulfur deposition was conservatively estimated to range from 3 to 48 mg/m^2 over an annual period for the sensitive receptors.

The conservative deposition rates are not expected to alter the pH of lakes with good buffering capabilities but may slightly lower the pH level of the poorly buffered lakes in the Flat Tops Wilderness with pH values below 7. U.S. and Canadian scientists have agreed that wet sulfate deposition of 2,000 $mg/m^2/yr$ and dry sulfate deposition of 1,300 $mg/m^2/yr$ have not produced any recorded damage in most vulnerable areas (Roberts 1983). The sulfur deposition calculated represents a small percentage of this threshold value. Although no similar threshold value has been proposed for judging nitrate deposition, the threshold impact value would be expected to be about the same as for sulfate deposition. Again, the calculated nitrogen values are only a small percentage of this threshold value. It is not currently known what effect, if any, these shifts would have on sensitive biota of Class I and Category I areas. In general, as aquatic systems acidify, the physiological stress is likely to progressively alter biological population structures. At the acidification levels reported, elimination of certain phyto- and zooplankton species is possible (reducing diversity), but a significant change in total biomass is unlikely.

Table 4.2-9 MAXIMUM ANNUAL ELEMENTAL DEPOSITION RATES ($mg/m^2/yr$) IN SENSITIVE AREAS, GETTY PROPOSED ACTION

Constituent	Flat Tops Dry	Flat Tops Wet	Arches Dry	Arches Wet	Black Canyon Dry	Black Canyon Wet	West Elk Dry	West Elk Wet	Colorado[a] Dry	Colorado[a] Wet	Dinosaur Dry	Dinosaur Wet
Nitrogen	32	26	2	2	4	3	4	3	28	28	14	14
Sulfur	16	13	1	1	2	2	2	2	13	13	7	7

[a] Colorado National Monument.

4.2.8.2 Alternatives

This section considers the air quality impact of the proposed alternatives and subalternatives to the Getty project. These alternatives and subalternatives include the following:

- Reduced production rate at 50,000 bpd using Union B retorts
- Full production rate at 100,000 bpd using Lurgi retorts
- Reduced production rate at 50,000 bpd using Lurgi retorts
- Underground spent shale disposal
- Tom, Buck, and Doe gulch spent shale disposal
- On-site cogeneration

The emission rates in grams per second (g/s) were provided by Getty (1983c). The emissions inventory for each alternative is presented in Table 4.2-10. The emissions included all emissions from the alternative oil shale facility except for cogeneration. Cogeneration has been treated as a separate point source subalternative that could be added to any of the primary alternatives.

As for the proposed action, these emission rates were modeled using the ISC air quality model to analyze the short-term and annual concentration of TSP, SO_2, NO_x, and CO. Table 4.2-11 summarizes the significant results of these analyses. Ozone impacts are not shown because they would be negligible for all alternatives since the ratio of hydrocarbons to oxides of nitrogen emissions would be well below optimum ozone production ratios (see Section 4.2.8.1). Table 4.2-12 presents the acid deposition analyses conducted for the sensitive receptor areas. The acid deposition analysis was performed using the same methodology used for the proposed action. Table 4.2-13 presents the air quality impacts summary for the subalternatives of spent shale disposal and cogeneration. All short-term values are the predicted highest second-highest values. Level-1 visibility screening analyses were performed for all alternatives and are below. For those alternatives which failed the Level 1 screening analysis, a Level 2, PLUVUE analysis was performed. The results of these analyses, which are presented in Table 4.2-14, indicate the number of days during the visitor season that significant impacts are predicted.

Several of the techniques employed in this analysis make these visibility results conservative. First, the PLUVUE model assumes the Getty Project plume is unaffected by surface and mechanical roughness from intervening terrain. To reach Flat Tops, the plume must pass over terrain obstacles such as the Grand Hogback. As the plume encounters these obstacles, it would likely lose some of its continuity from increased turbulence with a corresponding decrease in visual perception. Second, it is physically impossible for the plume centerline to cross the viewing path midpoint of both the Blair Lake and Big Marvine Peak vistas simultaneously, but this

Table 4.2-10 SUMMARY OF EMISSION RATES (g/sec), GETTY PROJECT ALTERNATIVES[a]

	50,000 bpd Union B				100,000 bpd Lurgi				50,000 bpd Lurgi				Cogeneration			
Facility	TSP	SO_2	NO_2	CO	TSP	SO_2	NO_2	CO	TSP	SO_2	NO_2	CO	TSP	SO_2	NO_2	CO
Retorting and Upgrading Emissions																
Recycle Gas Heater	1	29	37	3	-	-	-	-	-	-	-	-				
Reboiler	0	3	4	<1	-	-	-	-	-	-	-	-				
Boiler	<1	10	17	13	1	19	34	25	<1	10	17	13				
Reformer Heater	<1	1	18	2	1	2	37	3	<1	1	19	2				
Hydroheater	0	1	4	<1	0	2	7	1	0	1	4	<1				
Tail Gas Incinerator	0	<1	0	0	0	1	0	0	0	<1	0	0				
Lurgi Retorts	-	-	-	-	180	70	520	100	90	35	260	50				
Mining and Material Handling																
Processing Area	8	0	0	-	15	-	-	-	8	-	-	-				
Mining	3	2	26	80	6	3	52	159	3	2	26	80				
Raw Shale Handling	5	0	0	0	63	-	-	-	33	-	-	-				
Spent Shale Handling	4	0	0	0	1	0	0	0	<1	0	0	0				
Disposal	4	<1	9	2	8	1	17	3	4	<1	9	2				
TOTAL EMISSIONS	21	46	114	99[b]	274	98	667	291	137	49	334	146	30	1	80	6

Source: Getty (1983c).

[a] For the underground disposal subalternative, the disposal/reclamation emissions are reduced 50 percent while the mining emissions increase by this amount. The Buck, Tom, and Doe gulches disposal subalternative emissions are the same as above.
[b] Total values are averaged. Round-off errors may occur.

assumption was maintained in order to provide a conservative assessment of the visibility impacts. In addition, the short length of the vista path and the great downwind distance of the observer means the observer's view covers only a small sector of possible plume trajectories. A deviation of only a few degrees in wind direction could mean the plume centerline would not intersect the vista path, and only the edges of the plume would be observable. The probability that the assumed plume-observer geometry would actually occur is small and it is likely that the stated impacts would be much less severe. Though no explicit cut-off point for the frequency has been established, the *Workbook for Estimating Visibility Impairment* (Latimer and Ireson 1980) suggests that an occurrence of perceptible impacts on four days may be considered significant.

50,000 bpd - Union B Retorts

For the Union B reduced-production rate alternative, 56 percent of the PSD Class II 24-hour TSP increment would be consumed. This impact would be located along the west central property line (Sleepy Ridge) where the maximum TSP concentration for the proposed action occurred. This value, when added to background, is about one-third of the federal standard. About 40 percent of the 24-hr and 3-hr PSD Class I SO_2 increments in the Flat Tops Wilderness would also be consumed. In addition, impacts of about 40 percent of the NO_2 annual and CO 8-hr and 1-hr national standards are predicted to occur. These CO impacts are very similar to the proposed action at 100,000 bpd because the sources contributing to the maximum off-property concentrations (which are at the same location) exists in both scenarios. The 50,000 bpd scenario omits the mesa mine vent and the northeast retorting complex. The mine vents are the major CO emitters. This alternative rates a low adverse impact.

A Level-1 visibility screening analysis indicated that a plume blight cannot be ruled out within a distance of 24 miles. All of the Class I and Category I areas are well beyond this distance and therefore no visibility impacts are expected in these areas due to this alternative.

Table 4.2-11 SUMMARY OF MAXIMUM AIR QUALITY IMPACTS, GETTY PROJECT ALTERNATIVES[a]

Sensitive Areas	50,000-bpd Union B								100,000-bpd Lurgi							
	TSP Annual	TSP 24hr	SO_2 Annual	SO_2 24hr	SO_2 3hr	NO_2 Annual	CO 8hr	CO 1hr	TSP Annual	TSP 24hr	SO_2 Annual	SO_2 24hr	SO_2 3hr	NO_2 Annual	CO 8hr	CO 1hr
Class I Areas																
Flat Tops Wilderness	0	<1	0	2	10				<1	4	<1	3	11			
Arches National Park	0	0	0	1	3				<1	1	0	1	5			
Black Canyon of the Gunnison Wilderness	0	0	0	1	4				<1	1	0	1	4			
West Elks Wilderness	0	0	0	1	3				<1	1	0	<1	2			
Category I Areas																
Dinosaur National Monument	0	0	<1	2	9				<1	2	<1	2	10			
Colorado National Monument	0	0	0	1	7				<1	2	<1	1	6			
Mesa County TSP Non-Attainment Area	0	0							<1	3						
Class II Areas																
Background	15	34	1	14	17	4	2,500	3,000	15	34	1	14	17	4	2,500	3,000
Maximum Conc.	5	21	5	18	72	34	1,940	17,300	12	85[b]	6	18	62	72	1,971	17,363
Total Conc.	20	55	6	32	89	38	4,440	20,300	27	119	7	19	79	76	4,471	20,363
PSD Increments																
Class I	5	10	2	5	25				5	10	2	5	25			
Class II	19	37	20	91	512				19	37	20	91	512			
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000	60	150	80	365	1,300	100	10,000	40,000
Significant Impact Level	1	5	1	5	25	1	500	2,000	1	5	1	5	25	1	500	2,000

Table 4.2-11 SUMMARY OF MAXIMUM AIR QUALITY IMPACTS, GETTY PROJECT ALTERNATIVES[a] (continued)

	50,000-bpd Lurgi							
Sensitive Areas	TSP Annual	TSP 24hr	SO_2 Annual	SO_2 24hr	SO_2 3hr	NO_2 Annual	CO 8hr	CO 1hr
Class I Areas								
Flat Tops Wilderness	<1	2	<1	2	7			
Arches National Park	<1	<1	<1	1	3			
Black Canyon of the Gunnison Wilderness	<1	<1	<1	1	3			
West Elks Wilderness	<1	<1	<1	<1	1			
Category I Areas								
Dinosaur National Monument	<1	<1	<1	1	3			
Colorado National Monument	<1	1	<1	1	3			
Mesa County TSP Non-Attainment Area	<1	1						
Class II Areas								
Background	15	34	1	14	17	4	2,500	3,000
Maximum Conc.	11	65[b]	4	15	53	44	1,940	17,318
Total Conc.	26	99	5	29	70	48	4,440	20,318
PSD Increments								
Class I	5	10	2	5	25			
Class II	19	37	20	91	512			
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000
Significant Impact Level	1	5	1	5	25	1	500	2,000

[a] All values $\mu g/m^3$.
[b] May consume or exceed PSD increment.

Table 4.2-12 MAXIMUM ANNUAL ELEMENTAL DEPOSITION RATES IN SENSITIVE AREAS, GETTY PROJECT ALTERNATIVES[a]

	Flat Tops		Arches		Black Canyon		West Elk		Colorado[b]		Dinosaur	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Union B Retorts 50,000 bpd												
Nitrogen	15	12	1	1	2	2	2	1	15	15	7	7
Sulfur	8	6	1	1	1	1	1	1	7	7	4	4
Lurgi Retorts 100,000 bpd												
Nitrogen	153	122	8	8	20	16	16	13	129	129	64	64
Sulfur	22	18	1	1	3	2	2	2	19	19	9	9
Lurgi Retort 50,000 bpd												
Nitrogen	71	57	4	4	9	7	8	6.3	72	72	34	34
Sulfur	5	4	1	1	1	1	1	1	10	10	5	5
Cogeneration with Proposed Action 100,000 bpd												
Nitrogen	50	40	3	3	7	6	6	5	45	45	22	22
Sulfur	16	13	1	1	2	2	2	2	14	14	7	7

[a] All values $mg/m^2/yr$.
[b] Colorado National Monument.

Acid deposition was analyzed for the 50,000-bpd reduced-production rate alternative using the methodology outlined in Sections 4.2.8.1. The results presented in Table 4.2-12 are well below threshold limits (Roberts 1983). Therefore, significant impacts associated with these acidification levels are not expected.

100,000 bpd - Lurgi Retorts

For the Lurgi alternative at 100,000 bpd, the 24-hr TSP concentration is predicted to more than double the PSD Class II increment at the off-property Sleepy Ridge location. When added to the background levels, this impact represents 80 percent of the NAAQS. No other Class II increment or NAAQS are predicted to be exceeded by this alternative. This alternative rates a medium adverse impact.

The 24-hr SO_2 impact at the southwest corner at the Flat Tops Wilderness boundary is predicted to be 60 percent of the PSD Class I increment. This value is lower than that predicted for the full scale proposed action, even though the overall emission rate is higher because the Lurgi retort stack from which SO_2 is emitted (in this case) is 20 meters above the Union B retort stack and the exit temperature is 129 °C higher than for the Union B. These two major revisions to the SO_2 emission characteristics would greatly increase plume rise, which in turn would reduce the downwind concentration in Flat Tops.

The 24-hr TSP concentration at the north boundary of the Mesa County TSP Non-Attainment area is predicted to be 3 $\mu g/m^3$, which is only 75 percent of the EPA significant impact level.

A Level-1 visibility screening analysis indicates that an NO_x-caused dark plume against a bright sky would be visible within a distance of 59 miles from the facility, while a light plume against dark terrain caused by TSP would be visible within a distance of 85 miles. Based on these results, a PLUVUE analysis was conducted to determine the plume blight impact more precisely. The refined analysis for Flat Tops indicated seven worst-case meteorological scenarios in which visibility impacts could occur. For the view of Shingle Peak from Blair Lake,

Table 4.2-13 SUMMARY OF OFF-PROPERTY CLASS II AIR QUALITY IMPACTS, GETTY PROJECT SPENT SHALE AND COGENERATION ALTERNATIVES[a]

	Underground Disposal								Gulch Disposal							
	Annual TSP	24-Hr TSP	Annual SO_2	24-Hr SO_2	3-Hr SO_2	Annual NO_2	8-Hr CO	1-Hr CO	Annual TSP	24-Hr TSP	Annual SO_2	24-Hr SO_2	3-Hr SO_2	Annual NO_2	8-Hr CO	1-Hr CO
Background Conc.	15	34	1	14	17	4	2,500	3,000	15	34	1	14	17	4	2,500	3,000
Proposed Action 100,000 bpd																
Maximum	5	37[b]	6	33	90	50	1,981	17,417	6	28	6	36	94	49	1,981	17,417
Total	20	71	7	47	107	54	4,481	20,417	21	62	7	50	111	53	4,481	20,417
Proposed Action 50,000 bpd																
Maximum	4	27	4	20	75	25	1,940	17,300	5	15	4	22	77	25	1,940	17,300
Total	19	67	5	34	92	29	4,440	20,300	20	59	5	46	94	29	4,440	20,300
Lurgi Retorts 100,000 bpd																
Maximum	11	82[b]	5	22	81	53	1,971	19,363	14	74[b]	4	20	91	49	1,971	17,363
Total	26	116	6	36	98	57	4,471	22,363	29	108	5	34	108	53	4,471	22,363
Lurgi Retorts 50,000 bpd																
Maximum	10	67[b]	3	18	68	27	1,940	17,318	12	56[b]	3	17	78	25	1,940	17,318
Total	25	101	4	32	85	31	4,440	20,318	27	90	4	31	95	29	4,440	20,318
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000	60	150	80	365	1,300	100	10,000	40,000
PSD Class II Increments	19	37	20	91	512				19	37	20	91	512			

Table 4.2-13 SUMMARY OF OFF-PROPERTY CLASS II AIR QUALITY IMPACTS, GETTY PROJECT SPENT SHALE AND COGENERATION ALTERNATIVES[a] (continued)

	Cogeneration							
	Annual TSP	24-Hr TSP	Annual SO_2	24-Hr SO_2	3-Hr SO_2	Annual NO_2	8-Hr CO	1-Hr CO
Background Conc.	15	34	1	14	17	4	2,500	3,000
Proposed Action 100,000 bpd								
Maximum	8	40[b]	7	29	88	73	1,981	17,417
Total	23	74	8	43	105	78	4,481	20,417
Proposed Action 50,000 bpd								
Maximum	5	23	5	18	72	34	1,940	17,300
Total	20	57	6	32	89	38	4,440	20,300
Lurgi Retorts 100,000 bpd								
Maximum	12	87[b]	6	18	62	72	1,971	17,363
Total	26	101	7	29	79	76	4,471	20,363
Lurgi Retorts 50,000 bpd								
Maximum	11	67	4	15	53	44	1,940	17,318
Total	26	101	5	29	70	48	4,440	20,318
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000
PSD Class II Increments	19	37	20	91	512			

[a] All values $\mu g/m^3$
[b] PSD increment may be consumed or exceeded

Table 4.2-14 PREDICTED VISIBILITY IMPACTS FOR ALL GETTY ALTERNATIVES

Alternative	Number of Days/yr of Potential Significant Impacts[a]	
	Blair Lake-Shingle Peak Vista	Big Marvine-Shingle Peak Vista
Proposed Action 100,000 bpd	0	0
Union B Retorts 50,000 bpd	0	0
Lurgi Retorts 100,000 bpd	7	7
Lurgi Retorts 50,000 pbd	7	3
Cogeneration with Proposed Action 100,000 bpd	4	0

[a] During the visitor season - May 15 to October 15.

the project plume was predicted to be perceptible on 7 days during the visitor season. For the view of Shingle Peak from Big Marvine, again the plume was estimated to be perceptible on 7 days during the visitor season. Because of the conservative assumptions concerning plume transport to Flat Tops, the intervening rough terrain, and the prediction of impacts, it is possible that vistas within Flat Tops will be impaired by emissions due to this alternative.

The maximum total acid deposition presented in Table 4.2-12 would be less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

50,000 bpd - Lurgi Retorts

The second-highest 24-hr TSP concentration that would occur off the Getty property due to a reduced-production Lurgi alternative would be almost 2 times the Class II PSD increment. When added to the background concentration this value would be two-thirds of the NAAQS. Again, the CO impacts are about the same as those are for the 100,000-bpd scenario due primarily to the mine vents located near the southwestern section of the property. No other PSD increments or NAAQS are predicted to be exceeded.

A Level-1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 40 miles from the facility, while a TSP-caused light plume against dark terrain would be visible to a distance of 62 miles. This analysis indicates a potential for visibility degradation in Flat Top Wilderness and Colorado National Monument. A Level 2, PLUVUE analysis for the Flat Tops indicates a potential for visibility impacts on 7 days during the visitor season for the Blair Lake and Shingle Peak vista and on 3 days for the Big Marvine and Shingle Peak vista. Only 3 days were found where perceptible plumes were predicted for the Blair Lake-Shingle Peak vistas. The plume discoloration test, however, failed the indicated thresholds for the other 4 days.

The maximum total acid deposition presented in Table 4.2-12 is less than 10 percent of threshold values presented earlier (Roberts 1983). Therefore, impacts to biota are unlikely.

Subalternatives

Underground Disposal

Table 4.2-13 presents the modeling results of the underground disposal subalternatives. The 24-hr TSP concentrations are predicted to consume or exceed the PSD Class II increment for the full-production proposed action and the 100,000- and 50,000-bpd Lurgi alternatives. The total concentrations, when added to the background values, result in values of 33, 66, and 44 percent of the NAAQS for the respective three alternatives. No other consumption or exceedances of PSD increment or NAAQS would occur. Visibility and acid deposition values and air quality impacts in the Class I and Category I areas would be the same as the alternative impacts discussed earlier.

Gulch Spent Shale Disposal

Table 4.2-13 also presents the modeling results of the alternative combination of Tom, Doe, and Buck gulch spent shale disposal areas. The 24-hr TSP concentrations are predicted to consume or exceed the PSD Class II increment for 100,000- and 50,000-bpd Lurgi alternatives. When added to the background values, these would result in 72 and 60 percent of the NAAQS for the 100,000-bpd and 50,000-bpd alternatives, respectively. Visibility and acid deposition values and air quality impacts in the Class I and Category I areas would be the same as the alternative impacts discussed earlier.

Cogeneration

Table 4.2-13 further presents the modeling results of the cogeneration alternative. The 24-hr TSP concentrations are predicted to consume or exceed the PSD Class II increment for the 100,000-bpd proposed action and the 100,000 and 50,000-bpd Lurgi alternatives. The total concentrations, when added to the background values, result in 50, 81, and 66 percent of the NAAQS of the respective alternatives. No significant consumption or exceedances of PSD increments or NAAQS would occur over other alternatives without cogeneration. All SO_2 and TSP concentrations for the regulated averaging times in the Class I and Category I sensitive receptors are less than 1 $\mu g/m^3$.

A Level-1 visibility screening analysis of cogeneration with the full production proposed action indicated a NO_x-caused dark plume against a bright sky would be visible out to 40 miles from the facility and a TSP-caused light plume against dark terrain would be visible out to 48 miles from the facility. This analysis indicates a potential for visibility degradation in the Flat Top Wilderness and Colorado National Monument. The refined PLUVUE visibility analysis for Flat Tops indicates 4 days for potential visibility impact for the view of Shingle Peak from Blair Lake, and no days for the Big Marvine-Shingle Peak vista. Of the four potential impact days, only 1 day indicates potential plume perceptibility while the other 3 days failed the plume discoloration test. Acid deposition values are presented in Table 4.2-12 and are below the threshold values (Roberts 1983).

4.2.8.3 Solid/Hazardous Wastes and Toxic Pollutants

None of the non-criteria pollutants typically found in combustor off-gas are expected to be emitted above *de minimis* (negligible) values by the Union B retort process. This conclusion is based upon a review of the Union Oil Company's PSD permit application (UOC 1982) and a review of EPA's document concerning trace elements associated with oil shale processing (EPA 1977a). An additional analysis for an example combustor off-gas trace elements has been supplied by Getty (1983c) and is presented in Table 4.2-15. Based on the analysis of potentially toxic pollutants that might be emitted from the proposed project, all ranges of emissions for the identified toxics are minor and are below EPA *de minimis* levels.

Only limited data are available concerning the emissions of potentially toxic substances. However as noted in the Uinta Basin Synfuels Development Final EIS (BLM 1983c), the risk to public health is very small, even for a 1,000,000-bpd oil shale industry. This risk calculation addressed project workers, the existing population, and people moving into the area.

4.2.8.4 Secondary Impacts

This section presents the estimated air quality impacts from secondary growth emission sources associated with the construction and operation of Getty's mining, upgrading, and retorting facilities. The secondary growth sources included in the analysis are increased space heating requirements and increased motor vehicle traffic in the De Beque area.

The emission estimates from increased space heating and transportation requirements are presented in Table 4.2-16. Space heating emissions were calculated by assuming each new household was a consumer of natural gas and used 115,000 standard cubic feet of gas per customer year (BLM 1983b). Emission factors for natural gas combustion were derived from EPA's compilation of emission factors (EPA 1977c). Vehicle exhaust emissions were calculated from national average emission factors. It was assumed that each household operated an average of two vehicles and each vehicle averaged 12,000 miles traveled per year. The highest emissions are expected in 1995. The air quality impacts of the 1995 projected emissions were estimated with the highly conservative screening technique outlined below.

A worst-case episode was considered to estimate the highest short-term concentrations possible in De Beque from the projected 1995 secondary emissions. The scenario assumes all motor vehicle emissions from 3 P.M. one day until 9 A.M. the next morning are trapped over the De Beque area. In addition, continuous space heating emissions are added to the vehicle emissions. The meteorological conditions assumed are a regional high pressure stagnation condition, with zero ventilation. Thus, pollutants emitted during the 18-hour period are assumed to

Table 4.2-15 TRACE ELEMENTS IN DEMONSTRATION UNION B RETORT OFF-GAS[a]

Element	Form	Concentration in Off-Gas ($\mu g/m^3$)	Toxicity Range[b] (TLV) ($\mu g/m^3$)	Annual Emission[c] Rate (Ton/Year)	De Minimis Value (Ton/Year)
Arsenic	Gas[d]	15	500 to 2,000	0.25	--
	Particulate	0.4			
		15.4			
Mercury	Gas	2.2	100 to 500	0.01	0.1
	Particulate	0.15			
		2.35			
Iron	Gas	120.0	--	0.44	--
	Particulate	6.0			
		126.0			
Chromium	Gas	90.0	500 to 2,000	0.32	--
	Particulate	2.0			
		92.0			
Zinc	Gas	40.0	500 to 150,000	0.14	--
	Particulate	0.5			
		40.5			

Source: Getty (1983b).

[a] Assumes net gas production of 500 SCM/ton shale (Harak et al. 1974).
[b] Source: Cowherd et al. (1977). TLV - Threshold Limit Value.
[c] Assumes volume flow rate of 100 m^3/sec.
[d] Gaseous forms are defined as those not collected by a 0.5μ neopore filter.

accumulate over the town, and then are fumigated down to the ground and fill a well-mixed box surrounding De Beque. A 32-square-mile area surrounding De Beque was assumed for the well-mixed region. To add to the conservatism, the vertical extent of the mixed region was taken as only 650 feet. The worst-case short-term concentrations were then calculated as the total amount of pollutant mass released during the period divided by the volume of the well mixed box.

The uniform hourly concentration estimates calculated using the above worst-case dispersion episode are 3, 9, 105, 384, and 61 $\mu g/m^3$ for SO_2, TSP, NO_x, CO, and HC respectively. Except for NO_x, these concentrations are at the level of background concentrations, and are insignificant.

Extrapolating the NO_x concentration to an annual average using a factor of 0.2 as recommended (EPA 1970) results in a concentration of 22 $\mu g/m^3$, or only 22 percent of the annual NO_2 NAAQS.

Table 4.2-16 MAXIMUM ANNUAL SECONDARY EMISSION RATES IN DE BEQUE, GETTY PROJECT

Source Type	(ton/yr) SO_2	(ton/yr) TSP	(ton/yr) NO_x	(ton/yr) CO	(ton/yr) HC
Space Heating (6,895 Units)	0.2	2	32	8	3
Transportation (13,790 Vehicles)	42	109	1,459	5,436	857
TOTAL EMISSIONS	42.2	131	1,491	5,442	860

4.3 Cities Service Project Impacts

4.3.2 Surface Water

4.3.2.1 Proposed Action

The proposed Mahogany Zone underground mine would underlie the upper Conn Creek drainage system in the Cities Service project area. Cities Service's proposed underground mine is not expected to affect the surface water regime. The main surface features of the proposed underground mine would be the mine bench, and services facilities. The mine bench area would be located on the upstream end of Cascade Canyon. Surface water impacts resulting from these facilities would be limited to minor increases in runoff and sedimentation in the upper Conn Creek drainage.

The waste rock would consist primarily of raw, low-grade oil shale. A total of 4.6×10^6 cubic yards of waste rock would be generated from mine development and production mining. The disposal site would be located at the headwaters of Conn Creek in the northern part of the Cities Service property. Surface water impacts associated with this waste rock disposal site should be minimal due to the installation of a downstream collection dam to impound runoff water from the disposal pile.

A total of 41.2×10^6 cubic yards of shale fines would be generated from the production mine consisting of particles less than 1/8-inch in nominal diameter. These particles would have the general characteristics of raw oil shale. The raw shale fines storage site would be located on the plateau in the headwaters of Conn Creek canyon, just south of the waste rock disposal area. The shale fines storage pile would be susceptible to water erosion due to its fine grain characteristics. Surface runoff from the pile could also contain high concentrations of dissolved solids and organic carbon. Any runoff from the disturbed areas would be contained by a downstream collection dam and recycled. There would be no direct impact on lower Conn Creek from the shale fines storage pile. However, on the mesa the short segment of the stream channel, downstream of the shale fines to the collection dam, could be affected.

The proposed plant site would be located on the ridge between upper Conn Creek and Cascade Canyon, upstream of the spent shale disposal area. The main processing facilities would include crushing and screening, retorts, upgrading, VMIS facilities, coarse shale stockpile, raw and upgraded shale oil storage, a water treatment plant, and utilities and service facilities. Surface water impacts associated with these facilities are mainly soil erosion and sedimentation. Surface runoff from the plant site could have high concentrations of certain constituents including suspended solids, oil and grease, and dissolved solids. Again, there would be no direct impacts on lower Conn Creek since all the sediment and runoff from the plant site would be controlled in the process wastewater treatment facilities.

The spent shale disposal site would be located within upper Conn Creek and Cascade Canyon. At ultimate capacity, approximately 500 million tons of spent shale would be generated and would cover approximately 800 acres of surface area. Runoff from the disposal area would be collected in a sedimentation dam below the spent shale pile. Surface flow from Conn and Cascade creeks would be diverted around the pile in lined culverts. Surface water impacts here would include soil erosion/sedimentation, and potential water quality degradation due to potential surface runoff and leachate from the spent shale pile.

The quantity of leachate was estimated based on the water balance analysis shown in Table 4.3-1 (In-Situ 1984). The runoff during construction from the Cities Service spent shale pile ranges from 2.2 inches for the 50-percent chance year to the 6.9 inches for the 1-percent chance year of annual precipitation (Table 4.3-1). Water infiltrating the spent shale pile during construction would be negligible for the 50-percent chance year increasing to approximately 2.65 inches for the 1-percent chance year. It should be noted that no leachate should be generated from the body of the pile during construction because processed shale will be laid down at a moisture content less than the specific retention.

Table 4.3-1 WATER BALANCE OF SPENT SHALE DISPOSAL PILE, CITIES SERVICE SHALE OIL PROJECT

	Percent of Chance Year for Annual Precipitation					
Variable	50	20	10	5	2	1
Construction						
Precipitation (in.)	20.01	23.43	25.37	27.04	29.02	30.39
Evaporation (in.)	14.78	15.64	16.09	16.44	16.85	17.13
Runoff (in.)	2.16	3.49	4.35	5.14	6.13	6.86
Moisture retention (in.)	3.07	3.45	3.54	3.62	3.70	3.75
Infiltration (in.)	0.00	0.85	1.39	1.84	2.34	2.65
(ac-ft)[a]	0	5.7	9.3	12	16	18
Post-Reclamation						
Precipitation (in.)[b]	17.51	20.93	22.87	24.54	26.52	27.89
Evaporation (in.)	15.11	15.11	15.11	15.11	15.11	15.11
Runoff (in.)	2.12	3.44	4.29	5.08	6.07	6.78
Moisture retention (in.)	0.28	2.38	3.47	4.35	4.97	4.97
Leachate (in.)	4.68	4.68	4.68	4.68	5.04	5.70
(ac-ft)[c]	260[d]	260	260	260	281	317

Source: In-Situ (1984).

[a] Assumes 80 acres of uncovered pile surface during spent shale disposal operation.
[b] Excludes 2.5 inches of precipitation that is assumed to be lost through sublimation and evaporation from snowpack during the months of January through March, November, and December.
[c] Assumes 690 acres of final reclaimed spent shale surface.
[d] Including 260 ac-ft of estimated seepage generated from the artificial alluvial channel to be constructed over the top of the pile at reclamation.

The post-reclamation runoff from the disposal pile will range from 2.1 inches for the 50-percent chance year to 6.8 inches for the 1-percent chance year (Table 4.3-1). In addition to infiltration due to rainfall and snowfall, seepage will occur from the artificial alluvial channel constructed over the top of the pile. Estimates of infiltration from this channel will be on the order of 260 acre-feet per year, resulting in the long-term leachate potential from the pile ranging from 260 to 317 acre-feet per year for the 50-percent and 1-percent chance years, respectively (In-Situ 1984). These estimates are based on an estimated permeability of 3.6 feet per year for the compacted retorted shale.

Using results of the water-balance modeling analyses (Table 4.3-1), water-quality characteristics of leachate and runoff were determined using the preliminary estimates in Table 4.1-2. Then mass-balance loads for the seven selected chemical constituents were computed (Table 4.3-2). The resultant loads were made in a probablistic sense to parallel the leachate/runoff modeling analysis for construction and post-reclamation conditions. This latter distinction reflects underlying assumptions regarding exposed shale area and evaporation versus evapotranspiration losses.

The short-term construction impacts are judged to be considerably less, due to water-management controls in place during project operation. Also, all of the water infiltrating into the pile during construction will be retained in the pile.

Relative water-quality impacts on Roan Creek near De Beque, Colorado, for the Cities Service spent shale pile are given in Table 4.3-3. Impacts of the spent shale pile on water quality in Roan Creek would be measurable. The long-term concern in constituent loading for the average year (50 percent chance) shows increases in sulfate, boron, and fluoride greater than 10 percent. Water quality impacts are also evaluated at 5 locations along the

Table 4.3-2 ESTIMATED CHEMICAL LOADS, CITIES SERVICE RETORTED SHALE DISPOSAL PILE INFILTRATION OR LEACHATE AND RUNOFF[a]

Percent Chance[b]	Dissolved Solids (tpd)		Sulfate (tpd)		Total Organic Carbon (tpd)		Arsenic (lb/d)		Boron (tpd)		Fluoride (tpd)		Selenium (lb/d)	
Construction (Short-Term)														
	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff	Infil.	Runoff
50	0.0	0.10	0.0	0.08	0.0	0.0005	0.0	0.00102	0.0	0.00026	0.0	0.00010	0.0	0.00051
20	0.54	0.17	0.37	0.13	0.0011	0.0009	0.00086	0.00172	0.00043	0.00043	0.00032	0.00017	0.00086	0.00086
10	0.87	0.22	0.59	0.16	0.0017	0.0011	0.00139	0.00215	0.00070	0.00054	0.00052	0.00022	0.00139	0.00108
5	1.14	0.25	0.78	0.19	0.0023	0.0013	0.00183	0.00253	0.00091	0.00063	0.00069	0.00025	0.00183	0.00126
2	1.34	0.31	0.91	0.23	0.0027	0.0015	0.00215	0.00307	0.00108	0.00077	0.00081	0.00031	0.00215	0.00153
1	1.68	0.34	1.14	0.26	0.0037	0.0017	0.00269	0.00344	0.00134	0.00086	0.00101	0.00034	0.00269	0.00172
Post-Reclamation (Long-term)[c]														
	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff	Leach.	Runoff
50	4.84	0.18	3.39	0.14	0.0097	0.0023	0.1937	0.00457	0.00484	0.00023	0.00968	0.00046	0.01937	0.00183
20	4.84	0.30	3.39	0.23	0.0097	0.0038	0.01937	0.00753	0.00484	0.00038	0.00968	0.00075	0.01937	0.00301
10	4.84	0.38	3.39	0.28	0.0097	0.0047	0.01937	0.00941	0.00484	0.00047	0.00968	0.00094	0.01937	0.00377
5	4.84	0.43	3.39	0.32	0.0097	0.0054	0.01937	0.01076	0.00484	0.00054	0.00968	0.00108	0.01937	0.00430
2	5.25	10.52	3.67	0.39	0.0105	0.0065	0.02098	0.01291	0.00525	0.00065	0.01049	0.00129	0.02098	0.00516
1	5.92	0.58	4.14	0.44	0.0118	0.0072	0.02367	0.01453	0.00592	0.00072	0.01184	0.00145	0.02367	0.00581

Source: In-Situ (1984).

[a] Indicated loads are unrounded, and do not reflect inherent uncertainties in estimates.
[b] 50 = 2-year recurrence; 20 = 5-year recurrence; 10 = 10-year recurrence; 5 = 20-year recurrence; 2 = 50-year recurrence; 1 = 100-year recurrence.
[c] Leachate from precipitation falling directly on pile is 0.0 cfs (0 acre-feet) for all but the 50-year and 100-year recurrence annual precipitation, which were estimated to be 0.03 cfs (21 acre-feet) and 0.08 cfs (57 acre-feet), respectively. The balance of leachate indicated would be due to seepage from a channel constructed on top of the pile to convey streamflows from upstream contributing areas of the Conn Creek and Cascade Gulch watersheds.

Table 4.3-3 POST-RECLAMATION ESTIMATED WATER-QUALITY IMPACTS ON ROAN CREEK, CITIES SERVICE RETORTED SHALE DISPOSAL PILE LEACHATE AND RUNOFF

Description	Constituent						
	DS	SO_4	TOC	As	B	F	Se
Ambient mean annual concentration of Roan Creek[a]	850 mg/l	323 mg/l	20 mg/l	4.5 μg/l	0.2 mg/l	0.6 mg/l	3.5 μg/l
Ambient mean annual loading of Roan Creek[b] (2-year recurrence interval)	97 tpd	37 tpd	2.3 tpd	1.0 lb/d	0.02 tpd	0.07 tpd	0.8 lb/d
Ambient extreme-year loading of Roan Creek[c] (100 year recurrence interval)	345 tpd	131 tpd	8.1 tpd	3.7 lb/d	0.08 tpd	0.24 tpd	2.8 lb/d
	Percent Chance						
Long-term load increase, runoff only[d]							
2-year runoff	0.05	0.1	0.03	0.1	0.3	0.2	0.06
100-year runoff	0.2	0.3	0.09	0.4	0.9	0.6	0.2
Long-term load increase, leachate only[e]							
2-year leachate	5.0	9.2	0.4	1.9	21	14	2.4
100-year leachate	6.1	11.0	0.5	2.3	27	17	3
Long-term load increase, leachate and runoff[e]							
2-year leachate and runoff	5.2	9.6	0.5	2.3	22	15	2.6
100-year leachate and runoff	6.7	12.0	0.8	3.8	30	19	3.7

Source: In-Situ (1984).

[a] Average concentrations are time-weighted, not discharge weighted, based upon 1980-81 water year data for USGS station 09095000. Hence, computed loads may be high.
[b] Based upon mean annual (approximately 2-year recurrence) Q of 42.3 cfs (using 22 years of historical records at USGS site 09095000.
[c] Based upon 100-year recurrence annual Q of 151 cfs (using 22 years of historical records at USGS site 09095000).
[d] Relation to extreme-year load (100-year recurrence interval, 1 percent chance).
[e] Relation to mean-year load (2-year recurrence interval, 50 percent chance).

Colorado River. This analysis utilized data available for the 1980, 1981, and 1982 water years. Also, no attenuation or other physical or chemical processes affecting the generated leachate and runoff loadings were assumed. The worst-case (1 percent chance) loading inputs are summarized in Table 4.3-4 for the spent shale pile.

Comparing modeling with currently applicable water-quality standards (Table 4.3-5), the maximum anticipated boron concentration due to a combined effect of leachate and runoff (associated with the 1 in 100 chance annual precipitation) is about 0.23 mg/l compared to an ambient level of 0.20 mg/l in Parachute Creek and a stream standard of 0.75 mg/l for boron.

In using stream standards that apply to Roan Creek upstream from Clear Creek for the selected constituents (arsenic, boron, and selenium), the results of this analysis indicate that no standard applied to the lower reach of Roan Creek would be exceeded. Under the worst-case assumptions (1 percent chance associated with annual precipitation input to pile), dissolved solids concentrations in lower Roan Creek might increase 7 percent (from 850 to 912 mg/l) and sulfate concentrations might increase 13 percent (from 323 to 366 mg/l). Both of these constituents have no state standard for the Roan Creek stream segment. The comparisons with currently applicable state standards for the Colorado River in Colorado and ambient concentrations for the selected constituents show no impact on concentrations (Table 4.3-5).

Table 4.3-4 ESTIMATED WATER-QUALITY IMPACTS IN THE COLORADO RIVER, CITIES SERVICE RETORTED SHALE DISPOSAL PILE LEACHATE AND RUNOFF (LONG-TERM, POST RECLAMATION, 1 PERCENT CHANCE)

	Ambient Water-Quality Loading Units[a]						
Location	DS (tpd)	SO_4 (tpd)	TOC (tpd)	As (lb/d)	B (tpd)	F (tpd)	Se (lb/d)
Colorado River at Cameo, CO (USGS 0909500, 8,050 sq mi)	4,115[b]	1,260	NA[c]	61	0.41[d]	3.05	20.3
Percent Change	0.2	0.4	--	0.06	1.7	0.4	0.2
Colorado River at CO-UT State Line (USGS 09163500, 17,843 sq mi)	9,860	4,430	247	62	NA[c]	4.63	250
Percent Change	0.07	0.1	0.08	0.06	--	0.3	0.01
Colorado River at Cisco, UT (USGS 09180550, 24,100 sq mi)	11,020[b]	5,300	222	202	1.61[d]	6.13	121
Percent Change	0.06	0.09	0.09	0.02	0.4	0.2	0.03
Colorado River at Lee's Ferry, AZ (USGS 09380000, 111,800 sq mi)	21,140[b]	7,730	144	131	3.11	9.82	229
Percent Change	0.03	0.06	0.01	0.03	0.2	0.1	0.01
Colorado River above Imperial Dam AZ (USGS 09429490, 188,500 sq mi)	23,520[b]	9,110	188	235	5.29	14.7	117
Percent Change	0.03	0.05	0.01	0.02	0.1	0.09	0.03
Long-Term Loads (100-year recurrence leachate and runoff)	6.5	4.6	0.02	0.04	0.007	0.013	0.03

Source: In-Situ (1984).

[a] See Table 4.3-2 for estimated pile generated leachate and runoff loads (assumes no attenuation or reduction of loads by physical, chemical, or biological processes).
[b] Based upon discharge-weighted concentrations for more accurate estimate of loads.
[c] Stream ambient data not available at this location.
[d] Based upon historical ambient data (Iorns et al. 1965). Percentage and long-term pile loads are rounded.

In the unlikely event of dam failure of the downstream collection dam, the cumulative effects of surface runoff from upstream waste rock and shale fines piles and plant site could aggravate water quality impacts on lower Conn Creek. Stream flows of Conn Creek could be reduced, especially during low flow periods, as the result of springs disruption, surface runoff interception by the spent shale pile, and reduction of recharge area.

Various corridors for access roads, railroad spurs, water pipelines, natural gas pipelines, transmission lines, and syncrude pipelines are proposed for the project. Surface drainages that would be disturbed by these corridors during construction and operation include Roan Creek, Clear Creek, Conn Creek, and West Fork Parachute Creek. Soil erosion/sedimentation, and streamflow disruption are expected at the intersection of corridor crossings and stream drainageways during the construction stage. In addition, accidental spills from the syncrude pipeline could also cause water quality degradation in the West Fork Parachute Creek.

4.3.2.2 Alternatives

The alternative mining method would be a room-and-pillar underground mine without the VMIS mining process. Surface water impacts would be essentially the same as those of the proposed action, due to the substitution of additional surface retorts for the eliminated VMIS surface facilities.

The 50,000-bpd production rate alternative would produce smaller amounts of waste rock, shale fines, and spent shale on a daily basis. Surface water disturbances over the short-term would be less than the proposed action, due to the reduction of storage areas for waste rocks, shale fines, and spent shale. Total project daily water requirement would also be reduced. However, overall impacts over the life of the project would be the same as the proposed action.

The Lurgi alternative process technology would generate smaller particle size spent shale material, compared to the proposed Union retort technology. It would therefore require more water to wet the surface of the particle for compaction due to more surface area per unit weight of spent shale. In addition, more sour water would be produced by the Lurgi process, as compared to the Union retort process (Cities Service 1983b). Surface drainages downstream of the spent shale disposal and plant site could be subject to slightly higher water quality impacts resulting from the potential leachate of this sour water.

Table 4.3-5 COMPARISON OF STREAM STANDARDS AND AMBIENT AND IMPACTED CONCENTRATIONS, ROAN CREEK AND COLORADO RIVER IN COLORADO, CITIES SERVICE RETORTED SHALE DISPOSAL PILE[a]

Constituent		Segment 15 Roan Creek above Clear Creek (42.3 cfs)[b]	Segment 2 Colorado River near Cameo (3,780 cfs)	Segment 3 Colorado River at CO-UT State line (5,740 cfs)
Dissolved Solids (mg/l)	Standard:	--[c]	--[c]	--[c]
	Ambient Concentrations:	850	405	639
	Impacted Concentrations:	912	405	639
Sulfate (mg/l)	Standard:	--[c]	250	--[c]
	Ambient Concentrations:	323	124	287
	Impacted Concentrations:	366	124	287
Arsenic (μg/l)	Standard:	100	50	50
	Ambient Concentrations:	4.5	3	2
	Impacted Concentrations:	4.6	3	2
Boron (mg/l)	Standard:	0.75	0.75	0.75
	Ambient Concentrations:	0.20	0.04	--[d]
	Impacted Concentrations:	0.23	0.04	--[d]
Selenium (μg/l)	Standard:	20	10	20
	Ambient Concentrations:	3.5	1	8
	Impacted Concentrations:	3.6	1	8

[a] Reference for standards: Colorado Department of Health (1983). Based upon the leachate of 1 percent chance for assumed annual precipitation impacting on associated streamflows.
[b] Impact is below this segment in Roan Creek.
[c] No state stream standard is applicable.
[d] Ambient data are not available.

The Cascade Canyon alternative spent shale disposal area would be used in conjunction with a mesa site above the canyon. This alternative would disturb more surface drainage area and several mesa springs which contribute to the stream flows of Conn Creek. In addition, spent shale disposal piles and embankments in Cascade Canyon would be more susceptible to water erosion and potential leaching.

Impacts of the alternative Rangely product pipeline corridor are addressed in the CCSOP EIS (BLM 1983a). Surface water impacts would be similar to the proposed La Sal pipeline corridor except that the impacts occur on a different drainage. The alternative North product pipeline corridor starts from the Cities Service property and runs directly north to the La Sal pipeline. The North corridor would generate increased construction impacts since it crosses several drainages of Parachute Creek. This corridor intersects the La Sal pipeline downstream of a stock pond in the headwaters of the West Fork Parachute Creek (the West Fork supports a wide variety of fish species). Accidental damage to the syncrude pipeline would, therefore, not cause direct water quality impacts on the stream flow and water in the stock pond.

The alternative water supply would involve the installation of a pumping structure off the Larkin Ditch (just east of De Beque) for pumping of water to the proposed GCC reservoir. This alternative would require construction of a pumping station at the ditch, a sedimentation basin, and a water pipeline to the GCC corridor. In addition, a sedimentation basin may be located within the floodplain of the Colorado River. This basin could restrict river flow conveyance to a minor degree during flood flow events.

4.3.2.3 Solid/Hazardous Wastes Disposal

All nonhazardous solid waste would be disposed of in the spent shale disposal area. No additional surface water impacts are anticipated. Some hazardous waste could be generated by the retorting and upgrading process. Hazardous waste disposal would be off-site in a licensed facility. There would be no surface water impacts in the vicinity of the Cities Service property.

4.3.2.4 Secondary Impacts

Secondary impacts to surface water would result from increased population in the region. These impacts could include increased water consumption, potential water contamination from wastewater and solid wastes, and increased suspended solids in streams due to development activities adjacent to the streams.

4.3.3 Ground Water

4.3.3.1 Proposed Action

Underground mining on the Cities Service property would remove a portion of the Mahogany Zone. Direct disturbance of subsurface strata would, therefore, be limited to this zone and immediate over- and underlying strata. As discussed in Section 3.3.3, water-bearing intervals identified beneath the Cities Service property occur above this mining interval. The potential for ground water inflow into the mine workings is, therefore, predicted on the degree of interconnected fractures between the oil shale horizon and overlying leached interval in the Upper Parachute Creek Member of the Green River Formation.

Existing data do not allow a precise evaluation of the potential for this interconnection. Data from the adjacent Chevron property, however, indicate that relatively minor inflows can be anticipated during mining from strata immediately above and below the mining zone. Total inflows estimated for the underground portion of the Chevron property are in the range of 100 to 1,500 gpm (BLM 1983a). Limited data for the Cities Service property, and the Pacific property to the west, indicate the apparent presence of a thick zone of relatively impermeable strata separating the mining zone from the Upper Parachute Creek/Uinta aquifer. If this intervening zone remains relatively unfractured beneath the proposed mine area, inflows from overlying strata should be minimal. Similarly, limited inflows would reduce the potential for potentiometric impacts (i.e., lowering of aquifer water levels) resulting from the underground mine. The low hydraulic conductivities for both the Mahogany and the Upper Parachute Creek zones would restrict the potential for any decline in potentiometric levels from propagating outside the property boundaries, where existing ground water use has been identified.

The effect of ground water flow from underground mining should also be minor. Vertical gradients have been identified on most adjacent properties. Such a gradient could be steepened somewhat if fracturing allows inflow from the overlying aquifer. Flow within the Uinta Formation and appurtenant spring discharge points should not be significantly affected by the proposed underground mine.

There is potential for increased ground water impacts associated with the VMIS underground retort. The use of explosives in the retorting process could propagate fractures (outside of the immediate mined interval) which would extend above the Mahogany Zone. It is possible that the overlying competent Upper Parachute Creek Member marlstones would be significantly affected; if less competent zones occur, however, they could exhibit some additional interconnection which could potentially increase the hydrologic interconnection between the mined interval and overlying aquifers. If such a phenomenon were to occur, increased inflows to the underground mine might result. These inflows would likely be exposed to rubblized shale and process gases. Concentrations of dissolved solids, including trace metal and organic constituents could, therefore, increase within the retorts. Based on existing data from Logan Wash and Federal Tract Ca, elevated concentrations of dissolved constituents have been observed in abandoned and flooded retorts. At neither property, however, were discernable trends of increased TDS levels detected in monitor wells outside of the retort area. The lack of migration is best explained by low gradient/velocity ground water flows, coupled with geochemical reactions, such as adsorption which tend to attenuate the movement of high TDS water. Continued water management would be required to ensure that contamination of off-site ground and surface water systems does not occur. Current technology includes a periodic flushing of the spent retorts to enhance the dissolution of rubblized spent shale. Processes should be considered to reduce the potential for long term increases in dissolved solids.

Further fracturing of overlying strata could occur if subsidence results from the eventual abandonment of underground workings. The extent of subsidence would be a function of the void space at the top of the rubblized zone. It is expected that little void space would be present and thus little subsidence will occur. If subsidence fractures intersect the overlying Upper Parachute Creek aquifer, increased inflows to the underground workings may occur. The magnitude and duration of any potential increase in flows cannot be predicted accurately. No surficial expression of subsidence, nor evidence of increased retort inflows, have been observed from abandoned retorts at existing Logan Wash (Fox et al. 1980) and Tract C-a (RBOSC 1983) oil shale facilities.

Water quality impacts associated with the underground mine should similarly be minor. The quality of existing ground water in the Mahogany Zone and Upper Parachute Creek Members is generally good. Ground water inflow to the mine would be discharged in such a manner so as to minimize contact with soluble mined spent shale materials, restricting the potential for infiltration of higher TDS waters. As discussed previously, proper handling of mine inflows would be particularly critical in areas of VMIS retorting where exposure to rubblized shale and process gasses is more likely.

Waste rock disposal would occur at the upper end of an ephemeral draw in the headwaters of Conn Creek. The waste rock pile would be placed largely on sandstone and marlstone strata of the Uinta Formation at this location. One spring emanates from the Uinta strata approximately 600 feet downgradient (about 10 feet lower in elevation) from the toe of the waste rock pile.

Drainage control and pile underlining measures would be installed in compliance with appropriate regulations. Any precipitation and runoff in contact with the pile could increase the TDS levels for water draining the area. Runoff from the waste pile will be collected in a dam below the pile, and recycled back to the process facilities. Similarly, a collection dam will be installed below the spent shale pile. No design details are currently available for this dam, but it would potentially include a key/cutoff trench or similar feature to preclude seepage losses via alluvial underflow. Such design criteria would be addressed as a part of the permitting process. Some water could infiltrate, however, creating a localized recharge to the Uinta Formation of high(er) TDS water. Down-gradient spring discharge could, therefore, exhibit increases in TDS concentrations. High sodium, calcium, sulfate, and bicarbonate concentrations could accompany the higher TDS levels.

The shale fines stockpile would be situated directly down valley from the waste rock pile. Two springs occur above this location, providing up to 60 gpm (0.13 cfs) of surface flow or alluvial underflow. Ground water impacts associated with this storage would be similar to that discussed above for the waste rock disposal. The opportunity for exposure to precipitation/runoff should be somewhat more restricted by timely reclamation (revegetation) of the fines stockpile. No more than about 1 acre of unconsolidated material would be exposed at any one time. Given the steeper drainage gradient within and below this pile, it is likely that most of the leachate would follow the drainage course to a collection dam below the pile.

Impacts associated with process facilities — including the raw shale stockpile, secondary feed preparation, retorting and upgrading, and associated surface disturbances — should be minor. The stockpiling of raw shale could pose a ground water contamination potential. Such contamination would be minimized by two factors: (1) storage would include a continual removal and addition of materials; consequently, the limited exposure of raw shale involved with stockpiling and conveyance to feed preparation should restrict generation of leachate; and (2) drainage design around the stockpiles could minimize the potential for infiltration or off-site migration of any leachate that might be generated.

Operation and maintenance of the remaining facilities in compliance with the Spill Prevention Control and Countermeasures Plan (SPCC) will restrict the potential for contamination by infiltration of accidental spills.

The extent and magnitude of ground water impacts from disposal of spent shale would be dependent on natural hydrologic conditions, and on the effectiveness and long-term stability of the liner system. The spent shale disposal area could potentially be a significant source of leachate which, in turn, could contaminate the alluvial aquifer of Conn Creek below the disposal area. Generation and migration of leachate from the disposal area would require both moisture levels of the spent shale to reach specific retention and the existence of a pathway by which leachate could leak.

Water infiltration into the spent shale pile could occur by surface water runoff, spring discharge above the pile, and direct precipitation. Cities Service proposes to control surface water flow, including that generated by spring discharge above the disposal pile by means of an impoundment downstream of the disposal site, and culverts diverting flow from above the disposal area. In contrast to the Getty site, no springs emanate directly from the Cities Service spent shale disposal area. Assuming that all upstream flow is successfully diverted or retained in header dams as necessary, water input to the spent shale should be limited to potential infiltration of precipitation and upstream surface water runoff lateral to the disposal pile. Cities Service proposes to inhibit these waters from contact with the pile by construction of a compacted spent shale liner, 10 feet in thickness, to surround the area. Construction of the top blanket or overlining is to be accomplished in a timely manner such that no more than about 20 acres of unconsolidated retorted material will be exposed at any one time.

Despite these precautions, some water infiltration to the spent shale would occur from accumulation of precipitation during periods when the pile is exposed. Construction of the underlining, 10-feet in thickness, is intended to preclude infiltration of these waters from the spent shale pile into bedrock strata below. Given the topographic conditions, including steep 1:1 valley side slopes, it is unlikely that a fully impermeable barrier could be constructed. It is, therefore, possible that leachate seepage below the liner could occur, and not be collected in the downstream impoundment. If such seepage occurs, it could follow fracture systems within the shallow bedrock beneath the disposal area, with potential infiltration into bedrock aquifer(s), or movement downward into the Conn Creek canyon alluvial aquifer. The latter is most likely, given site hydrogeologic conditions.

The magnitude of potential leakage cannot be predicted at this time. Losses would be dependent upon the hydraulic conductivity of the pile and the liner system. Weathering/erosion of liner material could occur on the surface and below, exacerbating pre-existing leachate production/migration. Appropriate design characteristics, such as rock drains beneath the lining, will be necessarily incorporated during the permitting process. Concern for leachate migration is greatest for the long-term, post-reclamation phase. During this time, seepage losses (and potential erosion) will occur from reconstructed channels across the spent shale pile. Short-term impacts are expected to be less due to evaporative losses and proposed water handling plans. If leachate migration does occur, studies reported in published literature indicate that higher concentrations of sulfate, cationic salts, ammonia, cyanide, other trace ions, and organic compounds could be introduced to the hydrologic system. Recent data (In-Situ 1984) provide estimates of chemical loading for selected constituents to the drainage. These data, presented on a probability basis in Tables 4.3-2 and 4.3-3, show loading to Roan Creek similar to that described for the Getty property. Specifically, increases of up to 10 percent in boron and fluoride are indicated. Further discussion of leachate chemistry is provided in Section 4.3.2.1 of this document. Impacts to the ground water regime should be less than projected for the surface water system. Existing TDS levels are as high as 1,200 mg/l in the ground water of the Conn Creek valley, and natural attenuation and dilution processes in the alluvial sediments should decrease the effects of potential chemical loading by leachate migration. Additional organic compounds may be present from the codisposal of wastewater from the upgrading plant. Permitting under applicable RCRA and TSCA standards would be necessary.

No significant ground water impacts are anticipated to occur from the construction of product transport, utility, road, railroad, and water corridors. Increases in TDS concentrations could occur during construction via infiltration of waters draining the disturbed areas. Such infiltration would be more prevalent along the Roan/Conn Creek alluvial areas than on upland areas (e.g., syncrude pipeline, access roads) underlain by bedrock. Any increase in TDS concentrations so occurring, however, would be short-term in nature.

4.3.3.2 Alternatives

Utilization of an all underground room and pillar mine would result in similar impacts as those described for the proposed action, except on a reduced scale. The potential for creation of artificial fracturing during the VMIS process, and associated impacts would be reduced.

Ground water impacts associated with a 50,000-bpd production rate would be essentially the same as those described for the 100,000-bpd proposed action. Surface and underground disturbance would occur at a reduced rate, however, thereby potentially decreasing the magnitude of any impacts, but increasing the duration.

Impacts associated with alternative retort technologies and appurtenant facilities should be similar to those described for the proposed action. However, spent shale derived from the Lurgi retorting process may cement more readily; therefore, the potential for erosion and/or leachate generation may be reduced. Effective and timely revegetation of the pile would be necessary for this potential to be lessened.

Processing of shale fines on site should have a similar net impact as the proposed action. Whereas some increased exposure to runoff/spring discharge could occur from these temporary piles (the stockpiles in the proposed action are to be revegetated), such contact should be offset by reduced potential for infiltration due to the constant addition and removal of fines to and from the pile(s).

Disposal of spent shale in the alternative areas could result in slightly less ground water impacts than for the proposed action. These potentially lessened impacts could result from two factors:

1. Over half of the alternative disposal area encompasses areas of flatter topographic relief, potentially enhancing the effectiveness and stability of the compacted underliner.

2. All disposal would occur within a single drainage system (Cascade Canyon) instead of two. Six of the 11 springs flowing into the proposed action site from above would not affect the alternative sites.

It is important to note that since the upper portion of the alternative disposal site would be on the plateau, leachate from this disposal site would have a greater potential for contamination of the Uinta/Upper Parachute Creek Member bedrock aquifer than exhibited at the proposed site. Furthermore, the location of the alternative site proximal to the topographic and ground water divide could allow some generated leachate to migrate into the West Fork Parachute Creek, heretofore largely unaffected. In general, contaminant migration into bedrock strata could be considered less significant (but still important) than contamination of alluvial deposits such as those within the Conn Creek canyon below the plateau. Ground water use in the area is more extensive in such unconsolidated aquifers. The precise impact potential rests necessarily more with the reliability of the protection system, including collection devices and liners, than with specific locations.

No significant ground water impacts are anticipated for the Rangely and North corridors. As described for the proposed action, potential increases in ground water TDS concentrations resulting from drainage (and infiltration) of disturbed areas should be short-term in duration and minor in magnitude.

No significant ground water impacts are anticipated from the Larkin Ditch intake and pumping system.

4.3.3.3 Solid/Hazardous Wastes and Toxic Pollutants

Nonhazardous wastes would be disposed of in the spent shale disposal area. As such, minor impacts to the ground water regime are anticipated. Hazardous waste would be disposed of in an off-site, licensed facility; no significant ground water impacts are anticipated.

Toxic pollutants could be generated during the Union B retort and VMIS processes. It is assumed that retort waters would be utilized to provide remoisturization of the spent shale, thereby introducing such trace metals as arsenic and lithium and various organic constituents. Impacts associated with this disposal would, therefore, be predicated on the effectiveness of the liner system to prevent production and migration of leachate. Leakage from the spent shale disposal pile could allow contamination of ground water below Conn Creek and Cascade Canyon. However, mitigation measures specified in Table 2.3-52 would prevent or reduce such impacts. Additionally, airborne pollutants could settle in the area soils, also providing potential ground water contamination if leached and transported by infiltrating precipitation. Further discussion of potential airborne contaminants is provided in Section 4.3.8.

4.3.3.4 Secondary Impacts

Secondary impacts associated with population growth should be limited to: (1) depletion of ground water resources if such a source is required for domestic/municipal supply, and (2) short-term increases in dissolved solids concentration if runoff from disturbed areas (e.g., housing construction) is allowed to infiltrate. Although no ground water use is proposed for the Cities Service project itself, concomitant industrial development could create such a demand. Furthermore, waste disposal areas required to support population increases could create localized areas of ground water contamination if they are not properly designed, constructed, and maintained.

4.3.7 Wildlife

This section of the EIS serves, in part, as a Technical Assistance report to address the concerns of the U.S. Fish and Wildlife Service (USFWS) and the Colorado Division of Wildlife (CDOW) under the Fish and Wildlife Coordination Act of 1958. The USFWS believes that the intent and implementation of these measures will assure compliance with the provisions of the Fish and Wildlife Coordination Act (USFWS 1984d).

Following is a description of direct impacts of the Cities Service proposed action and alternatives on wildlife. This discussion is based on the results of a wildlife impact analysis performed by the USFWS and CDOW. Sources of information for the analysis included the baseline report for the Cities Service project (Cities Service 1983a) and wildlife data currently in the USFWS/CDOW computer data base. Project impact analyses were accomplished by use of a modified USFWS, Geographic Information System (GIS; Porter et al. 1979; USFWS and CDOW 1983). GIS is a computer-based overlay system designed to provide a relatively fast impact evaluation capability. Wildlife values (wildlife range or habitat acreage weighted by species abundance, sensitivity, or other critical limiting factors) were compared with project development acreage (weighted by intensity and type of potential disturbances). The results of this analysis are given in Tables C-2, C-4, and C-6 in Appendix C and are summarized in this report. The habitat acreages and wildlife values shown in these tables and discussed in the following sections were generated for the DEIS, represent a worst-case analysis, and are intended for comparative purposes only.

Included in the discussions that follow are commitments made by Cities Service to the specific mitigation measures contained in Section 2.3.2. Therefore, the magnitude and probability of many impacts will be significantly reduced by the planned mitigation program. Therefore, it is expected that acreage figures reflecting maximum loss or disturbance of habitat as shown below and denoted with an asterisk (*) will be mitigated to an acceptable level.

Further details concerning the impact analysis methodology are provided in the Technical Assistance Report for the Clear Creek Shale Oil Project (USFWS and CDOW 1983).

4.3.7.1 Proposed Action

The proposed action would directly affect about 3,000(*) acres of specific wildlife habitats. This figure does not take into consideration overlapping wildlife habitats. An additional 23,550(*) acres of specific wildlife habitats within 0.5 miles of the project features would be potentially disturbed (Table C-4, Appendix C). Similarly, this value may be somewhat inflated since it does not take overlapping habitats into consideration. Of those areas directly affected by the proposed action, an estimated 2,020(*) acres are big game winter range (WR), winter concentration area (WCA), and critical habitat (CH).

Cities Service will avoid all Category 1 habitats as stated in Section 2.3.2. In addition, Cities Service recognizes that some acres need to be enhanced to offset project impacts to Category 2 and 3 habitat/ranges and agrees to enhance other acres using enhancement technologies in effect at the time so that no net loss of in-kind habitat value is realized. All disturbed lands except roadway shoulders and borrow ditches will be revegetated with mixtures favorable to wildlife.

Active nest locations for Cooper's hawk, red-tailed hawk, and golden eagle would also be impacted. Cities Service agrees to work closely with the USFWS and CDOW to determine appropriate buffer zones for federal and state protected raptor nest sites. Additionally, Cities Service will work with these agencies in making any further assessments needed to identify any problem locations and will participate in any conflict resolution, where needed. Construction will be coordinated to avoid critical nesting (sage grouse and raptors) and big game concentration periods, and no protected raptors or their nests will be taken unless specifically permitted by USFWS and CDOW under regulations in place at the time.

Sensitive habitats affected by the proposed action include aspen woodland, Douglas-fir, riparian areas, and cliffs (Table C-4, Appendix C). Wildlife impacts associated with each of the project features are summarized below.

Development and operation of the underground mine would have a low adverse effect on wildlife species or habitats in the project area. Disturbance of some cliff and plateau shrubland habitats could occur during construction of the mine bench, portal, vents, and associated surface facilities. The development of the waste rock disposal area, raw shale fines stockpile, and processing facilities would directly affect riparian, plateau shrubland, and aspen habitats. No known active raptor nests occur in these areas; however, several inactive buteo and accipitrine nests are present in the proposed shale fines stockpile and processing locations. Two active red-tailed hawk nests and one active Cooper's hawk nest occur in aspen stands within one-quarter mile of these facilities. It is likely that project-related activities within each of these areas could disturb the nests and cause their abandonment, particularly that of the more sensitive Cooper's hawk. Cities Service's committed mitigation plan should alleviate or avoid these impacts to raptors.

The disposal of spent shale in the Conn and Cascade Creek canyons would cover some riparian, valley shrubland, conifer, and cliff habitats. The cliff faces in both of these valleys are known nesting locations for golden eagles, buteos, and kestrels. Although no nests would be directly eliminated by spent shale disposal, nests in the vicinity of the disposal pile could be abandoned. The disposal pile could also interfere with a known elk migration route which runs from the plateau portion of the project area to Conn Creek canyon.

The construction of a syncrude pipeline and a transmission line from the Cities Service processing area north to the common corridor (with Getty) would cause short-term disturbance to plateau shrubland and aspen habitats

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(*)Denotes maximum potential affected acreage. Mitigation should reduce figure to an acceptable level.

along this route. One active red-tailed hawk nest lies in this corridor and would most likely be eliminated or disturbed. No raptor mortality due to contact with transmission lines is expected since only "electrocution-proof" lines will be installed.

Some plateau shrubland habitat would be directly affected by placement of the natural gas pipeline and power/water lines for the western portion of the project area. The construction of the proposed access road and power and water corridors would affect valley shrubland, riparian, cliff, conifer, and plateau shrubland habitats in its path. The upper portion of this corridor would potentially affect known golden eagle, buteo, and kestrel nesting locations. The lower portion of the corridor would traverse mule deer winter range, winter concentration areas, critical habitats, and migration routes to Conn Creek canyon (Table 4.3-6). Elk winter range and migration routes in Conn Creek canyon would also be traversed by this corridor (Table 4.3-6). As a result of vehicular traffic in the corridor, the incidence of big game roadkills is likely to increase above present levels. Committed mitigation measures which will reduce this impact include reseeding of roadway shoulders and borrow ditches with unpalatable vegetation, enforcement of vehicular speed on project-related property controlled by Cities Service, and implementation of other measures (e.g., underpasses, one-way deer gates, fencing, or other measures such as reflectors) if kill frequencies exceed 10 per mile per year. Cities Service will also consider mass transportation of workers at the time of project development.

Riparian communities potentially affected by the proposed action include those located at the shale fines site, shale disposal site, and Conn Creek road corridor (Table C-2, Appendix C). Approximately 190(*) acres of riparian habitat would be directly impacted at these localities, and an additional 800(*) acres within 0.5 miles of these features would be potentially disturbed (Table C-4, Appendix C). The effect on wildlife would be potentially significant and could include loss of breeding and nesting areas, escape cover, and preferred food and water sources. No threatened or endangered wildlife species would be affected by loss of riparian habitat at these locations.

4.3.7.2 Alternatives

No significant difference in wildlife impacts is anticipated for either the 50,000-bpd alternative or Lurgi retort alternative. The processing of shale fines on site would reduce the extent of wildlife habitat affected by shale fines storage (i.e., approximately 420(*) fewer acres would be disturbed). However, increased air emissions and water quality impacts due to processing of the fines on site could adversely affect local and downstream wildlife habitats.

The disposal of spent shale in alternative locations would eliminate cliff, conifer, riparian, and shrubland habitat in Cascade Canyon; plateau shrublands and extensive stands of aspen would be permanently covered on the plateau. Known nesting locations for red-tailed hawks and buteos (active and inactive) would be eliminated at the plateau location. No golden eagle nesting sites in Cascade Canyon would be directly affected by shale disposal. Disposal of spent shale in Cascade Canyon would eliminate about 500(*) acres of elk winter range (Table 4.3-6) and would potentially interfere with a known elk migration route.

The development of the North corridor for power and syncrude could disturb aspen, riparian, and plateau shrubland habitats. It is unknown whether or not any raptor nests would be affected by this corridor.

The use of a railroad versus a fleet of buses to transport workers to the staging area at the confluence of Roan and Conn creeks would result in a significant reduction in the incidence of roadkills in the lower Roan Creek corridor. Approximately 200 bus round-trips would be necessary on a daily basis to transport workers; whereas only 6 round-trips by rail would be required to perform the same function. Noise generated by the rail system would be of equivalent or greater intensity as that expected in the proposed action; however, the incidence and duration of the noise should be considerably less.

The construction of additional facilities at the Larkin Ditch could disturb existing riparian habitat along the Colorado River. Wintering bald eagles are known to use the large, live cottonwoods along the river and in the vicinity of De Beque as roosts and perch sites. Construction of this facility would not affect these trees; however, it might affect use of the river by eagles in this area, particularly if construction activities occur during winter. The wildlife habitats affected by the proposed pipeline from the intake to the Roan Creek multiple-use corridor are unknown but are most likely to be a combination of agricultural, valley grassland, and sagebrush types. A white-tailed prairie dog colony occurs near Mount Low (Lambeth 1983) which is located in the general vicinity of the pipeline route to the Roan Creek multiple use corridor. However, because of the size of this colony and its isolation from larger prairie dog towns in the Grand Valley near Fruita, black-footed ferret may not occur in this area (Lambeth 1983). The impacts of the Rangely corridor on wildlife and wildlife habitats were addressed in BLM (1983a).

The Cities Service alternatives which would directly affect riparian habitats include the alternate shale disposal site (136(*) acres of riparian habitat) and the North pipeline corridor (52(*) acres of riparian habitat). About 520(*) acres of riparian habitat within 0.5 miles of these project features would be potentially disturbed. Disturbance of these areas would create impacts to wildife similar to those described for affected riparian areas under the proposed action. Based on available information, no threatened or endangered wildife species would be affected by disturbance of riparian habitats associated with each of these alternatives.

4.3.7.3 Solid/Hazardous Wastes and Toxic Pollutants

Cities Service proposes to use engineering measures which should reduce the likelihood of surface and ground water contamination through contact with spent shale and upward migration of trace and toxic elements into the plant rooting zone. These preventive measures include use of an impermeable liner, capillary barrier, benching, adequate topsoiling, and revegetation of the pile (see Section 2.3.2.2). Therefore, spent shale disposal in Cascade and Conn Creek canyons should not result in uptake or bioaccumulation of toxic elements in plants or herbivores.

Runoff retention reservoirs below the disposal area could contain elevated concentrations of heavy metals (see Surface Water, Section 4.3.2). Cities Service plans to pump the water in the retention reservoirs back to the shale disposal site. Hence, exposure of wildlife species to metals in the reservoirs should be minimal and short-term in duration. Additionally, Cities Service has committed to use fencing practices which will be directed at excluding wildlife from hazardous areas and will use reasonable methods to minimize wildlife access to various project-related water retention reservoirs.

4.3.7.4 Secondary Impacts

Indirect loss of wildlife habitat would result from secondary impacts of the proposed project. A long-term reduction of wildlife densities from road kills and poaching could occur throughout the region. Direct loss of wildlife due to poaching could be locally significant, especially for deer and elk, where concentration areas are accessible. Direct regional impacts on wildlife habitat would result from housing and community infrastructure development. The magnitude of long-term reduction in the regional carrying capacity for many species would be minimized if such habitat losses are concentrated in areas of existing community development. Indirect impacts to wildlife would occur as a result of increased levels of noise, harassment by domestic pets, and human activity (including ORV use) in the area of secondary impact. A simultaneous increase in the demand for consumptive and nonconsumptive wildlife-related recreation would occur throughout the area.

To minimize these impacts, Cities Service will implement a company firearm policy and wildlife protection education program for use on its shale property. In addition, Cities Service will develop and implement an in-house monitoring program to monitor wildlife activities on its property. The program will be developed in consultation with CDOW and USFWS. In cooperation with these agencies, BLM, other appropriate agencies, and other oil shale companies, Cities Service will assist in organization and development of regional wildlife management plans.

Table 4.3-6 SUMMARY OF ESTIMATED POTENTIALLY AFFECTED ACREAGES OF BIG GAME WINTER RANGE (WR), WINTER CONCENTRATION AREA (WCA), AND CRITICAL HABITAT (CH) FOR MAJOR FACILITIES ASSOCIATED WITH THE CITIES SERVICE PROPOSED ACTION AND ALTERNATIVES

	Potentially Affected Acreages[a]					
	Mule Deer			Elk		
Alternative/Components	WR	WCA	CH	WR	WCA	CH
Proposed Action (100,000 bpd)						
Mine Bench	0.0	0.0	0.0	0.0	0.0	0.0
Retort and Plant Site	0.0	0.0	0.0	0.0	0.0	0.0
Spent Shale Disposal	6.0	0.0	0.0	762.0	0.0	0.0
Waste Rock Pile	0.0	0.0	0.0	0.0	0.0	0.0
Shale Fines Stockpile	0.0	0.0	0.0	19.5	0.0	0.0
Corridors						
Power, Syncrude (Mesa)	0.0	0.0	0.0	0.0	0.0	0.0
Natural Gas (Mesa)	0.0	0.0	0.0	0.0	0.0	0.0
Power, Water (Mesa)	0.0	0.0	0.0	0.0	0.0	0.0
Road (Mesa)	0.0	0.0	0.0	141.0	0.0	0.0
Power, Road, Water (Conn Creek)	342.0	246.0	225.0	279.0	0.0	0.0
Power, Road, Water (Lower Roan Creek)	2,097.0	1,674.0	1,581.0	0.0	0.0	0.0
Water Supply						
GCC Joint Venture	1,758.0	1,758.0	1,758.0	0.0	0.0	0.0
	4,197.0	3,678.0	3,564.0	1,201.5	0.0	0.0
Alternatives						
Proposed Action (50,000 bpd)	4,197.0	3,678.0	3,564.0	1,201.5	0.0	0.0
Spent Shale Disposal (Mesa and Cascade Creek)	0.0	0.0	0.0	498.0	0.0	0.0
Corridors						
Rangely B	1,464.0	0.0	1,638.0	2,856.0	0.0	1,008.0
Power, Syncrude (North Corridor)	0.0	0.0	0.0	0.0	0.0	0.0
Water Supply						
Larkin Ditch	0.0	0.0	0.0	0.0	0.0	0.0

Source: USFWS and CDOW (1983); See Appendix C, Table C-2.

[a] The acreages shown in the table for each big game species and range type are *not* mutually exclusive values (i.e., considerable overlap in ranges exists within *and* between each species).

4.3.8 Air Quality/Meteorology

4.3.8.1 Proposed Action

This section considers the air quality impacts due to Cities Service's proposed action, including the mine, retorting and upgrading facilities located on the plateau above Conn Creek Canyon.

Emissions

The air quality impact analysis of the proposed Cities Service project considered stack and fugitive releases of SO_2, TSP, NO_x and CO in addition to emissions of other regulated or potentially hazardous pollutants. The 100,000 bpd production rate was utilized. TSP emissions anticipated from mining and shale handling activities include a wide variety of source types. The year 2010, or 21 to 25 years into the project, was chosen to define the area source locations of the rock storage and spent shale areas, and the point source locations of the mine activities and processing plants. The year 2010 represents a maximum emission year.

The emission rates and stack height information associated with the retorting, upgrading and mining facilities are presented in Table 4.3-7. Sources with identical stack parameters and in the same vicinity were grouped to form a composite source. These composite sources for the upgrading, retorting and mining facilities were assigned geographical coordinates corresponding to the geometric mid-point of the individual sources of each source subgroup. Constant year-round emissions corresponding to retorting for a 100,000-bpd shale oil facility were assumed for the modeling analysis. Further details of the modeling analysis are provided in Appendix A of the DEIS. The emission source modeling configuration was derived from the plot plans and emission rates detailed in the project description (Cities Service 1983b).

Table 4.3-7 MINING, RETORTING, AND UPGRADING STACK EMISSIONS AND STACK DATA, CITIES SERVICE PROPOSED ACTION

Facility	Stack Height (m)	No. of Stacks	SO_2[a] (g/sec)	TSP[a] (g/sec)	NO_x[a] (g/sec)	CO[a] (g/sec)	HC[a] (g/sec)
Retorting Emissions							
Recycle Gas Heater	76	10	26	1	139	10	<1
Reboiler	61	10	2	1	3	1	<1
FGD	122	3	35	1	143	2	<1
Upgrading Emissions							
Auxiliary Boiler	61	2	<1	1	6	1	<1
Reformer Heater	61	4	1	1	126	9	<1
Whole Oil Heater	61	4	21	1	9	2	<1
Naphtha Heater	61	4	2	1	1	<1	<1
Tail Gas Incinerator	91	4	2	0	<1	<1	<1
Mining and Material Handling Emissions							
Mining	NA[b]	NA	2	4	25	33	2
Surface Material Handling	NA	NA	0	6	0	0	0
Disposal Reclamation	NA	NA	2	33	22	5	2
Miscellaneous	NA	NA	<1	<1	<1	<1	<1
TOTAL EMISSIONS			93	43	476	73	6

Source: Cities Service (1983c).

Note: Less than one (1) values and round off values do contribute to the total values.

[a] Total for all stacks.
[b] Not applicable.

Air Quality

Table 4.3-8 lists the predicted maximum air quality impacts of the plateau facilities. The table lists each appropriate pollutant, averaging time and receptor location for the predicted maximum concentration in the PSD Class II areas, the PSD Class I areas (Flat Tops Wilderness, Arches National Monument, the Black Canyon of the Gunnison Wilderness, and West Elk Wilderness), the Colorado Category I areas (Colorado National Monument and Dinosaur National Monument), and the Mesa County TSP nonattainment area. All of the short-term values are the highest second-highest values predicted by the ISC modeling.

For the proposed action, the PSD Class II 24-hour TSP increment could be consumed or exceeded by a factor of almost three. This predicted impact is located along the west central property line and is largely due to the close proximity of the fines stock pile area to this property line. No other Class II increments or NAAQS are predicted to be exceeded by the proposed action. In order for the project to receive an air quality construction permit, either the area of exceedance (approximately 0.1 square miles) would have to be acquired or the fines stockpile would have to be moved. Although the increment is predicted to be exceeded, the NAAQS is not.

The 24-hour SO_2 impact in the Flat Tops Wilderness, which is about 41 miles away, is predicted to be 60 percent of the PSD Class I increment. Transport of significant quantities of SO_2 and TSP for the other Class I and Category I areas would not be likely given the distances to these sensitive areas (about 87 miles to Arches National Monument, 71 miles to the Black Canyon of the Gunnison Wilderness, 66 miles to the West Elk Wilderness, 39 miles to the Colorado National Monument, and 63 miles to Dinosaur National Monument) and the low probability of the occurrence of meteorological conditions that would effectively transport pollutants to these areas.

All modeled CO impacts were well below EPA's levels of significant impacts in all Class II, Class I, and Category I areas.

An analysis of ozone impacts from the Cities Service proposed action has been conducted. Since ozone is a regional pollutant, the analysis presented in BLM (1983a,e) should be representative of the Cities Service location and emissions. Optimum ozone production typically occurs when the ratio of HC to NO_x is between 7 to 1 and 12 to 1 (EPA 1977b). The ratio for the Cities Service proposed action is only 1 to 79. The Chevron study (BLM 1983a,e) indicates emissions of hydrocarbons and oxides of nitrogen from oil shale facilities, which have a ratio of 1 to 3, would have a minimal impact on ambient ozone concentration with a range of predicted ozone concentrations for all scenarios less than 0.01 ppm. This would be less than 8 percent of federal standards. Cities Services impact would probably fall in this range.

Visibility

A Level-1 visibility screening analysis (Latimer and Ireson 1980) was performed to determine whether any significant impacts would occur in Class I and Category I areas. The Level-1 visibility screening analysis is a simple, straightforward calculation designed to identify those emission sources that have little potential of adversely affecting visibility. If a source passes this screening test, it would not be likely to cause significant visibility impairment, and further analysis of potential visibility impairment would not be necessary. The Level-1 analysis input requirements are the minimum distance of the emission source from the nearest Class I area boundary; total TSP, SO_2, and NO_x emission rates; and typical, worst-case meteorology. The meteorology used for this analysis is that suggested by Latimer and Ireson (1980) which is moderate atmospheric stability (F) conditions and light winds. (These are the most stringent conditions for maximizing the conservative nature of the analysis.) This analysis indicates that significant impacts cannot be ruled out within 55 miles where an NO_x-caused dark plume against a light sky could be noticeable.

Two sensitive areas, Flat Tops Wilderness and Colorado National Monument, fall within this radius (41 and 39 miles respectively) and thus fail the Level-1 analyses. The analysis indicates a potentially significant visibility impact due to a dark plume against the sky and a light plume against dark terrain resulting in these two sensitive areas. The pollutants responsible for this Level-1 test failure are SO_2, NO_x, and TSP.

Table 4.3-8 MAXIMUM AIR QUALITY IMPACTS SUMMARY, CITIES SERVICE PROPOSED ACTION

			Predicted PSD Class I[b] Concentrations ($\mu g/m^3$)				Category I[b] Conc. ($\mu g/m^3$)			Predicted Class II Conc. ($\mu g/m^3$)			Standards ($\mu g/m^3$)[b]			
Pollutant	Averaging Time	Background[a] Conc. ($\mu g/m^3$)	FLAT	ARCH	BACA	WELK	COLO	DINO	MESA	Receptor Location	Conc.	Total Conc.	Class I Incre.[c]	Class II Incre.	Limit. NAAQS	SIL
SO_2	Annual	1	<1	<1	<1	<1	<1	<1		N-Cen Prop. Line	4	5	2	20	80	1
	24-Hour	14	3	<1	<1	<1	2	<1		N-Cen Prop. Line	16	30	5	91	365	5
	3-Hour	17	10	3	1	4	6	5		EN-Cen Prop. Line	69	86	25	512	1,300	25
TSP	Annual	15	<1	<1	<1	<1	<1	<1	<1	NW Prop. Line	5	20	5	19	60	1
	24-Hour	34	<1	<1	0	<1	<1	<1	0	W-Cen Prop. Line[d]	87[d]	121	10	37	150	5
NO_2[e]	Annual	4								N-Cen Prop. Line	25	29			100	1
CO	8-Hour	2,500								W-Cen Prop. Line	39	2,539			10,000	500
	1-Hour	3,000								W-Cen Prop. Line	294	3,294			40,000	2,000

[a] Background concentrations are representative of facility area. The actual background concentration in other impact areas may be lower.
[b] FLAT = Flat Tops Wilderness west boundary; ARCH = Arches National Monument east boundary; BACA = Black Canyon of the Gunnison National Monument west boundary; WELK = West Elk Wilderness west boundary; COLO = Colorado National Monument north boundary; DINO = Dinosaur National Monument east boundary; MESA = Mesa County TSP Nonattainment Area; SIL = Significant Impact Level ($\mu g/m^3$).
[c] Colorado Category I increments are the same as PSD Class I increments for SO_2 only.
[d] Equal to or exceeds PSD increments.
[e] Modeled as total NO_x.

Based on these results, a Level 2, PLUVUE analysis was conducted to determine the plume impact in the Flat Tops Wilderness more precisely. The refined analysis indicates seven potential worst case meteorological days during the visitor season in which visibility impacts could occur. However, of these 7 days, only one falls appreciably outside the suggested control range. The seven meteorological cases and the results of the Proposed Action analyses for the four index values which are visual range reduction, contrast, blue-red ratio or plume discoloration, and plume perceptibility, are presented in Table 4.3-9. Also included in Table 4.3-9 are the threshold limits for the indices which determine significant impact.

Table 4.3-9 PREDICTED VISIBILITY IMPACTS, CITIES SERVICE PROPOSED ACTION

	Suggested[a] Significance Levels	Case 1[b]	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Blair Lake - Shingle Peak Vista								
Visual Range Reduction (%)	>10	0.42	0.52	0.57	0.60	0.33	0.33	0.87
Contrast at 550 m[c]	> 0.10[d]	−0.03	−0.03	−0.04	−0.04	−0.02	−0.02	−0.07
Contrast at 550 m[e]	> 0.10[d]	−0.02	−0.02	−0.03	−0.03	−0.01	−0.02	−0.05
Blue-Red Ratio[c]	0.9 <or> 1.1	0.92	0.91	0.89[f]	0.89[f]	0.94	0.93	0.78[f]
Blue-Red Ratio[e]	0.9 <or> 1.1	0.89[f]	0.88[f]	0.86[f]	0.86[f]	0.92	0.91	0.79[f]
Plume Perceptibility[c]	> 4	3.48	3.80	4.51[f]	4.68[f]	2.77	3.03	9.92[f]
Plume Perceptibility[e]	> 4	3.27	3.60	4.23[f]	4.35[f]	2.60	2.86	7.03[f]
Big Marvine - Shingle Peak Vista								
Visual Range Reduction (%)	>10	0.11	0.14	0.14	0.15	0.05	0.08	0.21
Contrast at 550 m[c]	> 0.10[d]	−0.01	−0.04	−0.02	−0.02	−0.01	−0.01	−0.04
Contrast at 550 m[e]	> 0.10[d]	0.001	0.004	0.001	0.001	0.002	0.00	−0.004
Blue-Red Ratio[c]	0.9 <or> 1.1	0.95	0.94	0.93	0.93	0.96	0.95	0.86[f]
Blue-Red Ratio[e]	0.9 <or> 1.1	0.99	0.98	0.98	0.98	0.99	0.99	0.97
Plume Perceptibility[c]	> 4	2.05	2.25	2.77	2.87	1.54	1.73	5.48[f]
Plume Perceptibility[e]	> 4	0.32	0.37	0.43	0.44	0.24	0.27	0.88

[a] From Latimer and Ireson (1980).
[b] Each case represents a set of meteorologic conditions for a sample period of daylight hours during the visitor season May to October.
[c] Clear sky background.
[d] Absolute value.
[e] Views against a black object.
[f] Not within the bounds of the suggested significance level.

For the view of Shingle Peak from Blair Lake, the project plume was predicted to be perceptible on 3 days with plume discoloration on another 2 days for a total of 5 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine the plume was estimated to be perceptible one case day. Clearly, significant impacts are predicted during one case day for both vistas; however, the values for the blue-red ratio (plume discoloration) are very near the threshold values for four cases and the value for plume perceptibility is very close to the threshold value for two of these cases.

Several of the techniques employed in this analysis make these results conservative. First, the PLUVUE model assumes the Cities Service Project plume is unaffected by surface and mechanical roughness from intervening terrain. To reach Flat Tops, the plume must pass over terrain obstacles such as the Grand Hogback. As the plume encounters these obstacles, it would likely lose some of its continuity from increased turbulence with a corresponding decrease in visual perception. Second, it is physically impossible for the plume centerline to cross the viewing path midpoint of both the Blair Lake and Big Marvine Peak vistas simultaneously, but this assumption was maintained in order to provide a worst-case assessment of the visibility impacts. In addition, the short length of the vista path and the great downwind distance of the observer means the observer's view covers only a small sector of possible plume trajectories. A deviation of only a few degrees in wind direction could mean the plume centerline would not intersect the vista path at all and only the edges of the plume would be observable. The probability that the assumed plume-observer geometry would actually occur is small, and it is likely that the stated impacts would be much less severe.

Though no explicit cut-off point for the frequency has been established, the Latimer and Ireson *Workbook for Estimating Visibility Impairment* (Latimer and Ireson 1980) suggests that an occurrence of perceptible impacts on 4 days may be considered significant.

Atmospheric Deposition

Impacts due to acid deposition are considered as an Air Quality Related Value (AQRV) for federally designated Class I areas which are within close proximity of a facility. Acid deposition is a regional phenomenon generally associated with emissions generated by large cities and major industrial sources. Even so, it has been documented in a high-altitude Rocky Mountain setting where no direct connection has been made to major emissions sources (Lewis and Grant 1980). Additional studies and analyses have been done by Lewis and Grant of Colorado State University, Ft. Collins (see reference above), Turk and Adams (1982) of U.S. Geological Survey, and Fox et al. (1981) of the U.S. Forest Service. Most of these studies of western acid deposition indicate it is unlikely, but still unknown, whether significant contributions are possible from an individual source.

Potential deposition of sulfur and nitrogen from the Cities Service proposed action in the Class I and Category I areas was modeled using the deposition results from the ISC long-term model and the annual meteorological data set collected at Chevron's Clear Creek mesa station. The analysis assumes the following:

- The estimated worst-case single concentration is representative of deposition to the entire wilderness area.
- All sulfur compounds were assumed to be SO_2 and nitrogen compounds were assumed to be NO_x.
- Dry deposition velocity of NO_x and SO_2 was assumed to be 1 centimeter per second (cm/sec).
- Complete mixing in lakes occurred due to snowmelt or runoff.

Wet deposition rates or deposition by precipitation events, were estimated from precipitation statistics for the Class I and Category I areas. Assuming annual average mixing depth of 8,300 feet to 8,500 feet (Holzworth 1972) and the complete removal during the 1-hour precipitation event on each of the event days (U.S. Department of Commerce 1968), the effective annual-average wet deposition velocity of 0.8 cm/sec was calculated for Flat Tops, Black Canyon, and West Elk Wilderness and 1.0 cm/sec for Arches, Colorado, and Dinosaur National Monuments. Applying these NO_x and SO_2 concentrations to these areas resulted in conservative wet deposition rates of 80 and 100 percent of the dry deposition rates. Table 4.3-10 presents the annual dry and wet deposition rates resulting from the proposed action.

The total nitrogen deposition is conservatively expected to range from 12 to 292 mg/m^2 over an annual period. The total sulfur deposition is, conservatively, expected to range from 2 to 58 mg/m^2 over an annual period. The estimated deposition rates are not expected to alter the pH of lakes with good buffering capabilities but may slightly lower the level of the poorly buffered lakes in the Flat Tops Wilderness with current pH values below 7. U.S. and Canadian scientists have agreed that wet sulfate deposition of 2,000 $mg/m^2/yr$ and dry sulfate deposition of 1,300 $mg/m^2/yr$ have not produced any recorded damage in most vulnerable areas (Roberts 1983). The sulfur deposition calculated represents a small percentage of this threshold value. Although no similar threshold value has been proposed for judging nitrate deposition, the threshold impact value would be expected to be about the same as for sulfate deposition. Again, the calculated nitrogen values are only a small percentage of this threshold value. It is not currently known what effect, if any, these shifts would have on sensitive biota of

Table 4.3-10 MAXIMUM ANNUAL ELEMENTAL DEPOSITION RATES IN SENSITIVE AREAS, CITIES SERVICE PROPOSED ACTION[a]

Constituent	Flat Tops Dry	Flat Tops Wet	Arches Dry	Arches Wet	Black Canyon Dry	Black Canyon Wet	West Elk Dry	West Elk Wet	Colorado[b] Dry	Colorado[b] Wet	Dinosaur Dry	Dinosaur Wet
Nitrogen	162	130	6	6	22	18	17	14	90	90	41	41
Sulfur	32	26	1	1	4	3	3	2	17	17	8	8

[a] All values are $mg/m^2/yr$.
[b] Colorado National Monument

the Class I and Category I areas. In general, as aquatic systems acidify, the physiological stress is likely to progressively alter biological population structures. At the acidification levels reported, elimination of certain phyto- and zooplankton species is possible (reducing diversity), but a significant change in total biomass is unlikely.

4.3.8.2 Alternatives

This section considers the air quality impact of the proposed alternatives to the Cities Service project. These alternatives and subalternatives include the following:

- Reduced production rate at 50,000 bpd using 40,000-bpd Union B retorts and 10,000-bpd VMIS
- Full production rate at 100,000 bpd using 90,000-bpd Lurgi retorts and 10,000-bpd VMIS
- Reduced production rate at 50,000 bpd using 40,000-bpd Lurgi retorts and 10,000-bpd VMIS
- Full production rate at 100,000 bpd using all Union B retorts
- Reduced production rate at 50,000 bpd using all Union B retorts
- Full production rate at 100,000 bpd using all Lurgi retorts
- Reduced production rate at 50,000 bpd using all Lurgi retorts
- Full production rate at 100,000 bpd using 90,000-bpd Union B retorts and 10,000-bpd VMIS, with an additional fines processing retort
- Reduced production rate at 50,000 bpd using 40,000-bpd Union B retorts and 10,000-bpd VMIS, with an additional fines processing retort
- Subalternatives
    - Spent shale disposal alternative
    - Cogeneration

The emission rates in grams per second (g/sec) were provided by Cities Service (1983c). The emissions inventory for each alternative (excluding the spent shale and cogeneration alternatives) is presented in Table 4.3-11. The emissions included all emissions from the alternative oil shale facilities.

Table 4.3-11 SUMMARY OF EMISSION RATES, CITIES SERVICE PROJECT ALTERNATIVES[a,b]

Facility	50,000 bpd (10,000 VMIS) (40,000 Union B)				100,000 bpd (10,000 VMIS) (90,000 Lurgi)				50,000 bpd (10,000 VMIS) (40,000 Lurgi)				100,000 bpd (All Union B Retorts)				50,000 bpd (All Union B Retorts)			
	TSP	SO_2	NO_x	CO	TSP	SO_2	NO_x	CO	TSP	SO_2	NO_x	CO	TSP	SO_2	NO_x	CO	TSP	SO_2	NO_x	CO
Retorting and Upgrading																				
Recycle Gas Heater	<1	13	70	5	--[c]	--	--	--	--	--	--	--	<1	26	139	10	<1	13	70	5
Reboiler	<1	1	1	<1	--	--	--	--	--	--	--	--	<1	2	3	1	<1	1	2	1
FGD	<1	35	143	12	<1	35	143	12	<1	35	143	12	0	0	0	0	0	0	0	0
Auxiliary Boiler	0	0	0	0	<1	<1	6	1	0	0	0	0	<1	1	57	14	<1	<1	29	7
Reformer Heater	<1	<1	63	5	<1	<1	126	9	<1	<1	63	5	<1	1	126	9	<1	<1	63	5
Whole Oil Heater	<1	11	5	1	<1	21	9	2	<1	11	5	1	<1	21	9	2	<1	<1	5	<1
Naphtha Heater	<1	1	<1	<1	<1	2	4	<1	<1	1	<1	<1	<1	2	<1	<1	<1	1	<1	<1
Tail Gas Incinerator	0	1	<1	1	0	2	<1	<1	0	2	<1	<1	0	<1	<1	<1	0	2	<1	1
Lurgi Retorts	--	--	--	--	156	63	456	84	78	32	228	42	--	--	--	--	--	--	--	--
Mining and Material Handling																				
Mining	2	<1	13	17	4	2	25	33	2	<1	13	17	4	2	25	33	2	<1	13	16
Surface Storage	3	0	0	0	27	0	0	0	13	0	0	0	6	0	0	0	3	0	0	0
Disposal	16	1	11	3	25	2	20	5	13	1	10	3	32	2	22	5	16	1	11	3
Miscellaneous	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TOTAL EMISSIONS	22	64	306	42[d]	213	127	788	147	107	81	463	79	42	59	384	75	21	18	193	37

Table 4.3-11 SUMMARY OF EMISSION RATES, CITIES SERVICE PROJECT ALTERNATIVES[a,b] (continued)

	100,000 bpd (All Lurgi Retorts)				50,000 bpd (All Lurgi Retorts)				100,000 bpd (Additional Fines Processing Retort)				50,000 bpd (Additional Fines Processing Retort)			
Facility	TSP	SO_2	NO_x	CO	TSP	SO_2	NO_x	CO	TSP	SO_2	NO_x	CO	TSP	SO_2	NO_x	CO
Retorting and Upgrading																
Recycle Gas Heater	--	--	--	--	--	--	--	--	<1	26	139	10	<1	13	70	5
Reboiler	--	--	--	--	--	--	--	--	<1	2	3	1	<1	1	1	<1
FGD	--	--	--	--	--	--	--	--	<1	35	143	12	<1	35	143	6
Auxiliary Boiler	<1	1	57	14	<1	1	29	7	<1	1	6	1	<0	0	0	0
Reformer Heater	<1	1	126	9	<1	1	63	5	<1	<1	126	9	<1	<1	63	5
Whole Oil Heater	<1	21	9	2	<1	11	5	1	<1	21	9	2	<1	11	5	1
Naphtha Heater	<1	2	<1	<1	<1	1	1	1	<1	2	1	<1	<1	1	<1	<1
Tail Gas Incinerator	0	2	<1	<1	0	1	1	1	0	2	<1	<1	0	1	<1	<1
Lurgi Retorts	156	63	456	84	78	32	228	42	16	6	46	8	8	3	23	4
Mining and Material Handling																
Mining	4	2	25	33	2	1	13	16	4	2	25	33	2	1	13	16
Surface Storage	27	0	0	0	13	0	0	0	6	0	0	0	3	0	0	0
Disposal	24	2	20	5	12	1	10	3	26	2	20	5	13	1	10	3
Miscellaneous	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
TOTAL EMISSIONS	212	93	696	148	106	47	348	74	52	99	520	82	26	67	328	40

Source: Cities Service (1983c).

[a] All values in g/sec.
[b] Spent shale subalternative emissions are the same as the above respective alternatives.
[c] -- indicates this facility does not exist for the respective alternative.
[d] Total values are averaged. Round-off errors may occur.

As for the proposed action, these emission rates were modeled using the ISC air quality model to analyze the short-term and annual concentrations of TSP, SO_2, and NO_x. Because the short-term federal standards may be exceeded once during the year, only the highest second-highest impacts are reported for short-term averaging times. All Lurgi retort alternatives showed CO emissions to be well below EPA's levels of significant impacts. Ozone impacts would be small for all alternatives due to the ratio of HC to NO_x emissions being well below optimum ozone production ratios (see Section 4.3.8.1). Table 4.3-12 summarizes the results of this analysis. Table 4.3-13 presents the acid deposition analysis in the sensitive receptor areas from the alternative configurations. The acid deposition analyses were performed using the methodology discussed in Section 4.3.8.1. Table 4.3-14 presents the spent shale disposal and cogeneration subalternatives. Level 1 visibility screening analyses and a Level 2 PLUVUE analysis for the Flat Tops were conducted and are discussed for each alternative below. The results of the PLUVUE analyses for each alternative which failed the Level 1 test are presented in Table 4.3-15. This table presents the possible number of days during the visitor season when potential impacts were predicted.

50,000 bpd - 40,000 Union B/10,000 VMIS Retorts

For the Union B/VMIS reduced-production rate alternative, the PSD Class II 24-hour TSP increment would be exceeded by 45 percent. This impact is located along the west central property boundary where the maximum TSP concentration of the proposed action occurred. This value, when added to the background concentration, represents 59 percent of the limiting federal standard. This alternative rates a low to medium adverse impact.

A Level 1 visibility screening analysis indicates that an NO_x-caused dark plume against a bright sky would be visible within a distance of 42 miles from the facility, while a TSP-caused light plume against dark terrain would be visible within a distance of 29 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness and Colorado National Monument due to a Union B-VMIS reduced-production alternative.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 1 day with plume discoloration on the same day for a total of 1 day where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be perceptible zero days, with zero discoloration and zero days total impact. Significant impact is clearly predicted during one case day for Blair Lake vistas.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

100,000 bpd - 90,000 Lurgi/10,000 VMIS Retorts

For the Lurgi full-production/VMIS alternative, the 24-hour TSP concentration is predicted to exceed the PSD Class II increment by 73 percent. When added to the background concentration, this impact represents 65 percent of the limiting federal standard. The 24-hour TSP concentration in the Flat Tops Wilderness is predicted to consume 40 percent of the Class I PSD increment. This alternative rates a moderate adverse impact. No other increments or federal standards are consumed or exceeded.

A Level 1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible within a distance of 67 miles from the facility, while a TSP-caused light plume against dark terrain would be visible within a distance of 79 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness, Black Canyon of the Gunnison Wilderness, West Elk Wilderness, Colorado National Monument and Dinosaur National Monument due to the Lurgi full-production/VMIS alternative.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 7 days (Cases 1-7) with plume discoloration on all 7 days for a total of 7 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be perceptible 7 days. Seven days of plume discoloration occurred, and again a total of 7 days of possible impacts are predicted. Clearly, significant impacts are predicted during all seven cases analyzed for both the Blair Lake vistas.

Table 4.3-12 SUMMARY OF MAXIMUM AIR QUALITY IMPACTS, CITIES SERVICE PROJECT ALTERNATIVES[a]

Sensitive Areas	50,000 bpd (40,000 Union B/10,000 VMIS)								100,000 bpd (90,000 Lurgi/10,000 VMIS)							
	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr
Class I Areas																
Flat Tops	0	0	<1	<1	5	--[b]	--	--	<1	4	<1	3	11	--	--	--
Arches	0	0	0	<1	1	--	--	--	<1	1	<1	<1	4	--	--	--
Black Canyon	0	0	0	<1	1	--	--	--	<1	1	<1	<1	2	--	--	--
West Elk	0	0	0	<1	3	--	--	--	<1	1	<1	<1	5	--	--	--
Category I Areas																
Dinosaur	0	0	0	<1	4	--	--	--	<1	2	1	1	5	--	--	--
Colorado	0	0	0	<1	4	--	--	--	<1	3	1	1	9	--	--	--
Mesa County Attainment Area	<1	<1	--	<1	--	--	--	--	<1	2	--	--	--	--	--	--
Class II Areas																
Background[c]	15	34	1	14	17	4	2,500	3,000	15	34	1	14	17	4	2,500	3,000
Maximum Conc.	4	54[d]	2	11	38	14	19	147	6	64[d]	4	18	74	28	85	630
Total Conc.	19	88	3	25	55	18	2,519	3,147	21	98	5	32	91	32	2,585	3,630
PSD Increments																
Class I	5	10	2	5	25				5	10	2	5	25			
Class II	19	37	20	91	512				19	37	20	91	512			
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000	60	150	80	365	1,300	100	10,000	40,000
Significant Impact Levels	1	5	1	5	25	1	500	2,000	1	5	1	5	25	1	500	2,000

Table 4.3-12 SUMMARY OF MAXIMUM AIR QUALITY IMPACTS, CITIES SERVICE PROJECT ALTERNATIVES[a] (continued)

	50,000 bpd (40,000 Lurgi/10,000 VMIS)								100,000 bpd (All Union B)							
Sensitive Areas	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr
Class I Areas																
Flat Tops	<1	2	<1	2	8	--	--	--	<1	<1	<1	2	8	--	--	--
Arches	<1	<1	<1	<1	2	--	--	--	<1	<1	<1	<1	4	--	--	--
Black Canyon	<1	<1	<1	<1	1	--	--	--	<1	<1	<1	<1	1	--	--	--
West Elk	<1	<1	<1	<1	4	--	--	--	<1	<1	<1	<1	5	--	--	--
Category I Areas																
Dinosaur	<1	1	<1	1	4	--	--	--	<1	<1	<1	<1	4	--	--	--
Colorado	<1	1	<1	2	4	--	--	--	<1	<1	<1	2	4	--	--	--
Mesa County Attainment Area	<1	1	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Class II Areas																
Background	15	34	1	14	17	4	2,500	3,000	15	34	1	14	17	4	2,500	3,000
Maximum Conc.	4	32	2	9	36	15	43	315	5	86[d]	4	15	74	24	39	294
Total Conc.	19	66	3	23	53	19	2,543	3,315	20	120	5	29	91	28	2,539	3,294
PSD Increments																
Class I	5	10	2	5	25				5	10	2	5	25			
Class II	19	37	20	91	512				19	37	20	91	512			
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000	60	150	80	365	1,300	100	10,000	40,000
Significant Impact Levels	1	5	1	5	25	1	500	2,000	1	5	1	5	25	1	500	2,000

Table 4.3-12 SUMMARY OF MAXIMUM AIR QUALITY IMPACTS, CITIES SERVICE PROJECT ALTERNATIVES[a] (continued)

Sensitive Areas	50,000 bpd (All Union B)								100,000 bpd (All Lurgi)							
	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr
Class I Areas																
Flat Tops	<1	<1	<1	<1	4	--	--	--	<1	4	<1	<1	10	--	--	--
Arches	<1	<1	<1	<1	2	--	--	--	<1	1	<1	<1	3	--	--	--
Black Canyon	<1	<1	<1	<1	<1	--	--	--	<1	1	<1	<1	1	--	--	--
West Elk	<1	<1	<1	<1	4	--	--	--	<1	1	<1	<1	4	--	--	--
Category 1 Areas																
Dinosaur	<1	<1	<1	<1	1	--	--	--	<1	2	<1	<1	5	--	--	--
Colorado	<1	<1	<1	1	2	--	--	--	<1	3	<1	<1	6	--	--	--
Mesa County Attainment Area	<1	<1	--	--	--	--	--	--	<1	2	--	--	--	--	--	--
Class II Areas																
Background	15	34	1	14	17	4	2,500	3,000	15	34	1	14	17	4	2,500	3,000
Maximum Conc.	2	43[d]	2	8	36	12	19	147	8	64[d]	4	18	74	27	85	630
Total Conc.	17	77	3	22	53	16	2,519	3,147	23	98	5	32	91	31	2,585	3,630
PSD Increments																
Class I	5	10	2	5	25				5	10	2	5	25			
Class II	19	37	20	91	512				19	37	20	91	512			
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000	60	150	80	365	1,300	100	10,000	40,000
Significant Impact Levels	1	5	1	5	25	1	500	2,000	1	5	1	5	25	1	500	2,000

Table 4.3-12 SUMMARY OF MAXIMUM AIR QUALITY IMPACTS, CITIES SERVICE PROJECT ALTERNATIVES[a] (continued)

Sensitive Areas	50,000 bpd (All Lurgi)								100,000 bpd (Additional Fines Processing Retort)							
	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr
Class I Areas																
Flat Tops	<1	2	<1	<1	5	--	--	--	<1	<1	<1	3	10	--	--	--
Arches	<1	<1	<1	<1	2	--	--	--	<1	<1	<1	<1	3	--	--	--
Black Canyon	<1	<1	<1	<1	<1	--	--	--	<1	<1	<1	<1	1	--	--	--
West Elk	<1	<1	<1	<1	3	--	--	--	<1	<1	<1	<1	4	--	--	--
Category I Areas																
Dinosaur	<1	<1	<1	<1	3	--	--	--	<1	<1	<1	<1	5	--	--	--
Colorado	<1	<1	<1	<1	3	--	--	--	<1	<1	<1	2	6	--	--	--
Mesa County Attainment Area	<1	<1	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--
Class II Areas																
Background	15	34	1	14	17	4	2,500	3,000	15	34	1	14	17	4	2,500	3,000
Maximum Conc.	5	32	2	9	36	13	43	315	5	45[d]	4	16	74	36	42	326
Total Conc.	20	66	3	23	53	17	2,543	3,315	20	79	5	30	91	40	2,542	3,326
PSD Increments																
Class I	5	10	2	5	25				5	10	2	5	25			
Class II	19	37	20	91	512				19	37	20	91	512			
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000	60	150	80	365	1,300	100	10,000	40,000
Significant Impact Levels	1	5	1	5	25	1	500	2,000	1	5	1	5	25	1	500	2,000

Table 4.3-12 SUMMARY OF MAXIMUM AIR QUALITY IMPACTS, CITIES SERVICE PROJECT ALTERNATIVES[a] (concluded)

	50,000 bpd (Additional Fines Processing Retort)							
Sensitive Areas	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_x Annual	CO 8-hr	CO 1-hr
Class I Areas								
Flat Tops	<1	<1	<1	<1	6	--	--	--
Arches	<1	<1	<1	<1	2	--	--	--
Black Canyon	<1	<1	<1	<1	1	--	--	--
West Elk	<1	<1	<1	<1	4	--	--	--
Category I Areas								
Dinosaur	<1	<1	1	<1	3	--	--	--
Colorado	<1	<1	1	<1	4	--	--	--
Mesa County Attainment Area	<1	<1	--	--	--	--	--	--
Class II Areas								
Background	15	34	1	14	17	4	2,500	3,000
Maximum Conc.	4	23	2	11	38	20	21	163
Total Conc.	19	57	3	25	55	24	2,521	3,163
PSD Increments								
Class I	5	10	2	5	25			
Class II	19	37	20	91	512			
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000
Significant Impact Levels	1	5	1	5	25	1	500	2,000

[a] All values $\mu g/m^3$.
[b] -- means was not modeled.
[c] Background concentration as measured by Chevron CCSOP (BLM 1983a) and the Pacific Project (CDM 1983h).
[d] May consume or exceed PSD increment.

Table 4.3-13 MAXIMUM ANNUAL ELEMENTAL DEPOSITION RATES IN SENSITIVE AREAS, CITIES SERVICE PROJECT ALTERNATIVES[a]

		Flat Tops		Arches		Black Canyon		West Elk		Colorado[b]		Dinosaur	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Union B/VMIS	50,000 bpd												
	Nitrogen	114	91	5	5	16	13	12	10	62	62	30	30
	Sulfur	24	19	1	1	3	2	2	2	13	13	6	6
Lurgi/VMIS	100,000 bpd												
	Nitrogen	273	218	10	10	37	29	27	22	153	153	67	67
	Sulfur	45	36	2	2	6	5	5	4	25	25	11	11
Lurgi/VMIS	50,000 bpd												
	Nitrogen	168	134	7	7	23	18	17	14	94	94	43	43
	Sulfur	31	24	1	1	4	3	3	2	17	17	8	8
All Union B	100,000 bpd												
	Nitrogen	118	94	4	4	16	12	12	10	68	68	26	26
	Sulfur	16	13	<1	<1	2	2	2	1	9	9	4	4
All Union B	50,000 bpd												
	Nitrogen	59	47	2	2	8	6	6	5	34	34	13	13
	Sulfur	8	6	<1	<1	1	1	<1	<1	5	5	2	2
All Lurgi	100,000 bpd												
	Nitrogen	228	182	8	8	30	24	23	18	130	130	52	52
	Sulfur	29	23	1	1	4	3	3	2	16	16	6	6
All Lurgi	50,000 bpd												
	Nitrogen	114	91	4	4	15	12	11	9	65	65	26	26
	Sulfur	14	11	<1	<1	2	2	1	1	8	8	3	3
Additional Fines	100,000 bpd												
Processing	Nitrogen	177	142	7	7	24	19	18	14	99	99	45	45
Retorting	Sulfur	34	27	1	1	5	4	3	3	19	19	9	9
Additional Fines	50,000 bpd												
Processing	Nitrogen	124	99	6	6	17	14	13	10	68	68	33	33
Retorting	Sulfur	26	20	1	1	4	3	2	2	15	15	7	7
Cogeneration with	100,000 bpd												
Proposed Action	Nitrogen	210	168	8	8	28	22	21	17	117	117	52	52
	Sulfur	32	26	1	1	4	3	3	2	18	18	8	8

[a] All values $mg/m^2/yr$.
[b] Colorado National Monument.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

50,000 bpd - 40,000 Lurgi/10,000 VMIS Retorts

For the reduced-production Lurgi/VMIS retorting alternative, the PSD Class II 24-hour TSP increment would be consumed by 86 percent. When added to the background concentration, the total concentration would represent 44 percent of the NAAQS. This alternative rates a low adverse impact.

Table 4.3-14 SUMMARY OF OFF-PROPERTY CLASS II AIR QUALITY IMPACTS, CITIES SERVICE PROJECT SPENT SHALE DISPOSAL AND COGENERATION[a]

	Alternate Spent Shale Disposal								Cogeneration							
	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_2 Annual	CO 8-hr	CO 1-hr	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_2 Annual	CO 8-hr	CO 1-hr
Background Concentration	15	34	1	14	17	4	2,500	3,000	15	34	1	14	17	4	2,500	3,000
Proposed Action 100,000 bpd																
Maximum	5	100[b]	4	16	66	31	56	370	5	87[b]	4	16	74	27	39	294
Total	20	134	5	30	83	35	2,556	3,370	20	121	5	30	91	31	2,539	3,294
Union B and VMIS 40,000 bpd/10,000																
Maximum	4	50[b]	2	11	33	17	28	185	2	54[b]	2	11	38	16	19	147
Total	19	84	3	25	50	21	2,528	3,185	17	88	3	25	55	20	2,519	3,147
Lurgi Retorts and VMIS 90,000/10,000																
Maximum	10	98[b]	5	18	65	35	85	630	6	64[b]	4	18	74	30	85	630
Total	25	132	6	32	82	39	2,585	3,630	21	98	5	32	91	34	2,585	3,630
Lurgi Retorts and VMIS 40,000/10,000																
Maximum	5	49[b]	2	9	32	14	43	315	4	32	2	9	37	17	43	315
Total	20	83	3	23	49	18	2,543	3,315	19	66	3	23	54	21	2,543	3,315
All Union B 100,000 bpd																
Maximum	5	100[b]	4	16	66	30	56	370	5	86[b]	4	15	74	26	39	294
Total	20	134	5	30	83	34	2,556	3,370	20	120	5	29	91	30	2,539	3,294
All Union B 50,000 bpd																
Maximum	4	50[b]	2	11	33	15	28	185	2	43[b]	2	8	37	14	19	147
Total	19	84	3	25	50	19	2,528	3,185	17	77	3	22	54	18	2,519	3,147

Table 4.3-14 SUMMARY OF OFF-PROPERTY CLASS II AIR QUALITY IMPACTS, CITIES SERVICE PROJECT SPENT SHALE DISPOSAL AND COGENERATION[a] (continued)

	Alternate Spent Shale Disposal								Cogeneration							
	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_2 Annual	CO 8-hr	CO 1-hr	TSP Annual	TSP 24-hr	SO_2 Annual	SO_2 24-hr	SO_2 3-hr	NO_2 Annual	CO 8-hr	CO 1-hr
All Lurgi 100,000 bpd																
Maximum	10	98[b]	4	18	65	34	85	630	8	64[b]	4	18	74	29	85	630
Total	25	132[b]	5	32	82	38	2,585	3,630	23	98	5	32	91	33	2,585	3,630
All Lurgi 50,000 bpd																
Maximum	5	59[b]	2	9	32	17	43	315	5	32	2	9	36	15	43	315
Total	20	93[b]	3	23	49	21	2,543	3,315	20	66	3	23	53	19	2,543	3,315
Additional Fines Processing Retort 100,000 bpd																
Maximum	5	72[b]	4	16	65	27	62	410	5	45[b]	4	16	74	38	42	326
Total	20	106	5	30	82	31	2,562	3,410	20	79	5	30	91	42	2,542	3,326
Additional Fines Processing Retort 50,000 bpd																
Maximum	4	36	2	11	33	15	31	205	4	23	2	11	38	22	21	163
Total	19	70	3	25	50	19	2,531	3,205	19	57	3	25	55	26	2,521	3,163
Limiting NAAQS	60	150	80	365	1,300	100	10,000	40,000	60	150	80	365	1,300	100	10,000	40,000
PSD Class II Increment	19	37	20	91	512	--			19	37	20	91	512	--		

[a] All values $\mu g/m^3$.
[b] Consumes or exceeds PSD Class II increments.

A Level 1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 52 miles from the facility, while a TSP-caused light plume against dark terrain would be visible within a distance of 59 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness, West Elk Wilderness, and Colorado National Monument due to a reduced Lurgi production alternative.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 5 days with plume discoloration on all 7 days for a total of 7 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be visible 1 case day. One day of plume discoloration is expected; this vista would have a total of 1 day of visible plume.

Table 4.3-15 PREDICTED VISIBILITY IMPACTS FOR CITIES SERVICE ALTERNATIVES

	Number of Days/Year of Potential Significant Impacts[a]	
Alternative	Blair Lake - Shingle Peak Vista	Big Marvine - Shingle Peak Vista
100,000 bpd - Proposed Action	5	1
50,000 bpd - 40,000 Union B/10,000 VMIS	1	0
100,000 bpd - 90,000 Lurgi/10,000 VMIS	7	7
50,000 bpd - 40,000 Lurgi/10,000 VMIS	7	1
100,000 bpd - All Union B	4	1
100,000 bpd - All Lurgi	7	7
50,000 bpd - All Lurgi	7	1
100,000 bpd - 90,000 Union B/10,000 VMIS Additional Fines Processing Retort	7	1
50,000 bpd - 90,000 Union B/10,000 VMIS Additional Fines Processing Retort	5	0
100,000 bpd - Cogeneration with Proposed Action	7	1

[a] During the visitor season - May 15 through October 15.

The maximum total acid deposition presented in Table 4.2-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

100,000 bpd - All Union B Retorts

For the all Union B full-production alternative, the 24-hour TSP off-property concentration would be one of the highest of all proposed alternatives, consuming the Class II increment by 2.3 times. When added to the background concentration, the total impact represents 80 percent of the NAAQS. Forty percent of the SO_2 24-hr

Class I increment would be consumed in the Flat Tops Wilderness. When added to background concentrations, the total annual TSP and NO_x concentrations would represent about 30 percent of the applicable limiting NAAQS. This impact rates a moderate adverse impact.

A Level 1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 40 miles from the facility, while a TSP-caused light plume against dark terrain would be visible to a distance of 48 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness and Colorado National Monument due to a Union B full-production alternative.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 2 days (Cases 4 and 7) with plume discoloration on an additional 2 days (Cases 2 and 3) for a total of 4 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be perceptible 1 day. Plume discoloration occurred on 1 day, for a total of 1 day when possible impacts are predicted. Clearly, significant impact is predicted during 1 day for both vistas, however, the values for the blue-red ratio (plume discoloration) is very near the threshold values for 2 case days and the value for plume perceptibility is very close to the threshold value for 1 case day.

The maximum total acid deposition presented in Table 4.3-13 would be less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

50,000 bpd - All Union B retorts

For the Union B reduced-production alternative, the PSD Class II 24-hour TSP increment would be exceeded by 16 percent. The total off-property TSP 24-hour concentration would be 50 percent of the NAAQS. No other increments would be exceeded. This alternative rates a low to medium adverse impact.

A Level 1 visibility screening analysis indicated an NO_x-caused dark plume against a bright sky would be visible to a distance of 27 miles from the facility while a TSP-caused light plume against dark terrain would be visible to a distance of 30 miles. This analysis indicates no potential for visibility degradation in the sensitive Class I and Category I areas due to a reduced Union B alternative.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

100,000 bpd - All Lurgi Retorts

For the all-Lurgi full-production alternative, the off-property PSD Class II 24-hour TSP concentration would be exceeded by 72 percent. The total 24-hour TSP increment would represent 65 percent of the limiting NAAQS. For the Flat Tops Wilderness, 40 percent of the 24-hour TSP Class I increment and 40 percent of the 3-hour SO_2 Class I increment would be consumed. This alternative rates a moderate adverse impact.

A Level 1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 63 miles from the facility, while a TSP-caused light plume against dark terrain would be visible to a distance of 78 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness, Black Canyon of the Gunnison Wilderness, West Elk Wilderness, Colorado National Monument, and Dinosaur National Monument due to a full-production/all-Lurgi alternative.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 7 days with plume discoloration on all days, for a total of 7 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be perceptible 4 days and plume discoloration on all 7 days. Clearly, significant impact is predicted during all seven cases for both vistas.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

50,000 bpd - All Lurgi Retorts

For a reduced-production all Lurgi alternative, no PSD Class I or Class II increments would be consumed. When added to the background concentrations, the background concentrations would represent 44 percent of the 24-hour TSP NAAQS and 30 percent of the annual TSP NAAQS. This alternative rates a low adverse impact.

A Level 1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 42 miles from the facility, while a TSP-caused light plume against dark terrain would be visible to a distance of 57 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness and Colorado National Monument due to a reduced-production all Lurgi alternative.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 5 days with plume discoloration on all 7 days for a total of 7 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be perceptible zero days. Plume discoloration occurred on 1 day, for a total of 1 day of predicted impacts.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

100,000 bpd - 90,000 bpd Union B/10,000 bpd VMIS With Additional Fines Processing Retort

The full production Union B/additional fines processing retort alternative represents the case in which the fine oil shale is not stockpiled, but instead is processed by Lurgi retorting. The 24-hour TSP Class II concentration would exceed the PSD increment by 22 percent. When added to the background levels, this would result in a total concentration which would be 52 percent of the federal standard. The 3-hour SO_2 concentration in Flat Tops would be 40 percent of the PSD Class I increment. This alternative rates a low to medium adverse impact.

A Level 1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 52 miles from the facility, while a TSP-caused light plume against dark terrain would be visible to a distance of 70 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness, Black Canyon of the Gunnison Wilderness, West Elk Wilderness, Colorado National Monument, and Dinosaur National Monument due to the additional fines processing retort alternative.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 5 days with plume discoloration on all days for a total of 7 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be perceptible 1 day. Plume discoloration occurred on 1 day, for a total of 1 day of predicted impacts.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

50,000 bpd - 40,000 bpd Union B/10,000 bpd VMIS With Additional Fines Processing Retort

The reduced production/additional fines processing retort alternative represents the case in which the fine oil shale is not stockpiled, but instead is processed by Lurgi retorting. No TSP or SO_2 Class I, Class II, or Category I increments would be fully consumed or exceeded. When added to the background concentrations, the 24-hour off property TSP total concentration represents 38 percent of the NAAQS. This alternative rates a low adverse impact.

A Level 1 visibility screening analysis indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 42 miles from the facility, while a TSP-caused light plume against dark terrain would be visible to a distance of 55 miles. This analysis indicates a potential for visibility degradation in the Flat Tops Wilderness and the Colorado National Monument.

Because of this result, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 1 case day with plume discoloration on 5 days for a total of 5 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to not be perceptible. Plume discoloration was likewise determined not perceptible for a total of zero days of expected impacts. Clearly, significant impact is predicted during 1 case day for the Blair Lake vista. However, the values for the blue-red ratio (plume discoloration) are very near the threshold values for four of the case days analyzed.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

Subalternatives

Spent Shale Disposal. Table 4.3-16 presents the modeling results of the spent shale disposal alternatives which involve two separate disposal areas. The 24-hour TSP Class II off-property increment is predicted to be exceeded by all alternatives except for the reduced production/additional fines processing retort alternative. The total concentration added to the background 24-hour TSP concentrations is compared to the NAAQS and is rated in Table 4.3-15.

Except for the 100,000 bpd - 90,000 Lurgi/10,000 VMIS and 100,000 bpd - additional fines processing retort alternatives, these impacts all occur along the west central property line due to the location of the fines stockpile on the western edge of the property. The maximum concentration for the 100,000 bpd - 90,000 Lurgi/10,000 VMIS and 100,000 bpd - additional fines processing retort alternatives occur on the east central property line due to emissions from the retorts themselves. All other total concentrations for pollutants considered are below 30 percent of the respective NAAQS. Because the low level emission rates are not considered in the long-range transport of the Level 2 visibility analyses, and these are the emissions which change when considering the spent shale disposal alternatives, the PLUVUE results presented in Table 4.3-15 will be representative of the spent shale disposal alternatives.

Cogeneration. Table 4.3-14 presents the modeling results of the cogeneration alternative. The 24-hour TSP concentrations are predicted to consume or exceed the PSD Class II increment for all full production alternatives and for the reduced production/split and all Union B retorts. These impacts would all occur in the same location as the original alternatives without cogeneration. When added to the background concentrations, the percent contribution to the 24-hour TSP NAAQS and the impact ratings are identical to those listed for the alternatives without cogeneration. All other total concentrations would be well below 30 percent of the NAAQS.

A Level 1 visibility screening analysis using the proposed action at full production indicated that an NO_x-caused dark plume against a bright sky would be visible to a distance of 64 miles from the facility, while a TSP-caused light plume against dark terrain would be visible to a distance of 46 miles. This analysis indicates a potential for visibility degradation in Flat Tops Wilderness, Colorado National Monument, and Dinosaur National Monument for the cogeneration alternative.

Because of these results, a Level 2 PLUVUE analysis was conducted for the Flat Tops Wilderness, with cogeneration added to the proposed action. For the view of Shingle Peak from Blair Lake, the project plume was predicted to be visible on 5 case days during the visitor season with plume discoloration on 7 days where possible impacts were predicted. For the view of Shingle Peak from Big Marvine, the plume was estimated to be perceptible only 1 case day. Plume discoloration is predicted 1 day, for a total of 1 day where impacts are predicted. Clearly, significant impact is predicted during the same 1 case day for both vistas; however, for the Blair Lake vista, the value for the blue-red ratio (plume discoloration) is very near the threshold values for 2 case days while the value for plume perceptibility is below the threshold value for these case days.

The maximum total acid deposition presented in Table 4.3-13 is less than 10 percent of threshold values presented earlier. Therefore, impacts to biota are unlikely.

Table 4.3-16 TSP Impact Rating for Spent Shale Disposal Alternatives

Alternative	Percent NAAQS	Impact Rating
100,000 bpd Proposed Action	89	Moderate to high adverse
50,000 bpd - 40,000 Union B/10,000 VMIS	56	Low to moderate adverse
100,000 bpd - 90,000 Lurgi/10,000 VMIS	88	Moderate to high adverse
50,000 bpd - 40,000 Lurgi/10,000 VMIS	55	Low to moderate adverse
100,000 bpd - All Union B	89	Moderate to high adverse
50,000 bpd - All Union B	56	Low to moderate adverse
100,000 bpd - All Lurgi	88	Moderate to high adverse
50,000 bpd - All Lurgi	55	Low to moderate adverse
100,000 bpd - 90,000 Union B/10,000 VMIS Additional Fines Processing Retort	70	Moderate adverse
50,000 bpd - 40,000 Union B/10,000 VMIS Additional Fines Processing Retort	46	Low to moderate adverse

4.3.8.3 Solid/Hazardous Wastes and Toxic Pollutants

None of the non-criteria pollutants typically found in combustor off-gas are expected to be emitted above *de minimis* values by the Union B and VMIS retort processes. This conclusion is based upon a review of the Union Oil Company's PSD permit application (UOC 1982a), a review of EPA's manual entitled Pollution Control Technical Manual: Modified In Situ Retorting Combined with Lurgi Surface Retorting (EPA 1983), and a review of EPA's document entitled Trace Elements Associated with Oil Shale Processing (EPA 1977a). Additional trace elements analysis for an example Union B retort combustor off-gas and noncriteria pollutant emissions for an example VMIS process has been supplied by Cities Service (1983c) and are presented in Table 4.3-17 and Table 4.3-18. Based on the analysis of potentially toxic substances that might be emitted from the proposed project, all ranges of emissions for the identified toxics are minor and are below EPA *de minimis* levels.

Only limited data are available concerning the emissions of potentially toxic substances. However as noted in the Uinta Basin Synfuels Development Final EIS, the risk is very small (BLM 1983c), even for a 1,000,000-bpd oil shale industry. The BLM (1983c) risk calculation covered project workers, the existing population and people moving into the area.

Table 4.3-17 TRACE ELEMENTS IN A UNION B TYPE RETORT OFF-GAS[a,b]

Element	Form	Concentration in Off-Gas ($\mu g/m^3$)	Toxicity Range[c] (TLV) ($\mu g/m^3$)	Annual Emission[d] Rate (Tons/Year)	De Minimis Value (Tons/Year)
Arsenic	Gas	15	500 to 2,000	0.25	--
	Particulate[e]	0.4			
		15.4			
Mercury	Gas	2.2	100 to 500	0.01	0.1
	Particulate	0.15			
		2.35			
Iron	Gas	120.0	--	0.44	--
	Particulate	6.0			
		126.0			
Chromium	Gas	90.0	500 to 2,000	0.32	--
	Particulate	2.0			
		92.0			
Zinc	Gas	40.0	500 to 150,000	0.14	--
	Particulate	0.5			
		40.5			

Source: Cities Service (1983c).

[a] Assumes net gas production of 500 SCM/ton shale (Harak et al. 1974).
[b] The emission rates shown on this table are for a typical Union B retort off-gas at an approximate production rate of 13,000 bpd. The emission rates should be increased by a factor of 7 to predict the release from Cities Service's project.
[c] Source: Cowherd et al. (1977). TLV = Threshold Limit Value (by the ACGHI).
[d] Gaseous forms are defined as those not collected by a 0.5μ neopore filter.
[e] Assumes volume flow rate of 100 m^3/sec.

4.3.8.4 Secondary Impacts

This section presents the estimated air quality impacts from secondary growth emission sources associated with the construction and operation of Cities Service's upgrading, mining, and retorting facilities. The secondary growth sources included in the analysis are increased space heating requirements and increased motor vehicle traffic in the De Beque area.

The emission estimates from increased space heating and transportation requirements are presented in Table 4.3-19. Space heating emissions were calculated by assuming each new household was a consumer of natural gas and used 115,000 standard cubic feet of gas per customer year (BLM 1983a,e). Emission factors for natural gas combustion were derived from EPA's Compilation of Emission Factors (EPA 1977c). Vehicle exhaust emissions were calculated from national average emission factors. It was assumed that each household operated an average of two vehicles and each vehicle averaged 12,000 miles traveled per year. The highest emissions are expected in the year 2007. The projected emissions impacts of the year 2007 were estimated with the highly conservative screening technique outlined in Appendix A of the DEIS.

Table 4.3-18 ESTIMATED EMISSIONS OF OTHER POLLUTANTS[a] FROM A TYPICAL VMIS PROJECT[b]

Pollutant	Emissions (tons/year)	
	De Minimis	Cathedral Bluffs
Volatile Organic Compounds	40	< 40
Lead	0.6	0.15
Asbestos	0.007	0
Beryllium	0.004	0.003
Mercury	0.1	0
Fluorides	3	7.8
Sulfuric Acid Mist	7	0
Hydrogen Sulfide	10	0
Total Reduced Sulfur	10	0
Reduced Sulfur Compounds	10	0

Source: EPA (1983).

[a] Criteria pollutants emission rates are shown in Table 4.3-6
[b] Emission rates shown on this table are for a typical VMIS project at 69,000 bpd. The emission rates should be reduced by a factor of 0.15 to predict the release from Cities Service's project.

Table 4.3-19 MAXIMUM ANNUAL SECONDARY EMISSION RATES IN DE BEQUE, CITIES SERVICE PROJECT

Source Type	SO_2 (ton/yr)	TSP (ton/yr)	NO_x (ton/yr)	CO (ton/yr)	HC (ton/yr)
Space Heating (9,447 Units)	0.3	2	24	9	3
Transportation (14,894)	45	118	1,576	5,871	929
Total Emissions	45.3	120	1,600	5,880	932

To estimate the highest short-term concentrations possible in De Beque, a worst-case episode was considered for the projected year 2007 secondary emissions. The scenario assumes all motor vehicle emissions from 3 pm one day until 9 am the next morning are trapped over the De Beque area. In addition, continuous space heating emissions were added to the vehicle emissions. The meteorological conditions assumed were a regional high pressure stagnation condition, with zero ventilation. Thus, pollutants emitted during the 18-hour period were assumed to accumulate over the town, and then dispersed down to the ground and fill a well-mixed box surrounding De Beque. A 32 square-mile area surrounding De Beque was assumed for the well-mixed region. To add to the conservatism, the vertical extent of the mixed region was taken as only 650 feet. The worst-case short-term concentrations were then calculated as the total amount of pollutant mass released during the period divided by the volume of the well mixed box.

The uniform hourly concentration estimates calculated using the above worst-case dispersion episode are 3, 8, 113, 415 and 66 $\mu g/m^3$ for SO_2, TSP, NO_X, CO and HC respectively. Except for NO_X, these concentrations are at the level of background concentrations, and are insignificant.

Extrapolating the NO_X concentration to an annual average using a factor of 0.2 as recommended (EPA 1970) results in a concentration of 23 $\mu g/m^3$, or 23 percent of the annual NO_2 NAAQS.

5.0
Consultation and Coordination

Getty
Cities Service

5.0 CONSULTATION AND COORDINATION

5.1 Introduction

Review of the Getty/Cities Service EIS has been undertaken by several federal, state, and local agencies, special interest groups, and the general public. The U.S. Army Corps of Engineers, Sacramento District, is the designated lead federal agency for this EIS. The U.S. Bureau of Land Management, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service are cooperating federal agencies. Other agencies and groups as noted below, have reviewed the DEIS, and many have provided the Corps with their evaluations and comments (see Section 5.3).

Federal Agencies

U.S. Army Corps of Engineers - Sacramento, San Francisco, and Grand Junction
U.S. Bureau of Land Management - Denver and Grand Junction
U.S. Environmental Protection Agency, Region VIII, Denver, and Industrial Environmental Research Laboratory, Cincinnati
U.S. Fish and Wildlife Service - Salt Lake City and Denver
U.S. Forest Service - Denver
National Park Service - Denver
U.S. Bureau of Mines - Denver
U.S. Department of Interior Program Offices and Oil Shale Environmental Advisory Panel - Denver and Washington, DC
Federal Energy Administration - Washington, DC
U.S. Bureau of Indian Affairs - Albuquerque
U.S. Senators' and Congressmen's Offices
Federal Energy Regulatory Commission - San Francisco
U.S. Soil Conservation Service - Washington, DC
Council on Environmental Quality - Washington, DC
U.S. Office of Surface Mining - Denver
U.S. Geological Survey - Denver
U.S. Department of Health and Human Services - Denver
U.S. Bureau of Reclamation - Salt Lake City, Denver, and Grand Junction
Federal Emergency Management Agency - Denver
U.S. Department of Commerce - Washington, DC
U.S. Synfuels Corporation - Washington, DC
U.S. Department of Housing and Urban Development - Denver

State Agencies

Department of Natural Resources - Executive Director's Office
Mined Land Reclamation Board
Geological Survey
Division of Water Resources
Water Conservation Board
Division of Wildlife
Department of Health
Department of Highways
State Historic Preservation Office
Department of Agriculture
Department of Transportation
Department of Local Affairs (Clearinghouse)
Public Utilities Commission
State Legislators' Offices

County Agencies

Garfield County
Mesa County
Rio Blanco County

Other Agencies

Northwest Colorado Council of Governments
Colorado West Council of Governments
Town of De Beque
Town of New Castle
City of Rifle
Town of Silt
Town of Parachute
Town of Collbran
Town of Fruita
Town of Palisade
City of Grand Junction
Town of Carbondale
Town of Glenwood Springs

Other Groups

Colorado Building and Construction Trades Council
Colorado State Council of Carpenters
Friends of the Earth
Garfield County Citizens Association
Colorado River Water Conservation District
Upper Colorado River Commission
Colorado River Water Conservation Board
American Wilderness Alliance
Audubon Society
Colorado Mining Workshop
Colorado Rivers Council
Colorado Wildlife Federation
Colorado Wilderness Study Group
Colorado Water Congress
Colorado Endangered Species Group
Environmental Action of Colorado
Environmental Defense Fund
League of Women Voters
Isaak Walton League
National Wildlife Federation
Nature Conservancy
Sierra Club
Rocky Mountain Sportsmen's Federation
Trout Unlimited
Wildlife Society
ACCORD
Colorado Municipal League
Colorado School of Mines
Colorado River Board of California
Colorado State University, Ft. Collins

Numerous other energy companies, consultants, and private firms and individuals received copies of the DEIS.

5.2 Review of the Draft EIS

The Draft EIS was filed with the U.S. Environmental Protection Agency in Washington, DC, on January 13, 1984. The Notice of Availability was published in the Federal Register on January 20, 1984. Copies of the DEIS were mailed to federal, state, and local government agencies, and to firms and individuals as noted above. Public review copies were available in Colorado, Utah, California, and Washington, DC. The 60-day public comment period ended on March 20, 1984.

5.3 Comments and Responses

Written comments on the DEIS were received by letter from the parties noted in Table 5.3-1. Comments were organized and received responses as follows:

- A letter number, as shown on Table 5.3-1, was assigned to each
- Individual comments in each letter were bracketed as shown in the original letters reproduced in Section 5.4
- Lengthy comments were paraphrased, and the letter and comment number (or numbers) are shown following the original or paraphrased comments
- Where appropriate, comments of a similar or identical nature were combined into one generalized, paraphrased statement

Table 5.3-1 LIST OF COMMENTORS AND LETTER NUMBER, GETTY/CITIES SERVICE DEIS

Letter Number	Commentor
1	Mesa County Policy and Research Office
2	Friends of the Earth
3	Getty Mining Company
4	State of Colorado (Combined agency comments)
5	U.S. Soil Conservation Service
6	Garfield County Department of Development
7	Cities Service Oil and Gas Corporation
8	Colorado Mountain Club
9	U.S. Office of Surface Mining
10	Union Oil Company of California
11	U.S. Department of Housing and Urban Development
12	U.S. Department of the Interior (Combined agency comments)
13	U.S. Department of Commerce - NOAA
14	U.S. Environmental Protection Agency
15	U.S. Department of Health and Social Services
16	Bluestone Properties

Thus, bracketed comment number 6, from the Mesa County Policy and Research Office (letter number 1), would be designated 1-6. The comments below are presented as in the following sample format:

3. **Comment:** The original or paraphrased comment is given. (6-2, 14-8)

Response: The response is given.

The response for each comment either addresses the comment with an explanation, identifies that the text of the EIS was changed, or provides the rationale for why the comment did not require a text change. Minor text changes are not reprinted in the FEIS, but are recorded in Corps/CDM files. Comments are grouped by environmental discipline (e.g., vegetation, wildlife) in the same order they appear in Chapters 3.0 and 4.0 of the DEIS.

As noted above, comment letters are reproduced in Section 5.4 of this chapter. Several letters had attachments to support or clarify their concerns. These attachments are not reproduced to save space and costs. Copies of the attachments are available for public review at the Corps Sacramento office.

5.3.1 Corps EIS Policy Issues

1. **Comment:** All issues raised at the EIS scoping sessions and in the written scoping comments should be addressed in the document, including further treatment of the GCC reservoir issue. (2-1, 2-2, 2-16, 2-24, 4-1)

Response: The DEIS and FEIS, in combination, considered all issues raised in the scoping process and addressed them in varying levels of detail. The combined DEIS/FEIS subject index can serve as a reader's guide to the location of certain discussion topics in the documents. Topics to be the subject of detailed treatment in later permit applications are only addressed generally in this FEIS. Some new water quality data on the GCC reservoir has been added and this and related information are presented in Section 4.1.2 of the FEIS. Coverage of the GCC reservoir impacts is adequate, considering both this EIS and the CCSOP EIS (BLM 1983a,e).

2. **Comment:** The EIS does not contain sufficient information, especially concerning waste stream characteristics, to fully evaluate the impacts of the proposed oil shale projects. A revised DEIS should be issued. (2-2, 2-3, 2-4, 2-24, 4-2, 4-5, 6-2, 6-4, 6-5, 14-80, 14-82, 14-85)

Response: The Corps feels that the information presented in the DEIS, in combination with the additional material present in the FEIS, is sufficient to address waste stream characteristics and their impacts for purposes of this EIS. Since we are dealing with new technologies, no field or operating data exist in many cases, and a worst-case analysis must be (and has been) used, in accordance with CEQ regulations. Further, many of the specific impact concerns raised will be the subject of future permits, after construction is planned and detailed engineering data become available.

3. **Comment:** A supplemental environmental impact statement (SEIS) is suggested at some point in the future when more specific project information is available, in order to address project impacts more specifically. (14-81, 14-83)

Response: The existing EIS is adequate for the stated purpose of assessing project impacts as a result of the water use authorized (in part) by the Corps 404 permit. However, the Corps recognizes that a supplement may be necessary in the future for either or both shale oil projects. See response to comment 2.

4. **Comment:** Approval by the Army Corps of Engineers of the Getty-Cities Service application for a 404 permit should await completion of: (1) adequate field surveys for plant associations on the project site; and (2) a thorough analysis of the impacts on vegetation from the proposed project. (4-49)

Response: The Corps will consider these matters as the 404 permit application is reviewed. We feel the treatment of vegetation impacts, including new information on plant associations and committed mitigation presented in the FEIS, is adequate for purposes of EIS analysis.

5. **Comment:** Detailed design information concerning project features and corridors will be the subject of future permitting activities at the local, state, and federal agency levels. All necessary project data has been provided for purposes of this EIS. (1-1, 7-2, 7-44)

Response: Concur. The Corps feels that the DEIS and FEIS, in combination, address all pertinent impact issues at this time.

6. **Comment:** Continued coordination is needed between the Corps and EIS cooperating agencies as the FEIS is prepared, in order to respond to various agency concerns. (14-84, 14-86)

Response: Concur. Such coordination has occurred with EPA, USFWS, Colorado Division of Wildlife, BLM, and others. Review meetings were held with EPA, USFWS, and BLM during preparation of FEIS comment responses and revised text in order to ensure that necessary agency input was received.

7. **Comment:** Shared project facilities between the CCSOP and Getty/Cities Service should be clarified in the EIS, and impacts of shared facilities addressed. Mitigation commitments by CCSOP for these facilities in their EIS should be similarly committed to by Getty/Cities Service. (12-8)

Response: It should be clarified that the committed mitigation concerning the GCC water system in the CCSOP EIS was a commitment by all the GCC Participants, not just Chevron. Multiple use of the water system and resultant GCC depletions were addressed in the CCSOP EIS, specifically for aquatic ecology. Multiple use of project features (e.g., corridors) in Roan Creek and Parachute Creek valleys is addressed in the cumulative impacts section (4.4) of the Getty/Cities Service DEIS.

8. **Comment:** Mitigation measures should be more precisely defined and receive commitments from the companies in the EIS. The project abandonment issue should be treated further. (2-22, 7-16, 12-10)

Response: Further mitigation measures or permit conditions may be developed by the respective permitting agencies following review of the FEIS. Also, it should be noted that both Getty and Cities Service have committed to certain mitigation measures since the DEIS was prepared. These are stated throughout the revised proposed action sections in the FEIS for Getty (2.3.1.2) and Cities Service (2.3.2.2). Other alternative mitigation measures which have not received commitment at this time are discussed following the FEIS project alternatives discussions, in Sections 2.3.1.4 and 2.3.2.4, for the respective projects.

9. **Comment:** Discussion of the *"no action"* alternative for the Getty and Cities Service projects (pages 2-72 and 2-89 of the DEIS, respectively) should be expanded and clarified. Both the adverse and beneficial impacts of these alternatives should be addressed and explained in more detail. (2-12, 7-17, 12-51)

Response: The Corps feels the discussions of the *"no action"* alternatives in the DEIS are balanced and objective, and properly emphasize both the adverse and beneficial impacts of this alternative for each project.

10. **Comment:** The Corps' *"environmentally preferred"* alternative should be stated and justified in the FEIS. (7-18)

Response: The Corps' position on this issue is as follows: by previous regulation and agency policy, the preferred alternative for a regulatory action (in either an "environmentally preferred" or "agency preferred" sense) is *"determined at the completion of the regulatory process, i.e., after the 30 day period following filing of the final EIS"* (COE 1984). Therefore, no preferred alternative is stated in the EIS; it awaits the 404 permit decision. The above citation is from the Corps' new proposed rules on this matter (January 11, 1984), which reinforce the previous agency practices.

11. Comment: The Corps' *"agency preferred"* alternative should be identified and discussed in the Final EIS. (7-19, 7-190)

Response: See response to comment 10.

12. Comment: OSM is currently preparing an EIS on Dorchester Coal Company's proposed Fruita mines complex, which involves the placement of surface facilities in Big Salt Wash. There could be a conflict between these facilities and the alternative power-transmission route in Big Salt Wash as discussed in the EIS. (9-1)

Response: The Corps is aware of potential conflicts between Dorchester, the Getty corridor alternative, and Chevron facilities planned for Big Salt Wash. Currently, BLM reports that the Dorchester EIS being written by OSM on the mine plan is scheduled for completion about April, 1985. On the northern lease (where the conflict would occur), Dorchester has requested an off-site lease for surface facilities, which would also conflict with Chevron's reservoir plans. No actions have been filed with BLM other than by Dorchester to date. It is assured by BLM that all conflicts will be resolved prior to project development.

13. Comment: A minor revision is needed in the introduction to the *"Affected Environment"* on page 3-1. (7-34)

Response: Concur. The text has been revised.

5.3.2 Purpose and Need

1. Comment: Additional justification is necessary in the Purpose and Need section to address the need for oil shale development, and its positive impacts. (2-5, 8-1)

Response: The Corps feels the justification in Section 1.0 of the DEIS is adequate. However, that full section has been revised and reprinted in consideration of this and other comments.

2. Comment: The regulatory actions initiating the EIS need clarification in Section 1.0, as does the list of agencies which issue other required authorizations and perform technical reviews concerning the projects. (7-1, 12-11, 12-23, 12-24, 12-26)

Response: Concur. See revised 1.0, Purpose and Need, in the FEIS.

3. Comment: Minor text revisions and clarifications are needed to the EIS Summary and Purpose and Need sections. (3-1, 3-10, 7-20, 7-81)

Response: Concur. See revised Summary and Purpose and Need in the FEIS.

4. Comment: On page 2-6, the need for *"economic justification"* of each project should be explained in light of this EIS effort. (8-4)

Response: Agencies like the Corps are required by law and regulation to respond to permit applications and perform the appropriate environmental impact analyses in a timely fashion, even though *"economic justification"* for a project may not be unanimously accepted under current circumstances.

The Corps feels that economic justification is adequately explained. The companies are projecting that when these projects are constructed the economic and energy circumstances will make them economically feasible.

5.3.3 Proposed Action and Alternatives

Project Description

1. **Comment:** Editorial changes and clarification need to be made in the project description for the Getty project (Section 2.3.1) to facilitate understanding of the project. (3-2, 3-11)

   Response: The entire Section 2.3.1 has been revised and reprinted in response to these comments.

2. **Comment:** Revisions and clarifications are needed concerning the project description and alternatives for the Cities Service project (Section 2.3.2). (7-21, 7-23, 7-31, 7-82, 7-83, 7-84, 7-85, 7-86, 7-87, 7-88, 7-89, 7-90, 7-91, 7-92, 7-93, 7-94, 7-95, 7-96, 7-98, 7-105, 7-118, 8-18, 12-27, 12-29, 12-33, 14-35)

   Response: The text and appropriate figures of Section 2.3.2 have been revised to respond to the various comments referenced above. The entire Section 2.3.2 (with all figures) has been reprinted, incorporating all revisions.

3. **Comment:** Revisions and clarifications are needed in the EIS regarding identification of public lands potentially affected by both the Getty and Cities Service projects and the impacts to those lands. (2-8, 4-3, 12-1, 12-3, 12-28, 12-31, 12-34, 12-37, 12-43, 12-44, 12-45)

   Response: To adequately address these comments, Tables 2.3-2 and 2.3-9 have been revised and reprinted, thereby presenting updated public lands information. Maps identifying project features and affected public lands have been developed and are included within the revised Section 2.3. The discussion of the impacts to public lands has been expanded within revised Section 2.4. Additional discussion of impacts has been included in the responses to specific land use comments - see that subject heading.

4. **Comment:** A summary of the analysis of the water supply system provided in the CCSOP EIS should be presented in the Getty/Cities Service EIS. Committed mitigation by Chevron Shale Oil Company must be accepted by Getty if the analysis is to be valid. Also, the Roan Creek corridor should be shown on a map in enough detail to demonstrate the difference proposed by Getty as opposed to what was analyzed in the CCSOP. (12-36)

   Response: The water supply system as described in the CCSOP EIS is summarized in the revised project description. Getty and Cities Service are participants in the GCC Joint Venture. Any commitments for mitigation made within the CCSOP EIS by GCC were made by Getty and Cities Service also. The general location of the Roan Creek valley corridor is shown on figure 2.2-3. Those corridors considered by the GCC participants coincide.

5. **Comment:** For Getty's water supply system, maps of the routes and pumping stations should be included and as much engineering detail as available be provided. The difference and impacts of alternatives should be analyzed and discussed, as well as justification for the West Fork Parachute Creek Reservoir. (12-42)

   Response: Engineering details for the proposed water supply system have not been developed and are beyond the scope of the EIS. Such details will be provided, as required, when Right-of-Way applications are filed. The proposed water supply system is detailed in Section 2.3.1.2.

6. **Comment:** Additional data on water rights, uses, and supply for both projects is necessary. (4-38, 4-39, 4-40, 4-41)

   Response: The project description has been revised and reprinted and incorporates the additional water rights, use, and supply information requested.

7. **Comment:** Recent conflicts with nesting raptors, resulting in generation failures, have occurred on metal 345 kv H-frame transmission line structures. Careful consideration should be given to reducing these conflicts. (12-38)

Response: Both Cities Service and Getty will install *"electrocution proof"* transmission lines to reduce the conflicts between these facilities and nesting raptors.

8. **Comment:** The product pipeline corridor from the Getty property should be shown and described, including pipeline size and ROW needed. The relationship of the Getty pipeline and the La Sal and Rangely product pipelines with reference to public lands needs to be discussed. (12-39, 12-41, 12-47)

Response: The corridor for the product pipeline route is shown on Figure 2.3-3 in the revised and reprinted project description. The pipeline ROW would be approximately 50 feet. The diameters and pipeline capacities are given within the DEIS and FEIS under the *"Product Pipeline"* section of the project description.

The tie into the La Sal and Rangely pipelines can be assessed by comparing the Getty and Cities Service project features with the appropriate maps in the CCSOP EIS and the La Sal pipeline EIS. Impacts to public lands have been addressed in more detail in the revised and reprinted project description.

9. **Comment:** It is not clear that economies of scale apply to a 100,000 bbl/day (bpd) project. In fact there may be greater economy of a scale at 50,000 bbl/day as well as reduced environmental impact. (14-24, 14-36)

Response: On the basis of detailed calculations supporting the energy balance in the DEIS (Tables 4.2-32 and 4.3-34), it can be concluded that the 100,000 bpd case does show economies of scale when compared to the 50,000 bpd case. For both the Getty and Cities Service projects, the energy input per barrel is less for the 100,000 bpd cases. This fact, in conjunction with proprietary economic calculations, indicate the 100,000 bpd rate is more favorable economically. The financial and technical assumptions on which the calculations are based have not been demonstrated in a commercial operation.

10. **Comment:** Underground disposal of spent shale should be considered as an option since it may lessen the environmental impacts and increase resource recovery. It may, however, be technologically difficult to coordinate with mining activity. (14-26, 14-30, 14-31, 14-40)

Response: The underground disposal of spent shale is being considered as an option by Getty. The problems inherent in such an operation are difficult to overcome. See discussion in Section 2.4.3.1.3.

11. **Comment:** Table 2.3-9 has inaccuracies: corrections have been submitted by Cities Service. (7-22, 7-197)

Response: Comment noted: Table 2.3-9 has been updated, including all applicable information.

12. **Comment:** The design lives for the diversion dams, reservoirs, shale piles, and other features must be long enough to prevent any impairment of beneficial uses. Long-term operation and maintenance for many of the project facilities needs further clarification. (4-28, 12-32)

Response: The specific design lives of diversion dams, reservoirs, and similar structures are beyond the scope of this EIS. These types of structures will, however, be designed to accommodate the expected use of the structure (e.g., 50-year, 24-hour precipitation event). The spent shale pile will be a permanent structure. Shale storage piles will be reclaimed (revegetated) as required by the Colorado Mined Land Reclamation Board.

13. **Comment:** The Draft EIS should indicate what widths were assumed for the various corridors and whether multiple use corridors were assumed in the impact analyses. Also the document does

not clearly indicate whether specific terrain and habitat interactions were included in the impact assessment. If they were not, the impacts would be overstated. (7-11)

Response: The right-of-way widths assumed are:

- Road - 60 feet
- Water pipeline - 50 feet
- Product pipeline - 50 feet
- Transmission line - 100 feet

Multiple use corridors were used for impact analysis. Specific terrain and habitat interactions were not included in the impact assessment. The resulting impact analysis may, in fact, be *"worst-case"*. However, this type of analysis is consistent with CEQ regulations and guidelines.

14. **Comment:** Changes in land uses in private land will occur due to the creation of multi-use corridors for rail lines, access roads, transmission lines, and pipelines. An assessment of the mining and retorting process cannot stand alone. The same assessment must be performed for the support facilities. This aspect of a shale project can have an equal, if not larger, impact on both the environment and local populations. (1-2, 1-3)

Response: Specific impacts to the existing private land uses within the project area will be addressed, as applicable, in future county permitting applications. Land use impacts have been addressed within both the DEIS and FEIS.

15. **Comment:** The operator must conduct all operations in accordance with all applicable environmental laws, regulations, and permit conditions. The assessment of water quality impacts should be clarified in view of the *"zero discharge"* design. (7-6)

Response: Concur. Water quality impacts have taken the *"zero discharge"* design into account.

16. **Comment:** Mitigation measures for various construction and operational impacts need to be developed. When an analysis of another NEPA document is referenced, a summary of impacts should be included. Any committed mitigation made in the referenced document must also be committed to by the new proponent. (12-30, 4-30, 4-31)

Response: Mitigation measures for both projects have been developed and are presented, as applicable, within the revised project description, as are summaries of impacts. The *"committed mitigation"* referenced in the above comments are from the CCSOP EIS. These commitments were made on behalf of the GCC Joint Venture, of which both Getty and Cities Service are participants.

17. **Comment:** On pages 4-17 and 4-86, it is stated that mine inflows will be discharged in such a manner so as to minimize contact with soluble mined spent shale materials. Will this water be discharged to the natural drainage or be retained? (4-42)

Response: Water will be retained in impoundments that are described within the revised project description. In actual practice, these impoundments would be sumps within the mine.

18. **Comment:** Are there going to be two rail lines built for the Getty and Cities Service project? The cumulative impacts of the two projects utilizing the rail lines should be addressed. (1-4, 1-15)

Response: Cities Service has included rail transportation up Roan Creek Valley as an alternative (see page 2-88 of the DEIS). The impacts of the rail line have been assessed as appropriate (see page 2-90 of the DEIS). In the event that such a rail line is constructed, Cities Service would coordinate with other oil shale developers, including Getty, to ensure that duplication of transportation facilities is minimized. Such coordination is prudent from the viewpoint of minimizing environmental impact and maximizing economic efficiency.

19. **Comment:** Funds for road improvements must be borne by the users that have created the need for improvement. (1-39, 1-40)

Response: The costs of road improvements are typically borne by the developer. Both Getty and Cities Service will consider their parts in providing funds for road improvements. The specific details of these funding arrangements are best made during special use permitting. If the roadways, once improved, belong to the state or county, then the government unit is responsible for maintenance. The developers will contribute funds for maintenance through property, income, and other state and local taxes and assessments.

20. **Comment:** The FEIS needs to address mitigation measures regarding transportation impacts. (4-60)

Response: The revised and reprinted project description provides mitigation measures for transportation impacts.

21. **Comment:** Retorting of raw shale fines should be considered whether Union B retorts or Lurgi retorts are utilized since the potential value of this resource is too large to ignore. (14-43)

Response: As stated on page 2-56, the processing of oil shale fines has been considered as an alternative. If such processing does occur, current plans are to use the Lurgi technology.

22. **Comment:** More detailed discussion on the Lurgi and VMIS technology is needed in the project descriptions and the alternatives and environmental consequences sections. (2-10)

Response: More detailed discussion on the Lurgi and VMIS technologies, particularly as regards waste streams and shale disposal have been included in the revised and reprinted project description.

Project Alternatives

1. **Comment:** Our basic concern with this section (Proposed Action and Alternatives) is that the alternatives are not fully included, much less explored in any detail. A number of alternatives are eliminated from consideration with little rationale. (2-6, 2-18)

Response: Alternatives were developed through joint discussions between the Corps of Engineers and the two project proponents. In the development of these alternatives, the economic and technical feasibility of each alternative was considered in conjuction with environmental concerns. Tables 2.2-1 and 2.2-2 are intended to summarize alternatives and reasons for elimination, not to provide a comprehensive discussion. Alternative types in the EIS were consistent with Corps of Engineers procedures as noted in Tables 2.2-1 and 2.2-2.

2. **Comment:** Alternative water sources, particularly Ruedi Reservoir, should be discussed in more detail. Reasons for elimination of alternatives should be expanded (2-6, 14-5, 14-32, 14-39, 14-42, 14-46)

Response: Section 2.2, Selection of Alternatives for Detailed Discussion, has been revised to expand the discussion for alternative selections. Tables 2.2-1 and 2.2-2 have been revised as appropriate, and reprinted in the FEIS. Ruedi Reservoir was not selected as an alternative water source for the various reasons discussed in the revised and reprinted project description.

3. **Comment:** Alternatives considered by the Corps have been presented in Table 2.2-2 and have been included or eliminated based on sound technological reasons. (7-3)

Response: Comment noted.

4. **Comment:** The processing of 8 percent fines would result in an additional energy recovery of approximately 5 percent (reference page 4-155). (7-74)

Response: Comment noted.

5. **Comment:** There has been no firm decision on the type of technology, which renders much of the discussion of consequences meaningless. The same concern applies to the details presented for the spent shale disposal pile. (2-19, 2-9).

Response: The proposed and alternative technologies presented in the DEIS represent the selections of both companies based upon the best information currently available. Selection of the technologies considered the economic and environmental components. The environmental impacts of the technologies selected (both proposed and alternative) have been addressed. As a point of fact, additional information has been added to the revised and reprinted project description.

6. **Comment:** There was no flexibility exhibited in the alternatives for the retort and upgrading plants. While this was apparently done on the basis of air quality data, that data is not referenced or explained. (2-7)

Response: For both projects, the retorting and upgrading facilities were located on the mesa (as opposed to the valley floors) to reduce air quality impacts. This decision was made based upon information provided to Getty and Cities Service through a 1976 Roan Creek meteorological study completed by Intera, Inc. The location of the facilities on the mesa has not been finalized. The locations shown, however, have been incorporated within the air quality impact analysis.

7. **Comment:** There are certain omissions and errors in Tables 2.2-1 and 2.2-2 regarding the presentation and discussion of alternatives. (14-20)

Response: The above-referenced tables have been modified to reflect all alternative information.

8. **Comment:** An alternate water source, suggested for at least part of the necessary water supply for CCSOP, would be equally applicable for the GCC Joint Venture. A pressurized 15,000 acre-feet/year saline water pipeline is currently under planning investigation by the Bureau of Reclamation's Glenwood-Dotsero Springs salinity control unit. The low quality water from this salinity control project, and agricultural drainage from the Grand Valley, may be available for use by the GCC Joint Venture. Consideration should be given to the possibility of substituting some of this low quality waste water for diversions from the Colorado River. This would have the dual benefit of assisting in desalinization efforts and relieving pressure on agricultural water supplies. (4-46, 12-16)

Response: Use of saline water for project-related uses has not been considered for the following reasons:

- Water rates and delivery schedule are uncertain at this time.
- Water quality of the saline water is not suitable for many uses, therefore, a dual system would be required.
- Use of this water is speculative at this time, as neither water rights or plans for augmentation have been approved by the Water Court.

9. **Comment:** Tables 2.2-1 and 2.2-3, pages 2-2 to 2-5, discuss alternatives considered and eliminated from analysis. Within this table, the Union B technology is described as developed commercially. There is no supporting evidence for this as Union is currently changing its technology. The Lurgi technology is described as developed and demonstrated. However, federal tract C-a found Lurgi too expensive for commercial development. The current situation with these technologies should be listed in this brief description. (8-3)

Response: We generally concur. Tables 2.2-1 and 2.2-2 have been revised.

Retort Technologies

1. **Comment:** For both the Getty and Cities Service proposals, why are Lurgi retorts considered as an alternative? What are the comparative advantages and disadvantages, economically and environmentally, of the two technologies? (8-5)

   Response: The Lurgi retort technology has been considered as an alternative means to process raw shale fines. At present, the Union B technology has the most complete data base; hence, it was selected as the proposed retort technology. At this time, however, a complete environmental or economic analysis cannot be made because of the lack of actual operating data. Once those processes have been operated on a commercial scale, these data will become available. Additional information, as available, has been developed and has been included in the revised and reprinted project description.

2. **Comment:** On page 2-18, Getty refers to the possibility of using a Lurgi retort for oil shale fines, if the quantity of fines justifies this approach. What quantity of fines does Getty estimate will be produced and subsequently disposed or retorted? (14-21)

   Response: An estimated 7 percent of the Getty crushed raw oil shale will not report to the Union B retorts because it will be classed as *"fines"*. Once sufficient Union B retort operating experience at steady-state conditions is gained, the definition of *"fines"* will be more precise and the quantity of fines to be generated will be verified.

   Lurgi oil shale units have been designed to process up to 25,000 tons per day. A minimum practical and economic size Lurgi retort would process about 8,000 tons per day. Based on the above range of daily production rates, the Getty Lurgi unit or units will be sized to process 8,000 to 25,000 tons per day based on the quantity of fines generated and the number of units specified when detailed design work is complete. The feed to the Lurgi retorting complex must be supplied from the crushing plant and probably from the *"fines"* stockpile.

3. **Comment:** If the Union B retorting technology is used, then Getty should consider burning the carbon on the spent shale as an energy source for recycle gas heating or power generation. This would produce a very different spent shale for disposal and have a much better overall energy balance. (14-29)

   Response: The project description has been rewritten and reprinted and includes a discussion of the combustion of carbonaceous material on spent shale from the Union B process.

4. **Comment:** On page 2-78, the Lurgi process should show a more favorable energy balance than the Union B because raw shale fines are retorted, not wasted, and the carbon on the spent shale is burned to produce energy. (14-48)

   Response: We concur. Page 2-78 of the DEIS reflects the above statement.

Spent Shale and Waste Rock Disposal

1. **Comment:** The design and supporting information describing spent shale disposal is incomplete and additional information is needed. (14-23, 14-40)

   Response: The descriptions of both the Getty and Cities Service projects have been revised to include additional information on spent shale disposal and reclamation.

2. **Comment:** The properties of Lurgi spent shale are greatly different than the properties of Union B spent shale especially regarding cementation, erosion, permeability, compaction, and ability to support vegetation. Hence, the same disposal methods that are proposed for Union B spent shale are not appropriate for Lurgi spent shale. Further, the environmental impacts may be quite different. The EIS must include a detailed discussion of each technology and the associated environmental effects of each. (14-27, 14-25, 14-37, 14-38, 14-67)

Response: The project description has been rewritten and reprinted and includes additional information on Lurgi spent shale. Additional impact analyses have been included, as appropriate, in various sections.

3. **Comment:** Installation and use of rock drains should be considered to collect potential spring discharge and leachate. What will happen to the rock drains and impoundments upon site closure? (14-12, 14-55, 14-66, 14-72, 14-78, 14-79)

Response: Rock drainage systems are being considered as alternative methods of collecting leachate and, as applicable, spring seepage. Conceptually:

- The rock underdrain would be designed to pass discharge from any ground water source.
- Finger drains could be installed to pass the peak discharge from any individual spring or seep.
- Drain material would be well graded and comprised of natural material such as waste rock.

Construction of these rock drains with well-graded natural material would ensure long-term use of the drains. Surface impoundments would be decommissioned upon final reclamation. The alteration of impacts prompted by the use of rock drains has been addressed, as appropriate, in other sections.

4. **Comment:** Page 4-81 states that for the Cities Service operation, no information is available for the contents, pile design or reclamation plans for the waste rock disposal pile or the shale fines stockpile. These areas could significantly affect air quality. The information should be included in the FEIS. (8-8)

Response: Reclamation (revegetation) of the waste rock pile and the shale fines pile will occur as described on pages 2-46 and 2-50 of the DEIS. Reclamation of the waste rock area will be completed following deposition. Reclamation of the fines pile will be an ongoing process (reference page 2-46). At this time, detailed design and reclamation plans are inappropriate. However, all designs and reclamation plans will comply with regulatory requirements current at the time of permitting. In addition, stipulations of federal and state air quality permits (e.g., for fugitive dust) will have to be met.

Additional information on the contents and composition of the waste rock and fines disposal piles have been included in the revised and reprinted project description.

Waste Streams

1. **Comment:** The waste streams associated with all aspects of both projects should be better defined. The discussion should address hazardous wastes, byproducts, catalysts, pollution control, and wastewater use and reuse. (2-21, 4-4, 12-40, 14-1, 14-8, 14-10, 14-13, 14-22, 14-33, 14-34)

Response: Sections 2.1 through 2.3 have been revised to incorporate additional information on waste streams. Those areas mentioned above are included in these revised sections.

2. **Comment:** An assessment of the impacts associated with the transport of hazardous materials is recommended to be included in the EIS. (1-42)

Response: The amounts of hazardous wastes generated have been estimated in the revised and reprinted project description. The precise mode of transport of these wastes or other hazardous materials is not firm at this time. All transport of hazardous materials will be regulated under the applicable regulations such as RCRA and Department of Transportation (DOT) regulations. Detailed assessment of the impacts of the above mentioned transport is beyond the scope of this EIS.

3. **Comment:** What are the non-hazardous wastes that would be deposited in the spent shale disposal area? Would not a separate, non-hazardous, disposal site be a good alternative to consider? The DEIS needs to discuss this issue further. We strongly recommend a flow chart in the EIS to depict all waste streams, approximate volume, estimated quality, disposal plans for each and the current and/or potential applicability of the RCRA or TSCA to each stream. Methods of disposal (e.g., co-mixed uniformly, disposed in cells, etc.) should be explained. (14-28, 14-41, 14-63)

Response: The project will probably have one or more on-site disposal areas for wastes which need no special management. It may be advantageous to dispose of some wastes with the spent shale. However, this *"co-disposal"* would constitute only a very small fraction of the spent shale volume.

A flow diagram depicting all waste streams has been included in the revised project description. Precise methods of disposal are beyond the scope of this EIS and will be developed in more detail during project permitting.

5.3.4 Project Impacts

Impact Analyses and Comparisons

1. **Comment:** Revisions and clarifications are needed to Section 2.4, Comparison of Alternatives Including the Proposed Action(s), in the DEIS. In general, the impacts are presented in either too optimistic or too pessimistic a fashion, and criteria are needed and further discussion is warranted concerning the impact ratings by discipline. (2-11, 2-17, 7-4, 7-5, 7-9, 7-12, 7-32, 7-33, 7-107, 7-113, 7-114, 7-116, 12-48, 12-50)

Response: See revised Section 2.4 in the FEIS. The analyses are too optimistic or too pessimistic depending on one's point of view: individual values are different, and what some see as a beneficial impact, others see as adverse, and vice versa. Concerning the impact rating scheme, the Corps feels that any rating criteria that are added would be subjective as well, and may serve to confuse the issue. The rating scheme used is considered to be detailed enough to address these complex projects and alternatives with some precision, yet simple enough for the layman to comprehend.

2. **Comment:** Minor revisions are needed to the project description summaries which introduce the impact comparisons in Section 2.4 (7-97)

Response: Concur. See revised Section 2.4.

3. **Comment:** The cumulative impacts of both Chevron and Getty use of the Big Salt Wash corridor should be identified and analyzed on page 4-14 of the DEIS. (4-66)

Response: At this time, it is expected (given BLM policy and statements on this matter) that large-capacity facilities (e.g., pipelines) would be constructed in various common corridors and used jointly by individual companies. The timing and magnitude of such use cannot be predicted at this time; therefore, the analysis is generally qualitative for purposes of the EIS.

4. **Comment:** The introduction for the *"unavoidable adverse impacts"* section for the Cities Service project should be revised to clarify the uncertain nature of such impacts. (7-185)

Response: This section, we agree, is a prediction of potential unavoidable adverse impacts from the project, and *"could be expected"* is perhaps a better phrase than *"would be expected."* The Corps feels, however, that the objective observer would agree that such impacts are likely to occur if the project were developed. The introduction to Section 4.5.1 (Getty) is also revised accordingly.

Cumulative Impacts

1. **Comment:** Cumulative impacts are not adequately detailed, especially in reference to corridors. (1-5, 1-7, 1-11, 1-13, 2-23)

   Response: Cumulative impact analysis requires the identification of reasonably foreseeable future actions which, when combined, result in a cumulative impact scenario. As such, cumulative impact analyses are speculative in nature. Section 4.4 presents a valid analysis of cumulative impacts to corridors based upon reasonable assumptions. Specific analysis of cumulative impacts to corridors has been considered to some extent in the impact analysis for each discipline, and to a larger extent in specific disciplines (e.g., wildlife, vegetation, transportation).

2. **Comment:** On page 4-168, Table 4.4-7, the production level values for Cities Service and Getty should be corrected. (3-8, 7-182)

   Response: Concur. See revised table.

5.3.5 Topography, Geology, and Paleontology

1. **Comment:** On page 2-80 in the impact comparisons, it is stated that the Cities Service alternative spent shale pile is preferred because of its reduced slope gradient and size. In fact side slopes and volume would be the same but the areal extent of the pile for the alternative is increased. (7-29)

   Response: We generally concur. The alternative action is preferred geologically and topographically due to the location of spent shale on the plateau. This location reduces the risk of pile slope failure which would adversely affect valley bottomland activities.

2. **Comment:** In the DEIS on page 4-15, the exploitation of local mineral resources for Getty project development (sand, gravel, and coal) is considered a beneficial use. How much sand, gravel or coal will be required? (4-67)

   Response: Volumes of construction materials (sand and gravel) required for Getty project development are presently unknown. Use of such resources is considered beneficial in the context of this discipline.

3. **Comment:** In the second paragraph on page 4-81 the discussion on subsidence assumes that a very slight subsidence is a foregone conclusion. Cities Service disagrees with this. In fact, Cities Service intends to use design criteria such that subsidence is a possibility, but not a probability. (7-42)

   Response: Any underground void, whether the result of underground extraction of solids or liquids, will potentially induce subsidence. Considering the proposed action of underground mining of oil shale, the potential for subsidence exists. The probability of its occurrence can be reduced by incorporating existing geologic and hydrologic conditions into the conceptual mine design.

4. **Comment:** Geodetic control survey monuments may be located in the proposed project area. Pertinent Federal agencies should be contacted if there is any planned activity which will disturb or destroy these monuments. (13-2)

   Response: Cities Service and Getty will comply with existing regulations concerning geodetic control survey monuments.

5. **Comment:** Minor corrections are needed to the text concerning the baseline and impact discussions on topography, geology, and paleontology. (3-17, 7-45, 7-110, 7-119, 7-128, 7-144)

   Response: Concur.

6. **Comment:** The document discusses the effects of the projects on the geology and paleontology of the region and notes potential geologic hazards, but does not address possible effects of subsidence and water consumption from the projects on mineral resources other than oil shale. The EIS should describe local and regional resources and discuss the effects of these projects upon the resources. (12-21, 12-22)

Response: Impacts as a result of the development of the proposed Getty and Cities Service oil shale mines and supporting facilities would potentially affect an area of approximately 43,000 acres (67 square miles). Within this area the Tertiary Age Uinta, Green River, and Wasatch Formations are exposed. The principal mineral resource within the project area is oil shale which is found within the Green River Formation. Presently, no mineral claims or leases, other than those held by Getty or Cities Service, exist for the proposed project areas, except for a 160-acre federal parcel on Cities Service property.

7. **Comment:** The discussion of the regional geologic setting should include a geologic map showing the suface geology of the basin and the major structure features. (14-6)

Response: A geologic map of the study area has been included in the reprinted section of the ground water baseline discussion.

8. **Comment:** On page 4-81, the third and fourth paragraphs state that no detailed information is currently available on the waste rock disposal pile or the shale fines stockpile. Cities Service respectfully submits that it is not the intent of this document to present detailed engineering designs for the projects disposal piles, but instead to present appropriate engineering concepts in such a manner that the impacts of the proposed and alternative actions can be properly assessed. (7-43)

Response: General engineering information would be required to precisely assess potential geologic-geotechnical hazards. Engineering concepts themselves are insufficient for this task. However, the Corps recognizes that more detailed engineering specifications will be required for future mining and reclamation permits. These data will be necessary to ensure the long-term stability of storage and/or disposal piles.

9. **Comment:** On page 4-14 the impacts of the Lurgi retorting technology are not discussed. The use of Lurgi retorting technology could change the potential for mass failure of the disposal pile if the Lurgi shale sets up as a solid mass. (14-61)

Response: Based only upon a comparison of available geotechnical data (without regard to other issues, such as air quality which show Union B to be preferred over Lurgi) for Unishale B and Lurgi process spent shale (In-Situ 1984), the Lurgi process alternative is preferred. In general, the Lurgi process spent shale is a finer grade material (having a greater unconfined compressive strength) when compared with the Unishale B spent shale. During testing of the Lurgi process, spent shale cementation of the material was also observed. Considering the increased unconfined compressive strength of the Lurgi spent shale (as a result of its cementatious behavior) the potential for the mass failure of a Lurgi spent shale pile may be less than a comparable Unishale spent shale pile. See the revised and reprinted project description for additional information on the Lurgi spent shale.

10. **Comment:** On page 4-13, it is concluded that *"no significant impacts would be expected"* in view of the spent shale design provided — yet the design details are not firm and even the use of drains to prevent saturation of the spent shale fill are not necessarily included (see page 2-20). (14-50, 14-60)

Response: Currently, the planned disposal piles at the Getty and Cities Service properties incorporate slopes of 3.5:1 for the toe of the pile (horizontal:vertical). Union Oil Company of California (UOC 1982b, Exhibit D) performed computerized theoretical stability analyses of models of their generalized embankment section constructed of Unishale B. The slopes in that model were also 3.5:1. A layered pile design and material properties for Unishale B obtained from laboratory tests were used in the analyses. The resulting factors of safety for the ultimate

1,000-foot high pile slope ranged from 2.2 to 3.0, which were considered well within the limits of standard engineering practice for the type of facilty being planned. Their stability analysis did not assume lower parts of slopes could become saturated. By analogy from laboratory tests on similar granular materials, saturated Union B process shale should show nearly the same strength parameters as were assumed for the unsaturated condition stability analyses (In-Situ 1984). Therefore, it is expected that the overall stability of the pile, should localized or general areas become saturated, would be similar to that expected for an unsaturated pile.

11. Comment: On page 4-81, documentation and calculations should be provided to support the claim of only one foot of subsidence at the surface. Even one foot of subsidence implies substantial fracturing and impact to the strata overlying the mine, including the hydrology. (14-65)

Response: The figure for subsidence given in the EIS was based upon computations made for the CCSOP EIS. The calculations were based upon underground mining of oil shale by the room-and-pillar method with a room height of 38 feet and width of 50 feet. The pillars are 55 feet square with an overburden thickness of 800 feet. Cities Service has proposed to employ the room and pillar technique with mining pillars measuring 60 feet square by 65 feet high having overburden thicknesses up to 900 feet.

Creep tests on oil shale samples from the Piceance Basin, at 50 percent compression strength, showed the secondary creep rates of 150 μ in/in/day. The stress of pillars in the Clear Creek mine should be about 3,000 psi, which is 25 percent of laboratory unconfined compressive strength. The deformation for an underground pillar of 20 feet height, standing for 10 years at a stress level of about 4,000 psi, has been calculated to be about 4.5 inches. The projected yield of the Clear Creek underground mine pillars standing for 10 years is about 12 inches. The deformation decreases with the vertical distance from the mining horizon, and the surface deflection will probably be less than 6 inches (Moore 1983).

Although the geologic setting of Cities Service property is similar to the proposed Clear Creek mine, given differences in mining methods Cities Service agrees to conduct additional site-specific geotechnical analyses of Mahogany Zone and overlying strata to generate mining plans which minimize subsidence and optimize worker health and safety as well as resource recovery (Cities Service 1984f).

5.3.6 Surface Water

1. Comment: On page 4-158 regarding cumulative water quality impacts due to salinity, it is not clear how the figure of 8.6 mg/l was obtained, or whether it is based on operational water consumption by all projects in Table 4.4-1. Preliminary assessment of GCC's total withdrawal alone indicated that substantially higher salinity levels would result. (12-57)

Response: The salinity impact discussed is based on operational water consumption by all projects in Table 4.4-1. The figure of 8.6 mg/l was calculated using the equations presented in the 1982 U.S. Department of Interior report (USDI 1982) titled *"Quality of Water - Colorado River Basin, Progress report No. 11"*.

The salinity of the Colorado River at the Imperial Dam in the year 2010 would increase by 4.8 mg/l for GCC total withdrawal of 73,000 ac-ft/yr, as noted in the FEIS of the Chevron Clear Creek Shale Oil Project (BLM 1983e).

2. Comment: The cumulative water quality and quantity effects from this project and other proposed energy developments have the potential of altering the natural aquatic regime in these areas. More discussion is needed on this topic in the EIS. (12-15)

Response: The cumulative effects of oil shale development projects on aquatic ecology in the Roan Creek and Parachute Creek basins are discussed in Section 4.4.4 of the DEIS. Cumulative impacts due to regional energy development projects are further discussed in the Colorado Department of Health report titled *"Assessment of the Cumulative Environmental Impacts of Energy Development in Northwestern Colorado"* (Ferraro and Nazaryk 1983).

3. **Comment:** More analysis is needed in the EIS concerning the water quality and quantity impacts of construction of the Roan Creek reservoir. (4-23, 4-24)

Response: Impacts of the GCC Roan Creek Reservoir have been addressed in the Chevron Clear Creek Shale Oil Project EIS (BLM 1983a). Additional information will be provided at the time of the 401 water quality certification application. Predicted reservoir water quality of the GCC Roan Creek reservoir is discussed in the revised Section 4.1.2 of the FEIS. Details concerning such impacts for the other small regulation reservoirs which are project features for both Getty and Cities Service are not available at this time because reservoir size, inundated area, and embankment height data are not yet formulated. Their impacts will be assessed by the appropriate regulatory agencies (e.g., Colorado divisions of Water Resources and Mined Land Reclamation) at the time of project construction.

4. **Comment:** More details should be presented in the EIS concerning the models used to determine water quality and quantity impacts. Additional modeling should be performed to determine hydrologic impacts. (4-29)

Response: Detailed discussions of model selection, theoretical aspects, sensitivity analysis and alternative models are beyond the EIS scope and content. This information is presented in the technical document (Terra Therma Inc. 1984) available for public review at the Corps of Engineers office in Grand Junction, Colorado. As to the specific additional modeling suggested stochastic modeling of hydrologic series is not warranted due to the lack of long-term continuous stream flow data for Clear Creek and Roan Creek.

5. **Comment:** Detailed discussion of any proposed or anticipated stream channel alteration, by the developers or resulting from upstream modification of flows or sediment transport, is absent. These topics should be addressed, with emphasis on impacts to existing beneficial uses, and should further include sediment scour, transport, and deposition, and velocity analyses. (4-26, 4-27)

Response: Most stream channelization activities, diversion dams, and sedimentation dams will occur or be located in the headwater of ephemeral (intermittent) streams. Impacts due to sediment scour, transport, deposition, and flow depletion are therefore expected to be minor. Impacts to beneficial water uses (as protected by the water rights system) and fish migration are not anticipated.

6. **Comment:** Concerning water quantity impacts, the discussion in Section 1.0 regarding regulatory approval of reservoirs is no longer correct. CRS 37-87-109 was amended last year to state in part that *"No reservoir of a capacity of more than 1 thousand acre-feet of water and having a dam or embankment in excess of 10 feet in vertical height from the bottom of the channel to the bottom of the spillway, shall be constructed in this State unless the plans and specifications for the same have first been approved by the State Engineer in accordance with regulations established by the State Engineer governing such approval and filed in his office."* Other substantive changes were also made in this statute. We suggest a copy of the amended statute be obtained. Further modifications to the amended statute are presently being considered by the Colorado Legislature. Further, the EIS should state what structures fall within the review requirements of CRS 1973, 37-87-109, quoted above. (4-37)

Response: Concur. See revised Section 1.0. No project structures, except the Roan Creek reservoir, are anticipated to fall within the requirements of CRS 1973, 37-87-109.

7. **Comment:** On page 4-160, in Table 4.4-2, the average annual water use for Cities Service's project is given as 39 cfs. Footnote "b" explains that this number excludes indirect water consumption such as community and power generation. Table 2.3-11 shows that the 39 cfs for Cities Service's project includes community and power water of 11 cfs. This should be clarified in the FEIS. (7-75)

Response: Water uses for Getty and Cities Service presented in Table 4.4-2 include water consumption for community and power generation. The table has been revised.

8. **Comment:** In the surface water paragraph on Page 2-66, Section 2.4.3.1.5, the assessment of impacts is too pessimistic, and is not supported by the factors cited in the following paragraphs on Ground Water. Further, design and operation, with proper handling and drainage control plans, will reduce hydrologic impacts. (3-12)

Response: The impacts discussed are worst-case analyses to some extent, and assume some problems due to inadequate design and operation of drainage control plans. We anticipate that these minor problems will occur. The Corps agrees, however, that those impacts will be reduced if all systems work properly.

9. **Comment:** No evaluation of the hydrologic or water quality related values or functions of impacted wetlands is contained in the document. Attenuation of runoff peaks, runoff detention, groundwater recharge, and pollutant settling, adsorption, and uptake from surface and subsurface waters are some of the possible functions for which mitigation will likely be required. (4-25)

Response: Based on the available information, no wetlands have been identified in the Roan Creek and Clear Creek drainage basins.

10. **Comment:** Plans for mitigation or compensation for unavoidable beneficial water use impairment need to be written. (4-32)

Response: Project mitigation measures for potential surface water impacts are included in the FEIS. Unavoidable beneficial water use impairment is not anticipated. Any compensation would have to be determined through the water court if there is any impairment to beneficial water use.

11. **Comment:** The EIS should note that Colorado State Water Law protects senior or prior appropriated downstream users from adverse impacts. (7-7, 7-47, 7-49)

Response: Colorado State Water Law protects senior downstream users. However, flow reduction and water quality impacts could occur and disturb the existing hydrologic balance of the stream drainage system. It is noted that Cities Service has committed to augment the flow to affected users to the extent necessary or required.

12. **Comment:** The EIS should comment that injury to water rights due to the construction of the various corridors will be mitigated. (4-44)

Response: Mitigation measures will be provided for reducing or eliminating the downstream water quality impacts. Injury to water rights due to construction of the various corridors is not anticipated. Mitigation measures will be determined through the water court if injury to water rights is identified.

13. **Comment:** On page 2-77, the analysis of surface water impacts of the Lurgi retorting alternative is incomplete. Lurgi spent shale may require no more water for moistening, and has a tendency to set up like cement (thereby reducing erosion, increasing stability and possibly reducing leachate). Also, why would downstream water quality impacts be greater for Lurgi technology? (14-44, 14-47, 14-53, 14-57, 14-69)

Response: 1. Due to the small particle size of Lurgi spent shale, there is more surface area per unit weight of spent shale. Therefore, more water would be required to wet the surface of the particles for compaction and dust control.

2. Topsoil and vegetation will eventually cover the spent shale pile. Direct exposure of spent shale to wind would be minimal. The advantage of cementation, therefore, is only limited to the stability of the disposal pile.

3. Processing of shale fines in the Lurgi retort technology generates relatively more sour water as compared to the Union B retorts. This sour water could potentially have greater impacts on downstream water quality if accidental spillage or leaching occurs.

14. **Comment:** Other comparisons of surface water impacts among the proposed actions and alternatives for the Cities Service and Getty projects should be revised and clarified. (3-2, 7-28, 7-97, 7-99, 7-103, 7-111)

Response: We generally concur. See revised Section 2.4 in the FEIS.

15. **Comment:** The discussion of cumulative surface water impacts needs minor revisions and clarification. (7-177)

Response: Concur. See revised text.

16. **Comment:** On page 4-158, it is stated that impacts on surface water do not apply to post-operations if reclamation efforts do not afford permanent stabilization. This is not acceptable as the state of the art exists for revegetation on spent shale piles. (14-77)

Response: In context, the next sentence states that "it is assumed, however, that the detailed reclamation permit would outline best management practices which would reduce or eliminate the impact to the surface water system."

17. **Comment:** The DEIS fails to mention the possibility of using more saline water in their industrial process rather than taking it directly from the Colorado River nor does it adequately address quantification of potential salinity impacts and opportunities to mitigate adverse water quality impacts. (14-30)

Response: Potential uses of saline water for retorting and upgrading processes have been evaluated. It is not suitable for the following reasons:

- Water rates and delivery schedule are uncertain at this time.
- Water quality is not suitable for many of the uses; therefore, a dual system would be required.
- Use of this water is speculative at this time, as neither water rights or plan for augmentation have been approved by the Water Court.

Salinity impacts are discussed in the revised sections 4.2.2 and 4.3.2 of the FEIS for the spent shale disposal activities. Mitigation measures for adverse water quality impacts are also included in the FEIS.

18. **Comment:** On page 2-20, the EIS must include an analysis of the water balance of the proposed spent shale disposal site on at least a monthly basis and estimates on the quality and quantity of leachate generated within the pile and released to the environment. The water balance should also evaluate the dynamics of pile construction as well as final pile configuration. The conceptual plans for any and all underdrain systems should also be provided in sufficient detail to determine the type, size and location of the underdrains being proposed. (14-16)

Response: The FEIS has included a detailed discussion (revised Sections 4.2.2 and 4.3.2) of potential leachate estimation and its effects on downstream water quality. The conceptual plans or underdrain systems are discussed in the revised Section 2.3.1 of the FEIS.

19. **Comment:** The DEIS should include information on mitigative measures and best management practices for controlling the source of water pollution. Such practices should include drainage control systems, leachate systems, and accidental spill plans. (14-2, 14-15)

Response: General mitigation measures for such impacts are discussed in Section 4.8.2.2 of the DEIS. More detailed mitigation measures are included in the FEIS.

20. **Comment:** The baseline discussions concerning surface water resources should be revised and clarified for both projects. (4-34, 4-36, 7-120, 7-129, 7-131)

Response: Concur. See revised text.

21. **Comment:** The surface water impacts discussions for the common project features, Getty, and Cities Service projects should be revised and clarified. (3-18, 7-46, 7-48, 7-136, 7-145, 14-62, 14-68)

Response: Concur. See revised Sections 4.1.2, 4.2.2, and 4.3.2 in the FEIS.

5.3.7 Ground Water

1. **Comment:** Geochemical modeling of reactions within the spent shale pile should be performed in order to predict the impact of leachate on ground water quality. (4-21)

Response: Geochemical modeling of the spent shale pile has been conducted, the results of which are discussed in appropriate sections of this document. The modeling included prediction of potential leachate effects on Roan Creek and the Colorado River. As stated in the respective project descriptions, disposal of process waste water with the spent shale is intended for both projects. The best available control technology will be used to treat such waters prior to disposal, which may include biological oxidation of organics.

2. **Comment:** The predicted approximate *"one foot"* of subsidence for the Getty mine on page 4-13 should be discussed further as it relates to possible inflow of water to mine workings. (14-49, 14-56, 14-59)

Response: This *"one foot of subsidence"* discussion is provided only as an indication of the potential magnitude based on existing data. Prior to development, site-specific geotechnical analysis will be continued to further evaluate the stability of the underground mining operations, and to allow for design of a specific mining plan which minimizes the potential for subsidence.

It should be emphasized that the *"less than one foot"* estimate for subsidence represents the most current information. At present, pilot-type operations at facilities such as Logan Wash and Tract C-a have exhibited no surface expression of subsidence. Similarly, no appreciable increases in ground water inflow have been observed.

3. **Comment:** Cities Service should provide additional supporting information on the projected inflow of water into the mine based on a surface subsidence of 1 foot. (14-70)

Response: Additional data are not available at this time. Ongoing studies performed by Lawrence Livermore Labs at Occidental's Logan Wash facility which is in proximity to Cities Service's property indicate negligible impact to overlying ground water intervals. No data are available however, regarding long-term (in excess of 10 years) conditions. Cities Service has committed to future geotechnical investigations on a site-specific basis, to analyze conditions in the Mahogany and overlying zones. In this manner, mining plans can be generated which minimize the potential for subsidence.

4. **Comment:** There should be a detailed discussion in the EIS of the competency of the various aquitards in the project vicinity. Further, the section on ground water quality impacts should provide more details on the potential magnitude of changes brought about by increased infiltration caused by subsidence cracks, and by the removal of the Mahogany zone. (14-11)

Response: Corehole data for both the Cities Service and Getty properties indicate that the Mahogany zone is relatively unfracturered at these locations. Rock quality designations (RQD) are near or above 90 percent, indicative of competent strata. These data are consistent with regional information in published literature.

Site-specific data are not available to fully evaluate specific impacts that may occur from subsidence cracks. The preponderance of spring discharge however, occurs from zones at or near the Uinta/Upper Parachute Creek geologic contact. Little or no spring/seep flow is apparent from stratigraphic zones near the Mahogany zone. This would suggest that significant water-bearing intervals may be concentrated closer to the ground surface than the Mahogany zone; as such, they would be less likely to be impacted by undergound mining.

5. **Comment:** Monitoring plans for ground and surface water should receive commitments from the companies, in order to quickly assess the impacts of any system failures (e.g., tailings liner or downstream collection system). Corrective measures should be planned. (12-14)

Response: Cities Service has committed to monitoring of potential leachate leakage downstream of the spent shale pile. To reduce the potential for leachate migration, Cities Service will utilize leachate collection systems. Getty has committed to the consideration of water quality monitoring and to the design and installation of a leachate collection system, as required by regulation. It is anticipated that specific monitoring plans will necessarily be an integral component of CMLRB permits. Monitoring plans will be tied to specific facility design.

6. **Comment:** Aquifers must be defined in context of geological formation. (3-14)

Response: The description of ground water occurrence on pages 3-48 through 3-52 already correlates water-bearing intervals with specific geologic formations. Discussion of the upper and lower aquifer occurs only in a regional perspective on pages 3-6 and 3-7; correlation is made on these pages between aquifer units and respective geologic formations.

7. **Comment:** Additional site-specific ground water studies are needed in order to predict impacts in the EIS. (2-20)

Response: Additional site-specific ground water studies will be needed for various permits at a later date. Existing data are adequate for ground water discussions in the document; some additional data have been incorporated in revised Sections 3.1.3, 3.2.3, and 3.3.3 with appurtenant impact analyses in Sections 4.2.3 and 4.3.3.

8. **Comment:** For both companies, the impact of the raw shale stockpile on ground water is described as a transient phenomenon. However, the stockpile will last for the life of the project and hence is not transient. (14-54, 14-58, 14-64, 14-71)

Response: In describing the stockpile as *"transient"*, the document intended to describe the continuous addition and removal of raw shale. The pile is *"transient"* such that no individual pieces of raw shale would remain in the pile for any great period of time; the length of time of exposure to dissolution/leaching processes will therefore be restricted.

9. **Comment:** On pages 4-86 and 4-87, a worst-case scenario is presented and the reader is left with the impression that spent shale liner failure is likely to occur. Cities Service does not agree with this conclusion. It should be noted that Cities Service intends to construct the liner using state-of-the-art design which will make liner failure highly unlikely. (7-51)

Response: The discussion on the noted pages does not indicate that liner *"failure"* is likely to occur. Rather, the document notes that *"leachate seepage below the liner could occur."* Given the current technology for liner construction, and site topographic conditions, even state-of-the-art design cannot presently ensure a fully impenetrable barrier.

10. **Comment:** On page 3-61, it should be clarified that all of the shale fines stockpile will be situated on the Uinta Formation. (7-130)

Response: Approximately three quarters of the pile will be situated on strata of the Uinta Formation, and one quarter on the Upper Parachute Creek member of the Green River formation. Hence the use of the words *"majority of"*.

11. Comment: On page 4-18, it should be noted that there are not 12 springs in the spent shale disposal area. The *"over 200 gpm"* number is misleading because 1983 was not a representative year in that the runoff quantities exceeded the 100-year event. (3-6)

Response: Baseline data provided by Getty indicate the presence of 14 springs or seeps within the shale disposal area. Several of these may be multiple outlets for the same spring. Although the runoff recurrence interval has not been determined for this document, the Corps concurs that spring flow measurements occurred in an abnormally wet year. For this reason, the word *"maximum"* was used to describe the over 200 gpm estimate.

12. Comment: Too much reliance is placed on ground water baseline data from adjacent projects. More site-specific data are needed for impact analysis purposes, in order to assess more fully ground water contamination, effects of subsidence, and water quality impacts of VMIS retort construction and use. (12-13)

Response: No additional site-specific data are available. Reliable information, however, is available for similar under ground facilities in the area. No surficial expression of subsidence nor evidence of appreciable increase in ground water inflow upon roof sloughing has been observed at the Tract C-a or Logan Wash properties. Roof sloughing alone may not exacerbate ground water inflows; subsidence-induced fracturing would be the principal cause, unless sloughing were to extend up to water-bearing intervals in Upper Parachute Creek strata. Existing data suggest this to be unlikely, given the competency of the overlying strata. Regarding water quality, ground water monitoring wells around the periphery of the C-a retort have not detected TDS concentrations appreciably in excess of baseline conditions (RBOSC 1983). This would suggest that attenuation/dilution factors are inhibiting the migration of high TDS waters in the ground water system. Data from Occidental's Logan Wash facility indicate TDS levels in the retort on the order of 2,500 mg/l; the values are comparable to baseline conditions at this site. As noted in the DEIS, proper handling of water entering the retorts will be required to minimize migration of salt-laden water.

13. Comment: The plans for and the impacts of VMIS retort abandonment must be included in more detail in appropriate sections of the EIS. (4-28)

Response: As discussed in response to Comment 12, the extent of potential impacts cannot be precisely determined based on existing data. It is probable that any ground water flowing into the retort will exhibit increased levels of dissolved solids. Data from Tract C-a and Logan Wash indicate that little, if any, migration of high TDS waters has occurred from the abandoned retorts, however.

Water handling plans to minimize ground water impacts from retort abandonment should include:

1. Collection and treatment of inflow water during operation.
2. Continued analysis of water samples in the retort chambers.
3. Continued analysis of ground and surface water samples from monitoring locations down-gradient of the retorts.
4. Cyclical flushing of the retorts to enhance accelerated dissolution of salts from the rubblized shale, and to allow controlled release and treatment of ground water which accumulates in the retorts.
5. Development of contingency plans should migration of high TDS waters be indicated from the monitoring wells. Such plans would include pumpage from the retorts, with concommitant flow gradient reversal, to remove high TDS ground water.

14. **Comment:** On page 2-82, the paragraph on Ground Water assumes the possibility of a liner which is less than effective, while the project descripton states that the spent shale dipsosal site impacts on ground water can be minimized. These statements should be reconciled. (7-30)

Response: The liner system is anticipated to minimize the potential for leachate migration during construction of the spent shale pile. The integrity of the liner after reclamation of the pile cannot be ensured, however. The description of the proposed action has been modified accordingly.

15. **Comment:** The design and impacts of the spent shale pile and associated liner and underdrain (if applicable) systems are not presented in sufficient detail. The EIS identifies no means for monitoring the integrity of the liner system or addressing any failures of that system. (4-20)

Response: Additional details regarding the design of the spent shale pile, liner, and underdrain have been provided in the project description. Further evaluation of potential impacts, therefore, have been provided in revised Sections 4.1.2 and 4.1.3. Also presented in these sections are revised discussions related to potential monitoring requirements.

16. **Comment:** Is further necessary ground water testing on both sites scheduled? What will be included? Also, is further testing planned for either project to determine the effectiveness of the shale liner in preventing leachate infiltration? (4-45)

Response: No further ground water testing is presently scheduled. When further testing is required in support of permit applications, testing plans will be developed in consultation with the appropriate state/federal agencies.

No testing is presently planned for liner characteristics. As stated in Sections 4.2.3 and 4.3.3, hydrologic modeling performed for this document assumes that some transmission of leachate through the liner may occur subsequent to reclamation of the spent shale pile.

As necessary during permitting processes, additional evaluation/testing may be required.

17. **Comment:** The baseline ground water sections in the DEIS should be expanded, revised, and clarified to more appropriately provide information upon which to assess project impacts. (4-43, 7-121, 7-132, 14-7, 14-9, 14-10)

Response: Concur. See revised Sections 3.1.3, 3.2.3, and 3.3.3, including new text, maps, and tables. Further, the following points should be noted:

- No physical survey for wells constructed prior to 1965 has been conducted.
- Data provided in the Cameron Engineer's report (cited in revised Section 3.3.3) are not conclusive as to the precise location of the ground water divide for all pertinent hydrostratigraphic units.

18. **Comment:** The ground water impact discussions concerning the Cities Service project should be revised and clarified. (3-6, 7-50, 7-52, 7-53, 7-130, 7-146)

Response: We generally concur. See revised Section 4.3.3.

19. **Comment:** Minor clarifications are needed to the ground water impact comparisons in Section 2.4 (7-26, 7-100, 7-104, 7-108, 7-112)

Response: Concur. See revised Section 2.4.

5.3.8 Aquatic Ecology

1. **Comment:** Further discussion is needed concerning terrestrial and aquatic wildlife impacts as result of extensive direct and indirect impacts of sand and gravel development on the Colorado River floodplain. (12-55)

   Response: Potential effects to fishes (especially threatened and endangered fishes) and their habitat in the Colorado River as a result of project development have been addressed in the Clear Creek Shale Oil Project (CCSOP) EIS (BLM 1983a). Impacts specifically related to sedimentation (gravel production) are addressed on pages 4-43 to 4-47 of that document.

2. **Comment:** Discussion of the aquatic ecology impacts of the alternative Larkin Ditch intake needs clarification on pages 4-89. (7-55)

   Response: Utilization of the Larkin Ditch alternative would involve the use of an existing intake system on the Colorado River just upstream of De Beque and on the opposite bank from the GCC intake system (the GCC intake is just downstream of De Beque). Cities Service has stated that the same amount of water will be withdrawn from the Colorado River, whether at the GCC intake only, or a combination GCC/Larkin. It should also be noted that improvements to Larkin intake have already been undertaken by Cities Service, and that the Corps of Engineers prepared an EA and issued a Finding of No Significant Impact (FONSI) on this matter on April 30, 1982 (COE 1982).

3. **Comment:** On page 3-8 of the DEIS, it should be noted that some researchers have found an overpopulation of brown trout in the West Fork of Parachute Creek. (4-33)

   Response: The text here indicates that trout do occur in Parachute and West Fork of Parachute Creeks. The low to moderate fishery potential of these streams was designated by EPA (1979). Section 3.1.4 at the DEIS is intended to provide only a regional setting discussion. For more detailed, site-specific discussions of fish populations in West Fork Parachute Creek, see the Getty analysis on page 3-52 of the DEIS.

4. **Comment:** On page 3-52, it should be noted that the existence of an abundance of brown trout in West Fork Parachute Creek would indicate that the fishery habitat is not poor. The breaching of the dam does not rule out the possibility of re-establishing a fish population. (4-35)

   Response: The fishery potential of upper West Fork Parachute Creek, under natural conditions, is *"low to moderate."* Fish occur primarily as a result of construction of an impoundment and a stocking program, as indicated on page 3-52. See page 4-21 for a note on the beneficial impact resulting from use of an alternative reservoir in West Fork Parachute Creek, which indicates the possibility of re-introducing a cold water fishery. However, Getty has indicated that the reservoir would not be suitable for a recreational fishery because of access problems and because it is dedicated to project operations, which could cause extreme fluctuations in its water level.

5. **Comment:** Getty should commit to (1) maintenance of a fishery in the West Fork Parchute Creek Reservoir, and (2) provision of public access, should such a reservoir be developed. Further it should be noted that, although the reservoir might contain an inadvertent oil spill, such a spill would *"play havoc"* with any fishery. (12-55)

   Response: See response to Comment 4. Dewatering and/or spills would affect aquatic biota, as stated page 4-21. There may also be minor impacts to riparian habitats. However, since an impoundment has previously existed in West Fork Parachute Creek, impacts related to dewatering have already occurred. Further, since this stream offers only a low/moderate fishery potential and little riparian vegetation, further dewatering effects related to re-establishment of a reservoir are likely to be very minor.

   Impacts related to pipeline breakage cannot be quantified at this time. However, as stated, it is hopeful that the impoundment would serve as a containment facility should such an unlikely event occur.

6. **Comment:** Impacts of spent shale run off and leachate on aquatic biota in project reservoirs should be addressed in terms of habitat and benthic invertebrate losses, specifically pertaining to West Fork Parachute Creek. The *"unavoidable adverse impacts"* pertaining to this matter on pages 4-175 and 4-176 should be clarified. (14-74)

Response: See responses to comments 4 and 5. Also, the words *"flow interruption or cessation in existing streams"* should be added to the text under Surface Water and Aquatic Ecology on pages 4-175 and 4-176.

7. **Comment:** On page 3-8, it should be noted that Colorado River cutthroat trout have been found in Carr Creek. They are a state threatened species. (12-52)

Response: Recent contacts with the Colorado Division of Wildlife (Bennett 1984) confirm that the Colorado River cutthroat is a state-listed threatened species. The text has been revised accordingly.

8. **Comment:** On page 3-8, concerning fishery designation, we suggest also including the State of Colorado's stream classification, which is specific to sections of the drainages in question. (2-13)

Response: Concur. An insert should be added to page 3-8, paragraph 4 as follows:

"The Roan Creek drainage . . . fishery potential (EPA 1979). The Upper Roan drainage, including the mainstem of Roan Creek and all tributaries from its source to a point immediately above the confluence with Clear Creek, is designated as Class 1 cold water biota and as Class 2 recreational waters (CDOH 1983)."

9. **Comment:** The likelihood of dam failure (page 4-89) should be further discussed. Also, the impact consequences of this event should be substantiated with facts and references. (7-54)

Response: See page 4-26 of the CCSOP EIS (BLM 1983a), which states the probability for any reservoir dam breaching as 0.01 percent per year. A worst-case scenario is described here in accordance with CEQ regulations (40 CFR 1502.22), and prediction of consequences is based on professional expertise and judgment.

10. **Comment:** Minor revisions and clarifications are needed to the cumulative impacts discussion concerning aquatic ecology. (7-178)

Response: Concur. The text has been revised to show the reference as *"Holden 1983a"*, and to change the Higgins and Taylor citation to *"Roberts 1983."* The sentence preceding the new Roberts citation should read *"18 pounds per acre per year."*

11. **Comment:** Minor text revisions are needed for aquatic ecology baseline and impact discussions. (7-147)

Response: Concur. The text has been revised.

5.3.9 Soils

1. **Comment:** The impacts of the Larkin Ditch settling pond on prime farmland should be clarified on pages 4-91 and 4-96. (7-57)

Response: The Larkin Ditch sedimentation pond will cause a prime farmland loss of about 10 acres. See revised Table 4.3-1, below. Also, from recent conversations with Cities Service (1984e), should Cities Service decide not to use the GCC system and choose to use the Larkin Ditch alternative, the GCC sedimentation pond and intake structure either would not be installed or would be reduced in size. The Larkin Ditch water supply system would consist of the Larkin Ditch intake structure, ditch, sedimentation pond, and a water pipeline to a reservoir, at the GCC reservoir site. The prime farmland loss for the Larkin Ditch water supply system is 473 acres. This is 36 acres less than the GCC water supply system (see revised Table 4.3-1).

Table 4.3-1 APPROXIMATE PRIME FARMLAND AND SOIL LOSS COMPARISONS OF THE CITIES SERVICE PROPOSED ACTION AND ALTERNATIVES[a]

	Water Erosion Rates (weighted average)		Wind Erosion Rates (weighted average)				
	Undisturbed (tons/ac/yr)	Disturbed (tons/ac/yr)	Undisturbed (tons/ac/yr)	Disturbed (tons/ac/yr)	Temp. or Perm. Prime Farmland Loss (acres)	Incremental Soil Loss (tons)	Percent Increase Over Undisturbed Soil Loss
Proposed Action							
Retorts, Upgrade and Mine Area	2.2	5.0	0.1	2.2	0	7,280	50
Conn & Cascade Canyon Spent Shale Disposal	3.4	4.0	0.1	11.7	0	64,220	83
Shale Fines Stockpile	1.8	7.5	0.1	2.5	0	23,050	10
Waste Rock Pile	1.3	5.7	0.1	2.5	0	4,230	113
GCC Water Supply System	1.6	2.4	0.1	10.0	509	89,880	105
Power, Water Corridor from the Spent Shale Disposal Area to the Retorting Area	1.9	7.0	0.1	2.5	0	1,320	63
Road, Power, Water Corridor from De Beque to Spent Shale Disposal Area[b]	3.7	5.2	0.1	10.0	815	57,000	50
Mesa-top (Syncrude, Power) Corridor	1.4	5.4	0.1	2.5	0	8,370	71
Natural Gas Pipeline	1.8	6.7	0.1	2.5	0	1,980	64
Mine Bench	3.9	4.6	0.1	9.0	0	12,400	40
La Sal Pipeline	2.1[c]	22.6[c]	0.1[c]	0.5[c]	0[c]	11,470[c]	95
Common Power & Syncrude Corridor	1.8	6.5	0.1	2.6	0	1,600	38
TOTAL					1,324	282,800	74
Alternatives							
Mesa/Cascade Spent Shale	4.1	3.1	0.1	10.4	0	50,570	28
Rangely Pipeline	2.6[c]	14.9[c]	0.1[c]	0.5[c]	0[c]	10,740	47
North Corridor	1.7	6.4	0.1	1.8	0	21,400	95
Larkin Ditch - Water Supply System[d]	.14	1.3	0.1	12.0	473	670	549

[a] Erosion rate and soil loss calculations were made using the Universal Soil Loss and Wind Erosion Equations (SCS 1982b; Craig and Turelle 1976). Although these equations were developed for use in mid-western cropland areas, modifications by the SCS facilitate calculations with a reasonable amount of accuracy in semi-arid and mountainous areas, at least equal to the accuracy of the soil survey data used in these calculations.

[b] This is a refined analysis from that presented in the CCSOP EIS (BLM 1983a). Further, the analysis here represents a worst-case since the route now traverses valley slopes rather than valley bottoms.

[c] Impacts values obtained from the CCSOP EIS (BLM 1983a).

[d] This water supply system includes the Larkin intake structure, Larkin Ditch, a sedimentation pond, a water pipeline from the sedimentation pond to the GCC reservoir, and the GCC Reservoir, which may be smaller than assumed for this analysis.

2. **Comment:** The soils impacts in Table 4.3-1 on page 4-91 which are directly attributable to Cities Service, irrespective of the other projects, should be clarified. (7-56)

Response: Much of the GCC water supply system, road, power, and water corridor in the Roan Creek valley, the La Sal pipeline, and the common power and syncrude corridor on the mesa top are joint features of the Getty/Cities projects. However, if only the Cities Service project was initiated, most if not all of the soil impacts shown in revised Table 4.3-1 would still occur in these joint feature areas, with the exception that the reservoir may be smaller. Therefore, most if not all of the impacts shown in Table 4.3-1 are attributable to the actions of Cities Service irrespective of other companies' projects.

3. **Comment:** On page 4-5 of the DEIS, the amount of prime farmland lost due to paved roads and reservoirs should be clarified. (7-37)

Response: The common project soil impacts, such as loss of prime farmland and accelerated erosion, are qualitatively and generally discussed in Section 4.1.5. Sections 4.2.5 and 4.3.5 discuss more specifically and quantitatively the impacts by project components. Since the total surface disturbance for Cities and Getty projects may approach 4,300 and 6,300 acres, respectively, and approximately 65,000 acres of prime farmland presently exist around or near the project area, the loss of 1,324 acres of prime farmland can be put into perspective. The impacts to prime farmland were not addressed in the CCSOP EIS because up-to-date prime farmland information became available in 1983, after the CCSOP FEIS was prepared; therefore, they are a subject of this EIS.

4. **Comment:** Minor changes are needed to the Cities Service soils impact analysis table. (7-148)

Response: Concur. See revised Table 4.3-1. Also, the Getty table concerning these impacts (Table 4.2-1) is revised identically as appropriate.

5. **Comment:** Minor revisions are needed to the common project baseline discussion concerning soils. (7-122)

Response: Concur.

6. **Comment:** Analyses of erosion factors should also include consideration of alternative models as well as site-specific calibration of the selected model. The resulting impacts on basin morphology, flow, sediment transport, or water chemistry should be addressed. (4-22)

Response: Analyses of erosion factors in the DEIS is based on Universal Soil Loss and Wind Erosion guidelines published by the Soil Conservation Service and Agricultural Research Service. To date, other guidelines used to calculate water and wind erosion have not been tested and proven reliable, therefore are not used in the erosion calculations of the DEIS.

5.3.10 Vegetation

1. **Comment:** On page 3-11 regarding vegetation, equal treatment of endangered plant species with wildlife should be considered, including maps of the ranges of the plant species. (2-14)

Response: The Colorado Natural Heritage Inventory (CNHI) prefers that such locality information not appear in widely distributed public documents such as this EIS. Locality information can be found in the *"Biological Assessment for the Getty Oil Company and Cities Service Oil and Gas Corporation Resource Properties and Access Corridors"*. This document is available from pertinent state and federal agencies, and is referenced in the EIS (Beck 1983a).

2. **Comment:** Mitigation of impacts to candidate and listed plant species and their habitats should be addressed more fully. (4-68, 12-12)

Response: Habitat for candidate plant species will be avoided to the extent possible. A mitigation program has been developed by the GCC Participants for Uinta Basin Hookless Cactus (*Sclerocactus glaucus*), a threatened species. The mitigation program, as approved by the USFWS, is detailed in the biological opinions for the GCC water system (USFWS 1984a,b). Copies of these documents are available from pertinent agencies. Committed mitigation for vegetation impacts is described in Sections 2.3.1 and 2.3.2 of the FEIS.

3. **Comment:** The DEIS does not contain sufficient information to evaluate project impacts on plant species of special concern as designated by the Colorado Natural Areas Program (CNAP). (4-48, 4-51)

Response: Summaries of impacts to special concern plant species are contained in Sections 4.2.6 and 4.3.6 of the DEIS. Impacts, by project feature, are summarized in Tables 4.2-3 and 4.3-3. More detailed information on project impacts to plant species of special concern is contained in the Biological Assessment for the Getty and Cities Service Projects (Beck 1983a) and in the Biological Assessment (Woodward-Clyde 1983) and Biological Opinion (USFWS 1984b) for the GCC water system.

Cumulative impacts to these species are described in Section 4.4.6 of the DEIS, including a summary of the Roan Creek Reservoir (*"GCC"* in Table 4.4-3) impacts.

4. **Comment:** We do not agree that all candidate plant species (see page 3-11, last paragraph) are appropriate for listing. As more data becomes available, downlisting is often appropriate and has already occurred for several candidate species. (3-3)

Response: Concur. In fact, the status of several candidate species have been downlisted since the time the Draft EIS was prepared. It should be noted that the referenced statement is a paraphrased quote from the USFWS (1980) list of candidate threatened or endangered species.

5. **Comment:** The various terms pertaining to threatened, endangered, and candidate species, and their habitats should be further defined in the Glossary. (7-13)

Response: The following clarification is provided and the Glossary revised as follows:

Threatened Species: Defined on p. 7-5 of the DEIS. Threatened species are protected under the Endangered Species Act of 1973.

Endangered Species: Defined on p. 7-3 of the DEIS. Endangered species are afforded protection under the Endangered Species Act of 1973.

Candidate Species: Those plant species listed by the USFWS for consideration as threatened or endangered. Candidate species are divided into three categories (Category 1, 2, or 3) which are defined on p. 7-1 of the DEIS. Candidate species are not formally protected under the Endangered Species Act; however, the USFWS has stated that its policies are: (1) avoidance of impacts to these species, and that (2) under NEPA guidelines, consideration be given to these species in environmental planning (USFWS 1980).

CNHI Plant Species of Special Concern: Plant species recognized by the Colorado Natural Heritage Inventory as sensitive. This category includes plants not listed by the USFWS as well as those in all of the above categories. Species not included in the USFWS lists are not legally protected; however, they are to be considered in environmental planning under State of Colorado guidelines.

In this document, *"rare plants"* and *"special concern plant species"* are synonomous and refer to all of the above categories.

Critical Habitat: Defined on p. 7-2 of the DEIS.

Essential Habitat: Defined on p. 3-16, paragraph 3, of the DEIS.

Sensitive Habitat: Defined on p. 7-4 of the DEIS.

6. **Comment:** Due to recent changes in the status of rare plant species, a number of revisions are needed to the text and tables concerning this topic for the Getty, Cities Service, and cumulative project impact discussions. (4-68, 4-69, 7-35, 12-53)

Response: Concur. See the revised text. Revised tables 3.1-5, 4.2-3, 4.3-3, and 4.4-3 are printed below. It should be noted that all species have been downlisted except for one. The revised plant listing was published on November 28, 1983 (USFWS 1983b).

7. **Comment:** On page 4-96, the second paragraph states that adverse impacts to plant species of special interest associated with the project alternatives would be less significant than those for the proposed action. This statement should be clarified. (7-59)

Response: Concur. The only project alternative that is expected to have a less significant adverse impact to special concern plant species is the spent shale disposal location. The text has been revised.

Table 3.1-5 PLANT SPECIES WITH FEDERAL OR STATE STATUS

Scientific Name	Status	Common Name
Endemic Desert Plants		
Sclerocactus glaucus	Threatened	Uinta Basin Hookless Cactus
Phacelia submutica	Candidate Category 2	DeBeque Phacelia
Endemic Plants of Moist Cliffs		
Aquilegia barnebyi	Candidate Category 3c	Barneby Columbine
Sullivantia hapemanii var. *purpusii*	CNHI list	Sullivantia
Endemic Plants of Talus Slopes		
Astragalus lutosus	Candidate Category 2	Dragon Milkvetch
Festuca dasyclada	Candidate Category 2	Fescue
Mentzelia argillosa	Candidate Category 3c (Proposed 2)	Sevier Blazing Star
Thalictrum heliophilum	Category 2	Sunloving Meadow Rue

Source: CDNR (1982); USFWS (1980).

Table 4.2-3 RELATIONSHIPS OF THE GETTY PROPOSED ACTION COMPONENTS WITH RARE PLANT SPECIES

			Facility Site[b,c]								
Plant Species	Common Name	Status[a]	M	PF	WG	TCR	RCR	TCA	BG	GM	GC
Aquilegia barnebyi	Barneby columbine	Category 3c			X				O		
Astragalus lutosus	Dragon milkvetch	Category 2				O		X	O		
Festuca dasyclada	Sedge fescue	Category 2				O		O	O		
Mentzelia argillosa	Sevier blazing-star	Category 3c (Proposed 2)				O		X	O		
Phacelia submutica	DeBeque phacelia	Category 2									
Sclerocactus glaucus	Uinta Basin hookless cactus	Threatened									
Sullivantia hapemanii v. *purpusii*	Sullivantia	CNHI[d] Species of Concern			X				O		
Thalictrum heliophilum	Sunloving meadow-rue	Category 2				O		X	O		

[a] Status based on USFWS (1980) and CDNR (1982). See Section 3.1.6 of DEIS for explanation of status categories.
[b] Facility Sites:
M = Underground Mine and Related Facilities
PF = Process Facilities
WG = Wiesse Gulch Spent Shale Disposal
TCR = Tom Creek Reservoir
RCR = Roan Creek/Clear Creek Reservoir
TCA = Tom Creek Canyon Access Road
BG = Buck Gulch Corridor
GM = Getty Property Multiple-Use Corridor
GC = Getty/Cities Service Common Power and Syncrude Corridor
[c] Occurrence: X = Verified Population Affected
O = Possibly Present, Based Upon Habitat Suitability
[d] CNHI = Colorado Natural Heritage Inventory.

8. Comment: On page 4-5, the third paragraph under Vegetation states *"Although the projects should operate within air pollution guidelines, fumigation by stack gases and coating by fugitive dust could adversely affect plant productivity and viability on-site."* This statement is not correct. It should state that the projects will operate within air pollution guidelines. The remainder of the sentence is speculative and should be deleted. (7-38)

Response: Concur. The projects will operate within air pollution guidelines under applicable permits.

9. Comment: The mitigation measures outlined for wildlife should address revegetation and plant materials needed to re-establish big game habitat. (5-2)

Response: The alternative mitigation measures as specified in the DEIS include revegetating disturbance areas with plant materials which are favorable to wildlife, including shrub and forest cover species (see Sections 2.3.1, 2.3.2, 4.8.2.7, and 4.8.3.7). These will be the subject of future mining and reclamation permit applications.

10. Comment: Clarification is needed regarding vegetation impacts of the 50,000-bpd and 100,000-bpd alternatives. See pages 4-93 and 4-95 of the DEIS. (7-58)

Response: Concur. See Revised Tables 4.3-2 and 4.3-4 below.

Table 4.3-3 RELATIONSHIPS OF THE CITIES SERVICE PROPOSED ACTION COMPONENTS WITH RARE SPECIES

			Facility Site[b,c]									
Plant Species	Common Name	Status[a]	MF	PF	WP	RS	CS	CM	RM	NG	PW	PS
Aquilegia barnebyi	Barneby columbine	Category 3c	X		X	X	X	X			X	
Astragalus lutosus	Dragon milkvetch	Category 2	O				X	X				
Festuca dasyclada	Sedge fescue	Category 2	X				O					
Mentzelia argillosa	Sevier blazing star	Category 3c (Proposed 2)	O				X	X				
Phacelia submutica	DeBeque phacelia	Category 2							X			
Sclerocactus glaucus	Uinta Basin hookless cactus	Threatened							X			
Sullivantia hapemanii v. *purpusii*	Sullivantia	CNHI[d] Species of Concern	X		X	X	X	X				
Thalictrum heliophilum	Sunloving meadow-rue	Category 2	O				X	X			X	

[a] Status based on USFWS (1980) and CDNR (1982). See Section 3.1.6 for explanation of status categories.
[b] Facility Sites:
MF = Mine Facilities
PF = Process Facilities
WP = Waste Rock Disposal Pile
RS = Raw Shale Fines Stockpile
CS = Conn/Cascade Canyon Spent Shale Disposal
CM = Conn Creek Multiple-Use Corridor
RM = Ronn Creek Multiple-Use Corridor
NG = Cities Natural Gas Corridor
PW = Cities Property Power and Water Corridor
PS = Cities to Getty Power and Syncrude Corridor
[c] Occurrence: X = Verified Population Affected
O = Possibly Present, Based Upon Habitat Suitability
[d] CNHI = Colorado Natural Heritage Inventory.

11. Comment: The impact analysis appears too negative concerning successful revegetation of Union B retorted shale. (3-5, 7-10, 10-1)

Response: The Corps agrees with statements in the Union Oil Phase II Mined Land Reclamation Application (Union 1982b) to the effect that successful vegetation re-establishment is achievable with Union B retorted shale. However, we also concur with statements in that document supporting studies, and other research identifying an unresolved concern with long-term revegetation success, particularly in situations where spent shale becomes the soil parent material following topsoil erosion.

12. Comment: On page 4-22, last paragraph, does the 3,835 acres of native vegetation affected include the GCC reservoir and Roan Valley corridor? (3-19)

Response: No. This acreage amount includes only those project components listed in Table 4.2-2 (Page 4-24) of the DEIS.

Table 4.4-3 APPROXIMATE NUMBERS OF CUMULATIVELY AFFECTED RARE PLANT POPULATIONS (LOCALITIES)[a]

Plant Species	Common Name	Status	Getty[c]	Cities Service[c]	Chevron	GCC[d]	Union	Colony[e]	Mobil[f]	Pacific	Total	Total Known in Colorado[a]	Percent[g]
Aquilegia barnebyi	Barneby Columbine	Category 3c	5	6	3	0	2	1		2	19	90	21
Astragalus lutosus	Dragon Milkvetch	Category 2	5	3	1	0	5	1		11	26	211	12
Festuca dasyclada	Sedge Fescue	Category 2	0	1	1	0	5	0		0	7	67	10
Mentzelia argillosa[b]	Sevier Blazing Star	Category 3c (Proposed 2)	3	2	0	0	1	0		2	8	8	100
Phacelia submutica	De Beque Phacelia	Category 2	0	0	0	7	0	0		0	7	11	64
Sclerocactus glaucus	Uinta Basin Hookless Cactus	Threatened	0	0	3	4	0	0		0	7	21	33
Sullivantia hapemanii v. *purpusii*	Sullivantia	Colorado Natural Heritage Inventory (CNHI) Species of Concern	3	3	3	0	0	1		3	13	35	37
Thalictrum heliophilum[b]	Sunloving Meadow-Rue	Category 2	5	2	0	0	0	0	1	0	—	18	44
Total			21	17	11	11	13	3	1	18	98	461	

[a] Based on information in available project documents, CNHI data, and published literature.
[b] Species recently discovered in Colorado, most projects not adequately searched. Available information suggests species are abundant in suitable habitat (barren talus slopes).
[c] Locality information for *Astragalus lutosus, Mentzelia argillosa,* and *Thalictrum heliophilum* incomplete. Numbers presented are based on personal observations by CDM personnel and from assumption that one canyon (such as Cascade Canyon, Buck Gulch) constitutes only one locality. This assumption is inconsistent with data provided for other projects.
[d] Common water supply system to be used by Getty, Chevron, and Cities Service (impacts analyzed in BLM 1983a and Woodward-Clyde 1983).
[e] Data from Colony (1975). Many of the plant species were unknown or did not have special status in 1974, and thus were not included in searches.
[f] Data unavailable. Record for *Thalictrum heliophilum* from Wilken & DeMott (1983).
[g] Percent of total known occurrences in Colorado.

Table 4.3-2 DIRECT IMPACTS OF THE CITIES SERVICE PROPOSED ACTION ON VEGETATION AND PRODUCTIVITY[a]

Project Components	Acreages of Affected Vegetation Types[b]													Wetlands			Total Potentially Affected Acreage	Affected Annual Production[c]	
	AG	AW	BL	BLH	DF	DS	GL	GR	OS	PJ	PS	US	VSB	P	R	RW		TOP	AUM
Mines and Process Facilities		10.5									153.0		31.5				195.0	63.3	31.2
Waste Rock Disposal Pile		4.5									43.5	3.0	33.0				84.0	24.3	11.6
Raw Shale Fines Stockpile		76.5							9.0		262.5		40.5		72.0		460.5	142.7	74.6
Conn/Cascade Canyon Spent Shale Disposal			6.0		12.0				4.5	3.0	103.5	519.0	127.5		93.0		868.5	240.3	117.3
Conn Creek Multiple-Use Corridor	10.5		3.0	4.5	7.5	28.5	6.0			75.0	90.0	123.0	91.5		9.0	4.5	453.0	240.7	211.9
Cities Natural Gas Corridor									15.0		34.5		10.5		1.5		61.5	18.7	9.1
Cities Property Multiple-Use Corridor		63.0	42.0						25.5		102.0	54.0	78.0		9.0		373.5	112.1	57.9
Cities Property Power and Water Corridor									16.5		40.5		7.5		6.0		70.5	20.7	10.2
Cities to Getty Power and Syncrude Corridor		27.0									171.0	1.5	127.5				327.0	96.7	46.7
Getty/Cities Service Common Power & Syncrude Corridor		24.0						6.0			75.0	90.0	27.0		4.5		226.5	80.8	40.9
TOTAL	10.5	205.5	51.0	4.5	19.5	28.5	6.0	6.0	70.5	78.0	1,075.5	790.5	574.5	0.0	195.0	4.5	3,120.0	1,040.3	611.4
PERCENT OF TOTAL	0.3	6.6	1.6	0.1	0.6	0.9	0.2	0.2	2.3	2.5	34.5	25.3	18.4	0.0	6.3	0.1			

[a] Acreage values determined by USFWS.

[b] AG = Agricultural
AW = Aspen Woodland
BL = Barren Land
BLH = Barren Land/Herbaceous
DF = Douglas-fir Woodland
DS = Dry-slope Shrubland
GL = Grassland
GR = Greasewood Shrubland
OS = Oakbrush Shrubland
P = Palustrine Wetland
PJ = Pinyon-Juniper Woodland
PS = Plateau Sagebrush Shrubland
R = Riverine
RW = Riparian Woodland
US = Upland Shrubland
VSB = Valley Sagebrush Shrubland

[c] TOP = Thousands of Pounds
AUM = Animal Unit Months

Table 4.3-4 IMPACTS OF CITIES SERVICE FACILITY SITING ALTERNATIVES UPON VEGETATION ACREAGE, PRODUCTIVITY, REVEGETATION POTENTIAL, AND PLANT SPECIES OF SPECIAL INTEREST

Project Component	Potentially[a] Affected Acreage	Affected Annual Production		Duration of[b] Impacts	Revegetation Potential	Potentially Affected Plant Species of Special Concern
		TOP	AUM			
50,000 bpd Production Rate Alternative[c]	3,120.0	1,040.3	611.4	R	Moderate to High	*Aquilegia barnebyi* *Astragalus lutosus* *Festuca dasyclada* *Mentzelia argillosa* *Sclerocactus glaucus* *Phacelia submutica* *Sullivantia hapemanii* var. *purpusii* *Thalictrum heliophilum*
Spent Shale Disposal in Cascade Canyon & Mesa	1,674.0	531.2	282.5	R	Low to High	*Aquilegia barnebyi* *Astragalus lutosus* *Festuca dasyclada* *Mentzelia argillosa* *Sullivantia hapemanii* var. *purpusii* *Thalictrum heliophilum*
Cities North Power and Syncrude Corridor	920.5	257.5	125.2	S,R	Moderate to High	None
Larkin Ditch Water Supply Alternative	9.0	58.3	69.5	R	Low to Moderate	None

[a] Acreage values determined by USFWS.
[b] R = Residual; S = Short-term
[c] Assume total long-term disturbance equivalent to the proposed action at 100,000 bpd.

13. Comment: Project impacts on Plant Associations of Special Concern as identified by the Colorado Natural Heritage Inventory, should be addressed. (4-50)

Response: Lists have been compiled for both companies showing Plant Associations of Special Concern (PASC) potentially occurring on their properties and we have, as a worst-case analysis, calculated the maximum potentially affected acreages of PASC. It should be noted that the Colorado Natural Areas Program (CNAP) is concerned with the protection of quality examples of PASC. Due to historical and present grazing and other disturbances, such examples are probably very limited in areal extent on both the Getty and Cities Service resource properties.

Tables 4.2-4a and 4.3-4a summarize the PASC potentially contained, as small inclusions, in the broader vegetation types defined in the DEIS. A detailed listing of affected acreages of vegetation by project component can be found in Tables 4.2-2 and 4.3-2 of the DEIS.

Table 4.2-4a IMPACTS OF THE GETTY PROJECT ON PLANT ASSOCIATIONS OF SPECIAL CONCERN

Vegetation Type	Total Potentially Affected Acreage[a]	Plant Associations of Special Concern Potentially Ocurring in Vegetation Type[b]	Rank[c]
Grassland	30.0	• AGIN1-ORHY Great Basin Grassland • AGIN1 Great Basin Grassland • ARTRW-ATCO/ELSA	G1S1 G2S1 G2S2
Dry Slope	7.5	• AGIN1-ORHY Great Basin Grassland • ATCO/AGINI-ORHY • AGIN1 Great Basin Grassland • ATCO/ORHY	G1S1 G1S1 G2S1 G3S1
Oak Brush	34.5	• QUGA-AMUT-(PRVIM-ROWO-SYOR1)/ CAGE 1 • QUGA-AMUT-(ARTRW-CEMO-SYOR1)/ CAGE 1	G3S3 G3S3
Upland Shrubland	633	• AMUT-ARTRW-CEMO-PUTR-SYOR1/CAGE 1 • AMUT-ARTRW-CEMO-PUTR-SYOR1/ ORHY-STCO	G3S2 G4SH

[a] Total potential acreages from DEIS Table 4.2-2

[b] Based on Colorado Natural Heritage Inventory (CNHI) classification

AGIN1 = *Agropyron spicatum* var. *inerme*
AMUT = *Amelanchier utahensis*
ARTRW = *Artemisia tridentata* ssp. *wyomingensis*
ATCO = *Atriplex confertifolia*
CAGE 1 = *Carex geyeri*
CEMO = *Cercocarpus montanus*
ELSA = *Elymus salina*
ORHY = *Oryzopsis hymenoides*
PRVIM = *Prunus virginiana* var. *melanocarpa*
PUTR = *Purshia tridentata*
QUGA = *Quercus gambellia*
ROWO = *Rosa woodsii*
STCO = *Stipa comata*
SYOR1 = *Symphoricarpos oreophilus*

[c] See response for comment 13 for definition of rank.

Table 4.3-4a IMPACTS OF THE CITIES SERVICE PROJECT ON PLANT ASSOCIATIONS OF SPECIAL CONCERN

Plant Association[a]	Rank[b]	Possible Habitat (acres)	Potentially Affected (Acres)		
			Disposal	Corridors	Total
AGIN1-ORHY Great Basin Grassland	G1S1	890	76	54	130
AGIN1 Great Basin Grassland	G2S1	890	76	54	130
ARTRT/ELCI	G3S2	796	196	35	231
AMUT-ARTRW-CEMO-PUTR-SYOR1/CAGE1	G3S3	796	196	35	231
QUGA-AMUT-(ARTRW-CEMO-SYOR1)/CAGE1	G3S3	1,213	332	30	362
QUGA-AMUT (PRVIM-ROWO-SYOR1)/CAGE1	G3S3	1,213	332	30	362
PSME/AMUT-QUGA-SYOR1/CAGE1-POFE	G3S3	284	7	10	17
PSME/SYOR1/CAGE1-POFE	G3S3	284	7	10	17

[a] Based on Colorado Natural Heritage Inventory (CNHI) classification
AGIN1 = *Agropyron spicatum* var. *inerme*
AMUT = *Amelanchier utahensis*
ARTRT = *Artemisia tridentata* ssp. *tridentata*
ARTRW = *Artemisia tridentata* ssp. *Wyomingensis*
CAGE1 = *Carex geyeri*
CEMO = *Cercocarpus montanus*
ELCI = *Elymus cinercus*
ORHY = *Oryzopsis hymenoides*
POFE = *Poa fendleriana*
PRVIM = *Prunus virginiana* var. *melanocarpa*
PSME = *Pseudotsuga menziesii*
PUTR = *Purshia tridentata*
QUGA = *Quercus gambelii*
ROWO = *Rosa woodsii*
SYOR1 = *Symphoricarpos oreophilus*
[b] See response to comment 13 for definition of rank.

The ranking categories for the PASC listed below are defined as follows:

Global Rank

G1 Critically imperiled globally; extreme rarity; few occurrences and vulnerable; Critical National Concern.

G2 Imperiled globally; 6-20 occurrences; endangered throughout range; National Concern.

G3	Very rare and local throughout range, or with very restricted range; threatened throughout range; 21-100 occurrences.
G4	Apparently secure globally though it may be quite rare in parts of its range, especially at the periphery.

State Rank	
S1	Critically imperiled in Colorado because of extreme rarity; 1-5 known occurrences; Critical State Concern.
S2	Imperiled in Colorado because of rarity; 6-20 known occurrences or few acres; vulnerable to extirpation from Colorado. State Concern.
S3	Rare in Colorado; 20-40 known occurrences; restricted distribution.
SH	Of historical occurrence in Colorado; may be rediscovered.

These ranking categories have no legislative status in Colorado, though they are recognized and utilized by the Colorado Natural Areas Program, Department of Natural Resources, for prioritization in meeting the legislative mandate of the Colorado Natural Areas Act.

14. **Comment:** A number of minor corrections and clarifications are needed to the text and tables in the DEIS concerning the vegetation baseline and impact analysis discussions. (7-24, 7-133, 7-137, 7-149, 7-179)

Response: Concur. The text and tables have been revised accordingly.

5.3.11 Wildlife

1. **Comment:** On page 4-192 in the first full paragraph, it is recommended that buffer zones of at least 0.5 mile be established for sage grouse leks and raptor nest sites to minimize disturbance during critical periods. A reference or data should be supplied justifing this 0.5 mile buffer. (7-79)

Response: Raptor nest sites ranging from ¼ mile to more than 1 mile away from human activity have been reported as unusable (Call 1979; Steenhof 1978; Snow 1974). Nest sites immediately adjacent to intense human activity are usually abandoned nearly 100 percent of the time (BLM 1983d). The 0.5-mile buffer zone recommended by the USFWS and CDOW (1983) is a guideline for significantly reducing or eliminating disturbance to nesting raptors and breeding grouse (see comment response 9).

2. **Comment:** There is a lack of commitment to mitigation for wildlife impacts. Without appropriate mitigation for wildlife resource losses, the proposed action will have an unacceptable level of impacts on this resource. (4-47, 5-1, 12-2, 12-7, 12-9, 12-58, 14-75)

Response: The proponents have met with the USFWS, CDOW, Corps, and CDM to discuss mitigation measures that would be technically and economically feasible. Committed mitigation, to date, has been incorporated into the project description and alternatives discussion of the FEIS. See revised wildlife text in Sections 2.4.3, 4.2.7, and 4.3.7 of the FEIS.

3. **Comment:** The Wildlife Impact Analysis, Appendix C, Tables C-5 and C-6 were referenced in the text, but are not found in the appendix or in the DEIS text. (3-9, 7-150)

Response: Tables C-5 and C-6 have been reprinted in the FEIS as an Addendum to Appendix C in order to correct the DEIS omission and to complete Coordination Act requirements.

4. Comment: On pages 2-62 and 2-63 (Table 2.24-3) and page 2-64, Spent Shale Alternatives, it is our understanding that the surface spent shale alternative for Getty includes simultaneous disposal in Buck/Doe Gulch and Tom Gulch. Wildlife impacts on page 2-64 are discussed based on this combination, but that discussion is inconsistent with Table 2.4-3, where these sites are listed separately. (12-49)

Response: The commentor is correct in noting that the Tom Creek canyon and Buck/Doe Gulch disposal alternatives were combined in the impact analysis. To be consistent with Table 2.4-3, the text on page 2-64 has been revised. It was determined that, since the impacts associated with the disposal of shale in Tom and Buck/Doe gulches were similar in nature and extent, the wildlife impact rating for each alternative should be the same as that assigned for the combined disposal alternative (Tom/Buck/Doe gulches). Ratings are presented separately in the table for the reader's information, since these are discrete sites.

5. Comment: On page 4-7, the second paragraph under Common Project Facilities states: *"Operation of the syncrude pipeline above ground should have no adverse effect on wildlife . . ."*. It should be noted that no decision by the operator as to whether the pipeline will be above or below ground has been made. (7-39)

Response: Because the location of the pipeline (above or below ground) had not been identified, a worst case situation (i.e., pipeline above ground) was assumed in the assessment of wildlife impacts. A statement noting that no decision has, as yet, been reached concerning the above or below ground placement of the pipeline has been inserted. See revised text.

6. Comment: Provide supporting information in the wildlife baseline discussion as to why cliffs are included as important raptor habitat. Provide a reference to indicate that Tom, Buck, Doe and Deer Park areas are critical habitat for wintering elk. (3-4)

Response: Cliffs fit the stated criteria because of the potential cover and nest sites which they provide for certain listed and protected wildlife species (e.g., peregrine falcon and golden eagle). CDOW (1983b) computer-generated maps show that critical habitat for elk exists in Tom, Buck, Doe, and Deer Park gulches. See revised text.

7. Comment: The DEIS states that there are certain federally listed threatened and endangered wildlife species which are known to occur in the region. It should be noted that none of these species were found on Cities Service's property during baseline studies. (7-36)

Response: Threatened and endangered species and species of high federal interest are mentioned on pages 3-15 and 3-17 of the DEIS as a part of the discussion of the regional setting. The occurrence and potential concurrence of black-footed ferret, bald eagle, and peregrine falcon in the Cities Service project area are specifically addressed on page 3-68. The commentor is correct in noting that no listed species were observed on Cities Service's property during baseline investigations.

8. Comment: On page 3-54, Tom Creek Canyon was identified as a corridor for migrating elk. However, the reference is unclear (two CDOW references in 1983) and the facts seem contrary to the available data. (3-15)

Response: The correct reference is *"CDOW 1983b"*. CDOW computer-generated maps showing the project area in relation to known big game concentration areas and migration routes show an elk movement corridor from the mesa to Tom Creek Canyon. The route is intersected by the proposed road corridor.

9. Comment: The first full paragraph on page 4-97 states that activity within 0.25 miles of raptor nests would cause their abandonment; however, it has been reported that red-tailed hawks have been known to nest in urban subdivisions. This seems to be inconsistent and should be clarified. (7-60)

Response: Various raptor species do have different levels of tolerance to human activity which may occur in relative close proximity (e.g., 0.25 mile) to their nests. The red-tailed hawk is one of those species which has a high tolerance threshold, as does the American kestrel. Other species, such as the Cooper's hawk, are likely to abandon any nests as a result of human activities in the area (Lockhart 1984). The text of the DEIS notes that two active red-tailed hawk nests and one active Cooper's hawk nest occur within 0.25 mile of proposed disturbance areas. It is likely that project-related activities could disturb the nests, particularly that of the more sensitive Cooper's hawk. See revised text.

10. **Comment:** The DEIS contains no discussion of impacts of the project on riparian habitat, wetlands, and other waters of the United States which are regulated pursuant to Section 404 of the Clean Water Act. (14-4)

Response: The amount of riparian and wetland vegetation types affected by each of the projects are specifically addressed in Tables 4.2-2 and 4.3-2 of the DEIS. The impacts of the proposed actions on riparian habitats (including wetlands) and associated wildlife are addressed in Sections 4.2.7 (p. 4-28 and 4-29), 4.3.7 (p. 4-97 and 4-99), and 4.4.7 (p. 4-174). No significant wetland habitats occur within the project areas. Impacts to aquatic habitats in the vicinity of the project areas are discussed in Sections 4.2.4 and 4.3.4. No dredge and fill operations are planned for either of the proposed actions as addressed by this EIS. The effects of dredge or fill activities associated with the GCC water supply system on aquatic habitats are discussed in the CCSOP EIS (BLM 1983a).

11. **Comment:** Minor clarifications and revisions are needed to the wildlife impact comparisons (which address the proposed action and alternatives) in Section 2.4. (7-25, 7-109)

Response: Concur. See revised Section 2.4 in the FEIS.

12. **Comment:** Reference is made on page 1-2 and throughout the DEIS to U.S. Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act of 1958 and to impact assessments performed by FWS. These wildlife impact assessments were performed jointly by FWS and the Colorado Division of Wildlife. All such statements should be revised to reflect this cooperative effort. (12-25)

Response: Concur. See revised text.

13. **Comment:** Minor corrections are needed to the text in the wildlife baseline discussions and wildlife mitigation section of the DEIS. (7-134, 7-186)

Response: Concur. See revised text.

14. **Comment:** The fourth paragraph on page 4-97 states that obstruction of a known migration route for elk in Conn Canyon was identified as an impact. Disturbance of a specific route is unlikely in this area, where movement from the valley to the plateau along numerous pathways appears to be the general rule according to the information from CDOW. (7-61)

Response: The commentor is correct in noting that various corridors for movement by deer and elk exist between the plateau and the valley floors of Conn and Cascade Creek canyons. However, according to computer-generated maps (prepared by CDOW) showing the project area in relation to known big game concentration areas and migration routes, the proposed road corridor does intersect generalized routes used by elk (Cascade Canyon) and mule deer (Conn Creek Canyon). The DEIS does not state that migration routes would be obstructed, only that increased incidence of roadkills is likely as a result of vehicular traffic. See revised Section 4.3.7 in the FEIS.

15. **Comment:** Revisions and clarifications are needed to the wildlife impact discussions for the Getty and Cities Service projects in Section 4.2.7 and 4.3.7, respectively and cumulative wildlife impacts in Section 4.4.7. (7-61, 7-62, 7-150, 7-180, 12-56)

Response: Concur. See revised Sections 4.2.7 and 4.3.7 in the FEIS. Section 4.4.7 has been revised in the file.

5.3.12 Air Quality

1. Comment: The Short Z and Long Z models would be more appropriate for the air quality impact analysis. (4-19, 14-18)

Response: Because there are no significant terrain features above stack height within a reasonable distance, the ISC model is preferred due to its significantly greater regulatory history and public acceptability. Although the Short Z model is similar to ISC, its use history is limited. Similarly, the Long Z model has a relatively short regulatory history.

2. Comment: The EIS should provide an Air Quality Related Values (AQRV) analysis in Rocky Mountain National Park and Colorado National Monument. (12-20)

Response: An AQRV analysis for Colorado National Monument has been provided in revised Sections 4.2.8 and 4.3.8. An AQRV analysis has not been provided for Rocky Mountain National because the park is over 150 miles from the Getty and Cities Service projects. Additionally, all conventional modeling techniques show inconclusive results at this distance. The likelihood of a coherent plume reaching this distance is small. Furthermore, the occurrence of meteorology to afford a trajectory to the park is not likely, and significant impacts to the Park from these projects are not anticipated.

3. Comment: The issue of additional SO_2 burden from these projects on the air quality of Mesa County has strong environmental and financial implications. (1-41)

Response: The current impact due to levels of SO_2 on Mesa County from existing sources is under review by the Colorado Air Pollution Control Division. At this time, no nonattain ment designations have been proposed. Based on previous analyses and new source controls on existing sources (principally Gary Refinery), no exceedance of SO_2 standards is expected. As the proposed sources have yet to obtain PSD permits, the project proponents will be required, prior to beginning construction, to provide additional analysis to substantiate the fact that no violations would occur.

4. Comment: Addition of the air quality impacts for both projects on pages 2-62 and 2-77 apparently shows that the 24 hour. SO_2 Class I increment will be exceeded by 40 percent. Please explain. (8-7)

Response: The ISC air quality model was run with the Getty and Cities Service projects sources combined. Complete consumption of the Class I increment was not indicated because different wind directions are needed to maximize the transport from each project emission into the Flat Tops. Simply stated, the maximum impacts from each project are not additive. Nevertheless, a Class I increment consumption analysis will be required as part of the PSD permit applications.

5. Comment: The EIS should thoroughly discuss recycled emissions, zero emissions, and greatly reduced emissions alternatives. (8-3, 8-15, 8-17)

Response: BACT has already been specified for the proposed action and alternatives. Further reduction of emission levels, including recycled emissions and zero emissions, is beyond the state-of-the-art.

6. Comment: The EIS should state that, because the total 24-hour SO_2 Class I increment is not available in the Flat Tops Wilderness, the Getty project may not be permitted in an air quality sense. (4-18).

Response: The Operator will be required to perform an analysis of PSD Class I increment consumption as part of the PSD permit application. At that time, a less conservative analysis may indicate available increment. In any case, the project will be required to comply with all standards, including Class I increment, before a construction permit could be issued.

7. **Comment:** The EIS should contain a better description of the meteorology used in the worst-case air impacts analysis. (4-15, 12-18)

Response: The following response concerning worst-case analysis is adapted from the CCSOP FEIS (BLM 1983e):

- Worst-case analyses, such as the one used, will estimate high pollutant concentrations since worst- case emission, source siting, and meteorologic assumptions are used. Although all models have certain limitations, the results represent a best approximation of potential worst-case impacts under the conditions assumed. These analyses are performed to provide an indication of potential problem areas and ranges are provided to indicate the uncertain nature of the predictions.

- For pollutants to reach regional PSD Class I areas, long transport is necessary. Conditions likely to cause the highest level of pollutants at these sensitive receptors would include light, persistent winds under moderately stable to stable conditions with a moderate mixing depth. Winds of 4 meters per second from the west-southwest under stability class (E) were assumed as the worst-case meteorologic scenario.

- The Systems Applications, Inc. (1983) analysis for the Unita Basin EIS of the actual meteorologic data suggests 24 hour wind persistance, although not a frequent occurrence, is not an unrealistic assumption and is indeed worst-case. Wind persistence of 10 hours is likely based on data collected in the Piceance Basin. Taking this into consideration, the EIS contains ranges of concentrations assuming fixed 10 to 24 hour wind patterns.

- Stability class (E) should be sufficient for limiting vertical dispersion under the mixing depth assumed. An excessively high mixing height will allow excessive dispersion. However, a very low mixing height will isolate elevated plume sources from the ground. Plume rise must also be selected to minimize dispersion prior to transport, but also avoid undue proximate impacts. The dispersion parameters selected for these conditions are those generally used by the EPA to model in complex terrain.

- In summary, predicted cumulative impact results must be evaluated with an understanding of the general limitations of air quality modeling in complex terrain — uncertainties of an order of magnitude could be expected. The analyses performed were designed to provide conservative estimates rather than average values. Therefore, the worst-case assumptions and computer results expressed in this environmental statement should not necessarily be construed as a basis for *"no action"*. However, high pollutant concentrations do indicate potential air quality problem areas.

8. **Comment:** An air quality technical report should be provided as part of the EIS. (4-6, 14-14)

Response: Appendix A, Air Quality Technical Appendix, of the Getty Cities Service DEIS provides information concerning the methodology used in assessing air quality impacts and substitutes for an air quality technical report. Information provided includes a discussion of federal standards, as well as modeling protocol information. Further information concerning emission factor development can be found in the Getty and Cities Service project descriptions (Getty 1983b; Cities Service 1983b).

9. **Comment:** The visibility analyses should include simulation of the following: impacts to all applicable Class I, Category I and sensitive Class II areas; support for the conclusion that no regional haze problems are predicted; and coincidental plumes. (4-11, 12-19)

Response: Although there is no scientifically accepted method for assessing potential cumulative visibility impacts from several sources, one method of evaluation is to perform a conservative Level I screening analysis for each potential source in the region. This visibility analysis is based on the best available data and current analysis methodology in the form of the EPA workbook for Estimating Visibility Impairment (Latimer and Ireson 1980). The information listed in Table 4.4-7 of the DEIS presents this analysis and indicates the minimum distance beyond which visibility impairment from each individual source is highly unlikely. Potential for visibility impacts can be determined by measuring the distance from these sources to the sensitive receptors.

For each individual source, the regional haze component did not exceed its threshold values, although this component (C_3) treats only haze from secondary aerosols based on the HC/NO_x ratio. Photochemical haze is not expected to be a problem from the proposed projects, although the combination of sources may indeed result in a haze problem. The technology does not exist which allows for modeling of coincidental plumes within a reasonable degree of accuracy.

10. Comment: Has Gary refinery been considered in the cumulative air quality analysis? (4-8)

Response: Gary Western refinery pollutant emissions contribute to and are a part of the monitored background values. No changes to these emissions were assumed in this analysis.

11. Comment: The emission inventory used in the cumulative air quality analysis should be listed. (4-9)

Response: The emissions inventory used in the cumulative air quality impact sections is referred to in the revised Sections 4.2.8 and 4.3.8 of the FEIS and Section 3.3.1.1 and 4.3.1.1 of the Mobil Pacific Oil Shale Project DEIS (BLM 1984a). These emission rates have been reprinted in Table 4.4-9a.

12. Comment: Is the pH of sensitive lakes in the Flat Tops Wilderness area going to change as a result of acid deposition? (4-12)

Table 4.4-9a HIGH-DEVELOPMENT CUMULATIVE SCENARIO EMISSION RATES (g/s)

Source	Location			Production rate[a]	Emissions		
	Elevation	Latitude	Longitude		TSP	SO_2	NO_x
Cathedral Bluffs	2,120 m	39°47′40″	108°12′56″	76	42	153	613
Chevron-retort	2,450 m	39°37′44″	108°25′53″	100	120	100	1,029
Chevron-upgrade	1,550 m	39°19′42″	108°45′26″	100	16	44	183
Colony	2,490 m	39°35′53″	108°07′15″	48	23	40	177
Mobil	2,560 m	39°31′30″	108°02′30″	100	57	142	462
Pacific	1,780 m	39°32′30″	108°19′30″	100	44	60	185
Rio Blanco	2,160 m	39°54′37″	108°30′17″	100	28	26	205
Union	2,440 m	39°34′23″	108°04′26″	90	5	83	146
Craig Power	1,940 m	40°27′44″	107°37′30″	1,340	90	371	742
Hayden Power	1,980 m	40°29′09″	107°11′03″	465	23	348	245
S.W. Power	1,470 m	39°19′43″	108°51′44″	500	15	131	291
Enercor-Rainbow	2,130 m	39°43′48″	109°08′34″	5	4	3	3
Paraho-Ute	1,650 m	39°59′49″	109°07′40″	42	4	50	74
Syntana	1,170 m	40°02′23″	109°06′46″	57	12	35	78
Western	1,800 m	40°12′43″	109°04′06″	5	6	6	3
White River	1,650 m	39°55′49″	109°11′37″	100	18	37	87
Moonlake Power	1,520 m	40°04′58″	109°17′22″	800	31	53	562

[a] Synfuel production in 1,000 bpd; power production in megawatts.

Source: Dames and Moore (1984).

Response: As discussed in revised Sections 4.2.8 and 4.3.8 under the Atmospheric Deposition subtitle, the conservatively predicted deposition rates may slightly lower the pH level of poorly buffered lakes. At the acidification levels of a pH ranging from 6-7, elimination of certain phyto- and zooplankton species is possible, but a significant change in total biomass is unlikely as a result of these projects.

13. **Comment:** Air quality impact information should be presented more clearly so that implications of these impacts can be interpreted. (8-19)

Response: The air quality impact information is intended to be presented so that the average layman can interpret the implications on subjects of interest. Air quality is a complex issue, and some complex data and terminology are necessary for technical precision and accuracy. However, the pertinent sections have been revised for the FEIS. The reader is also referred to the Glossary.

14. **Comment:** The EIS should contain a comprehensive ozone analysis. (13-1)

Response: An analysis of ozone has been presented in revised sections 4.2.8 and 4.3.8. A further, refined analysis of ozone, such as EKMA modeling, will be required as part of the PSD applications, but is beyond the scope of this document, especially on a regional basis including Front Range cities. Emission inventories of precursor pollutants are not yet complete, so accurate analyses cannot be performed at this time.

15. **Comment:** A cumulative impact assessment of nearby projects with air emissions into the drainage flow of Clear Creek should be included in the EIS. (4-14)

Response: An analysis was performed to estimate worst-case TSP and SO_2 concentrations into Clear Creek canyon for the Chevron CCSOP as part of that PSD application (CCSOP 1982) and for the Pacific Project (Dames and Moore 1984) as part of the Mobil Pacific DEIS effort. Drainage conditions typically occur in the absence of strong gradient flow when wind flow regimes are controlled by diurnal solar heating and terrestrial cooling. During the night, air near the ground is cooled by the earth's radiational heat loss, becomes denser, and flows down slope, which in turn drains to the canyon bottom.

It has been observed that this drainage flow is usually not as stable in deep canyons such as Clear Creek as is found in typical mountain-valley situations. This is probably due to enhanced mechanical mixing from the ruggedness of the canyon terrain, which produces surface shear stresses.

The results of the canyon drainage modeling for the Clear Creek Shale Oil Project (Chevron 1982) indicate 24 hour-average TSP and SO_2 concentrations in Clear Creek of 24 and 7 $\mu g/m^3$, or 65 and 8 percent of the applicable Class II increment, respectively. Several worst-case meteorological scenarios were modeled for the Pacific source emitting into Clear Creek. The 24-hour TSP concentrations ranged from 18 to 42 $\mu g/m^3$, while the 24-hr SO_2 concentration ranged from 37 to 94 $\mu g/m^3$. The TSP concentration range is predicted to be 49 to 114 percent of the PSD Class II increment while the SO_2 concentration is predicted to be 41 to 103 percent of the PSD Class II increment. The Pacific results are much higher than the Chevron results, due to the siting of Pacific's sources in deep canyons in contrast to the mesa tops. Since both Getty and Cities Service upgrading and retoring emissions are expected to be released from tall stacks on the mesa tops, box modeling results would probably be in the range of Chevron's results. Nevertheless, a refined Class II increment consumption of all operators' emissions into the Clear Creek Canyon drainage flow will probably be required in each Operator's PSD application.

16. **Comment:** The TSP background levels reported are too low. (4-17)

Response: The Chevron CCSOP total suspend particulate (TSP) data collected on the mesa are the most complete and best available data for describing the TSP background characteristics of the Getty and Cities Service Shale Oil project areas. These values are 15 $\mu g/m^3$ for an annual geometric mean and 34 $\mu g/m^3$ for a maximum 24-hr concentration. The now completed Pacific Oil Shale project air quality program (CDM 1984k) supports these numbers. The annual geometric mean collected at the Pacific mesa site from June to October 1984 is 16 $\mu g/m^3$. The maximum and second highest 24-hr concentrations measured at this site are 43 and 29 $\mu g/m^3$, respectively. The existing TSP concentrations are not below measurable limits and the text has been revised appropriately.

17. Comment: Specifications of air quality control equipment should be provided. (4-10, 8-6)

Response: Further definition of air quality control equipment is provided in the revised Project Description. Cities Service's description is based on information provided by Union for the surface retort system and Occidental for the VMIS system. Getty's design is based on the Union B BACT Section of the Phase 2 PSD permit application (Union 1982a).

18. Comment: The EIS should include an analysis of air quality impacts on Grand Mesa. (8-13)

Response: A cumulative air quality analysis on sensitive, regional Class II areas such as the Grand Mesa has been included in the DEIS in Section 4.4.8 on pages 4-166 and 4-167. The 24-hr and 3-hr SO_2 impacts at Grand Mesa are at levels such that sigificant air quality degradation of this area is not anticipated.

19. Comment: Each wind direction should be considered in the cumulative impact section. (14-73)

Response: Given the uncertainty in both the mathematical model as well as inadequate input data, a single wind direction representing a realistic worst case was selected. A discussion of the modeling basis can be seen in response to comment 7.

20. Comment: Because of potential visibility degradation and potential consumption of PSD Class II increment, mitigation measures will have to be developed for these facilities to be permitted. (14-18, 14-19)

Response: The refined PLUVUE analyses presented in revised Sections 4.2.8 and 4.3.8 of this FEIS further interpret the potential for visibility degradation. We concur that mitigation measures will need to be developed during the permitting phase of these projects to prevent these potential violations. The project sponsors will be required to demonstrate compliance prior to any construction when they apply for their PSD permit.

21. Comment: Determination of the maximum short-term off-property air impact concentrations should be verified because of the data sets (Pacific and Chevron) used. (14-17)

The location of the Pacific mesa meteorological monitoring site provides the closest and most current data set collected and available in the area. At the time of issuance of this DEIS, only a 9-month data set was available. Since this time additional air quality modeling has been conducted using the remaining Pacific 3-month data set. The changes in results occurred in concentrations in Class I and Category 1 areas and have been reflected in revised Sections 4.2.8 and 4.3.8.

22. Comment: Additional technological alternatives such as combustion of char on the spent shale should be considered. (4-7, 14-45)

Response: Current technology and available data are too preliminary and inadequate to perform a quantitative analysis with any degree of reliability. Retorting technology alternatives will undoubtedly be considered by Getty and Cities Service at the time of project development. However, it can be generally stated that air impacts will include some increase in oxides of nitrogen due to the combustion of the char. Those will be offset in part by reducing the need for boilers and recycle gas heaters at the retorts. Further discussion of this option is provided in the revised Project Description.

23. Comment: Several clarifications and revisions should be made in Appendix A concerning air quality technical issues. (7-189)

Response: Concur. See revised text.

24. **Comment:** Several clarifications and revisions should be made in the air quality impact comparison, Section 2.4.3. (7-27, 7-101, 7-106)

Response: Concur. See revised Section 2.4.3.

25. **Comment:** Several clarifications and revisions should be made in the common environment air quality baseline description, impact discussion, and the air quality references. (3-13, 7-123, 7-124, 7,138, 10-2)

Response: Concur. The text has been revised.

26. **Comment:** Several clarifications should be made and typographical errors corrected in the discussion of Getty air quality impacts. (3-7, 3-20, 4-13)

Response: Concur. See revised Section 4.2.8.

27. **Comment:** Several clarifications and revisions are needed in the Cities Service Project air quality impacts discussion. (4-16, 7-8, 7-40, 7-63, 7-64, 7-151, 7-152, 7-153, 7-154, 7-155, 7-156, 7-157, 7-158, 7-159, 7-160, 7-161, 7-162, 7-163, 7-164, 8-9, 8-10, 8-11, 12-17)

Response: Concur. See revised Section 4.3.8.

28. **Comment:** The cumulative impacts air quality discussion should be revised. (3-24, 7-76, 7-181, 7-182, 8-12, 8-14)

Response: Concur. See revised text.

5.3.13 Noise

1. **Comment:** On page 4-119 the fifth paragraph states: *"Employees would be mass transported from De Beque to the plant site via buses. These sources coupled with other transportation/traffic noise impacts would be less than the proposed action traffic noise levels."* This should be clarified since the transportation to the plant site via buses is the proposed action. (7-65)

Response: Concur. The text has been revised.

2. **Comment:** On page 4-119, the paragraph under Solid/Hazardous Wastes and Toxic Pollutants states that on-site disposal of hazardous wastes would not create additional noise impacts. This should be clarified since there are no plans to store hazardous wastes on-site. (7-66)

Response: Concur. The text has been revised.

3. **Comment:** Other minor revisions and clarifications are needed in the discussion of Cities Service noise impacts, impact comparisons, and mitigation section. (7-67, 7-102, 7-117, 7-166, 7-187)

Response: Concur. The text and tables have been revised.

4. **Comment:** Minor clarifications and revisions are needed to the sections addressing common project and Getty noise impacts. (3-16, 3-21, 7-139, 7-165)

Response: Concur. The text and tables have been revised.

5. **Comment:** Impacts on the I-70 Business Loop should be addressed, particularly in regard to noise impacts. (1-36).

Response: Noise impacts have been addressed for both projects in Sections 4.2.9 and 4.3.9 of the DEIS. Traffic impacts have been addressed in Sections 4.2.14 and 4.3.15. The increases in traffic on I-70B can be assumed to increase noise and other traffic impacts proportionately. Specific impacts will be addressed during the local permitting process.

5.3.14 Cultural Resources

1. **Comment:** On pages 4-187 and 4-193, it should be noted that the lead federal land management agency (in this case, the BLM) will contact the State Historic Preservation Officer (SHPO) and Advisory Council on Historic Preservation. An inventory for cultural resources is required prior to any surface disturbance activities. A Class III 100 percent field inventory should be conducted on both public and private lands to be affected. (4-61, 4-62, 4-63, 12-59)

   Response: We agree that the federal land management agency, not the applicant, will consult with the State Historic Preservation Officer and the Advisory Council concerning impacts to cultural resources on public lands. Prior to any surface disturbance activities, a cultural resource survey will be conducted to determine whether sites are eligible to the National Register of Historic Places (NRHP). The companies are currently considering the alternative mitigation measure of a 100 percent inventory of potentially affected lands on private property prior to disturbance.

2. **Comment:** Minor text corrections are required to the cultural resources baseline and environmental consequences sections. (7-115, 7-167)

   Response: Concur. The text has been revised.

5.3.15 Land Use, Recreation, and Wilderness

1. **Comment:** A more detailed assessment of potential land use impacts needs to be provided in the EIS. Specific land parcels to be affected should be identified. The acreage to be converted to commercial, industrial, and residential uses should be provided. (1-6, 1-12, 1-16, 1-20, 1-21)

   Response: Detailed assessments of land use impacts from each project are expected to be the subject of future county land use permit applications. Preliminary acreage calculations concerning this matter are presented on page 4-50 (Getty) and page 4-123 (Cities Service) of the DEIS.

2. **Comment:** What are the impacts of project water use on agricultural lands? What are resultant economic gains and losses to agriculture and other sectors of the economy? (1-21)

   Response: Water use figures by each project are contained in Sections 2.3.1.2.2 and 2.3.2.2.2 of the DEIS. Economic losses or gains are predicted in the socioeconomic impacts sections, 4.2.13 and 4.3.13 of the DEIS. See response to Comment 3.

3. **Comment:** We disagree with the statements on competition for water between agricultural and industrial uses. Each oil shale developer will operate within his own water rights and cannot impact senior water rights. It is not clear how oil shale development could reduce the amount of water available for irrigation. (7-41, 7-68, 7-77)

   Response: The Corps agrees that senior water rights cannot be impacted under State regulations. However, junior water rights could be affected by development of the operator's more senior water rights.

4. **Comment:** Concerning the impact rating on page 2-69, recreational use of corridors and reservoirs will follow project abandonment 30+ years from now. How can this be rated a beneficial impact? (1-8, 1-10, 1-14)

Response: Following project abandonment, corridors may allow more access to areas currently having little or no access. Reservoirs and roads are assumed to remain and could serve other agricultural irrigation or recreational uses. Although this condition will occur 30 or more years from now, it is expected to be a beneficial recreational and land use impact.

5. **Comment:** The residential allocation of approximately 23 percent of the population for the Cities Service project to Battlement Mesa (thereby minimizing agricultural land impacts) is a direct data input to the CITF model. (1-28)

Response: Concur. Section 4.3.13.2 (page 4-127) states that Battlement Mesa would accommodate about 23 percent of the non-local construction workers. This was a direct data input to the CITF model. Allocation assumptions will be reviewed and the model rerun during the preparation of future land use permit applications, in close coordination with local officials.

6. **Comment:** Specific mitigation proposals to address land use impacts to local ranchers and farmers should be the subject of local land use permit applications. (6-3)

Response: Concur. Such mitigation is expected to be the subject of future land use applications in Garfield and Mesa counties.

7. **Comment:** Secondary land use impacts of project development (including corridors) on private lands should be assessed in the EIS. The impact ratings for the Getty project production rate alternatives, and for the corridor alternatives on pages 2-60 and 2-68, respectively, should be clarified. (1-9)

Response: Private lands are considered in the evaluation of land use impacts. Low adverse impacts to land use are expected for the La Sal corridor and the Big Salt Wash corridor, while medium adverse impacts are predicted for the Rangely B corridor. As a portion of the complete project impact, the ratings for the corridors on page 2-68 are consistent with those for the complete project on page 2-60.

8. **Comment:** Following review of statements on Pages 4-48 and 4-161, it is not clear if Getty will or will not affect prime farmland. (3-22)

Response: The text on page 4-161 addresses cumulative impacts of seven shale oil projects. The Getty oil shale project will not affect prime farmland, as stated on page 4-48.

9. **Comment:** The wilderness discussion on page 4-10 is vague. How many additional visitors can wilderness areas accommodate and how many additional visits will be generated by the proposed projects and the cumulative population growth? (4-65)

Response: It is difficult to predict the number of additional visitors that wilderness areas can accommodate. Individual tolerances of crowding in wilderness areas determine the quality of the wilderness experience. Data are not available for estimation of wilderness use by the Getty and Cities Service work forces. U.S. Forest Service personnel estimate that carrying capacities would be reached by the year 2000.

10. **Comment:** The companies should commit to control public access to project roads leading to back-country areas, thereby eliminating adverse impacts to soil (due to erosion) and wildlife. (5-3)

Response: Concur. The fact that public access will be controlled is stated in Sections 4.2.11.1 and 4.3.11.1. The limits to this access are not known at this time, but would be expected to be stringent, thereby eliminating most of the impacts noted.

11. **Comment:** On page 4-124, the first paragraph under Land Use states: *"With the exception of the 50,000-bpd alternative, the alternatives to the Cities Service proposed action would result in fewer adverse impacts to land use than the proposed action."* This is unclear, especially since it seems that the opposite is true from information presented elsewhere in the Draft EIS. (7-69)

Response: This statement in the DEIS is in error. We agree that the Cities Service alternatives would have similar or higher (in the case of spent shale disposal in upper Cascade Canyon and adjacent plateau areas) adverse impacts than the proposed action. This statement is supported by discussions in the remaining land use text on page 4-124.

12. **Comment:** Some minor revisions and clarifications are needed to the baseline and impact discussions addressing land use, recreation, and wilderness. (7-168, 12-54)

Response: Concur. The text has been revised.

13. **Comment:** The fact that the tourism/vacation/outdoor recreation industry is the second largest industry in the state should be recognized in the purpose and need statement in the EIS, and in the section on existing environment. The impacts to tourism and recreation should be recognized throughout the document and become an integral part of the analysis. (8-16, 8-20)

Response: Concur. Insert the following statement as the third paragraph on page 4-10: *"The outdoor recreation industry is one of Colorado's most important, stable, and fastest growing industries (Colorado Mountain Club 1984). Economic impacts to the tourism and recreation industry could be significant if air and water quality and access to recreation areas are adversely affected."*

In addition, it should be noted that another commentor (BLM 1984b) has requested more information on secondary impacts of worker and support populations on regional recreation areas. Most of the increased recreational use would occur on Federal lands, although municipal and county facilities would also experience increased activity (see DEIS Section 3.1.11).

Population increases associated with the Getty and Cities Service projects would increase use levels of recreational areas in the region. The projected peak project employment for Getty occurs in 1995 (DEIS Section 4.2.13). Based on per capita participation rates (CDPOR 1981), total activity days can be expected to increase by 25 percent over current use rates for fishing, hunting, camping, and other outdoor activities as a result of the Getty project.

The peak project employment and concomitant population peak for Garfield and Mesa counties as a result of the Cities Service project occurs in 2007 (DEIS Section 4.2.13). Total activity days would, therefore, increase by approximately 26 percent over current levels by the year 2007.

The cumulative population growth due to the Getty and Cities Service projects and other projects considered in the cumulative impacts scenario in Section 4.4.13 of the DEIS would result in an overall increase in outdoor recreational activities of 80 percent. This increase would necessarily lead to changes in management practices at the (then) overused regional recreational areas.

14. **Comment:** More information should be presented in the EIS on the impacts of both projects on public lands. (12-3, 7-191)

Response: The respective companies have provided more detailed information on public land parcels which may need to be acquired as rights-of-way (ROW) and those which could potentially be disturbed (See Tables 2.3-2 and 2.3-30 in the FEIS), in response to these and earlier BLM comments (BLM 1983f). Impacts to public lands would result from the construction of road, railroad, pipeline, and electric transmission line corridors. The acquisition of other public land parcels would be necessary for the GCC reservoir.

Impact comparisons of various project alternatives on public lands are discussed in Section 2.4 of the FEIS. General project impacts of the proposed actions are described below, and should be inserted on page 4-49 (Getty) and 4-123 (Cities Service) of the DEIS.

Getty Project and GCC

Getty Oil Company's proposed project may affect public land in the Roan Creek valley through development of the GCC Joint Venture reservoir and construction of various road, railroad, and power line rights-of-way. The tables and figures in the proposed action and alternatives discussion (Section 2.3.1) identify public lands which may be affected and the area of those lands potentially disturbed. Approximately 2,612 acres of public land would potentially need to be acquired for the Getty project. Of those lands, only about 547 acres would actually be affected. The reservoir would require lease, right-of-way, or acquisition of twenty-five 40-acre plots and the various rights-of-way would require acquisition of an additional forty 40-acre plots, and two plots less than 10 acres each, of public land.

Cities Service Project

The proposed Cities Service project may affect public land in Roan Valley through development of the GCC Joint Venture reservoir and construction of various multiple-use road and powerline rights-of-way; in Conn Creek Canyon through construction of access road, power line, and water pipeline rights-of-way specific to the Cities Service project; and on the Roan Plateau through development of the underground mine and construction of syncrude pipeline and powerline rights-of-way.

A total of 128 parcels of potentially affected public land were identified, corresponding to 5,037 acres which may eventually be involved in land trade, land purchase, or BLM right-of-way negotiations related to the project as currently proposed. Of those lands, a surface area of approximately 610 acres would be expected to be actually impacted. In addition, subsurface impacts could be 565 acres. Parcels are described in detail in the tables and figures in the proposed action and alternatives discussion in Section 2.3.2.

The duration of impacts would be related to the specific interactions. Pipelines and transmission line impacts would result from construction and would last until revegetation of disturbances was complete. Roads would remain in place during the life of the project. Mining impacts, although causing no surface effects, would be lasting in a subsurface sense.

5.3.16 Visual Resources

1. **Comment:** The *"Mesa County Roadway Landscape Guidelines"* should be used for reclamation and landscaping of all major roads in the project area, including Roan Creek Road and roads near De Beque. (1-45)

   Response: All applicable county regulations will be followed during the reclamation and landscaping of roads developed by Getty and Cities Service for use for project activities.

2. **Comment:** On page 4-124, the third paragraph under Visual Resources states that the form of the canyon bottom would be permanently altered, but that the form change is not visible from an existing public roadway, community or recreation center. The latter part of this sentence is an important one and perhaps should summarize the whole discussion of visual impacts, in that the entire area is isolated from public view, therefore, the impacts are minimal. (7-70)

   Response: The areas proposed for mining, retorting and spent shale disposal are not currently visible to the general public from a public roadway, community, or recreation site. The areas proposed for the Roan Creek reservoir, Roan Creek access road, railroad unloading, and intake and pumping stations on the Colorado River are now and will continue to be visible to the general public.

3. **Comment:** On page 4-125, the second paragraph states: *"Those portions of the utility, road, and water pipeline corridors that would traverse the bottom of Conn Creek canyon are not expected to have an insignificant linear impact."* It would appear that the word "not" should be removed in order to make this sentence compatible with the following sentences in the paragraph. (7-71)

Response: Concur. The sentence should read *"are expected to have an insignificant linear impact"*.

4. **Comment:** On page 4-125, under Alternatives, the last paragraph states: *"The use of an existing structure (the De Beque Bridge) to cross the river would have a nonsignificant to nondiscernible (visual) impact. However, a water pipeline crossing the Colorado River on a new structure would introduce a significant impact."* This should be clarified. If a new structure means a separate structure to support the pipeline only, then this would have a significant visual impact. However, this is not planned by Cities Service. If a new structure means a new bridge, the new bridge would have a significant visual impact, but the fact that a pipeline is attached to the new bridge would have no more impact than if the pipeline was attached to the old bridge. (7-72)

Response: Concur. A pipeline using the existing or a replacement bridge would not have a new and significant visual impact in itself.

5. **Comment:** Minor corrections and revisions are needed to the visual resources impact discussions in the DEIS. (7-140, 7-169, 7-183)

Response: Concur. See revised text.

5.3.17 Socioeconomics

1. **Comment:** On Page 4-173, the cumulative housing impacts of oil shale development should be discussed in more detail, and proposed mitigative measures to alleviate these impacts should be addressed more specifically. (11-1)

Response: The cumulative economic impacts of such development on services and facilities were addressed as part of the assessment, and the resulting expenditure impact was included in the fiscal analysis (e.g., see pages 4-63 to 4-68 of the DEIS for the Getty project impacts). Specific mitigation measures are more appropriately addressed during the local permit process and are beyond the scope of the EIS.

2. **Comment:** The Draft EIS clearly shows a very significant positive contribution in the area of socioeconomics, especially for the proposed action at 100,000 bpd. Some of the significant economic effects include employment, income, and purchases. It also points out that some areas need to be addressed prior to commercialization of Cities Service's Conn Creek shale property. These areas are to be addressed as a key component of the local permitting process. (7-14)

Response: Concur. All of the impacts mentioned, including employment, income, and purchases are addressed in the EIS.

3. **Comment:** Coordination among oil shale developers, and with the remaining private sector and local governments, could minimize the potential cumulative socioeconomic impacts. (7-15)

Response: We generally concur. However, without the specific coordination process being defined in terms of procedures and objectives, we cannot speculate on the specific extent to which such efforts might reduce the cumulative impacts. Such coordination is certainly desirable, and we believe local governments would agree that it has the potential to mitigate cumulative adverse socioeconomic impacts to a considerable extent.

4. **Comment:** Too much reliance is placed on the Mountain West Research-Southwest, Inc. (Mountain West) technical background report rather than other reports on the area. Use of other sources would give a more comprehensive view of the socioeconomic structure. (2-15)

Response: All available documents and reports relevant to the EIS objectives were used in preparation of the Mountain West report, and its analysis relies upon the authors' experience and knowledge of other socioeconomic assessment efforts in the region.

5. **Comment:** There are a number of unsubstantiated socioeconomic impact statements in the EIS, such as the impact on agriculture and the elderly. (2-15)

Response: Many summary statements made in the EIS reflect professional judgement based on the synthesis of extensive knowledge of the area and many research reports. By their very nature, certain statements can be debated from many different perspectives.

6. **Comment:** Explain why cumulative socioeconomic impacts are probably understated on page 4-171. (4-55)

Response: A full discussion of this matter is contained in the Mountain West technical report (MWSW 1983). Sentences have been added to the text on page 4-171 to give examples.

7. **Comment:** Alternative socioeconomic impact scenarios, using different assumptions, should have been included in the EIS. (1-23, 1-30)

Response: The assumptions used in the analysis for the EIS reflect reasonable assumptions at the time the analysis was performed. The purpose of the assessment is to provide an overview of the socioeconomic impacts associated with the projects. One could construct literally hundreds of scenarios with different assumptions about likely future events. However, the quantitative impacts of the Getty/Cities Service projects most likely would not change significantly. Alternative scenarios and mitigation strategies are more appropriately addressed in local government permitting processes.

8. **Comment:** Socioeconomic data provided in the EIS is dated and is inadequate for review under Section 5.08 of Garfield County's Fiscal Impact Mitigation Program. Also, current population data should be used in the impact assessment. (1-17, 6-1)

Response: The data used in the EIS was the best available at the time the analysis was performed. Also, the purpose of the EIS is not necessarily to meet the requirements of local use permits. More recent data will be used in these county use permit applications at the time application is made.

9. **Comment:** The assumptions used to allocate the project's direct workforce should be reassessed. (1-22, 1-29, 12-5)

Response: The residential allocation assumptions were developed through review of assumptions for other shale projects in the study area, through review of other EISs, and from discussions with company personnel and the local planning community. More specific and detailed assessment is beyond the scope of the EIS and is more appropriate for local permit processes.

10. **Comment:** The fiscal assessment included in the EIS did not address all taxing jurisdictions. In addition, more technical description and detail is needed concerning the socioeconomic impact assessment, and any technical documentation should be made available for public review. (1-18, 1-19, 1-24, 1-25, 1-27, 1-31, 1-32, 4-52, 4-53, 4-56, 10-3, 10-4, 12-4)

Response: The major taxing jurisdictions in the study area were addressed in the EIS. Further, detailed analysis, addressing other taxing jurisdictions, is more appropriate during the local permit process. Further documentation on the methodologies, data, and assumptions is included in the technical report prepared by Mountain West. It is available at Corps, Mesa County, Garfield County, CDM, and Mountain West offices. This report also addresses impacts at the sub-county level, and a summary of impacts to these taxing jurisdictions is included in the DEIS (e.g., for Cities Service project impacts, see pages 4-141 to 4-149).

11. **Comment:** Under different socioeconomic conditions, would the projections of impact change? (16-2, 16-3)

Response: Speculation concerning how the projections might change under different socioeconomic conditions is beyond the scope of the EIS and may be more appropriate for the local permit process.

12. **Comment:** Allocation of sales tax revenue to Mesa County needs clarification. (1-26, 1-33)

Response: An insert should be added to pages 4-67 and 4-143 which amends the first sentence following each Mesa County subheading to read "*. . . . County collects 2 percent on most sales, of which 45 percent is returned to the County General Fund.*"

14. **Comment:** Will applicants assist the Town of De Beque in improvements to their utility system? (16-1)

Response: Such specific socioeconomic mitigation measures are beyond the scope of the EIS and should be considered during the local permit process.

15. **Comment:** The socioeconomic mitigation strategies presented in the EIS are too general and are not complete. The applicants should commit to more detailed mitigation measures at this time. (1-43, 4-54, 15-1)

Response: The mitigation section of the EIS is designed to provide a brief discussion of the overall mitigation strategies that the companies might employ during the construction and operation of their facilities. More specific and detailed mitigation plans are beyond the scope of the EIS and may be more appropriate for the local permit process.

16. **Comment:** Premature project shutdown and its socioeconomic impacts should be assessed for both projects. (12-6)

Response: Both Getty and Cities Service have stated in the mitigation section of the DEIS (see Pages 4-188 and 4-194, respectively) that they will work cooperatively with local governments regarding financing and other community needs when project development occurs. The companies have each made other statments concerning front-end funding and recognition of the uncertainties associated with the oil shale industry. Specific impact predictions concerning premature shutdown, and mitigation measures to address it, are more appropriately the subject of local government permitting processes.

17. **Comment:** On page 4-52, the employment levels by year and for 50,000/100,000 bpd are unclear. (3-23)

Response: We disagree. The text seems clear, especially in combination with Table 4.2-19, as referenced and explained in the fourth paragraph on that page.

18. **Comment:** Minor clarifications and revisions are needed to the text and tables in the DEIS concerning the sections on socioeconomic baseline conditions and impacts. (7-73, 7-125, 7-141, 7-170, 7-171, 7-172, 7-173, 7-184, 10-5)

Response: We generally concur. The text and tables have been revised appropriately.

5.3.18 Transportation and Energy

1. **Comment:** The discussion of the existing environment for transportation needs editorial changes and clarification. (7-126)

Response: Concur. See revised text and tables.

2. **Comment:** Certain clarifications and editorial changes need to be made under the Common Impact sections for energy and transportation. (7-142, 7-143)

Response: Concur. See revised text.

3. **Comment:** The transportation impacts of the Getty and Cities Service projects, when taken together, should be addressed. Additional discussion of other oil shale projects as well as proposed coal and mineral developments is needed. (1-37, 4-57, 4-58)

Response: Impact analyses for the two projects, when considered separately, have been provided within Sections 4.2.14 (Getty) and 4.3.14 (Cities). The analysis of the two projects together can be assessed by comparing these two sections. Selected impact analysis of the Getty and Cities Service projects taken together is inappropriate in that such a comparison would make no more sense than selectively analyzing any other two projects (e.g., Getty and Mobil-Pacific). The chances that Getty and Cities Service projects will be developed simultaneously are no greater than any other of the projects considered. Various oil shale projects have been considered in the cumulative impact analysis as shown on Table 4.4-1 of the DEIS. These projects were selected so as to represent on-going development in the area and yet limit the cumulative impact analysis to a reasonable level.

4. **Comment:** Editorial changes and corrections need to be made to the Cities Service impact sections for Energy and Transportation. (7-174, 7-175)

Response: Concur. See revised text and tables.

5. **Comment:** Minor editorial changes are needed to the baseline and cumulative impacts sections concerning energy. (7-78, 7-135, 7-176)

Response: Concur.

6. **Comment:** It should be noted that Cities Service will monitor progress of the Union retorting technology regarding retorting of shale fines and burning of carbon off the spent shale, and if environmentally acceptable will consider incorporating them in future plans. (7-80)

Response: Comment noted.

7. **Comment:** The Draft EIS fails to provide a discussion of the source of the required 495 megawatts (Mw) of electric generating capacity (431 Mw requirement plus 64 Mw reserve requirement). (4-64)

Response: The precise source of electrical power is unknown. However, there is excess power available within the region at this time (e.g., Craig, Hayden power plants). It should be noted that the impacts for these and other projects are considered to be tertiary in nature, and outside the scope of this EIS.

8. **Comment:** Impacts on the local roads in the area should be addressed, including impacts to bridges. (4-59)

Response: The traffic impacts on the local roads will be dependent on the alternative mode of transportation selected. An indication of the impacts can be derived from Tables 2.3-7 and 2.3-14 for the Getty and Cities Service projects, respectively. These tables indicate the peak construction and operating work forces for each project. The projects propose using trains or buses as the transportation modes, which will reduce impacts to roads significantly. If, however, personal vehicles are used, a *"worst case"* scenario would be as follows:

Getty Project

- Work force is as specified on Table 2.3-7 with 7,200 persons in peak construction work force; 3,000 persons in peak operating work force.
- Assume 3 shifts per day. Therefore, there would be 2,330 people per shift in peak construction work force; 1,000 people in peak operating work force.
- Assume an average of two people per vehicle. Therefore:
    - At peak construction there would be 1,166 additional vehicles per shift crew.
    - At peak operation there would be 500 additional vehicles per shift crew.

Cities Service Project

- Work force is as specified on Table 2.3-14 with 5,328 persons in peak construction work force; 3,368 persons in peak operating work force.

- Assume 3 shifts per day. Therefore, there would be 1,776 people per shift in peak construction work force; 1,123 persons in peak operating work force.

- Assume an average of two people per vehicle; therefore:

  - At peak construction there would be 898 additional vehicles per shift crew.

  - At peak operation, there would be 562 additional vehicles per shift crew.

The impacts of the vehicle numbers presented above under this *"worst case"* scenario would be in addition to those vehicles already specified for non-worker transportation in Tables 2.3-7 and 2.3-14.

While specific road improvement plans have not and should not be developed until the permitting phases, it is likely that certain road improvements to the I-70 De Beque interchange and the bridge from I-70 into De Beque will be needed.

9. **Comment:** Mass transportation systems should be discussed further and their use is recommended. Use of mass transport systems would reduce impacts. (1-34, 1-35, 1-38, 1-44, 12-35, 12-46, 14-76,)

Response: Mass transportation systems are the proposed mode of worker transportation from De Beque to the project sites. The impact analyses on the existing transportation systems indicate that, while there will be some traffic congestion on certain road segments, the existing transportation system will accommodate the anticipated traffic load during peak construction and peak operation periods. Additional mass transport systems will be considered during future permitting discussions with the county agencies.

10. **Comment:** In Table 3.1-20 (page 3-45), footnote *"b"*, the term *"intermediate units"* should be explained. (7-127)

Response: The term *"intermediate units"* means those power generating units that are utilized to handle the power demand load between base level power requirements and peak load requirements.

5.3.19 Miscellaneous Comments

List of Preparers and References

1. **Comment:** Minor revisions are needed to the List of Preparers in the DEIS. (7-188)

Response: Concur. See revised text.

2. **Comment:** Corrections are needed to the reference list in the DEIS. (7-188, 14-51, 14-52)

Response: Concur. See revised text.

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Mesa County
Policy and
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(303) 244-1678

March 12, 1984

Mr. Tom Coe
Regulatory Section
U.S. Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Mr. Coe:

Thank you for giving Mesa County the opportunity to review the Draft Environmental Impact Statement, Getty and Cities Service Shale Oil Projects. The following comments reflect the staff analysis from the Policy & Research Office, Health Department, Road Department, Engineering Department and Planning Department. Policy recommendations not noted as adopted by the Board of County Commissioners are the opinion of the specific department and not that of Mesa County.

POLICY AND RESEARCH OFFICE

1. (P.1-3)(1.33 Local Jurisdictions) The pipeline, regulating pond, railroad and any other development within Mesa County will require a land use permit. 1

2. (P.2-24 to 2-26)(2.3.1.2.3 Support Facilities) The construction of a rail line, main access road, electric transmission lines and pipelines in the same general area will create a multi-use corridor. Such an industrialized corridor exiting from public to private lands will create changes in land use on that private land. This EIS has failed to assess this impact and its effect on the Roan Creek valley and the De Beque area. An assessment of the mining and retorting process cannot stand alone. The same assessment must be performed for the support facilities. This aspect of a shale project can have an equal, if not larger, impact on both the environment and local populations. 2

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STAFF ANALYSIS: DRAFT ENVIRONMENTAL IMPACT STATEMENT

3. (P.2-50 to 2-52)(2.3.2.2.3 Support Facilities) Comment #2 also applies to Cities Service. 3

4. (P.2-54)(Railroad Transportation) Does Cities Service intend to build a rail line in addition to Getty's? If two rail lines will be used the cumulative impacts of noise and land use need to be assessed. If one rail line is projected, the cumulative transportation requirements needs to be assessed and this increased level of service assessed for noise and land use impacts. 4

5. (P.2-58)(2.4.3 Impact Comparisons) Several items in this section assert that they have been previously addressed in the CCSOP EIS (ie. La Sal power and syncrude corridor, Roan Creek/Clear Creek multi-use corridor, Rangely, product pipeline and Big Salt Wash transmission line). All of the aforementioned corridors were addressed in the CCSOP EIS for use by a single shale oil project. The inclusion of additional development facilities within the same corridors will affect the width, construction time, environmental impacts and land use impacts. The cumulative impacts of these additional facilities must be completely addressed. The reference to a previous EIS is not satisfactory. 5

6. (P.2-61)(Land Use) The conversion of land uses is of major concern to this county. Large changes from agricultural to industrial or commercial land uses will affect many residents and landowners. A more detailed assessment of the anticipated impacts needs to be provided to aid local government in preparing for these impacts. What lands are projected to be converted? Does Getty have specific plans for its property in Roan Creek? How many acres is projected to be converted to commercial, industrial and residential uses? 6

7. (P.2-67)(2.4.3.1.6 Corridors) Comment #5 above also applies here. 7

8. (P.2-69)(Recreation) If recreational use will only follow abandonment, how can it be rated as beneficial for a probable benefit 30 plus years from now? 8

9. (P.2 -69)(Land Use) This paragraph appears to totally ignore the impacts that will be created on private lands due to the industrialization of these corridors. This EIS itself on P.2-61 acknowledges "significant secondary effects on land uses off-site". Such statements as appear here, indicates more analysis is required to assess these off-site impacts. 9

10. (P.2-72)(Land Use) This again is similar to comment #8. How can this be assessed as beneficial when use is deferred 30 plus years? 10

11. (P.2-73)(2.4.3.2. Cities Service) Comment #5 above also 11

2

applies to this section. 11

12. (P.2-75)(Land Use) Comment #6 above also applies to this section. 12

13. (P.2-83)(2.4.3.2.7 Corridors) Comment #5 above also applies to this section. 13

14. (P.2-85)(Recreation) Comment #8 above also applies to this section. 14

15. (P.2-88)(2.4.3.2.10 Transport of Workers and Materials) Comment #4 above also applies to this section. 15

16. (P.3-27)(Land Use) Three paragraphs have been devoted to describing the land use of an area that, according to the map on page 1-1, covers approximately 10,000 square miles. A much more detailed analysis of the existing land use should be required, especially since both Getty and Cities Service have acknowledged major land use changes will occur due to their respective projects. On both page 2-61 and 2-75 it states that "Lands which are now utilized as agricultural or range land would become predominantly industrial, commercial and residential". This statement definitely indicates a potential problem. A detailed land use study and analysis of the affected areas should become a part of this EIS. Existing land uses should be identified and the projected conversion should be analyzed concerning its effect on Mesa County and current land uses. 16

17. (P.3-34)(Table 3.1-13) Since current population data for 1981 to 1983 is available from both Mesa County and the Colorado State Demographer, we recommend that this table be updated to reflect such data. 17

18. (P.3-36)(3.1.13.4 Public Facilities and Services) The greatest impacts on Mesa County from oil shale development is expected be on its facilities and services. These impacts are of major concern to the county and its jurisdictions. To adequately assess probable impacts, a complete baseline needs to be established. This has not been done. There is no data on existing capacities and current revenue and expenditures. There is also no data on any of sewer, water or fire districts that may be impacted by these projects. This is a most feeble attempt to develop the existing conditions of an area of crucial concern. 18

19. (P.3-36 to 3-37)(3.1.13.5 Local Finances) The two paragraphs on local finances falls short of an adequate assessment. As in the previous comment, sewer, water and fire districts should also be assessed. Also, Mesa County has been struggling through 1983 and so far in 1984 with a distinct revenue shortfall. By reading this section, no one would suspect the fiscal problems being faced by the County. This section does not accurately reflect the fiscal conditions of the county and its

jurisdictions. 19

20. (P.4-9)(4.1.11 Land Use, Recreation and Wilderness) This office cannot argue with any of the statements made within this section, but they are highly subjective and require specific data to support such views. Both companies should know what support facilities will be needed and be able to estimate land conversion to industrial and commercial uses. Also, with population projections and existing housing availability data, they should be able to project required housing and residential land conversions. This data should be analyzed by municipality and sub-county geographic areas. The significance of indirect land use impacts is large, but unsupported statements as those found in this section cannot assist local governments in preparing for these impacts created by Getty and Cities Service. Specific data to support the conclusions in this section is required. 20

21. (P.4-50)(4.2.11.4 Secondary Impacts) This section raises more questions than it answers. What is the breakdown of these 3,740 acres into residential, commercial and industrial uses? Where are these conversions most likely to occur? What are the impacts on the land and on the local residents of the area from this conversion? How much water will be lost to project development? What Impact will this water loss have on agriculture? What will be the projected economic losses or gains to the area? 21

22. (P.4-52)(4.2.13.2 Residential allocation of Workforce) The allocation of the Getty project workforce between Mesa and Garfield counties and within Mesa County is not totally acceptable to this office. Current monitoring of the Union and Colony projects shows a higher percentage of their workforce residing in Mesa County than is projected in Table 4.2-20. Given that both of these projects are located further from Mesa County than either Getty or Cities Service, it seems reasonable that a reassessment of these percentages be undertaken. 22

23. (P.4-52)(4.2.13 Socioeconomics) This entire section is based on one production and growth scenario; "with the Getty project". This alternative has been based on a single set of residency assumptions for the proposed workforce. All of the projected impacts and the entire mitigation strategy are based on this single set of assumptions. If the actual residency patterns are substantially different, the locations of the impacts will be altered. Thus, the mitigation strategy offered by Getty will have to be changed. Several alternatives developed into socioeconomic scenarios would provide a much more useful base of information to local governments for dealing with the impacts of the project. 23

We find that this lack of socioeconomic alternatives is a deficiency in this Draft EIS. The CITF model, used to develop this current alternative, is readily adaptable to develop several

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alternative scenarios. These same alternatives should be applied to the fiscal projections. If the residency patterns are different than anticipated by the project proponent, sufficient data should be available for local governments to prepare for population impacts. 23

24. (P.4-56)(4.2.13.4. Population) What is the definition of a "significant jurisdiction"? Who has made this determination? In addition to the jurisdictions considered "significant" in this EIS, there are seven fire districts, three water districts and six sanitation districts that can also be considered significant. Each of these jurisdictions has the ability to levy a property tax on their respective population and is required to provide a specific service. Adverse impacts affecting these jurisdictions that are related to growth caused by this project can affect the level of service and cost to local residents. Therefore, we recommend that "significant jurisdiction" include all taxing entities within the county and that they be equally assessed in this EIS. 24 … 24

25. (P.4-63)(4.2.13.7 Public Facilities, Services, and Fiscal) This section does not give a complete assessment of the fiscal impacts due to this project. Because many public service and facility providers have not been included in this EIS (see comment #24, above), an entire level of revenue and expenditures has been deleted. We recommend that all taxing jurisdictions be included to assess the true fiscal impact to the county and its residents. 25 … 25

26. (P.4-67)(Mesa County) The County collects 2 percent on most sales, but 1 percent is allocated to the Capital Improvements Fund, .45 percent to the General Fund, .32 percent to Grand Junction, .07 percent to Palisade, .03 percent to Collbran, and .03 percent to De Beque. 26 … 26

27. (P.4-68)(Summary) The summary does not reflect the entire fiscal situation. Please refer to #25, above. 27

28. (P.4-123)(Land Use) Comment #21, above also applies to this section. Also, the CITF model did not predict more than 25% of the population increase to occur in Battlement Mesa. That was a direct result of the residential allocations (Table 4.3.22) and was a direct input. 28 … 28

29. (P.4-126)(4.3.13.2 Residential Allocation of Workforce) Comment #22, above also applies to this section. 29

30. (P.4-125)(4.3.13 Socioeconomics) Comment #23, above also applies to this section. 30

31. (P.4.141)(4.3.13.7 Public Facilities, Services, and Fiscal) Comment #25, above also applies to this section. 31

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32. (P.4-130)(4.3.13.4 Population) Comment #24, above also applies to this section. 32

33. (P.4-143)(Mesa County) Comment #26, above also applies to this section. 33

34. Both Cities Service and Getty propose projects of similar scale and timing on adjacent properties. Each project places a demand on the same transportation facilities of the area, particularly on I-70 and roads which access I-70. Roan Creek is the preferred access corridor to the two projects.

Many of the mitigation measures are similar. Obviously, some savings were made in the preparation of this DEIS. These savings could be put to use in coordinating a transportation plan for the two projects. 35

35. The DEIS indicates a road segment H p 3-25 being under capacity through the year 2010. This segment H is US 6 through Palisade; not shown is I-70 Business Loop, which is the primary access for the eastern part of the Grand Junction area and Clifton. With 28% of the total local workforce of each project coming from Grand Junction Area (reference Tables 4.2-20 and 4.3-22). For 1995, based on 8,700 total workforce (Getty and Cities Service), the daily commuters from Grand Junction area would be 1,900. Many of these would use I-70B; thus this segment should be assessed. 36 … 36

36. Given that the economic and energy demand situations which would justify the Getty and Cities Service projects would also justify the other five area projects, and given that peak have demands on I-70 could require a six lane facility from Grand Junction to Rifle, the DEIS should address this impact. A potential 1995 workforce of 31,000 (Table 4.4.-10) would place extreme demand on I-70, the interchanges, and the local streets accessing the interchanges. 37 … 37

With the highway system potentially reaching D, E or F levels of service (p. 4-174) and associated problems of air pollution, noise and energy consumption, the DEIS should consider an alternative under which workers do not drive to De Beque. Both Getty and Cities Service portions assume that mass transit would start at De Beque. One alternative would be park-and-ride, kiss-and-ride facilities in Fruita, Grand Junction, Clifton, and Palisade. These facilities could be tied into rail and/or bus modes. 38 … 38

MESA COUNTY ROAD DEPARTMENT

1. 45 Road currently serves very limited traffic. The increased volume and increased weight of traffic that will be associated with both of these projects will require major upgrading of this road. The cost of this road improvement must 39

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be borne by the users that have created the need for improvement. 39

40

MESA COUNTY ENGINEERING DEPARTMENT

1. Mesa County has been approved for federal funds to replace the bridge across Roan Creek, west of De Beque. Mesa County's matching cost will be approximately $25,000. This may be an item to consider, when developing specific mitigation strategy. 40

41

MESA COUNTY HEALTH DEPARTMENT

1. The recent attention focused on SO_2 (sulfur dioxide) emissions here and the possibility that the standard for this pollutant is now being violated should heighten the concerns about any added SO_2 burden from either or both of these projects impacting Mesa County. This issue has strong environmental and financial impacts which must be weighed. 41

42

2. This Department is concerned about the increased amounts of industrial wastes which will require transport and disposal; especially hazardous wastes. There is currently a steady flow of hazardous materials through the county by rail and highway. There will probably be an increased flow of chemicals to and from the facilities for use in processing shale or other functions. An assessment of the impacts associated with the transport of hazardous materials is recommended to be included in this EIS. 42

MESA COUNTY PLANNING DEPARTMENT

The Draft Environmental Impact Statement prepared by Getty and Cities Service Shale Oil Projects provides a great deal of information on the project and its impact on Mesa County.

The Mesa County Commissioners and Planning Commission were pleased with the response on the part of B.L.M. and Chevron in addressing major concerns and incorporating them into the Final E.I.S. last year, and we anticipate similar cooperation on the part of Getty/Cities Service and the U.S. Army Corps of Engineers.

Mesa County has adopted the following land use and development policy regarding the siting of major energy facilities:

Policy #20 ENERGY SITING
Siting Major Energy Facilities

The siting and construction of major energy facilities will have environmental and socioeconomic impacts that will profoundly affect this County. It is the policy of Mesa County to work cooperatively to locate new energy facilities including pipelines, power plants, oil shale facilities, and other similar major energy facilities. It is also the policy to mitigate adverse environmental impacts of such facilities

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by requiring energy companies to fully disclose details of proposed projects, conduct activities to mitigate their effect on the environment, and to help compensate for their fiscal impact on the County.

The following items should be included or addressed in the following sections of the E.I.S.:

43

			(Mitigation)
Getty	-	4.8.2.13	Socioeconomics (p. 4-188)
Cities Service	-	4.8.3.13	

The worker housing strategies stated here are sound and in keeping with Mesa County Land Use and Development Policies (adopted 1983) which encourage medium - high density growth where there is sufficient infrastructure (water, sewer, schools, parks, etc.).

We would suggest amplifying these statements to include the following:

1) Population for middle/upper management and general workforce should be encouraged to reside in existing urban and town centers where adequate infrastructure exists to support population impacts. Temporary housing and "man camps" should be used only for highly transitory workforce and should be located as close to the mine sites as possible. Getty and Cities Service should adopt a policy of encouraging its primary workforce (other than man camps) to reside in the urban area of Grand Junction, Palisade, Fruita, Parachute, Rifle, and Glenwood Springs. "Sprawl Growth" should be discouraged especially along the Roan Creek and I-70 corridors, and especially where such growth cannot be supported by water, sewer and other facilities and services.

2) Getty/Cities Service should contribute to a growth management program for Mesa County to give the County management tools to deal with boom/bust growth cycles.

3) Mesa County should be compensated for the discrepancy between revenue and population impact vis-a-vis Garfield County. While the revenue projections show a substantial property tax revenue for Garfield County, Mesa County will receive the bulk of the socio-economic impacts requiring new roads, schools, parks, etc.

4) Mesa County should be compensated immediately to help develop an economic development program to help mitigate the adverse impacts of boom-bust growth. Getty/Cities Service participation in the current Mesa County/Industrial Development Incorporated (IDI) economic development program would help address this issue.

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5) Getty/Cities Service should participate in the town of De Beque's Capital Improvement Program and Plan which was begun by Chevron. This will enable De Beque to accommodate the major growth anticipated. Participation should be limited at this point to preparation and development of a capital improvement program to accommodate De Beque's anticipated growth. At the beginning of the project, funds should be allocated in proportion to the impact of the project to help offset the costs of capital improvements. 43

Getty - 4.8.3.14 Transportation 44
Cities Service - 4.8.2.14

Specific commitments should be made towards development of a mass transit system from Grand Junction, Fruita, Palisade and De Beque to the oil shale sites. Both oil companies should fund this transportation for their workers 100%. The use of "existing transportation facilities" is not a viable alternative in view of the projected workforce and the road conditions between Grand Junction and De Beque. 44

Getty - 4.8.2.6 Vegetation 4.8.2.12 Visual Resources 45
Cities Service - 4.8.3.6 4.8.3.12

The "Mesa County Roadway Landscape Guidelines" should be used as a guideline for reclamation and landscaping all major roads in the project area, including Roan Creek Road and roads in the De Beque area. 45

Sincerely,

Raymond J. Gronwall

Raymond J. Gronwall
Policy Analyst

RJG/mls

(2)

FRIENDS OF THE EARTH

CRN 8425-185-8

NEW ADDRESS:
P.O. Box 728
Palisade, CO 81526
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March 19, 1984

Rec'd
COM
3/21/83

Mr. Tom Coe
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814

Dear Mr. Coe:

The following comments are officially submitted by Friends of the Earth on the Draft Environmental Impact Statement of the Getty and Cities Service Shale Oil Projects. We have several major concerns which apply to the entire EIS, which we shall first discuss, followed by more specific comments on the major sections of the EIS.

One of the major problems with the EIS, from our viewpoint, is that for all practical purposes it totally ignores the detailed, written scoping comments of September 28, 1983 which Friends of the Earth submitted. In our comments we requested a substantive analysis of the cumulative impacts of the shale projects in question, as well as the other energy projects in the region; air quality and acid precipitation issues; and options regarding waste disposal. The EIS draft does not meet this request. 1 More significantly, the draft EIS totally omits the analysis which FOE requested of the GCC Reservoir, and related water resource issues. 2 Instead the draft EIS simply references the Clear Creek EIS, apparently on the assumption that the Clear Creek EIS is adequate in its treatment of the reservoir and related aquatic and terrestial impacts. However, in our comments to the BLM on the Clear Creek EIS we have contended, and continue to do so, that the Final Clear Creek EIS does not meet NEPA requirements, partially on the basis of its inadequate treatment of the GCC Reservoir. In fact, both the description and analysis of the GCC Reservoir were so poorly done that the companies involved wrote lengthy letters revealing some of the basic facts. Lastly, there have been concerns expressed at the initial meetings on the GCS EIS that this EIS should be able to stand as an independent statement, rather than simply being a jumble of references and studies from other oil shale EIS's and documents. Therefore, in order to achieve a comprehensive and defensible EIS, as well as provide proper background for the decision on the 404 permit for the project reservoir, we request complete description; alternatives; and environmental consequences sections be included for the GCC Reservoir, and related aquatic, terrestial, and water resources impacts. Including the USFWS biological assessment is necessary, however, it will not meet all of the suggestions listed both here and in our scoping comments. 2

Another general criticism relevant to the entire EIS is the lack of certainty and specificity about nearly every issue. This is reflected in the tone of the EIS by the continual usage of words such as: "may," "might," "should," "minimize," "potential," "anticipated," "expected," and "unlikely." The usage of these words also exhibits a rather remarkable downplaying of many of the impacts associated with the shale projects. An example from Section 4.4.3, p. H-160 demonstrates: 3

cc: Zimmerman, Fanko, Rohler, Goodwin, EIS Team, Wahtola, McMullan

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4.1.1
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4.1.3

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"Cumulative impacts to bedrock aquifers should be somewhat limited due to several factors . " ". . . the potential for cumulative impacts to the alluvial aquifers appears to be greater." (Emphasis added.) The treatment of waste issues throughout the EIS is generic, and at times exhibits wishful thinking, as shown by comments such as: "Toxic wastes may be generated by oil shale. . ." (Unfortunately, a number of toxics are generated, and the types and amounts depend on the type of shale, technology, and other factors. These should be listed and discussed in the EIS.) In sum, the draft EIS needs a major rewriting if it is to acquire the specificity to be accurate and realistic. 3

The below comments are made roughly in the sequence of the draft EIS outline. All comments, unless otherwise noted, basically apply to both Getty and Cities Services, so as to avoid the repetition. The below statements touch on some of the more glaring deficiencies; we suggest the entire DRAFT EIS needs thorough overhauling. 4

PURPOSE AND NEED

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The purpose and need section is descriptive of the companies' intentions, accompanied by a feeble attempt to denote oil shale as a feasible alternative energy source. We suggest a thorough factual analysis to support the statement: "This alternative energy technology is perhaps closer to commercialization than some of the others mentioned." We also assume that EIS's are done to detail and analyze the impacts of projects, not to serve as an "example of the progress of two of these shale oil projects." (page 1-4) 5

PROPOSED ACTION AND ALTERNATIVES

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Our basic issue with this section is that the alternatives are not fully included, much less explored in any detail. A number of alternatives are eliminated from consideration with little rationale. As an example, the GCC Reservoir is included as acceptable on an economic basis, but Ruedi Reservoir is eliminated also on this basis, with no explanation for either choice. Additionally, why is Ruedi water eliminated when it has previously been cited as a source of augmentation water for Colorado River diversions, and when Texaco, now the owner of Getty, has bid for Ruedi water? 6

Secondly, regarding facility locations there was no flexibility exhibited in the alternatives for the retort and upgrading plants. While this was apparently done on the basis of air quality data, that data is not referenced or explained. 7

Thirdly, on the issue of public lands impacts, listing of section numbers is not a sufficient explanation of the anticipated impacts or alternatives. Please include maps to show where project facilities would cross and/or impact BLM lands. Also include the affected acreages and resources. 8

Fourthly, since neither Getty or Cities have developed their own working oil shale technology, and since these companies do not have solid plans or schedules for real oil shale development, the choice of technologies in the alternatives presents real difficulties. 9

The EIS is based rather heavily on Union B technology. In addition to the current technical and environmental problems with the testing of Union B, the refinement of Union B, which is Unishale C, is also being pilot tested. By the time Getty or Cities might have a real shale project, it's unclear what stage of the Union technology would be relevant and useful. And since

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different shale technologies produce different impacts in terms of spent shale disposal, air quality, etc., any assessment based solely on Union B will be quite incomplete. The heavy reliance on Union's plans is also exhibited in the section 2-20-2 on spent shale disposal and reclamation. The repeated references to Union's engineering design are used as a basis for the discussion of spent shale disposal, however, we could not find any references in the bibliography other than Union's Mined Land Reclamation application. Furthermore, the engineered shale dump with the underdrain, which is the major component of Union's disposal plans, has come under heavy criticism from a number of fronts, including the Mined Land Division. So why is this option the centerpiece of the waste disposal discussion in the EIS? Since this is a speculative EIS with no basis on a proven technology, it presents great difficulties in delineating alternatives, as we pointed out in our scoping comments. Please refer back to our scoping comments for guidance. 9

The discussions of spent shale disposal (p. 2-28) for the Lurgi technology, and for the Vertical Modified In-Situ technology (p.2043) are so generic as to be meaningless. It's different to ascertain why VMIS is even being considered since Occidental (Cities' parent company) has never been able to produce anything resembling consistent production from their MIS test retorts, much less on a commercial basis. We suggest a much more detailed discussion of the Lurgi and VMIS technologies especially in comparison of impacts with the Union technology. Retort abandonment for VMIS and worker health and safety issues associated with MIS are virtually ignored throughout the EIS. We recommend these issues be included in the alternatives and the environmental consequences sections. 10

Fifthly, the impact comparisons are also so generic as to have little meaning. The descriptive terminology centers on "lesser" or "greater" impacts per alternative; how much lesser or greater is left strictly to the numerical rating system. This numerical system does not indicate site-specific impacts or cumulative impacts, and the values that are the basis for the rating system are not revealed. For example, why would the 50,000 bpd alternative (p.2-74) produce a spent shale pile of the same dimensions as the 100,000 bpd alternative, but supposedly create less impacts? We suggest a specific factual analysis to back-up and describe the various alternatives throughout the section, with attention given to beefing up the impact comparisons, too. 11

Lastly, the no action alternative(which is repeated for both projects) is so skewed towards the supposed negative consequences of not building the projects, that it is inaccurate and ludicrous. First of all, the impacts of the two projects would presumably be somewhat different, yet here, as throughout the EIS, generic statements are repeated for both projects. Secondly, we fail to see how non-construction of reservoirs and pipelines, with its associated retention of the ecosystem can be considered as having NO beneficial impact to the environment. (See point 4 of sec. 2.4.3.2.11.) Also, non-development would lessen or alleviate socio-economic problems in the boomtowns—how can this be construed as "elimination of the economic and social benefits?" Obviously, the no action alternative needs further evaluation and truthful descriptions. 12

AFFECTED ENVIRONMENT

Due to lack of time we could not thoroughly evaluate this portion of the EIS; however we shall note a few more apparent deficiencies.

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AFFECTED ENVIRONMENT (con'd)

On page 3-8 Aquatic Ecology and fishery designation, we suggest also including the State of Colorado's stream classification, which is specific to sections of the drainages in question. 13

On page 3-11 regarding Vegetation, we suggest equal treatment of endangered plant species with wildlife. For example, please include maps of the ranges of the plant species, too. 14

15 Regarding the socio-economic section we believe there is too heavy a reliance on the Mountain West report. Given the number of other reports that are available, we suggest that you consult and incorporate them in order to give a more comprehensive view of the socio-economic structure of the region. Also, there are a number of statements on Mesa County, p. 3-39, which are quite unsubstantiated in our view. For example, contrary to the statement of the agricultural and elderly populations being the least affected by oil shale development, these groups have probably been among the most adversely impacted, due to the increased price of land and pressure for housing, with which they cannot compete. 15

On Page 3-4 heavy metals are also an issue with certain sections of streams and the Colorado River.

ENVIRONMENTAL CONSEQUENCES

The environmental consequences section is gravely deficient, based on a number of problems which we have already described for earlier sections, including:

a) no description or discussion of the GCC Reservoir 16

b) general, uncertain language which downplays many impacts 17

c) ill-developed alternatives which affect the entire EIS 18

d) no firm decision on the type of technology, which renders much of the discussion of consequences meaningless. 19

e) need for additional studies, as exhibited in the groundwater discussion (p.4-17) 20

f) totally inadequate treatment of air quality, waste stream, and toxics issues. 21

g) mitigation consists of philosophical proposals and general programs, with no treatment of project abandonment issue 22

h) cumulative impact section is inadequate in detailing the locale, extent, and irreversibility of impacts 23

24 In sum, we still contend that this EIS is not only speculative in nature, but totally premature. The Draft EIS exhibited this in its inability to comprehensively treat impacts when the type of technology is not tested or decided on. Furthermore, given the major omissions in the Clear Creek EIS regarding the GCC Reservoir, if the GCC EIS treats this issue lightly, there is a major risk of permitting the reservoir without the benefit of an adequate and defensible EIS to analyze alternatives such as use, size, etc. This could have drastic implications for the Colorado River and endangered species habitat, among other resources. 24

Thank you for the opportunity to comment.

[signature] Carrie Albrecht, Colo. West Representative

(3)

Getty

Getty Mining Company | 3810 Wilshire Boulevard, Los Angeles, California 90010 • Telephone (213) 739-2100

Mine Technical Services

March 19, 1984

Mr. Tom Coe
Regulatory Section
Construction - Operations Division
U.S. Army Corps. of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814

CRh8425/85-06

RE: Draft Environmental Impact Statement
Getty Shale Oil Project

Dear Mr. Coe:

Enclosed are comments submitted on behalf of Getty Mining Company with respect to the Draft Environmental Impact Statement published January 20, 1984. We understand that separate comments are being submitted by Cities Service Company as to those aspects of the document relating to their project.

The Getty comments are divided into Comments Affecting Meaning of Text and those remaining Specific Comments. We feel that the first set may affect the actual meaning and need clarification in the Final EIS. The second set relate to more detailed aspects of the document.

In general, we feel the Draft EIS is well done and organizes a great deal of information in a clear and manageable format. We are prepared to assist in responding to comments on the document by other public and private entities, to the extent deemed appropriate by you or your contractor.

We appreciate your continued efforts in completing the Environmental Impact Statement in a timely and accurate manner.

Yours very truly,

[signature]

C. A. Zimmermann

CAZ:ig

cc: Mr. S. Mernitz
Mr. J. M. Mintz
Mr. C. W. Rohler
Mr. W. C. Robb

bcc: J. P. Davies
D. A. Nichols
J. E. Maguigan
P. W. Marshall
D. F. Rogers
M. J. Franko

cc: EIS Team (incl wattle)
FG 4.1.1
4.1.2
4.1.3
10.3

3

COMMENTS AFFECTING MEANING OF TEXT

Page iii, 2nd paragraph: Correct to read: "one 50,000 bpd addition". 1

Page 1-2, Section 1.3.1: Under Environmental Protection Agency, reference to EPA review of plans for Noise Control and Spent Shale disposal should be deleted. EPA has no direct authority in these two areas. 1

Page 2-3, Section 2.2: The underground disposal alternative should be referenced to footnote (2), not to footnote (4). 2

Page 2-9, Table 2.3-2: Public lands identified within this table whose project feature is mining should be deleted as they were erroneously included in the table.

Page 2-11, Mining, last paragraph: The last two sentences are unclear as stated. The intent is that several shafts will probably be required for the second Getty 50,000 bpd mine. The second mine may or may not be connected to the first mine for safety, operating, economic and/or other reasons.

Page 2-16, Figure 2.3-5: Add footnote: Underground Mining will advance up to the Getty property line in accordance with standard mining practice and in compliance with Colorado Mining Law.

Page 2-18, Figure 2.3-8: The material balance that is presented is the same as for Figure 2.3-20 which is Cities. The correct Getty raw shale input is 150,000 TPO with outputs of Crude Shale Oil of 18,000 TPO, Spent Ory Shale of 126,000 TPO, Sour Water of 2,000 TPO, and High - BTU Gas of 4,000 TPO.

Page 2-25, Water Source and Supply System, 4th paragraph: Correct to read: "14,000 gpm", not "gpd".

Page 2-29, Section 2.3.1.3.1, Water Supply System, second paragraph: Should read similar to equivalent paragraph on page 2-25.

Page 2-60, Table 2.4-1: The difference in the surface water impacts ratings for the two GOC alternatives is too big. It appears that the rating for 50,000 bpd is in error. 2

Page 3-11, Vegetation, last paragraph: Getty does not agree that all candidate plant species are appropriate for listing. As more data becomes available downlisting is often appropriate and has already occurred for several candidate species for listing. Oistribution and abundance data often suggests that the population of the species is larger and more widespread than previously recognized. 3

Page 3-16, Sensitive Habitats, 2nd paragraph: Not enough supporting information to include cliffs as an important habitat; cliffs do not seem to fit the stated criteria. 4

Page 3-54, 3rd paragraph: If Tom, Ooe, Buck, and Oeer Park areas are critical habitat for wintering elk, please provide a reference to indicate that each may be specifically important to wintering elk. 4

3

Page 4-5, Section 4.1.6, 2nd paragraph: Statement refering to the Redente and Cook study is overly pessimistic; it should be revised to agree with the corresponding statements made in the sections on vegetation for the two projects (4.2.6.1 and 4.3.6.1). 5

Page 4-18, 4th paragraph: Runoff ponds will be unlined. Spent shale leachate ponds will be lined. Rewrite for clarity. 6

Page 4-18, 5th paragraph: Per COM/USACOE comments at the recent EPA meeting, there are not 12 springs in the spent shale disposal area. The "over 200 gpm" number is misleading because 1983 was not a representative year in that the runoff quantities exceeded the 100 year event. 6

Page 4-36, Section 4.2.8.1: 100,000 bpd Lurgi Retorts; second paragraph: percent should be 60; third paragraph: percent should be 60. 7

Page 4-37, Table 4.2-10: The Carbon Monoxide (CO) impacts do not change by a factor of two when comparing the 100,000 bpd and the 50,000 bpd. Also, the impacts from Lurgi alternative do not change by a factor of two when comparing 100,000 and 50,000 bpd.

Page 4-39, Table 4.2-11: Correct the title for the first row to read: "Union Retorts 50,000 bpd".

Page 4-40, Table 4.2-12: Total concentrations of Total Suspended Particulates (TSP) for underground disposal are incorrect due to adding the wrong background values to the impact values.

Page 4-41, Table 4.2-12: SO_2 impacts and total concentrations for the proposed action are not impacts but are PSO Class I increments.

Page 4-41, Table 4.2-12: Carbon Monoxide (CO) impacts are not presented.

Page 4-43, Table 4.2-14: TSP emissions for space heating should be "2 Tons/year" as in Table 4.3-16 not "22 tons/year".

Page 4-166, Section 4.4.8: Air Quality, 1st paragraph: The primary source of air quality impact at Colorado National Monument should be identified as it is for the Mt. Zirkel Wilderness. 7

Page 4-168, Table 4.4.7: Production level values for Cities and Getty should be 100, as the units in the table are thousands of barrels of oil. 8

Appendix C, Table C-5 and C-6 were referenced in the text, but are not found in the appendix or in the report. 9

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SPECIFIC COMMENTS

Page 1-4 Section 1.4: In the fourth sentence of the first paragraph on this page, delete the words "contains a larger proportion of growth for" and insert "yields a larger proportion of". 10

Page 1-5, Section 1.4.1: In the first line of the fourth paragraph, delete the words "national interest" and insert "nation". 10

Page 2-11, Section 2.3.1.2.2: In the fourth sentence of the second paragraph, delete the word "daily". 11

Page 2-15, Table 2.3-5: Natural gas should be shown as an alternative fuel for all "combusters", except mobile equipment.

Page 2-19, Section headed Retorting: The third sentence should read, "A portion of the product oil may be used directly for fuel."

Page 2-20, Spent Shale and Waste Rock disposal, 2nd paragraph: The phrase in parenthesis is out of place. The correct meaning is the compacted blanket of retorted shale is 10 foot thick (measured normal to the slope). 11

Page 2-66, Section 2.4.3.1.5: In the surface water paragraph the asessment of impacts is pessimistic. Factors cited in the following paragraphs on Ground Water outline the cohesive property of the Lurgi processed shale tends to reduce the potential for adverse impacts. Further, design and operation, with proper handling and drainage control plans, will reduce hydrologic impacts. 12 12

Page 3-19 Section 3.1.8: Immediately after the first paragraph, the first sentence of the first paragraph of page 3-22 should be inserted, to explain the use of the term "sensitive" in the proceeding sentence. 13

Page 3-24: Ozone: The probable cause for high values should be discussed.

Page 3-24: Air Quality Related Values: The last three words of the first paragraph should be deleted; they imply an operator's obligation which does not exist. 13

Pages 3-48 through 3-52: Ground water discussion of upper and lower aquifer is only presented as an interpretation. Aquifers must be defined in context of geological formation. 14

Page 3-54, Section 3.2.7: Tom Creek Canyon was identified as a corridor for migrating elk. However, the reference is unclear (two CDOW references in 1983) and the facts seem contrary to the available data. 15

Page 4-8 Noise: Table 4.1-1: Blasting is listed "at Operators Position" as having 140 dB. Personnel are always remote from blasting at the time of detonation. 16

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Page 4-13, 4th paragraph: The text reads "volume of 1.3 x 10^{-7}" and should read "1.3 x 10^{7}" 17

Page 4-14, 4th paragraph: The elevation at the top of the cliff is 7800 feet not 7600 feet as in the report.

Page 4-14, 4th paragraph: "An embankment structure at the toe of the disposal pile may be needed to prevent mass movement..." No determination for the need of an embankment can be made at this time. 17

Page 4-15, Section 4.2.2: 4th paragraph "No more than 200 acres" should read "approximately 200 acres". 18

Page 4-16, last paragraph: This paragraph needs to be consistent to water with the 3rd paragraph on page 4-19. 18

Page 4-22, last paragraph: Does 3825 acres include the GCC reservoir and Roan Valley corridor? 19

Pages 4-22, last paragraph and page 4-25, 4th paragraph: We disagree that reclamation and revegetation will not be permanent "without a continued input of water and fertilizer". Permanet revegetation is a realistic goal that can be achieved. Planned revegetation will employ a topsoil cover to facilitate revegetation. 19

Page 4-39, Section 4.1.8.1: Distance to Flat Tops from Getty property should be about 45 miles. Please check. 20

Page 4-39, 50,000 bpd Lurgi Retorts: The use of the second highest concentration to determine impacts on short term standards should be standard practice. This is the only place where this practice is cited.

Page 4-42 and 4-43 Table 4.2.13 and Section 4.2.8.3: Emissions of toxics, should not be discussed as those from Union B Retort Off-Gas. The table applies to demonstration retort only. Should be footnoted as example of what toxic emissions might be. 20

Page 4-44, 5th paragraph: Noise: Note that 108 dBA should probably be at 50 feet. Why are the trucks on the haul road 105 dBA and the trucks on the level spent shale pile 108 dBA? 21

Page 4-48, Land Use, 1st paragraph: "No prime farmland" would be affected per this paragraph, but on page 4-161 (last paragraph, first sentence) it is not clear if Getty will or will not affect prime farmland. 22

Page 4-52, 3rd paragraph: Employment levels by year and for 50,000/100,000 bpd are unclear. 23

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Page 4-165, Section 4.4.8, 2nd paragraph: Reference for TAPAS model is personal communication, not technical report. 24

Page 4-168, Section 4.4.8" Acid deposition references are from personnel communications, not technical report. 24

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E OF COLORADO RICHARD D. LAMM, Governor

DEPARTMENT OF NATURAL RESOURCES

DAVID H. GETCHES, Executive Director
1313 Sherman St., Room 718, Denver, Colorado 80203 866-3311

Geological Survey
Board of Land Commissioners
Mined Land Reclamation
Division of Mines
Oil and Gas Conservation Commission
Division of Parks & Outdoor Recreation
Soil Conservation Board
Water Conservation Board
Division of Water Resources
Division of Wildlife

March 21, 1984

Mr. Tom Coe
U.S. Army Corps of Engineers,
Regulatory Section
Sacramento Division
650 Capitol Mall
Sacramento, California 95814

Dear Mr. Coe:

The State of Colorado is pleased to submit comments on the Getty-Cities Service Shale Oil Projects Draft Environmental Impact Statement. This letter presents a general overview of our comments, with our discipline-specific comments attached.

1 The scoping process for these projects yielded a long list of significant issues to be analyzed in the DEIS. Unfortunately, the document does not fully analyze and disclose the impacts associated with a majority of the identified issues. One possible explanation is that the project descriptions and impact analyses are themselves very vague. The degree of similarity in the descriptions of both projects and their impacts suggests oversimplification. 1

2 The utility of the DEIS document to federal decision-makers is doubtful in light of frequent failure to quantify impacts, repeated mention of designs and impacts to be addressed in future permitting efforts, heavy reliance on sources of information not easily accessible to reviewers, and overuse of qualifiers (if, could, may, etc.). The attached comments cite numerous examples of the vagueness which dilutes the value of the DEIS. 2

3 Important data and analyses are lacking in the DEIS. Many are discussed in the attached comments. An especially glaring omission is the failure to discuss impacts to federal lands necessary for the projects. Necessary BLM land use authorizations, including land exchanges, land purchases, rights-of-way and leases are identified on page 1-2, and the potentially affected lands are identified in Tables 2.3-2 and 2.3-9. But specific information on the proposed major federal actions and disclosure of their associated impacts are not included. 3

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The absence of information on waste stream characteristics from the various retorting, processing and upgrading facilities is a similar deficiency. The uncertainties associated with the regulations governing potentially hazardous mining wastes are acknowledged on pages 2-26 and 2-52. However, the descriptions of waste disposal plans go on to state that "due to these uncertainties, the types and quantities of any waste is indeterminant." We fail to see the connection between how a particular waste product will be regulated and the disclosure of what is actually produced. In our scoping comments we specifically requested that the EIS identify and characterize each individual waste stream by the projects. Unfortunately, our recommendations on this and other significant issues were not heeded. 4

We find the DEIS inadequate. It does not meet the intent of the National Environmental Policy Act (NEPA) and is not consistent with the compliance guidelines promulgated by the Council on Environmental Quality. We recognize that in many respects the proposed projects are in an early stage of development. Nevertheless, the Corps is not relieved of its responsibilities under NEPA to ensure that there is an early and comprehensive analysis of the direct and indirect effects of the proposals and any related actions. 5

I hope our comments will be helpful in revising the DEIS. If you would like to discuss any of the questions or issues raised in our comments, please contact Adam Poe of my office to arrange a meeting.

Sincerely,

DAVID H. GETCHES
Executive Director

DGH:ljc
Attachment

(4)

STATE OF COLORADO
COMMENTS ON THE
GETTY-CITIES SERVICE SHALE OIL PROJECTS
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Colorado state agencies have reviewed the Getty-Cities Service Shale Oil Projects Draft Environmental Impact Statement. Outlined below are the major comments organized by discipline.

Air Quality

The comments on the portions of the DEIS related to air quality were prepared by the Colorado Department of Health, Air Pollution Control Division. It should be noted that the comments are based solely on the information contained in the DEIS since an air quality technical report was not submitted. 6

Emissions: 7

Both Getty and Cities Service expect to use the Union retorting process. Thus, emissions from the combustion of char on the spent shale should be considered. Union intends to test this technology and possibly incorporate it into their process. This could result in a change in emission levels, especially in terms of NO_x. 7

8 The cumulative impacts analysis on page 4-166 must include Gary Refining Company in Fruita; Gary's actual emissions are increment consuming. Hayden power plant must be considered for acid deposition purposes but not for increment consumption purposes. 8

9 The emission rates for the projects used in the cumulative analysis must be listed.

10 The major types of control equipment used on the project should be identified (p. 4-31).

Impacts: 11

The cumulative visibility analysis is inadequate (p. 4-167-8). A level 1 screening analysis for each source is not adequate to assess impacts and cannot be used to support the conclusion that "no regional haze problems are predicted." No mention is made of which Class I and sensitive Class II receptors (e.g., Colorado National Monument, Dinosaur National Monument, Rifle Gap State Park, Powderhorn Ski Area) would be affected; nor is there mention of the effects of overlapping plumes. The Division understands that cumulative visibility modeling is difficult; however, this EIS gives no indication of what might be expected. 11

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Is the pH of sensitive lakes in the Flattops Wilderness Area going to change? The Chevron Clear Creek EIS indicated that potential shifts would occur; the cumulative acid deposition analysis in this EIS shows no impact. Because this EIS considered more sources than did Chevron, this phenomena should be explained in more detail. 12 12

Please explain why the lurgi 24-hour SO_2 impact at Flattops (p. 4-37) is shown to be less than for the proposed action even though the emissions are higher (98 vs 91 ug/m^3). 13

An estimate should be done of the amount of emissions (mainly TSP emitted at low levels) from Getty and Cities Service which might be caught in drainage flow and transported down to Clear Creek. With this information and emissions data from Pacific and Chevron, a box model analysis in Clear Creek should be performed as part of the cumulative impact assessment. 14 14

The meteorological conditions which were used when estimating cumulative air quality impacts are not given. Are these met conditions based on actual data or hypothetical situations? Was a separate set of worst-case meteorological conditions selected for each of the ten receptors listed on page 4-165? Each of these sensitive receptors should have been analyzed under its own worst case conditions. 15 15

High 24-hour SO_2 impacts were found at Flattops Wilderness Area. The statement (page 4-32 and 4-100) which, paraphrased, said that "transport of significant quantities of SO_2 and TSP for other regulated averaging times (3-hr. and annual) would not be likely at Flattops and other sensitive receptors because of distances and low probability of the necessary meteorological conditions" is confusing and probably incorrect. Met conditions necessary for a high 3-hour impact, principally persistent wind direction, would be <u>more</u> likely to occur at these sensitive receptors. 16 16

Other:

On pages 3-23 and 4-33, the TSP background levels are too low and would not be accepted by the APCD. The Division recommends background concentrations of 20 ug/m^3 annual and 80 ug/m^3 24-hour for this region of the state. Also, the statement on page 4-165 that "existing TSP concentrations are below the measurable limit" is incorrect. 17 17

Page 4-32 - A statement should be made that the entire Getty project may not be permitted since the total SO_2 increment at Flattops is not available and 4 ug/m^3 20-hour impact will probably exceed the increment. 18

The Division questions the use of ISC, a flat terrain model, in estimating long range impact in complex terrain. The new model "Shortz" would be more appropriate. 19

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<u>Water Quality</u>

The water quality comments below are based on a review of the DEIS, however, they are also pertinent to the issuance of the required 401 Water Quality Certification.

Spent Shale Disposal:

The design and impacts of the spent shale pile and associated liner and underdrain (if applicable) systems are not presented in sufficient detail. The EIS identifies no means for monitoring the integrity of the liner system or addressing any failures of that system. 20

The potential for water quality impacts will result from the movement of water through and over the spent shale. Geochemical modelling of reactions within the pile would appear essential to the prediction of leachate chemical composition and resulting surface and groundwater impacts. Rates of leachate loading to streams and/or aquifers will also be a contributing factor. The use of process wastewater for spent shale moisturizing will likely compound potential impacts. Process wastewater may contain priority pollutants which may alter reactions within the pile and/or aggravate the impacts of leachate on receiving water quality. This will needlessly complicate runoff/leachate treatment, should such treatment prove necessary. The Water Quality Control Division, therefore, cautions against this aspect of the proposal. 21 21

Analyses of erosion factors should also include consideration of alternative models as well as site-specific calibration of the selected model. The resulting impacts on basin morphology, flow, sediment transport, or water chemistry should be addressed. 22

Reservoirs:

Temperature and D.O. modelling should be done and the impacts of alternations of existing levels as well as sediment deposition within the reservoir should be evaluated. Other factors which should be considered include: "clear water" scouring and alteration of stream morphology and hydraulics below the reservoir; ultimate fate of scoured sediments; nutrient loading to the reservoir (eutrophication potential), destruction of spawning areas, etc. on existing and proposed beneficial uses. 23 23

All analyses must consider the effects of upstream hydrologic alterations (e.g., construction of spent shale pile and resulting TDS increase) on inflows to the reservoir. If a reservoir is to be dismantled after use, the impacts on channel morphology, hydraulics, etc. need to be assessed. Otherwise, plans for their operation and maintenance need to be included in the EIS. 24 24

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Wetlands:

No evaluation of the hydrologic or water quality related values or functions of impacted wetlands is contained in the document. Attenuation of runoff peaks, runoff detention, groundwater recharge, and pollutant settling, adsorption, and uptake from surface and subsurface waters are some of the possible functions for which mitigation will likely be required. 25 25

Channelization of Streams: 26

Detailed discussion of any proposed or anticipated stream channel alternation, by the developer or resulting from upstream modification of flows or sediment transport, is absent. These should be addressed with emphasis on impacts to existing beneficial uses and should include sediment scour, transport, and deposition, and velocity analyses. 26

Diversion Dams: 27

The impacts of flow depletions, obstruction of recreational use, obstruction of fish migration, and instream construction activity need to be assessed and mitigated. 27

Miscellaneous: 28

The plans for and the impacts of VMIS retort abandonment must be included in appropriate sections of the EIS. Statements such as the one found on page 2-74, "Existing data indicate that prudent use of the VMIS process and associated water handling (or treatment if necessary) should keep impacts in the low to medium adverse range, with a slightly lower rating for the 50,000 bpd alternative" are reassuring but do not disclose project-related impacts. The 4th paragraph in section 4.3.3.1 (page 4-85) is also a good example of where the overuse of qualifiers renders a discussion of impacts practically meaningless. 28

The design lives for the diversion dams, reservoirs, shale piles, etc. must be long enough to prevent any impairment of beneficial uses. Long term operation and maintenance for many of the project's facilities needs further clarification, detail (particularly the shale pile, reservoir, sediment traps). 28a 28a

There should be more detail in the EIS about model selection, theoretical aspects, justification of assumptions, sensitivity analysis, and alternative models available and reasons for their rejection. Modelling should use a representative sample for inputs, with adjustments for proposed basin alternations. Stochastic modelling of hydrologic time series through use of an autoregressive model should be done. 29 29

Management practices and plans of operation for construction activities that will minimize and mitigate beneficial use impairment need to be drawn up. 30

Plans for correcting and mitigating any failure of systems, pipeline breaks, accidental spills, failure of revegetation plans, etc., need to be written. 31

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Plans for mitigation or compensation for unavoidable beneficial use impairment need to be written. 32

Other Specific Comments:

Page 3-8 paragraph 6 - Engineering Science found an overpopulation of brown trout in the West Fork of Parachute Creek. 33

Page 3-47, paragraph 4 - Clear Creek and Roan Creek are also classified for Recreational (class 2) uses. 34

Page 3-47, paragraph 6 - West Fork Parachute Creek is also classified for Recreational (class 2) uses. 34

Page 3-52, paragraphs 4 and 7 - See comment for page 3-8 above. The existence of an abundance of brown trout would indicate that the fishery habitat is not poor. The breaching of the dam does not rule out the possibility of reestablishing a fish population. 35

Page 3-61, paragraph 1 - The fecal coliform standard is 2,000/100 ml for this segment. 36

Water Quantity 37

The discussion concerning the approval of reservoirs is no longer correct. CRS 37-87-109, was amended last year to state in part that "No reservoir of a capacity of more than one thousand acre-feet of water and having a dam or embankment in excess of ten feet in vertical height from the bottom of the channel to the bottom of the spillway, shall be constructed in this state unless the plans and specifications for the same have first been approved by the state engineer in accordance with regulations established by the state engineer governing such approval and filed in his office." Other substantive changes were also made in this statute. We suggest a copy of the amended statute be obtained. Further modifications to the amended statute are presently being considered by the Colorado Legislature.

The EIS should state what structures fall within the review requirements of CRS 1973, 37-87-109, quoted above. 37

We were pleased the Getty discussion listed the quantity, the adjudication date and appropriation date of their Colorado River De Beque water right. We would like the EIS to list the Water Court case number associated with this water right and indicate that the priority is based upon adjudication date. The EIS should also include a brief yield analysis summary of the water rights involved. 38

The Cities Service discussion contains little information about their Colorado River diversion. The EIS should include the water right information that is discussed above. 38

An alternate water supply for Cities Service is discussed on page 2-87. Would further Water Court actions be necessary to use the Larkin ditch water supply? Would any Water Court actions be required for Getty's alternative water supply plan? 39

Do the two project's water rights allow for the reuse of wastewater and zero discharge? 40

41 The EIS should briefly discuss the water rights and augmentation plans needed to replace loss of water or out-of-priority use of water caused by the following:

- o retention dams below the spent shale pit;
- o storage in other sedimentation reservoirs;
- o interruption and use of spring flows by the operations;
- o runoff from above the spent shale pile that is not returned to the natural drainage;
- o inflows into the mine that are not returned to the natural drainage. How much water will be removed from each of the creeks in the Roan Creek basin? What impacts are expected in the basin on water users whose land is not taken out of production? Will water be transferred out of the Parachute or White River basin?

Augmentation plans should be included as a potential mitigation measure in section 4.8. 41

On page 4-17 and page 4-86, it is stated that mine inflows will be discharged in such a manner so as to minimize contact with soluble mined spent shale materials. Will this water be discharged to the natural drainage or be retained? 42

43 Pages 3-52 and 3-65 discuss ground water use in the area of the projects. We think the Environmental Impact Section should comment on the impacts to these users even if it is negligible. Also, wells constructed before 1965 were not required to register. Has a physical survey been made of the area for wells? 43

The EIS should comment that injury to water rights due to the construction of the various corridors will be mitigated. 44

45 It is apparent that further ground water testing needs to occur on both sites. Has testing been scheduled? What will be included?

Is further testing planned for either project to determine the effectiveness of the shale liner in preventing leachate infiltration? 45

46 The state's scoping comments (see letter from Adam Poe to Tom Coe, November 18, 1983) called for an investigation of the potential for using highly saline water for spent shale compaction and/or process water The DEIS does not address this possibility. We believe the FEIS should contain such an analysis. 46

Wildlife 47

The Wildlife portions of the DEIS were largely based on the results of a wildlife impact analysis performed by the U.S. Fish and Wildlife Service and the Colorado Division of Wildlife. The results of the analysis indicated that the projects would have significant impacts on the state's wildlife resources. In order to help alleviate the identified impacts, a list of mitigation recommendations was submitted as well. Unfortunately, the DEIS indicated that neither Getty nor Cities has committed themselves to mitigating any wildlife impacts. In keeping with past practices of other EIS's, the FEIS should clearly indicate which measures are committed to and which remain uncommitted. By the time the FEIS is released we would expect both companies to clearly indicate those wildlife mitigation measures that they will voluntarily implement. 47

Natural Areas 48

The Colorado Natural Areas Program's review of the Getty - Cities Service Shale Oil Project DEIS reveals that it does not contain sufficient information to evaluate the potential impacts to plant communities from the proposed project. Although the DEIS contains information suggesting that there will be significant impacts to federally listed and candidate plant taxa from the proposed projects, it does not identify any adverse impacts to these plant taxa. The Colorado Natural Areas Program finds that the analyses in the DEIS are based on incomplete vegetation baseline data and are incomplete for expected environmental impacts from the proposed project. CNAP recommends 48 that approval by the Army Corps of Engineers of the Getty - Cities Service application for a 404 permit be denied until completion of 1) adequate field surveys for plant associations on the project site; and 2) a thorough analysis 49 of the impacts on vegetation from the proposed project.

50 Neither the Getty - Cities Service DEIS nor the R. W. Beck Environmental Baseline Description consider important plant associations on the project site. CNAP's Natural Heritage Inventory publishes annually a "plant associations of special concern" list containing Colorado plant communities which are rare, endemic, disjunct, threatened throughout their range or in Colorado, or vulnerable to extirpation in Colorado. Attachment I (see back of comments) contains a list of plant associations of special concern which are likely to occur on the proposed project site and for which data are lacking in the DEIS on their location, extent, and condition. Project proponents need to cooperate with CNAP's Natural Heritage Inventory to access existing data on, and to complete on-site field surveys for, plant associations of special concern. This needs to be done prior to a final determination of project impacts on those plant associations of special concern to the State of Colorado. 50

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CNAP's Natural Heritage Inventory also publishes annually a "plant species of special concern" list which contains species of plants which are rare, endemic, threatened throughout their range or in Colorado, or vulnerable to extirpation in Colorado. Potential impacts to threatened, endangered, or sensitive plant species are not adequately or consistently identified or assessed in the DEIS. For example, Table 4.4-3 (DEIS, 4-163) indicates that the proposed project will cumulatively affect 10% to 100% of each of the federally listed and candidate plant species' populations in Colorado. However, the discussion of "unavoidable adverse impacts" from the development of the Getty - Cities Service Shale Oil Project omits any mention of the significant impacts on federally listed and candidate plant taxa acknowledged earlier in the DEIS. Similarly, the "irreversible and irretrievable commitments of resources" section omits any mention of the irretrievable loss of significant percentage of populations of these plant taxa in Colorado. Furthermore, Table 4.2-3 shows no populations affected by the projects' Roan Creek reservoir, even though 83% of the Debeque population (7% of the known Colorado population) of Sclerocactus glaucus (federal threatened) will be extirpated by the project. Attachment II lists specific comments related to information on special plant taxa contained in the Getty - Cities Service DEIS. Inconsistencies in the DEIS on plant data and on project impacts to federally listed and candidate plant taxa must be clarified by project proponents prior to a more thorough evaluation of the proposed project by CNAP. 51

Socioeconomics 52

The socioeconomic analysis presented only includes a sketchy discussion of fiscal impacts. Even though the analysis is premature, a useful document, prepared to support the negotiations with local officials at the time of project development," would have more completely presented the assumptions, data, analysis and findings of fiscal impacts.

In the specific sections reviewed,

Baseline	3.1.12.5
Impact - Getty	4.2.13.7
Impact - Cities Service	4.3.13.7
Cumulative Impacts	4.4.13
Mitigation - Getty	4.8.2.13
Mitigation - Cities Service	4.8.3.13

no discussion of the fiscal analysis methods, assumptions or data is provided other than a vague reference to the Cumulative Impacts Task Force and "subsequent augmentation." 52

53 The importance of the missing documentation is emphasized in the impact sections where it is pointed out that severance taxes from the projects will serve as the major response to the public revenues/expenditures jurisdictional mismatch problem. This is a very important conclusion which needs far more documentation to be credible and useful. 53

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54 The socioeconomic mitigation strategy presented in Section 4.8 is composed of brief, euphemistic aphorisms to the effect that there will be enough money for everyone, and the proponents will negotiate and cooperate with local governments. Again, while these are symptomatic of the premature nature of the analysis provided, they do not form the basis of an assessment and mitigation discussion which is appropriate at this stage in both projects developments. 54

55 The last paragraph on page 4-171 asserts that cumulative socioeconomic impacts are probably understated. A brief discussion of this understatement should appear in the EIS.

56 In short, the socioeconomic analysis provided in the Getty-Cities Service EIS should provide more detailed technical materials to document the assumptions, data, methods and analysis used to determine the fiscal impacts. From this material the proponents and affected state and local agencies can proceed with the important discussion, negotiation and agreements that constitute the functioning assessment and mitigation which are the objective of the NEPA process. 56

Transportation 57

The DEIS identifies two major transportation impacts resulting from the development of the proposed project; 1) increased traffic on U.S. 6 which will consume or exceed the highway's capacity on certain segments, and 2) substantial increases in the number of accidents on the transportation system serving the region. While these project-specific impacts are disclosed, the cumulative impacts of both projects have not been adequately addressed. The DEIS does not provide actual project numbers for volumes and accidents in the common project discussion. We feel that it is necessary to estimate these total numbers for both projects so the state as well as impacted local governments can see the magnitude of the cumulative impacts resulting from these two projects. 57

58 We are also concerned that the cumulative impacts to the transportation system of the six or seven proposed oil shale projects as well as proposed coal and mineral developments in the Garfield county are have not been fully discussed in the document. The Colorado Highway Department (CDH) cannot develop a realistic estimate of the cumulative impacts to the highway network without up-to-date figures on number of employees, related population increases, location of employee residences, transportation of employees, ridesharing measures, and project phasing. 58

59 The document makes no estimate of the traffic impact on local roads in the area. Will the only bridge into De Beque from I-70 adequately handle the traffic increase, particularly during peak hours? Present CDH plans show only one interchange near De Beque after I-70 is completed. Tables 4.2-30 and 4.3-32 which discuss traffic projections should include some estimate of average daily traffic on the bridge and the main street in De Beque which will serve work trips through town up to the transit terminal and beyond. 59

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The FEIS needs to provide a more complete discussion as well as a commitment to mitigation measures for the transportation impacts created by these projects. A plan of oil shale development control strategies and funding for mitigation of cumulative impacts needs to be developed in the near future to protect the transportation systems. In addition to the need for new facilities it will be equally important to provide funds on an annual basis to help defray the costs of maintenance of major roadways. 60

Cultural Resources 61

A Class III survey should be completed on all lands, public or private, that will be impacted by the project to determine if there are cultural resources eligible for the National Register of Historic Places. 61

The lead federal agency must consult with the State Historic Preservation Officer on eligibility and effect. At this time, formal consultation on cultural resources has not been initiated. A copy of the Class II cultural resource report by Nickens and Associates has not been received. 62

Page 4-187 Section 4.8.2.10 Cultural Resources; Page 4.193 Section 4.8.3.10 Cultural Resources - It is the federal agency, not the applicant, who is required to consult with the State Historic Preservation Officer concerning possible mitigation measures for sites on public lands eligible for the National Register. 63

Energy

Review of the draft indicated that the Getty Project would have a direct electrical requirement of 210 MW for a production rate of 100,000 barrels per day, with an estimated 27 MW of secondary demand, and the Cities Project would have a direct electrical requirement of 160 MW for a production rate of 100,000 barrels per day with an estimated 34 MW of secondary demand. Combining yields 431 MW. The power would be delivered via a 345 KV transmission line loop from De Beque through the projects back to Parachute.

While the Draft EIS addressed the impact of the transmission line and its corridor, the document fails to provide a discussion of the source of the required 496 MW of electric generating capacity (431 MW requirement plus 64 MW reserve requirement). To place this electrical requirement in perspective, one might look at the previously proposed 500 MW generating station near Mack, Colorado as announced by Colorado-Ute Electric Association. The impact of constructing such a generating station is not inconsequential. Therefore, the issue of the ultimate electric power source is relevant for analysis in the subject EIS. 64

Miscellaneous 65

The wilderness discussion on page 4-10 is extremely vague. How many additional visitors can wilderness areas accommodate and how many additional visits will be generated by the proposed projects and the cumulative population growth. 65

4

The impacts from the use of the Big Salt Wash corridor as discussed on page 4-14 and elsewhere in the DEIS relies totally on the Clear Creek Shale Oil Project EIS. The Clear Creek EIS did not contemplate the use of the corridor for other than Chevron facilities. While the impacts may be similar, it is likely that the cumulative impacts of using the corridor for several projects will be greater than the impacts from Chevron alone. These additional impacts should be identified and analyzed. 66

With regards to the secondary impacts of the Getty project, the statement is made on page 4-15 that "geologic impacts include the use of locally derived mineral resources such as sand and gravel or coal. The exploitation of these resources locally is considered a beneficial use." This statement is made without any basis. How much sand, gravel, or coal will be required. Where will it come from, and how will it be transported to the project site? 67

(4)

Attachment I

68

The Getty and Cities Services EIS is inadequate to assess the presence or absence of Plant Associations of Special Concern. Some of the following Plant Associations of Special Concern are likely to occur on the sites:

G1S1 Agropyron spicatum var. inerme-Oryzopsis hymenoides Great Basin Grassland
Atriplex confertifolia/Agropyron spicatum var. inerme-Oryzopsis hymenoides

G2S1 Agropyron spicatum var. inerme Great Basin Grassland
Juniperus osteosperma-Pinus edulis/Agropyron spicatum var. inerme

G2S2 Artemisia tridentata ssp. wyomingensis-Atriplex confertifolia/Elymus salina
Artemisia tridentata ssp. wyomingensis-Symphoricarpos oreophilus/Elymus cinereus
Juniperus osteosperma-Pinus edulis/Amelanchier utahensis-Artemisia tridentata ssp. wyomingensis-Cercocarpus montanus-Symphoricarpos oreophilus/Agropyron spicatum var. inerme
Juniperus osteosperma-Pinus edulis/Amelanchier utahensis-Cercocarpus montanus Marlstone Barren

G3S1 Atriplex confertifolia/Oryzopsis hymenoides
Elymus cinereus Great Basin Grassland

G3S2 Artemisia tridentata ssp. tridentata/Elymus cinereus
Atriplex confertifolia/Elymus salina
Juniperus osteosperma-Pinus edulis/Cercocarpus montanus/Oryzopsis hymenoides

G3S3 Amelanchier utahensis-Artemisia tridentata ssp. wyomingensis-Cercocarpus montanus-Purshia tridentata-Symphoricarpos oreophilus/Carex geyeri
Artemisia tridentata ssp. tridentata-Sarcobatus vermiculatus/Agropyron smithii
Pseudotsuga menziesii/Amelanchier utahensis-Quercus gambelii-Symphoricarpos oreophilus/Carex geyeri-Poa fendleriana
Pseudotsuga menziesii/Symphoricarpos oreophilus/Carex geyeri-Poa fendleriana
Quercus gambelii-Amelanchier utahensis*-(Artemisia tridentata ssp. wyomingensis-Cercocarpus montanus-Symphoricarpos oreophilus)/Carex geyeri
Quercus gambelii-Amelanchier utahensis*-(Prunus virginiana ssp. melanocarpa-Rosa woodsii-Symphoricarpos oreophilus)/Carex geyeri

(4)

p.4-25	Table 4.2-3	Aquilegia barnebyi	Category 3C
		Mentzelia argillosa	Category 3C (proposed for 2)
		Phacelia submutica	Category 2
		Sullivantia purpusii	RCR = X (not S. h. var. p.)
		Thalictrum heliophilum	Category 2
		Sclerocactus glaucus	RCR = X
p.4-92	¶7	same comments as p.4-25 ¶6	
p.4-94	Table 4.3-3	same comments as p.4-26 Table 4.2-3, except RCR = X.	
p.4-162	¶5	This table doesn't adequately reflect numbers of known individuals. Occurrences have from 1 to several hundred individuals. For instance, the largest known occurrence (and apparently most viable over the long term) of Sclerocactus glaucus in the Debeque population center, and one which will be affected by the proposed project, contains ca. 300 individuals.	
p.4-162	¶6	The CCC water supply/storage system and construction within the Roan Creek corridor will extirpate 83% of the known individuals of Sclerocactus glaucus in the Debeque population center.	
p.4-163	Table 4.4-3	Aquilegia barnebyi	Category 3C
		Mentzelia argillosa	Category 3C (proposed for 2)
		Phacelia submutica	Category 2
		Sclerocactus glaucus	40 known occurrences
		Sullivantia purpusii	not S. h. var. p.
		Thalictrum heliophilum	Category 2
p.4-175	¶9	Most of the known individuals of Sclerocactus glaucus in the Debeque population center will be extirpated by the proposed project facilities in the Roan Creek corridor; the proposed project will have a significant irreversible impact (Table 4.4-3) on Mentzelia argillosa, Phacelia submutica and Sclerocactus glaucus in this region.	
p.4-176	¶2	same comment as p.4-175 ¶9.	
p.4-[illegible]	line 18	long-term significant effects will occur to Sclerocactus glaucus, Mentzelia argillosa, and Phacelia submutica in the Debeque region.	

68

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p.4-185 ¶7 (sentence 5) Designation of candidate and listed plant species habitat areas for protection is recommended, since the project and cumulative impacts are significant. **68**

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Attachment II

p.3-11	P 10	Phacelia submutica is a Category 2, Notice of Review species; Mentzelia argillosa was recently published as Category 3C, though this appears to have been an error, and it is proposed for publication in the next Notice of Review (by Peterson & Welsh) as Category 2. **69**
p.3-13	P 1	The CNHI-listed species have no legislated state status, though they are recognized by the State of Colorado, Department of Natural Resources, Colorado Natural Areas Program and the U. S. Fish and Wildlife Service cooperative agreement for plant conservation under Section 6 of the federal Endangered Species Act, as the plant conservation list for Colorado.
p.3-13	P 2	Sclerocactus glaucus is known from two population centers (ca.40 occurrences) in Colorado. The smaller of the two population centers, Debeque (which encompasses this project), contains 404 known individuals in about a dozen occurrences. The largest known occurrence in this population center (ca.300 individuals) is found in the proposed reservoir site.
p.3-13	Table 3.1-5	Phacelia submutica Category 2
		Aquilegia barnebyi Category 3C
		Sullivantia purpusii (not S. hapemanii var. p.)
		Mentzelia argillosa Category 3C (proposed for Category 2)
		Thalictrum heliophilum Category 2
p.4-25	P 6	Associated activities with the proposed Roan Creek reservoir and Roan Creek corridor project would extirpate approximately 83% (ca.337 of 404) of the known individuals of Sclerocactus glaucus in the Debeque population center, plus a minimum of one Phacelia submutica occurrence. **69**

(5)

United States Department of Agriculture

Soil Conservation Service

Diamond Hill, Bldg. A, 3rd Floor
2490 West 26th Avenue
Denver, Colorado 80211

March 7, 1984

Mr. Tom Coe
Regulatory Section
Sacramento District
U.S. Corps of Engineers
650 Capitol Mall
Sacramento, California 98514

Re: Review Draft EIS, Getty and Cities Service Shale Oil Project, Colorado

Dear Mr. Coe:

Based on our review of the above DEIS, the following comments are made:

1 — 1. On pages 4-185 and 4-191, it is stated that Getty and Cities Service has not committed to mitigation of wildlife impacts. This attitude pervades much of the Mitigation Section (4.8) where commonly used words are "should" and "could." It is our recommendation that mitigation be addressed more positively in the final EIS. — 1

2 — 2. The mitigation package outlined for wildlife should address revegetation and plant material trials needed to re-establish big game habitat. The involved corporations should have a leading role in this effort which, while benefitting wildlife, will also reduce erosion. A more positive attitude is needed on revegetation of disturbed areas. — 2

3 — 3. The report recognizes that restrictions on access roads may need to be imposed. It is suggested that the final EIS recognize that access road use will be controlled to limit public access to back-country areas. This will protect the area from increased usage with the accompanying increase in soil erosion caused by unnecessary vehicular activity. Access road control will also offer some degree of isolation which will benefit wildlife. — 3

Sincerely,

Sheldon G. Boone
State Conservationist

cc: Peter Myers, Chief, SCS
Washington, DC

The Soil Conservation Service is an agency of the Department of Agriculture

SCS-AS-1
10-79

(6)

GARFIELD COUNTY
DEPARTMENT OF DEVELOPMENT

PLANNING / ENVIRONMENTAL HEALTH / BUILDING: 945-8212

March 16, 1984

Arthur E. Williams, Colonel, C.E.
District Engineer, Regulatory Section
USAED Sacramento
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Williams:

Garfield County appreciates the opportunity to review the Draft Environmental Impact Statement for Getty and Cities Service's Shale Oil Projects. Overall, the document appears to address, in a rather cursory manner, the impacts of the two 100,000 barrel per day oil shale projects.

1 — Typically, in the review of any EIS, one of our primary concerns is related to socioeconomic impacts. The socioeconomic data provided is already dated and will not be adequate for review under Section 5.08, Fiscal Impact Mitigation Program of the Garfield County Zoning Resolution of 1978, as amended. Additional baseline information has been generated subsequent to Chevron, Mobil, Pacific and Union Shale Oil EIS's that would affect the validity of the information in this document. — 1

2 — Other general concerns noted are related to noise, land use and transportation. In all of these catagories, the impacts are identified as being fairly significant. While this information may be adequate for the purposes of the EIS, additional information will have to be developed to more specifically identify the impacts. — 2

3 — Additionally, more specific mitigation proposals will be necessary for local land use permits. As an example, what kind of efforts will be made to accommodate the needs of local ranchers and farmers? To say that "efforts should be made" and "to the extent possible", really does not indicate any commitment on the part of the companies to work with the affected landowners. — 3

4 — In general, this EIS falls short of analyses provided in other studies for other projects. To say that this document provides a baseline for further study might be more appropriate. As noted in a letter dated September 9, 1983, for scoping purposes, the document is indicative of an overly ambitious schedule for completion and that the information provided reflects that point. — 4

100 8TH STREET P.O. BOX 640 GLENWOOD SPRINGS, COLORADO 81602

(6)

Again, Garfield County appreciates the opportunity to review the document and hopes that your agency will recognize that the information provided does not adequately address the environmental impacts of two 100,000 barrel per day oil shale projects. For the Section 404 permit process, the document may be adequate. If we can be of assistance to you, please do not hesitate to contact this office. 5

5

Very truly yours,

Mark L. Bean
Senior Planner

MLB/emh

(7)

CITIES SERVICE OIL AND GAS CORPORATION
PLANNING AND DEVELOPMENT
BOX 300
TULSA, OKLAHOMA 74102

March 19, 1984

J. HULSEBOS
MANAGER
OIL SHALE AND COAL

Cities Service Shale Oil Project
Comments on the Draft EIS
Getty and Cities Service Shale Oil Projects

Mr. Tom Coe
Regulatory Section
U. S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814

Dear Mr. Coe:

Cities Service Oil and Gas Corporation has reviewed the Draft Environmental Impact Statement on the Getty and Cities Service Shale Oil Projects. Cities Service has concluded that it is a highly professional document and commends the U. S. Army Corps of Engineers and cooperating agencies involved in the preparation of the document.

We have attached comments which address Cities Service's and the Common Parts of the DEIS. These comments are aimed at enhancing and strengthening the effectiveness of the DEIS. They are presented in three sections. The first section of our comments deals with general issues addressed by the DEIS, the second section offers specific comments on various parts of the document, while the third suggests clarifications, corrections, and errata.

We appreciate the opportunity to comment on this DEIS and trust that our comments will be considered in preparation of the final EIS.

Very truly yours,

J. Hulsebos

kb

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I. GENERAL COMMENTS
DRAFT ENVIRONMENTAL IMPACT STATEMENT
GETTY AND CITIES SERVICE SHALE OIL PROJECTS

Purpose

1 The document indicates that the EIS was initiated by a Section 404 permit application, filed by the GCC Joint Venture. However, it does not clearly state that the EIS is intended to satisfy NEPA requirements for all federal agency actions for final approval of Cities Service's Conn Creek and Getty's shale projects. As noted in the document, other federal actions may require the support of a Final EIS, and it should be clear that this is the supporting EIS for all federal, state, county, and other local jurisdiction actions which require such a document. 1

Scope of Data and Analyses

2 The Draft EIS indicates in several instances that additional baseline data, engineering details, as well as impact analyses may be needed in applicable permits or authorizations. The statements are correct. Additional details which may be necessary for specific permits or authorizations will be provided as required. However, Cities Service firmly asserts that the U. S. Army Corps of Engineers has been provided all necessary data, including engineering data and environmental baseline studies, to prepare the EIS. No additional data is needed prior to final agency action by the U. S. Army Corps of Engineers. 2

Proposed Action and Alternatives

3 Cities Service's proposed action is to produce 100,000 BPD of shale oil; surface retorts (Union B) will produce 90,000 BPD and modified-in-situ (VMIS) retorts will produce 10,000 BPD. The project is planned to be implemented in four phases.

Table 2.2-2 presents those alternatives to the action proposed by Cities Service which were considered by the U.S. Army Corps of Engineers to be reasonable and feasible alternatives, requiring detailed study in the DEIS, as well as those which were considered to be unreasonable and unfeasible. Sound reasons are presented for the inclusions and exclusions, which address resource recovery, level of technological development, system integration, resource recovery, logistics, environmental impacts, economy, efficiency, and others. 3

Impacts and Impact Assessment

4 In general, Cities Service believes the assessment leaves a far too pessimistic impression on the reader. In many cases, a worst case event is described, without describing in terms which can be understood by a lay reader what the likelihood is of this event occurring. 4

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5 Criteria are not given for the impact ratings and impacts are generally described in absolute terms, without giving the reader a proper perspective of their significance. For example, if 40 acres are impacted by an action and 40,000 acres are available for the same purpose, the impact is 0.10 percent. If only 50 acres were available, the impact would be 80 percent. The bases for impact assessment, as to significant or insignificant, should be defined. 5

6 Assessments of water quantity and water and air quality impacts fail to give the lay reader a proper perspective by not discussing the legal and regulatory framework within which any operator is required to conduct its activities. This framework requires an operator to conduct its activities at all times during construction and operation in accordance with all applicable laws and regulations, and all required permit conditions. In addition, the operator is required to apply best available control technology to all facilities, as specified in the applicable permits. Also, comments on water quality impacts from leachates and surface runoff from spent shale pile should be clarified in the Final EIS in view of the "Zero Discharge" design. 6

7 Statements dealing with potential impacts on streamflow quantity and quality should be placed in perspective by describing how Colorado Water Law protects senior or prior appropriated downstream users from adverse impacts, and by describing the existence of the Colorado River Salinity Control Act. In other words, beneficial users are already protected by a sound legal framework. 7

8 The final EIS should also emphasize that detailed air quality modeling studies assume maximum emissions. The results, therefore, tend to overpredict the levels of exposure.

9 The impacts of the GCC reservoir and Water Corridor, already evaluated in the CCSOP EIS, are also listed as impacts due to Cities Service's action. The Final EIS should define the portion of the impact attributable to Cities Service's action. It is unreasonable to assign 100 per cent of the total GCC impact to Cities Service's shale oil project. 9

10 The impact analysis also appears far too negative on successful revegetation of spent shale. As only reference, Redente and Cook is quoted. The Final EIS should indicate what success, if any, additional studies have shown.

11 The Draft EIS should indicate what widths were assumed for the various corridors and whether multiple use corridors were assumed in the impact analyses. For example, space requirements for a power line and a pipeline need not be additive. Also the document does not clearly indicate whether specific terrain and habitat interactions were included in the impact assessment. If they were not, the impacts would be overstated. 11

7

The DEIS discusses slightly increased impacts should Cities Service implement its Larkin Ditch water supply alternative. It should be clearly stated that the Larkin Ditch alternative represents only a different water withdrawal point and the amount of water withdrawn for Cities Service's project needs will not increase. Therefore, the increased impact due to implementation of the Larkin Ditch alternative would be negated by a similar reduction in the GCC system impact. 12

Throughout the discussion of vegetation and wildlife, mention is made of: "Threatened and Endangered Species, Category 1, 2 and 3 Species, Candidate Species, Rare Plants, Special Concern Plant Species, Critical Habitat, Essential Habitat and Sensitive Habitat." It would be helpful to the reader if all of these were defined in the Glossary Section, along with a discussion in the text explaining the relationship between these items, their legal status, and the process by which they were derived. 13

Socioeconomics

The Draft EIS clearly shows a very significant positive contribution in the area of socioeconomics, especially for the proposed action at 100,000 BPD. Some of the significant economic effects include employment, income, and purchases. It also points out that some areas need to be addressed prior to commercialization of Cities Service's Conn Creek Shale Property. These areas are to be addressed as a key component of the local permitting process. 14

It should be noted that the cumulative socioeconomic impacts section of the document does not reflect the potential coordination among the shale developers, and coordination with the private sector and various levels of government to manage growth. As an example, Garfield County, in presenting its preliminary draft for a new "master permit" procedure which would apply to all major new projects such as shale oil plants, indicates that one of its goals is to coordinate construction schedules in a way to minimize potential cumulative impacts. 15

Mitigation

Cities Service recognizes the need to mitigate adverse environmental impacts of its actions. It is currently in consultation with the U. S. Fish and Wildlife Service under the Endangered Species Act and the Coordination Act, to determine suitable mitigation to wildlife and vegetation. It is Cities Service's understanding that the mitigation measures in Section 4.8 of the DEIS are preliminary and are subject to modification. When that has been done, Cities Service will present its comments on the proposed mitigation measures. 16

7

No Action Alternative

The DEIS complies with the CEQ regulations by including a discussion of the "no action alternative" (Section 2.4.3.2.11). However, the FEIS should expand on the "no action alternative" discussion in order to more fully and clearly explain why this alternative is not reasonable. It should emphasize that continued heavy reliance on foreign energy supplies through non-development of the oil shale resource could have grave national and international implications. A few of these are: increased vulnerability to a recurrence of foreign crude disruptions of the 1970's; inability to resist oil exporting nations' demands for large price increases and/or political concessions; further shocks to the world economic order as oil exporting nations demand a higher proportion of gross national product from oil importing nations, and continued increases in the United States' balance of trade deficits. The FEIS should also expand on the economic and social benefits lost to the Region, to Colorado as a whole, and to the Nation in the "No Action Alternative". 17

Environmentally Preferred Alternative

Identification of an environmentally preferable alternative in the Final EIS, an identification that is encouraged but not required by the Council on Environmental Quality's regulations, must consider the "Human Environment". 18

The environmentally preferable alternative is described as the alternative "that will promote the national environmental policy as expressed in NEPA, Section 101". It is the "alternative that causes the least damage to the biological, physical and human environment ..."; "Human environment" shall be interpreted to include the natural and physical environment and the relationship of people with that environment. This includes growth inducing effects, and other socioeconomic factors.

The document's analysis clearly shows the substantial beneficial socioeconomic impacts of the proposed action and its alternatives and these should be included as a major component in determining the environmentally preferable alternative.

These comments would also apply to any environmentally preferable alternative identified in the Record of Decision as required by 40 CFR 1505.2(b).

Agency Preferred Alternative

Cities Service asserts that the "Agency's Preferred Alternative" must be identified and discussed in the Final EIS, even if it has been omitted from the Draft EIS. The basis for this comment is provided in Appendix CS-1. The "Agency's Preferred Alternative" is the alternative which the agency believes would fulfill its "statutory mission and responsibilities" and "which reflects the 19

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national concerns for both the protection and utilization of important recources", "giving consideration to economic, environmental, technical and other factors."

The "Agency's" Preferred Alternative should include consideration of the following comments:

The 100,000 BPD proposed action and alternatives represent more energy efficient actions than the corresponding 50,000 BPD alternatives. This is due primarily to the greater economies of scale. This higher efficiency results in a more effective use of the shale resource. The larger production rate also would result in a greater initial contribution to the nation's energy security.

Operating flexibility at the 100,000 BPD capacity would be greater than at 50,000 BPD because more multiple processing trains would be employed. This would result in an operation better able to respond to unplanned conditions. Ultimately, this will result in a more effective operation of the emission control units at the larger capacity.

The areal extent of both plant site and project support facilities would be very similar for all actions, independent of capacity. Project support facilities would include corridors for the access road, water supply pipeline, railroad spur, electrical transmission loop, natural gas pipeline and syncrude pipeline. At the 100,000 BPD capacity, the impacts associated with the facilities would not be significantly different from those at the 50,000 BPD capacity, and on a per barrel basis the impacts would be substantially lower.

Finally, the beneficial socioeconomic impacts to the Region, the State and the Nation would be significantly greater from the 100,000 BPD capacity than from a 50,000 BPD plant. 19

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II. SPECIFIC COMMENTS
DRAFT ENVIRONMENTAL IMPACT STATEMENT
GETTY AND CITIES SERVICE SHALE OIL PROJECTS

Page iii
The last sentence on this page should be deleted. There are no plans in Cities Service's proposed action for spent shale disposal facilities on the mesa. 20

Page 1-2
Paragraph 1.3 states "The authorizations and reviewers listed below do not require prior preparation of an EIS...". This is incorrect. As an example, the Bureau of Land Management requires an EIS before it can issue its various land use authorizations. 20

Page 2-4 21
The reason for inclusion of the 50,000 bpd Production Rate should be "May reduce daily impacts; but not overall impacts."

Under "Fines Processing", the Reason for Inclusion of the Retort Alternative should be changed to read: "Oil may be recovered from fines by installing an additional retort of different technology."

Table 2.2-2 states that underground water source was eliminated as not sufficient for project needs. However, Cities Service desires to maintain the option of using underground water for use during construction and possibly the project's initial phase. 21

Page 2-33
Table 2.3-9 lists the public lands potentially affected by the Cities Service shale oil project. This Table has shown inaccuracies; a corrected table is substituted in Appendix CS-2. 22

Page 2-50 23
The first paragraph under Water Sources and Supply Systems gives the ultimate water withdrawal capacity of the GCC system from the river as 442.24 cubic feet per second. This is the combined withdrawal by Getty, Chevron and Cities Service. The maximum withdrawal rate by Cities Service is 100 cfs. This should be clarified.

Page 2-52
The first paragraph under Waste Disposal states that by-products are an example of hazardous wastes. The principal by-products are ammonia and sulfur and these are not hazardous wastes.

Page 2-53
In the third paragraph under Surface Retort Technology, the tendency of the Lurgi process spent shale to cement and become harder is overstated.

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Page 2-55
Table 2.3-15 gives the transportation requirements for the railroad alternative. The railroad alternative will only go as far as the confluence of Conn and Roan Creeks, and buses will transport the workers from that point to the work site. 23

24 Page 2-75
The paragraph on Vegetation discusses impacts to special interest plants (threatened or candidate plant species). The FEIS should note that no threatened and endangered plants are known to occur on Cities Service's land. 24

25 The paragraph on Wildlife states that fewer acres of wildlife habitat would be disturbed under the 50,000-bpd alternative due to a smaller spent shale pile. This is not correct. The ultimate size of the shale pile will be essentially the same for both the 50,000-bpd and 100,000-bpd alternatives (including the proposed action). 25

26 Page 2-77
The paragraph on Ground Water states that since the Union B process cannot process raw shale fines, these fines will be disposed of with the retort by-products. This is not correct. The shale fines which cannot be processed by the Union B process will be stored separately on the mesa. 26

27 The discussion of Air Quality states there is a violation to the PSD Class II increment which occurs on the west boundary of the property. It should be noted that this violation can be removed by a minor shift in the location of the raw shale fines pile, or by acquiring some minor additional land to move the property boundary. 27

28 Page 2-80
The discussion under Surface Water states: "Retorting on-site would have slightly higher adverse impacts since some stockpiling is assumed." It should be clarified that retorting of shale fines is meant. If shale fines are retorted, the amount of stockpiling will be less. In addition, the word "reagents" is referred to; however, there are no reagents used in retorting. 28

29 The paragraph on Geology states that the alternative spent shale pile is preferred because of less steep slopes and its probably reduced size. The steepness of the slopes and the volume would be the same; however, the aerial extent of the pile for the alternative is increased. This discussion should be clarified. 29

30 Page 2-82
The paragraph on Ground Water assumes the possibility of a liner which is less than effective, while the project description states that the spent shale disposal site impacts on ground water can be minimized. These statements should be reconciled. 30

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31 Page 2-83
The paragraph on Transportation states: "The plateau /canyon alternative involves a slightly greater transport distance." This is not correct, since in the plateau/canyon alternative part of the spent shale will be disposed of on the mesa which requires less transportation than to the canyon. 31

32 Page 2-86
The discussion of Topography and the discussions of Surface Water and Land Uses on Page 2-87 indicate slightly greater impacts if Cities Service utilizes the Larkin Ditch alternative. This is not correct. If Cities Service takes water at the Larkin Ditch, it intends to reduce the amount of water taken at the GCC intake. Therefore, the GCC system would be reduced in size, which would offset the impacts of the Larkin Ditch. 32

33 Page 2-88
The discussion of Transportation of Workers and Materials states that as an alternative to the transport of workers and materials by vehicles, Cities Service has proposed rail transport for workers. The word "proposed" should be "considered". In addition, the rail would only go to the point identified in Figure 2.3-15. From that point, the workers would be transported by buses. 33

34 Page 3-1
The first paragraph states that the only facility common to the Getty and Cities Service projects is the power and syncrude corridor on the north end of the Getty Property. It should be explained, that there are other common facilities, such as the GCC water system, which have been covered in BLM (1983a). 34

35 Page 3-11
The last paragraph states that for all of the candidate threatened or endangered plants the USFWS (1980) has stated that the listing is probably appropriate. This reference is no longer current. For example the USFWS has proposed to change the status of Barneby's columbine, De Beque phacelia and sunloving meadowrue. The status of these species should be updated. 35

36 Page 3-15
The first full paragraph states that there are certain federally endangered raptors in the region such as the peregrine falcon and bald eagle, and additionally there is the regionally rare osprey and goshawk. It should be noted that these species were not found on Cities Service's property.

The first paragraph under Threatened and Endangered Species mentions that three federally listed endangered wildlife species are known or likely to occur within the region: the peregrine falcon, bald eagle, and black-footed ferret. It should be noted that these species were not found on Cities Service's property.

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Page 3-17
In Figure 3.1-2, certain areas are defined as being Peregrine Falcon Nesting Habitat. It should be noted that this nesting habitat is secondary nesting habitat and that no known Peregrine Falcon nests are on Cities Service's property. 36

37
Page 4-5
The second paragraph states that prime farmland would be lost due to construction of paved roads and reservoirs. This statement should be put into perspective by mentioning the acres lost for prime farmland. It also should be noted that the reservoir impacts to prime farmlands were addressed elsewhere and are not a subject of this EIS. 37

38
The third paragraph under Vegetation states "Although the projects should operate within air pollution guidelines, fumigation by stack gases and coating by fugitive dust could adversely affect plant productivity and viability on-site." This statement is not correct. It should state that the projects will operate within air pollution guidelines. The remainder of the sentence is speculative and should be deleted. 38

39
Page 4-7
The second paragraph under Common Project Facilities states: "Operation of the syncrude pipeline above ground should have no adverse effect on wildlife...". It should be noted that no decision by the operator as to whether the pipeline will be above or below ground has been made. 39

40
The third paragraph under Air Quality/Meteorology states: "Because the rate of emissions resulting from project activities would vary, the detailed modeling studies assume potential worst case or maximum emissions." This is an accurate statement, and should be emphasized in the FEIS, particularly in the sections concerning air quality impacts. 40

41
Page 4-9
The third paragraph under Land Use states that oil shale development could reduce the amount of water available for irrigation. We do not agree this can happen. Each oil shale developer is operating within his own water rights and those water rights cannot impact senior water rights. Therefore it is not clear how oil shale development could reduce the amount of water available for irrigation. 41

42
Page 4-81
In the second paragraph, the discussion on subsidence assumes a very slight subsidence (one foot or less) is a foregone conclusion. Cities Service disagrees with this. In fact, Cities Service intends to use design criteria such that subsidence is a possibility, but not a probability. 42

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43
The third and fourth paragraphs state that no detailed information is currently available on the waste rock disposal pile or the shale fines stockpile. Cities Service respectfully submits that it is not the intent of this document to present detailed engineering designs for the project's disposal piles, but instead to present appropriate engineering concepts in such a manner that the impacts of the proposed and alternative actions can be properly assessed. 43

44
Cities Service firmly asserts that all necessary engineering studies, environmental studies, and other data have been provided for the U.S. Army Corps of Engineers to prepare the EIS. No supplemental data collection is needed in any discipline. 44

45
Page 4-82
The first paragraph under Alternatives, second sentence, should be changed to read: "The extent of planned mining would remain substantially the same as the proposed action, and thus impacts due to mining would not change."

The fourth paragraph under Alternatives states: "The processing of fines would eliminate the need of a shale fines disposal pile on the mesa, but would create spent shale containing finer particle size than the proposed action." The point of this sentence should be clarified. 45

Page 4-83
The first paragraph under Proposed action, third line, should delete "primary crushing facilities" since these facilities are below ground. 46

47
The second paragraph under Proposed Action suggests that three springs will be covered by the waste rock pile and will cause the flow in Conn Creek to be reduced. It should be noted that Colorado State Water Law protects senior or prior appropriated downstream users from adverse impacts. 47

48
Under Proposed Action, third paragraph, sixth line, the sentence starting with "Since the shale fines ..." is not correct and should be deleted. The following sentence should be substituted: "Any runoff from the disturbed areas would be contained by a downstream collection dam and recycled." The next sentence should be changed to read: "There would be no direct impact on lower Conn Creek from the shale fines storage pile. However, on the mesa the short segment of the stream channel, downstream of the shale fines to the collection dam, could be affected." 48

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Page 4-84
The first paragraph states that stream flows of Conn Creek could be reduced for various reasons. It should be noted that Colorado State Water Law protects senior or prior appropriated downstream users from adverse impacts. 49

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Page 4-86
The third and fourth paragraphs state that runoff from the waste pile and shale fines pile would probably drain into the spent shale disposal area. This is not correct. There will be a collector dam below each pile which will recycle the runoff back to the process facilities. In no event will surface water be allowed to flow into, or across the spent shale pile. 50 50

In the seventh paragraph on Page 4-86 and in the first full paragraph on Page 4-87, a worst case scenario is presented and the reader is left with the impression that liner failure is likely to occur. Cities Service does not agree with this conclusion. It should be noted that Cities Service intends to construct the liner using state-of-the-art design which will make liner failure highly unlikely. 51 51

Page 4-87
In the first paragraph under Alternatives, third line, "eliminated" should be deleted and "reduced" substituted. 52

Page 4-88
The last paragraph before Secondary Impacts discusss the impacts of disposing retort waters in the spent shale. This discussion should note the comments made by the EPA in their reference on trace elements associated with oil shale and its processing (EPA 1977a). In that document they noted that levels in retort waters vary widely between retorting processes, laboratories and imput shales. Generally most elements are present at levels below 1ppm in retort waters although Zn, As, V, F, Ba, and Fe have been measured at higher levels. Typical retort water would not meet the federal drinking water standards, but does compare favorably for many parameters with the quality of the treated effluent from a large metropolitan waste water treatment facility. 53 53

Page 4-89
Aquatic Ecology, Proposed Action, fourth paragraph, describes a worst case scenario. The likelihood of this event occurring should be further discussed. Also, the consequences of this event occurring should be substantiated with facts and references. 54 54

The discussion of Alternatives states that the Larkin Ditch water intake alternative would cause impacts to aquatic organisms. Impacts to aquatic organisms will be the same regardless of whether Cities Service takes its water from the Larkin Ditch or the GCC intake or both, since the same quantity of water is involved. 55 55

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Page 4-91
It should be noted that some of the features in Table 4.3-1 are for facilities that will be used by Cities Service jointly with others. As an example, the impacts caused by the GCC reservoir and the La Sal Pipeline are not totally attributable to the actions of Cities Service. 56 56

The Larkin Ditch settling pond is shown as causing a temporary or permanent prime farmland loss of 46 acres. This is not consistent with the 10 acres indicated in the first paragraph on Page 4-96. This should be clarified. Also, were Cities Service to use the Larkin Ditch alternative, the impacts caused will be offset by a reduction of impacts by the GCC system. 57 57

Page 4-94
The first paragraph under Alternatives states that the amount of vegetation disturbed due to the 50,000 barrel per day production rate alternative would be slightly less due to the smaller area required for physical facilities and surface retorts. However, in Table 4.3-4 the affected acreage disturbed, the thousands of pounds of annual production and the animal unit months affected are higher for the 50,000 barrel alternative than shown in Table 4.3-2 for the 100,000 per day proposed action. This should be clarified. 58 58

Page 4-96
The second paragraph states that adverse impacts to plants species of special interest associated with project alternatives would be less significant than those for the proposed action. This statement is not correct. The only project alternative that could have a less significant impact to special interest plants is the spent shale alternative. All other alternatives would have the same impact on special interest plants. 59 59

Page 4-97
The first full paragraph states that activity within 0.25 miles of rapture nests would cause their abandonment; however, it has been reported that redtail hawks have been known to nest in urban subdivisions. This seems to be inconsistent and should be clarified. 60 60

The fourth complete paragraph states that the lower portion of the corridor which also includes rail would traverse mule dear winter range, etc. Rail is not included in the proposed action and in any event there will not be rail in Conn Canyon even in the alternative. The rail will only go as far as the confluence of Conn Creek and Roan Creek. This paragraph also states that an obstruction of a known migration route for elk was identified as an impact. Disturbance of a specific route is unlikely in this area where movement from the valley to the plateau along numerous pathways appears to be the general rule according to the information from CDOW. Cities Service suggests that this be clarified. 61 61

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Page 4-99 62
The first paragraph the states that golden eagle nesting sites in Cascade Canyon would be inundated during shale disposal. This is not correct. The potential golden eagle nest sites in Cascade Canyon are well above the top of the shale disposal pile.

In the third paragraph, the statement dealing with the use of a railroad versus a fleet of buses to transport workers to the staging area in the Conn Creek Valley should be corrected to note that the staging area will be at the confluence of Conn and Roan Creeks. 62

Page 4-114
In Table 4.3-13 an alternative is labeled Proposed Action 50,000 bpd. There is no proposed action at 50,000 bpd. 63

Page 4-117 64
The title of Table 4.3-15 indicates Cities Service project, while the data presented is for the Cathederal Bluffs project. This data is merely a possible indicator of emissions from the Cities Service project which may be different because of project size or differences in ore body characteristics. 64

Page 4-119 65
The fifth paragraph states: "Employees would be mass transported from De Beque to the plant site via buses. These sources coupled with other transportion/traffic noise impacts would be less than the proposed action traffic noise levels." This should be clarified since the transportation to the plant site via buses is the proposed action. 65

The paragraph under Solid/Hazardous Wastes and Toxic Pollutants states that on-site disposal of hazardous wastes would not create additional noise impacts. This should be clarified since there are no plans to store hazardous wastes on-site. 66

Page 4-120
The title of Table 4.3-19 is not correct. There is no railroad in Cities Service's proposed action. 67

Page 4-123 68
Under Land Use, the second paragraph states: "Project development could also reduce the amount of water available for irrigation." This is not correct. Cities Service will develop its project using its own water rights and will not be allowed to impinge on the senior water rights of others. 68

Page 4-124 69
The first paragraph under Land Use states: "With the exception of the 50,000-bpd alternative, the alternatives to the Cities Service proposed action would result in fewer adverse impacts to land use than the proposed action." This is unclear and it should be clarified, especially since it seems that the opposite is true from information presented elsewhere in the Draft EIS. 69

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The third paragraph under Visual Resources states that the form of the canyon bottom would be permanently altered but the form change is not visible from an existing public roadway, community or recreation center. The latter part of this sentence is an important one and perhaps should summarize the whole discussion of visual impacts, in that the entire area is isolated from public view, therefore, the impacts are minimal. 70 70

Page 4-125
The second paragraph states: "Those portions of the utility, road, and water pipeline corridors that would traverse the bottom of Conn Creek canyon are not expected to have an insignificant linear impact." It would appear that the word "not" should be removed in order to make this sentence compatible with the following sentences in the paragraph. 71 71

Under Alternatives, the last paragraph states: "The use of an existing structure (the De Beque Bridge) to cross the river would have a nonsignificant to nondiscernible (visual) impact. However, a water pipeline crossing the Colorado River on a new structure would introduce a significant impact." This should be clarified. If a new structure means a separate structure to support the pipeline only, then this would have a significant visual impact. However, this is not planned. If a new structure means a new bridge, the new bridge would have a significant visual impact but the fact that a pipeline is attached to the new bridge would have no more impact than if the pipeline was attached to the old bridge. 72 72

Page 4-126
The section under Residential Allocation of Work Force states in a couple of places that workers are assigned to certain areas. The word assigned is misleading. Cities Service will not assign workers to live in certain places; however, to assist the local jurisdictions Cities Service may encourage workers to live in certain areas. The word assign in the context of this document is that the model assumed that workers would live in certain places and to that extent the model assigned personnel, but not Cities Service. 73 73

Page 4-155
Under alternatives, third paragraph, there is a discussion of the small amount of energy to be produced by processing shale fines. To put this comment in perspective it should be noted that the processing of the approximately 8% shale fines would result in an additional energy recovery on the order of 5%. 74 74

Page 4-160
In Table 4.4-2, the average annual water use for Cities Service's Project is given as 39 cfs. Footnote "b" explains that this number excludes indirect water consumption such as community and power generation. Table 2.3-11 shows that the 39 cfs for Cities Services's Project includes Community and Power Water of 11 cfs. This should be clarified in the FEIS. 75 75

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Page 4-166
It should be stated clearly in the Final EIS that the order in which the projects are listed in Table 4.4-4 does not, in any way, imply priorities in the allocation of air increments or of any other resources. 76

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Page 4-170
In the paragraph under Land Use, Recreation, and Wilderness there is reference to competition for available water and competition for agricultural water. It should be noted that the oil shale developers will be operating within their own individual water rights. 77

Page 4-174
In the third paragraph, first line under Transportation, the phrase "and upgraded oil" should be deleted, since there are no plans to move upgraded oil by railroad. 78

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Page 4-192
In the first full paragraph it is recommended that buffer zones of at least one-half mile should be established for sage grouse leks and raptor nest sites to minimize disturbance during critical periods. A reference or data should be supplied justifying this 0.5 mile buffer. 79

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Page 4-195
The paragraph under Energy, last sentence, states: "Retorting of the shale fines and burning of the carbon off the Union B spent shale would improve the overall energy balance." It should be noted that Cities Service will monitor these potential developments to Union's retort technology and if environmentally and economically acceptable will consider incorporating them in future plans. 80

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III. CLARIFICATIONS, CORRECTIONS AND ERRATA
DRAFT ENVIRONMENTAL IMPACT STATEMENT
GETTY AND CITIES SERVICE SHALE OIL PROJECTS

Page ii
In the first paragraph, delete the word "Company" after Cities Service. 81

Change the first sentence in the second paragraph to read "The Sacramento District announces the release of the Draft EIS for separate shale oil projects proposed by Getty Oil Company and Cities Service Oil and Gas Corporation."

Page iii
In the first paragraph under Cities Service, first line, delete the word "Company" and substitute "Oil and Gas Corporation".

In the last paragraph, fifth line, delete "1991" and substitute "1992". In the ninth line, after the word "processing", delete "retort" and substitute "surface retorts". In the twelfth line, pluralize "powerline" and "corridor" and delete "a" before "utility". In the fourteenth line, delete "upper portion of" and substitute "Conn and". In addition, "canyon" should be pluralized.

Page 1-2
In paragraph 1.2, second line, insert after the word "California": "as operator of the Joint Venture."

Page 1-4
In the first paragraph, line six, delete "of growth for petroleum products such as jet and diesel fuel." and substitute "of hydrocarbons used to make jet and diesel fuels, which are projected to show substantial increases in demand."

Page 1-6
In the fourth paragraph, first line, delete "was" and substitute "has been". 81

82

Pages 2-4 and 2-5
The following changes should be made to Table 2.2-2:

Under Mining Method and Retort Type the acronym for Modified In-Situ should be VMIS.

Under Power Source, the alternative listed as "Cogeneration/Construction" should be changed to "Dedicated Power Plant".

Under Retort Site and Upgrading Site, the Reason for Inclusion of the Mesa alternative should be listed as "Better from an air quality impact standpoint."

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Under Spent Shale Disposal, the first alternative listed as "Conn/Cascade Creeks" should be "Conn/Cascade Canyons"

Under Spent Shale Disposal, the alternative listed as "Mesa/Canyon" should be "Mesa/Cascade Canyon".

The Alternative Category labeled "Access Road" should simply be labeled "Access". 82

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Page 2-30
Under alternatives to the proposed action, delete "Method of mining - underground only" and substitute "Room and pillar mining only".

Page 2-35
The next to the last sentence of the first paragraph should read "Fuel utilized would include high, medium and low Btu gas, natural gas and diesel fuel."

In the second paragraph, second line, the sentence starting with "Offsite water" should be changed to "Current plans call for offsite water to be mixed with ..."

Page 2-36
On Figure 2.3-15, the location of the Alternate Transfer Facilities should be shown at the juncture of Conn and Roan Creeks. The figure should also show the location of the primary facilities. The dotted line from the north of the property should be labeled "Alternate North Corridor for Power and Syncrude."

Page 2-37
In the diagram the facility shown as "Ponds" should be changed to "Effluent Treatment Ponds". In addition the line showing the location of the crushing and screening facilities should be extended further north to also include the facility due north of the indicated facility.

Page 2-39
In Table 2.3-12, the quantity of 3,000 MMBtu's per hour for hydrogen feedstock should be changed to 3,600 MMBtu's per hour.

In the last paragraph, second line, "facilites" should be "facilities". 83

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Page 2-40
In the first paragraph, second line, "occurrance" should be "occurrence".

In the fourth line, first paragraph, the sentence ending with "... monitored by the rock mechanics program." should be "... monitored by a rock mechanics program."

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In the fourth paragraph add the following phrase to the last sentence "... prior to revegetation."

In the paragraph Feed Preparation and Handling, line nine, after the word "process" insert "for processing fines".

In the paragraph Feed Preparation and Handling, line ten, delete "need for" and insert "feasibility of".

In the first paragraph under Retorting, second line, the use of the word "underfeed" is not clear. This word as it is used in the sentence is referring to the shale which enters the bottom of the reactor and flows upward. This should be clarified.

In the last line of the first paragraph under Retorting, the statement is made that "The remainder would be released to the fuel gas system." The word "remainder" should be deleted and "remaining gas" substituted.

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Page 2-43
In the first paragraph, third line, "sulfuric acid mist" should be deleted since it is not shown in Table 4.3-6.

In the first paragraph, change the last phrase of the sentence ending on line 4 to "... are based on the best available control technology."

In the last line of the first paragraph, "EPA recommended levels" should be "EPA regulated levels".

In the third paragraph, change the fifth line to read "... zone and produce gases, and water vapor and shale oil mist which condense at the bottom of the rubblized column."

In the fourth paragraph, third line, insert "Union B retort" prior to "off-gas".

In this same paragraph, last sentence, the verb "are" should be changed to "is". 85

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Page 2-44
In Figure 2.3-21 delete the words "retort center shaft" and indicate that the left line coming from the sump is for "oil from the sump" and the right hand line coming from the sump is for "gases from the sump". Also indicate an arrow exiting the make gas blower.

In figure 2.3-22 the material balance does not balance because of the large amount of shale which remains in the retort. To make this clearer, we would suggest that the word "shale" be included in the box labeled retorts.

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Page 2-45
In the first sentence of the first paragraph, the indicated Table "4.3-14" should be changed to "4.3-6".

In the first paragraph, fourth line, "recommended rates" should be "regulated rates".

In the fourth line of the first paragraph, the indicated Table "4.3-14" should be "4.3-15".

In the first paragraph under Upgrading, second line, the figure shown as "2.3-15" should be "2.3-16".

In the second paragraph, second line, under Spent Shale and Waste Rock Disposal, add the word "Canyon" after "Creek".

In the discussion under Spent Shale and Waste Rock Disposal, it would be helpful to have a description of the various zone materials. We therefore suggest the following paragraph be inserted after the second paragraph of this section:

"The spent shale pile would be constructed utilizing four zones of material: (1) Zone I, an impermeable liner of highly compacted shale; (2) Zone II, moderately compacted shale; (3) Zone III, appropriate slope protection material such as overburden; and (4) Zone IV, the main portion of spent shale fill." 87

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Page 2-46
In the first paragraph, line five, "lechate" should be "leachate".

In the third paragraph, second line, "filtration" should be "migration".

In the third paragraph, fourth line, delete "reclamation zone of retorted shale" and substitute "capillary barrier material, such as waste rock or retorted shale".

In the seventh paragraph, first line insert "above mentioned" after "these".

In the eighth paragraph, first sentence, insert the word "of" after "disposed". 88

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Page 2-47
Figure 2.3-23. There should be a line labeled "Sour Gas" flowing from the "Nitrogen Removal" step to the "Sulfur Recovery" step. This is in addition to the line labeled "Sour Gas" flowing from the "Water Treating" step to the "Sulfur Recovery" step. In addition there should be a line leaving the "Sulfur Recovery" step labeled "Stack Gas".

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Page 2-49
In the first paragraph, second sentence, substitute "would" for "will". In the last line of this paragraph, delete "northwest" and substitute "west".

Page 2-50
In the first paragraph, third line, "mixture" before the word "expected" should be "mixtures".

In the first paragraph,first line, under Transportation Systems, "Services'" should be changed to "Service's". In addition, in the first sentence of that paragraph, delete "of" before "workers" and "a" before "rail". In the fifth line, "form" should be "from".

In the third paragraph under Transportion Systems, second line, the "Figure 2.3-16" should be changed to "Figure 2.3-15". In the next sentence, "Conn Creek" should be inserted after the first word "The".

In the paragraph under Water Sources and Supply Systems, in the second line, "Chevron" should be changed to "Chevron Shale Oil Company". In the thirteenth line, the phrase "to the plant" is repeated twice. 90

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Page 2-51
In Table 2.3-13, footnote "b" should be changed to read "PLS=Pure Live Seed. 1.0 pounds PLS/Acre is equivalent to 60 seeds per square foot."

In Table 2.3-14, the number of people shown in the Work Force appears to be inconsistent with the number of people shown in Table 2.3-8. This can be explained by adding the following sentence to footnotes b and c: "Numbers based on Table 2.3-8 less 80% of administrative/management personnel who do not regularly commute to the project area".

Table 2.3-14 does not show the transportation requirements for explosives. These requirements should be included and would be the same as the requirements shown in Table 2.3-15. 91

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Page 2-52
In the second paragraph under Transmission Lines, the last sentence should be changed to read: "A right of way for a single 345kV transmission line would be 150 feet wide."

Under Waste Disposal, the second and third paragraphs are the same and one should be deleted. In this paragraph, in the second line within the parentheses, shale fines is indicated as a

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miscellaneous non-hazardous item. The shale fines are certainly not a miscellaneous item.

In the paragraph under Alternatives to the Proposed Action, second line, "Section 2.2" should be "Section 2.2.3". 92

93

Page 2-53
In the paragraph under Production Rate, first line, insert "addressed" after the first "alternative". In the fourth line, "sizes" should be "size".

In the paragraph under Mining Method in the first sentence "All underground mining" should be deleted and "Only room and pillar mining" inserted.

Under Retort Type, the second sentence should be changed to "Using surface retort technology only will result in loss of shale oil resource."

In the first paragraph under Surface Retort Technology in the second sentence, the words "were considered, but" should be deleted. 93

94

Page 2-54
In Figure 2.3-26, an arrow should be placed on the line from the Solid Surge Bin to the Dust Removal Cyclone.

In the paragraph under Power Source, the last sentence should be changed to read as follows: "It is estimated that an approximate maximum of 1.8MMscf per hour of natural gas may be required additionally to supplement the fuel balance." 94

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Page 2-55
In Table 2.3-15 under the Quantity for Catalyst the phrase "Delivered and Waste" should be inserted. Under By-products, the number of round trips for ammonia and sulfur should be changed from 8 and 5 to 6 and 4.

In Footnote "a", "are" after the word "parking" should be "area".

In the paragraph under Water Supply System, first line, the phrase "that of" should be deleted. In the third line "Credek" should be "Creek". 95

96

Page 2-56
In the first paragraph, last sentence, insert "water in the" after the first word "The".

In the third paragraph, first line, "The water sedimentation pond would be pumped" should be changed to "The water from the sedimentation pond would be pumped". In the last sentence, delete "assumed to be". 96

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Page 2-73
In the last item under the Proposed Action delete "base of the".

97

Page 2-74
Under the item Corridors, delete "intertie" and insert "tie in".

In the paragraph on Surface Water, third line, insert "approximately" after "would be". 97a

Page 2-76
In the paragraph on Transportation, fourth line, "doubted" should be "doubled". 98

Page 2-77
In the first line under Surface Water, "finer raw shale" should be inserted after "process". 99

In the fifth line, under Ground Water, "careful" should be placed before "design" not before "drainage". 100

In the ninth line of the first paragraph under Air Quality, the word "Flattops" should be "Flat Tops". 101

In the second paragraph under Air Quality, second line, "Services'" should be "Service's".

Page 2-78
In the second paragraph, lines three and five, "PDS" should be "PSD".

In the fifth paragraph, first line, "of" should be deleted.

In the sixth paragraph, last line section "4.2.8" should be deleted since it refers to the Getty project.

In the eighth paragraph, second line, after "production" should be insert in parentheses "Union B/VMIS". 101

In the paragraph on Noise first line, "Services" should be "Service". In the third line, "producton" should be "production". 102

103

Page 2-79
The sentence under Surface Water should be changed to read as follows: "The alternative all-underground mine type would have substantially the same surface water impacts compared to the proposed action, because overall mining areas are the same and volumes of spent shale piles would be essentially equal. 103

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Page 2-80
In the discussion on Ground Water, first line, "schemes" should be "scheme". 104

In the first line under Energy, delete "a" before "low". 105

Under Air Quality, last line, "approximatley" should be "approximately". 106

Page 2-81
In Table 2.4-12, the column heading "On Site Disposal with Spent Shale (Proposed Action)" is not correct. The proposed action does not include disposing of the shale fines with the spent shale, therefore "with Spent Shale" should be deleted from the column heading. 107

Page 2-82
Under Ground Water, fourth line, delete "over". 108

In the discussion on wildlife, the beginning of the first sentence should be changed to: "The proposed action disposal site ..." 109

Page 2-83
In the discussion of Geology, fourth line, "piles" should be "pile". 110

Under Surface Water, the last line should be clarified by adding "because of the smaller particle size" after "moistening". 111

In the discussion on Ground Water, third line, "solidifed" should be "solidified". Fourth line, "leachage" should be "leachate". 112

Page 2-84
In Table 2.4-15, the heading "North Corridor (Alternative)" should be "North Corridor to La Sal (Alternative)". 113

Page 2-86
In Table 2.4-16, footnote "e" is incomplete. 114

Page 2-87
In the discussion of cultural resources, second line, the reference "BLM (1983)" should be "BLM (1983a)". 115

In the discussion of Power Generation, first sentence, insert "to" after "alternative". 116

Page 2-89
In the discussion of Noise, first and second lines, "residences" should be changed to "residents". 117

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Under Energy, first line, "consuption" should be "consumption". 118

Page 3-4
In the first line, "strcture" should be "structure". 119

In the second full paragraph, third line, "presently" should be "previously".

In the first paragraph in the discussion of Surface Water, in the next to last line, "near Grand" is repeated twice. 120

Page 3-5
The discussion under Roan Creek should be clarified. In the second line reference is made to a drainage area of 515 square miles. The third paragraph makes reference to a drainage of 321 square miles. It is not clear why these numbers are different.

In the third paragraph under Roan Creek, it is stated that flows have ranged from 3.2 cfs to 2,765 cfs, yet it is further stated that sometimes the creek is dry. This is inconsistent and should be clarified. In addition, a reference should be given which indicates that the creek has been dry.

Under Parachute Creek, first paragraph, second line, "Town" should not be capitalized. In line six , "Colorada" should be "Colorado". 120

Page 3-6
In the third paragraph, third line, "has" should be "as". 121

122

Page 3-10
In Table 3.1-2 under "Water Holding Capacity" the unit "(in.)" is given. This should be deleted since the chart does not show any numbers. The Heading "Sodic (SAR > 13)" should clarify what SAR stands for.

Page 3-11
In the second full paragraph, second line, "and" after the parenthesis should be deleted. 122

123

Page 3-19
In the first paragraph, first line "Servies" should be "Service".

Page 3-21
In the first paragraph, it is stated that the relative humidity will be assumed to be similar to Grand Junction. In the second sentence it goes on to say that the humidity is expected to be slightly drier in the project area due to less evapotranspiration associated with agriculture, coupled with increased elevation. Since this second sentence is unsubstantiated and does not agree wtih the assumption made, the second sentence serves no purpose and should be deleted. 123

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Page 3-22
In the second paragraph under Air Quality, the first sentence gives the definition of criteria pollutants. This definition is not consistent with that given on Page 7-2, which includes hydrocarbons. 124

Page 3-23
In Table 3.1-7, the heading "PSD Increment" should give the units of the numbers shown.

Page 3-24
In the first paragraph under Air Quality Related Values, fourth line the distance from the Flat Tops Wilderness area to the project area is given as 43 miles. However, on page 3-29 in the paragraph above Visual Resources, this same distance is given as 50 miles. Figure 3.1-4 indicates the distance is 45 miles. These discrepancies should be clarified. 124

Page 3-32
In Table 3.1-11 the Wholesale Trade Employment for 1981 is given by "(D)[a]". This would indicate that either the data was not available because it is confidential or it just wasn't available This should be clarified. 125

Page 3-42
Fifth paragraph, third line, "are" should be inserted before the figure "150". 126

Under Airports, first paragraph, line six, "Howver" should be "However".

Page 3-43
In footnote "a" of Table 3.1-18, it is stated that accident rates are not available but may be available for the DEIS and FEIS. This is an incorrect statement since the data is shown in Table 3.1-19. 126

Page 3-45
In Table 3.1-20, footnote "b", the term "intermediate units" should be explained. 127

Page 3-59
In the fifth paragraph, seventh line, "in" should be deleted after "Formation". 128

Page 3-60
In the second paragraph under Surface Water, "7,000 feet" should be "8,000 feet". 129

In the third paragraph under Surface Water, second line, "Conn Gulch" should be "Conn Canyon".

The third paragraph states "Land use in the vicinity of Conn Creek is primarily agricultural rangeland." The term agricultural rangeland should be clarified.

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In the first paragraph under Stream Flow, the third line indicates that May and June provide 45% of the annual runoff. This is not consistent with the 46% shown in Table 3.3-1.

In the first paragraph under Water Quality, third line, "conditons" should be "conditions". 129

Page 3-61
In the second paragraph under Ground Water, first line, delete the words "majority of" and substitute "the". 130

In the third paragraph, third line,"intersticial" should be "interstitial". In the fourth line, "south" should be "west". 130

Pages 3-62 & 3-63
In Tables 3.3-2 and 3.3-3 the footnote "a" follows the heading Laboratory Analysis. Footnote "a" indicates that the unit is milligrams per liter unless otherwise noted. However, nowhere in the Laboratory Analysis is any other unit noted. This needs to be clarified. 131

Page 3-64
The last sentence on the page should be deleted and the following sentence substituted: "The Cities Service property is dissected by a drainage divide trending northwest to southeast which cuts through the northern and eastern boundaries of the property. The ground water divide corresponds closely with this drainage divide (Cameron Engineers, 1974). 132

Page 3-66
In the first paragraph under Vegetation, second line, place a comma after "shrublands", and delete the following word "and". 133

Under Vegetation, last paragraph, it is stated that large populations of sedge fescue are present in Conn Creek and Cascade Canyons. This is not correct. It should be corrected to indicate limited populations of this species were noted in Cascade Canyon. 133

Page 3-68
In the first line, "inhabitat" should be "inhabit". 134

Page 3-71
In the second paragraph under Energy, "would be" should be deleted and "is planned as" should be inserted. 135

Page 4-2
Under Surface Water General Impacts, in the second paragraph, fifth line, "the" should be inserted before "watershed". 136

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Page 4-5
In the last paragraph, second line, "crosse" should be "cross". 137

Page 4-7
In the first paragraph under Air Quality/Meteorology, second line, "SO_2" should be "SO_x". 138

Page 4-8 139
First paragraph, fifth line, "souces" should be "sources".

In the second paragraph, fourth line, a reference is given as U. S. Office of Naval Research (1977) Guidelines. It would appear from the reference section of this document that this reference should be Department of Commerce (1977) Guidelines. This should be clarified. In the last line a reference is given as Cities 1983b. This should be Cities Service 1983b. 139

Page 4-11
In the first paragraph, second line, starting "In addition" there should be a comma after "addition". 140

In the fifth line of the paragraph under Socioeconomics a reference is made to Sections 4.4.1.13 and 4.4.2.13. This is incorrect and should read simply 4.4.13. 141

In the third paragraph under Transportation, third line, reference is made to section 4.2.13 and 4.3.13. These are incorrect and should be Sections 4.2.14 and 4.3.14. 142

Page 4-12 143
In the first paragraph, third line, "constucting" should be "constructing".

In the second paragraph, third line, "uncovered" should be "unrecovered". 143

144
Page 4-81
In the sixth line, last paragraph "(Section 2.3.2)" should be inserted after the word "above". In line seven, "as necessary" should be inserted after "constructed". In the seventh and eighth line, "piles" should be pile".

Page 4-82
In the second paragraph, first line, "sytem" should be "system".

(7)

The third paragraph under Alternatives, states: "The cohesiveness of the Lurgi-type spent shale could reduce the erosion of the spent shale piles by sheet wash and mass-wasting processes." The terms sheet wash and mass-wasting processes should be clarified.

The last paragraph under Alternatives states that the Larkin Ditch alternative consists of a sedimentation basin, a pumping station and a pipeline to the Cities Service site. This is not correct, and this sentence should be changed to be consistent with the alternative as described in Section 2.3.2.3.1.

In the last paragraph on the page, "existing" on line one should be deleted. The word "an" should be changed to "a". 144

145
Page 4-83
In the third paragraph under Surface Water fourth line, "the" should be inserted before "waste rock disposal area."

Page 4-84
The word "the" should be inserted in several places on this page. It should be inserted in the fourth line of the first partial paragraph before "spent shale pile". Also in the first paragraph under Alternatives, second line, it should be inserted before "proposed action". In the fifth paragraph under Alternatives, sixth line, it should be inserted before "West Fork". In the sixth paragraph under Alternatives, fourth line, it should be inserted before "Colorado River".

In the fifth paragraph under Alternatives, "LaSal" should be "La Sal".

In the sixth paragraph under Alternatives, third line the following phrase should be added after the word pipeline "to the GCC corridor".

In the last paragraph on the page, "of" should be inserted after "disposed" in the first line.

Page 4-85
In the first line, "form" should be "from". 145

In the second paragraph under Proposed Action, fifth line, 146
"south" should be "west".

Page 4-86
Fourth paragraph, fifth line, "this pile" should be deleted and "unconsolidated material" substituted.

Page 4-87
In the first partial paragraph, insert "unconsolidated" before "material".

(7)

In the first full paragraph, the second sentence is not a complete sentence and should be corrected as follows: "Construction of the underlining, 10 feet in thickness, is intended to preclude infiltration of these waters from the spent shale pile into bedrock strata below.

In the first paragraph under Alternatives, second line, the phrase "except on a reduced scale." should be deleted.

In the third paragraph under Alternatives, third line, "upon" should be deleted and "therefore" substituted.

In the last paragraph, it is stated that the stockpiles in the proposed action are to be covered. This should be clarified to indicate that this means revegetated.

Page 4-88
In the second full paragraph, first line, reference is made to the upper alternative disposal site. This statement should be clarified to note that in the spent shale alternative a portion of the spent shale will be disposed of on top of the mesa. This paragraph addresses the impacts of that portion of the spent shale disposed of on the mesa.

In the last line of the second full paragraph, "that" should be changed to "than". 146

Page 4-89
In the paragraph under Alternatives, first line, "alternatives" should be "alternative". 147

Page 4-90 148
The first paragraph under Soils, Proposed Action, third line, mentions that the calculated incremental soil loss for surface disturbance areas is about 149,000 tons. This value is supposed to have come from Table 4.3-1. An examination of that table makes it unclear where this number came from. This should be clarified. The sixth line gives the value 89,900. This should be 89,880 to be consistent with Table 4.3-1.

In the third paragraph under Soils, first line, "facilites" should be "facilities".

Page 4-91
The heading "Incremental Soil Loss (acres)" in Table 4.3-1 is incorrect. It should be "Incremental Soil Loss (tons)".

Under Proposed Action, the item titled Conn Creek (Rail, Road, Power, Water) Corridor should not include Rail. 148

Page 4-92 149
In the first paragraph, seventh line, "wwould" should be "would".

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Page 4-94
In Table 4.3-3, the facility labeled CS is not explained in footnote "b". 149

Page 4-96 150
Under Wildlife, second paragraph, line nine, reference is made to table C-6 in Appendix C. There is no Table C-6 in the Appendix.

In the paragraph on Solid/Hazardous Wastes and Toxic Pollutants, "of" should be inserted after "disposed" in the first line.

Page 4-97
In the second full paragraph, first line, "inundate" should be replaced by "cover".

Page 4-98
In Table 4.3-5 under Proposed Action, the items "Power, Rail, Road and Water" should be corrected in both cases by deleting "Rail".

Page 4-100
First partial paragraph, fifth line, "harassment of domestic pets" should be "harassment by domestic pets".

In the first paragraph under Proposed Action, second line, "Deer Park Gulch" should be "Conn Creek Canyon". This paragraph states that this section considers the combined air quality impacts due to Cities Service's proposed action with the mine, retorting and upgrading facilities located on the plateau, etc. This could be misinterpreted since the proposed action is the mine, retorting, and upgrading facilities on the plateau.

The first paragraph under Emissions states that the exact location of sources could move across wide areas in a day to day progression. This is not correct and should be clarified. The location of emission sources does not change from day to day.

The third paragraph under Air Quality, first sentence, states that the 24-hour SO_2 impact in the Flat Tops Wilderness which is about 41 miles away is predicted to be 40% of the PSD Class I increment. According to Figure 3.1-4 the distance to Flat Tops is 45 miles and according to Table 4.3-7 the prediction is 60%. This should be clarified.

The third paragraph under Air Quality, second sentence, refers to transport of SO_2 and TSP for other regulated averaging times. This sentence could be clarified by stating that it refers to other Class I and Category I Areas not discussed in the prior sentence. 150

Page 4-101 151
The paragraph before Table 4.3-6, states that the ratio of HC to NO_x for the Cities Service Proposed Action is only 0.3 to 1.

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Table 4.3-6 indicates the ratio is 6 to 476, much smaller than the 0.3 to 1. This should be clarified.

Table 4.3-6 is referred to earlier in the Project Description Section. The Project Description Section refers the reader to this table to determine the emissions from above ground retorting, from VMIS and from upgrading facilities. It would be helpful to show in this table which retorting and upgrading emissions come from the various types of facilities. It could be shown that the recycle gas heater and the reboiler emissions are from above ground retorting, that the FGD unit is for the VMIS facilities, and that the remaining five items are considered upgrading facilities.

The total emissions shown in Table 4.3-6 should be clarified, e.g., NO_x is shown as 476 whereas adding the numbers above one would get 474 if no value was put on the less than 1 designations. Likewise, the hydrocarbon totals would be 4 if no value was given for the less than 1 values. This would be consistent with the TSP total of 43, which gives no value to any of the less than 1 values. 152

153

Page 4-103

In the next to the last line of the first partial paragraph, "55 miles" should be "within 55 miles".

In the first paragraph under Atmospheric Deposition, fifth line, the reference Turk (1982) should be Turk and Adams (1982).

In the first partial paragraph there appears to be a sentence missing at the end of that paragraph which should address visibility impacts due to TSP and sulfate aerosol emissions. This sentence should be included.

In the second paragraph under Atmospheric Deposition, third line, "Chevrons" should be "Chevron's".

The first line of the last paragraph states: "The total nitrogen and sulfur deposition is conservatively expected to range from 7 to 294 $\mu g/m^2$". Table 4.3-8 indicates that the range is 7 to 194. This should be clarified. 153

154

Page 4-104

Table 4.3-8 should be clarified as to the meaning of dry and wet. It also should be made clear that the heading "Colorado" is "Colorado National Monument".

The section under Alternatives should clarify what is meant by the alternatives "Full production rate at 100,000 bpd with an additional retort" and "Reduced production rate at 50,000 bpd with an additional retort". These alternatives should include the components of the rates, such as 90,000 bpd Union B and 10,000 VMIS, and the additional retort, should be identified. In addition it should clarify that the alternatives listed as "Spent shale disposal alternative" and "Cogeneration" are subalternatives which can be applied to any of the above alternatives.

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The second paragraph under Alternatives incorrectly states that Table 4.3-9 includes all emissions from the alternative oil shale facilities. Table 4.3-9 does not show emissions from spent shale disposal and cogeneration alternatives. 154

155

Page 4-105

Emission rates for the project alternatives shown in Table 4.3-9 show inconsistencies with respect to the emission rates shown in Table 4.3-6 for the Proposed Action. The No_x for the auxiliary boiler in the Proposed Action is shown as 6 grams per second. In the Alternative case, the NO_x for the 50,000 bpd using 40,000 Union B and 10,000 VMIS, the NO_x is given as 0. However in the 100,000 bpd all Union B retort case, it is given as 57. These appear to be inconsistent with the value of 6 given for the Proposed Action. The TSP for the Surface Material Handling and Disposal Reclamation are shown respectively as 6 and 33 grams per second for the proposed action. However, for the 50,000 bpd Alternative using all Union B retorts, these values are shown respectively as 0 and 76 grams per second. These values appear to be inconsistent.

Some total emissions figures shown in Table 4.3-9 appear to be incorrect. Under the 50,000 bpd all Union B retorts, TSP is shown as a total of 21; SO_2 as 30 and NO_x as 192. Adding the numbers shown, would give numbers of 78, 20 and 193 respectively.

Also in Table 4.3-9 the dashed lines should be explained. If these lines are "0", "0" should be shown. If they were not modeled, there should be some indication that they were not modeled. In any event, the meaning of the dashed lines needs to be clarified. 155

156

Page 4-106 - 4-107, 4-108

Table 4.3-10 should explain as to what constitutes the background for the Class II Areas. The meaning of the dashed lines should be clarified. Arithmetical errors should be corrected. Under the 50,000 bpd alternative (40,000 Union B/10,000 VMIS), under Class II Areas for SO_2 3 Hr., the total is shown as "42". Under the 50,000 bpd all Union B alternative, TSP 24 Hr, Class II is shown as "76". Under the 50,000 bpd alternative with an additional retort, the total NO_x Annual under Class II areas is shown as "24". Addition of the numbers presented would give values of 52, 77, and 54 respectively. The significant impact level under the 100,000 bpd all Union B case for SO_2 3 Hr., is shown as "21" and should be "25". 156

Page 4-107

The alternative shown as 10,000 bpd (All Union B/10,000 VMIS should read 100,000 bpd all Union B. 157

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Page 4-109
Table 4.3-11 suggests that the proposed action is 50,000 bpd. This is incorrect and should be corrected in the FEIS. 158

In the Table Heading the word Colorado refers to the Colorado National Monument. This should be indicated. 158

Page 4-110 159
Table 4.3-12 suggests that the proposed action is 50,000 bpd. This is incorrect and needs to be corrected.

The alternatives called Lurgi Retorts 90,000/100,000 and Lurgi Retorts 40,000/100,000 should be Lurgi Retorts 90,000/10,000 and Lurgi Retorts 40,000/10,000.

Under Proposed Action with Cogeneration, the totals for TSP 24-Hr., SO_2-3 Hr., and NO_2 Annual appear incorrect.

The SO_2 3-Hr. total under Cogeneration for the Alternative incorrectly labeled Proposed Action 50,000 bpd appears to be incorrect.

The total SO_2-3 Hr under Cogeneration for the Alternative Lurgi Retorts 90,000/10,000 appears to be incorrect.

Under the all Lurgi 100,000 bpd Alternative, all totals with the exception of the TSP annual and the TSP 24-Hr. appear to be incorrect.

Under the all Lurgi 100,000 bpd Alternative under Cogeneration it appears that the maximum for TSP Annual and TSP-24 Hr. have been reversed.

Under the Lurgi 100,000 bpd Alternative, no value is shown for NO_2 Annual Maximum. This should be explained. 159

Page 4-112 160
Under the 50,000bpd - 40,000 Lurgi/10,000 VMIS alternative, the first sentence of the first paragraph should be clarified. The numeral values shown are not consistent with the values in Table 4.3-12.

Page 4-113
In the first paragraph under 100,000 bpd - All Lurgi Retorts, third line, the notation for SO_2 is incorrect.

Under the 100,000 bpd - Additional Retort alternative, the first sentence should be clarified. It is suggested that it be reworded as follows "The full production Union B/additional retort represents the case in which the fine oil shale is not stockpiled, but instead is processed by Lurgi retorting." 160

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Page 4-114
Under the 50,000 bpd Additional Retort alternative, the first sentence should be clarified. The following wording is suggested: "The reduced production/additional retort alternative represents the case in which the fine oil shale is not stockpiled, but instead is processed by Lurgi retorting." 161

161

Page 4-115 162
The second line of the first paragraph states that a Level-1 visibility screening analysis indicates that an NO_x-caused dark plume against the bright sky would be visible for 46 miles from the facility. This is at full production with cogeneration. However, on Page 4-103, the first paragraph states that at full production with no cogeneration the plume can be visible for a distance of 55 miles. It is not clear as to why this distance is less with cogeneration than without it and this should be clarified.

In the first paragraph under Solid/Hazardous Wastes and Toxic Pollutants, reference is made to data supplied by Cities Service (1983c) which is presented in Table 4.3-14. However, this table shows the source as Getty (1983c). This should be clarified. In the fourth line, the title associated with the EPA 1983 reference is not the same as the title shown in the reference section.

In the first paragraph under Secondary Impacts, second line, "Services" should be "Service's".

In the second paragraph under Secondary Impacts, fourth line, the reference (EPA 1977) should be (EPA 1977c).

The last paragraph, line six states that the pollutants emitted during the 18-hour period were assumed to accumulate over the town and then fumigated down to the ground. This seems to be an improper use of the word fumigate and the word "settled" is suggested as a replacement. 162

Page 4-116 163
In Table 4.3-14, the units for Concentration in Off-Gas are given as µg/SCM and for Toxicity Range as µg/m^3. Are these units not the same? This should be clarified. In the footnotes, "c" is mislabeled "b". 163

Page 4-117 164
In Table 4.3-15, it would be helpful to the reader if an asterisk were placed after the word "Other" and then in a footnote explain

3-19

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that primary pollutants are shown in Table 4.3-6. The value shown for Volatile Organic Compounds for Cathedral Bluffs should be shown as less than 40.

In Table 4.3-16 the total for NO_x emissions is shown as 1610, and the total for hydrocarbons is shown as 929. The addition, however, would indicate 1600 and 932, respectively. This should be clarified. 164

Page 4-118
In Table 4.3-17, "Spent Shale Disposal Truck" should be "Spent Shale Disposal Trucks". 165

166
Page 4-119
Third paragraph states that in Table 4.3-18 the noise levels of mobile equipment were assumed to be the same as for the proposed action. However there is no mobile equipment shown in Table 4.3-18. It is also unclear as to whether the spent shale disposal trucks shown in Table 4.3-17 for the proposed action are the same as mobile equipment discussed in this paragraph. This should be clarified. 166

167
Page 4-121
Under Cultural Resources Proposed Action, the first paragraph discusses Construction of the Cities Service underground room and pillar mine (100,000 bpd). This should be clarified because the proposed action is not a 100,000 bpd underground room and pillar mine. In the third line, first paragraph, "primary crusher" should be deleted. The primary crusher is located underground and will not affect the topography.

In the last paragraph, second line, "have" should be "has". 167

Page 4-123
In the sixth paragraph, fifth line, "potentiall" should be "potential". 168

Page 4-124
In the first paragraph under Proposed Action, second line, "mines" should be "mine", "therefor" should be "therefore". 169

170
Page 4-126
The first full paragraph states that information on project employment, wages and local purchases was supplied by Cities Service. This is incorrect. Cities Service supplied only the project employment.

The last paragraph under Direct Project Employment, Wages, and Purchases states that the highest construction purchases are $181 million which is reached in the year 2004. This statement is incorrect. The highest construction purchases are reached in the year 2003 and the figure of $181 million should be $152 million.

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In the last line, "construction" should be inserted after "non-local". 170

171
Page 4-127
Table 4.3-21 gives Construction Local Purchases for the year 2003 as $181,300,000. This is not correct, it should be $151,900,000 and the Total Local Purchases for the year 2003 should be $203,900,000.

Page 4-128
The third paragraph states that local purchases were provided by Cities Service. This is not correct.

Page 4-129
Discrepancies and inaccuracies should be corrected in Tables 4.3-23, 24, 25, 26, 27, and 28.

Page 4-130
Next to the last paragraph, second sentence, "about" should be deleted and "7,707" substituted for "7,700".

Page 4-131
The last line of the second paragraph states that Grand Junction is expected to have impacts of about 4 to 7 percent from 1997 to 2009. This is inconsistent with Table 4.3-25 which shows the impacts to vary from 4 to 9 percent. This should be clarified.

Page 4-133
In Table 4.3-25 (on Page 4-133 only) the headings Garfield County and Carbondale should be changed to Parachute and Rifle, respectively. 171

172
Page 4-136
The sixth line of the first paragraph makes reference to section 3.1.13.4. This should be changed to section 3.1.13.3.

The fifth paragraph should be clarified. The housing for Mesa County is shown in actual units with and without the Cities Service project for the years 1983 and 2009. The discussion on Garfield County shows increase in housing by percentage and does not indicate the years for which the percentages are calculated. This should be clarified.

Page 4-140
Table 4.3-26, the heading "Glenwood Springs" should be changed to "Total Garfield and Mesa County".

Page 4-141
In Table 4.3-27, the school age population in District 49 with the project for the year 1984 is shown as 113. This should be 118. 172

7

Page 4-143
The second line, first paragraph, makes reference to a fiscal balance of $278.8 million. This number should be $278.9 million to be consistent with Table 4.3-28. 173

In the next to the last line on this page, reference is made to Table 4.3-28. This reference should be Table 4.3-29.

Page 4-151
In the next to the last line, "samller" should be "smaller". 173

Page 4-153 174
Table 4.3-32 gives the PHT to CAP ratio for Segment H in 1980 as .13. This should be .43. In the year 2010 the ratio for Road Segment E is given as .66. It should be .69. The ratio for Road Segment F is given as 1.24. It should be 1.11. In addition there should be a Reference for this Table.

Page 4-154
There should be a Reference or Source for Table 4.3-33.

In Table 4.3-33, the Total Accidents for Road Segment E in the year 2010 is given as 509. This value should be 506 to be consistent with the other numbers in the table. 174

Page 4-155
Table 4.3-34, footnote "a", gives a reference as (BLM 1982). 175
This should be (BLM 1982d).

Page 4-157
In the second line of the first paragraph, "whom" should be 176
"who".

Page 4-158 177
In the third line of the last paragraph, the Roan Creek drainage basin disturbance is estimated at 12,128 acres. This is inconsistent with Table 4.4-2. This needs to be clarified.

Page 4-159
In the seventh line of the first paragraph, "flouride" should be "fluoride". 177

Page 4-161 178
In the second paragraph under Aquatic Ecology, fourth line, a reference is given as (Holden 1983). This reference should be (Holden 1983a).

The fourth paragraph under Aquatic Ecology, first line, states that Acid deposition as a result of air emissions needs to exceed 18 pounds per acre to impact even the most sensitive aquatic ecosystems. The time frames should also be indicated. 178

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Page 4-162
In the first paragraph under Vegetation, sixth line, 179
"anticipated" is improperly typeset.

Page 4-164
In the second line of the first paragraph, there is a reference 180
USFWS 1981. This reference is not given in the Reference Section.

Page 4-165 181
Under Air Quality/Meteorology, first paragraph, second line, NO_2 should be NO_x.

In the second paragraph under Air Quality/Meteorology, a reference is given for the TAPAS model as Taylor and Higgins., both of 1983. These are personal communications. The technical reports which supplied the data should be referenced.

Page 4-166
Under Air Quality, the first paragraph states that a 24-hour SO_2 increment at Colorado National Monument is consumed. It then goes on to say that half of this impact is due to a source which is non-increment consuming. This needs to be clarified.

Page 4-167
In Table 4.4-5, the title "Colorado" should be "Colorado National Monument".

In Table 4.4-6, the source is given as BLM (1983d). This reference is not listed in the Reference Section. Footnote "a" states highest second-highest. The meaning is not clear. 181

Page 4-168 182
In Table 4.4-7, under Production Level, two of the production levels are in parentheses. The meaning of the parentheses should be clarified. Cities and Getty's projects are shown at a production level of 100,000. They should be shown as 100, since the production levels are already in thousands of barrels per day.

In the last paragraph, the statement is made that cumulative acid deposition was determined by adding Getty's and Cities Service's deposition to those used in other studies. But the references indicate personal communications, not the studies actually used. This should be clarified.

Page 4-169
Table 4.4-8 does not show the units for Annual Deposition of Total Sulfur.

In the first paragraph under Secondary Impacts, the first two words of the first line should be deleted. Fifth line, "impact" should be "impacts". 182

7

Page 4-170
In the paragraph under Visual Resources, fourth line, "Chevron" should be replaced with "CCSOP". 183

184
Page 4-171
In the second paragraph under Employment and Income, line one, "annual" should be inserted before "rates" and "per employee" should be inserted after "operation" in the second line. In the first line, $32,612 is not consistent with the value given in Table 4.4-10 and this should be clarified.

The third paragraph under Employment and Income, line one states that the number of new jobs could reach 59,000 by 1995, which is double the "no action" alternative of 56,000. This needs to be clarified.

Page 4-172
In Table 4.4-10 the headings would be more meaningful if the word "Employment" were inserted over the items Construction, Operation and Total. In the year 2002, the construction employment is shown as 2250. This should be 2240 to be consistent with the other numbers in the table. Other inaccuracies in the Table should also be corrected.

In footnote "a" of Table 4.4-10, total construction wages are given as $7.2 billion. This should be $7.3 billion. In footnotes "a" and "b", it is suggested that "Per Employee" be put after the wage rates, to make these footnotes more meaningful.

The title for Table 4.4-10 was changed in the errata sheet. However, there should be no comma after the word "Operations".

In the paragraph under Local Purchases, the last line states that annual purchases would range from $475 million to $650 million. These numbers are not consistent with Table 4.4-10.

Page 4-173
The first partial paragraph, fourth line, states that 16,000 is two and one-half times the "no action" projection of 4,662. This should be corrected. 184

185
Page 4-176
The opening sentence of this page states: "The following unavoidable adverse impacts would be expected from development of the Cities Service shale oil project." This seems to be an overstatement of the possible effects and should read: The following potentially unavoidable adverse impacts could be expected from development of the Cities Service shale oil project. 185

186
Page 4-191
In the last paragraph, first line, "facilties" should be "facilities".

7

Page 4-192
At the top of the page, second bullet, "approxmiately" should be "approximately".

In the first full paragraph, line four, the sentence starting with "Not" should start with "No". 186

Page 4-193
In the paragraph under Noise, second line, "adsorbers" should be "absorbers". 187

188
Page 6-1
In the title for Eric J. Hinzel, "Manger" should be "Manager".

Page 8-2
In the reference 1983j under CDM, "Octber" should be "October".

Page 8-6
The reference "Goodwin, C. (Environmental Coordinator, Cities Service Company)" should be changed to "Goodwin, C. M. (Manager Environmental Compliance, Cities Service Oil and Gas Corporation) 188

189
Appendix a-1
In the fifth line, first paragraph, "were" should be "was".

Appendix a-2
At the top of the page, the last two alternatives need to be clarified. It is not clear what the components are of the 100,000 bpd and the 50,000 bpd production rates.

Appendix a-3
In the first full paragraph, fifth line, the sentence could be clarified by placing "produced by" before the word "shale".

Appendix a-4
In the paragraph under Emission Inventories, reference is made to Table 4.3-7, this should be Table 4.3-6.

Appendix a-5
The first full paragraph, third line, states five particle size classes were used in modeling the Getty and Cities Service fugitive dust area sources for alternative.The meaning of this sentence should be clarified.

In the next to the last line of the last paragraph, "getty" should be capitalized. 189

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APPENDIX CS-1

CITIES SERVICE
INTEROFFICE LETTER

LEGAL DIVISION

March 15, 1984

190

TO: Mr. J. Hulsebos

FROM: Rodney G. Buckles

SUBJECT: "Agency Preferred Alternative"

COMMENT:

The "agency's preferred alternative" must be identified and discussed in the Final EIS.

BASIS FOR COMMENT:

Applicable Regulations of the Council on Environmental Quality and COE require the "agency's preferred alternative" to be identified and discussed in the Final EIS even if it has been omitted from the Draft EIS.

The Council on Environmental Quality has issued NEPA Regulations which establish specific requirements for the "alternatives" section of an EIS. Those Regulations state that an agency shall explore and evaluate all reasonable alternatives, including the alternative of no action and reasonable alternatives not within the jurisdiction of the lead agency, discuss each alternative in detail, and identify the agency's preferred alterative. See 40 CFR §1502.14(e).

On March 17, 1981, the Council on Environmental Quality released to the public a memorandum in which it had interpreted its Regulations to relevant government officials, a memorandum published March 23, 1981 at 46 Fed. Reg. 18026 entitled "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations."

In that memorandum 40 CFR §1502.14(e) was interpreted at Questions 4(a) and 4(b) as follows:

> "4a. What is the 'agency's preferred alternative'?
>
> A. The 'agency's preferred alternative' is the alternative which the agency believes would fulfill its statutory mission and

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> responsibilities, giving consideration to economic, environmental, technical and other factors. The concept of the 'agency's preferred alternative' is different from the 'environmentally preferable alternative,' although in some cases one alternative may be both. See Question 6 below. It is identified so that agencies and the public can understand the lead agency's orientation.
>
> 4b. Q. Does the 'preferred alternative' have to be identified in the Draft EIS and the Final EIS or just in the Final EIS?
>
> A. Section 1502.14(e) requires the section of the EIS on alternatives to 'identify the agency's preferred alternative if one or more exists, in the draft statement, and identify such alternative in the final statement . . .' This means that if the agency has a preferred alternative at the Draft EIS stage, that alternative must be labeled or identified as such in the Draft EIS. If the responsible federal official in fact has no preferred alternative at the Draft EIS stage, a preferred alternative need not be identified there. By the time the Final EIS is filed, Section 1502.14(e) presumes the existence of a preferred alternative and requires its identification in the Final EIS 'unless another law prohibits the expression of such a preference.'" 46 Fed. Reg. at 18027

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40 CFR §1502.14(e)'s requirements as to the considerations to be included in establishing the "agency's preferred alternative" (economic, environmental, technical and other factors) and the timing and location of its identification (no later than in the Final EIS) are clearly stated in the Council on Environmental Quality's memorandum.

40 CFR §1502.14(e) must be followed by the Corps of Engineers pursuant to

(a) 40 CFR §1500.3 which states:

> "Parts 1500-1508 of this title provide regulations applicable to and binding on all Federal agencies for implementing the procedural provisions of [NEPA] except where compliance would be inconsistent with other statutory requirements."; and

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(b) its own statement of policy that the COE "will continue to implement vigorously . . . the regulations of the Council on Environmental Quality" in carrying out COE's Civil Works Mission. 33 CFR §230.5

The Corps of Engineers' implementation of Council on Environmental Quality regulations as they pertain to 40 CFR §1502.14(e) are found in paragraph 11(d) of Appendix B to 33 CFR §230. That paragraph does not cite any statutory requirement or authority for non-compliance with 40 CFR §1502.14(e)'s clear direction to identify the "agency's preferred alternative" in the Final EIS. The paragraph does note that actual decisions made by the final decision maker will be stated in the Record of Decision, but that is not inconsistent with identification of the "agency preferred alternative" in the Final EIS. To the contrary, it supports the need for the identification in the Final EIS so that it is available to the final decision maker when the actual decision is made based upon the public interest review which underlies and leads to the Record of Decision.

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APPENDIX CS-2
Public Lands Potentially Affected by the
Cities Service Shale Oil Project

The following tabulation describes public lands that potentially may be needed for Cities Service's Conn Creek Shale Oil Project. The plots are shown as 40 acres, even though there may be a need for only a portion of them.

This list may contain some private land due to Cities Service's inability to definitely determine ownership from the BLM Surface Management Quads and also the Master Title Plats obtained from the BLM office in Denver.

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TABLE 2.3-9
PUBLIC LANDS POTENTIALLY AFFECTED BY
THE CITIES SERVICE SHALE OIL PROJECT

Range and Township	Section	Quarter-Quarter Section	Project Feature	Land Action
T5S, R96W	Section 6	Lots 3, 4, 5, 6	Road/Utility Corridor	(1)
	Section 18	Lot 4	Road/Utility Corridor	(1)
T6S, R97W	Section 3	Lots 5, 6, 7, 8	Mine	(1)
		Lot 8	Road/Utility Corridor	(1)
	Section 4	Lots 5, 6, 7, 8	Mine	(1)
		Lot 5 and 8	Road/Utility Corridor	(1)
T6S, R97W	Section 15	All SW¼	Mine	(1)
T7S, R97W	Section 5	NW¼ NW¼	Road/Utility Corridor	(1)
		SW¼ NW¼	Road/Utility Corridor	(1)
		NW¼ SW¼	Road/Utility Corridor	(1)
		SW¼ SW¼	Road/Utility Corridor	(1)
T7S, R97W	Section 8	NW¼ NW¼	Road/Utility Corridor	(1)
		NE¼ NW¼	Road/Utility Corridor	(1)
		SE¼ NW¼	Road/Utility Corridor	(1)
		SW¼ NW¼	Road/Utility Corridor	(1)
		NW¼ SW¼	Road/Utility Corridor	(1)
		NE¼ SW¼	Road/Utility Corridor	(1)
		SE¼ SW¼	Road/Utility Corridor	(1)
		SW¼ SW¼	Road/Utility Corridor	(1)
		SW¼ SE¼	Road/Utility Corridor	(1)
T7S, R97W	Section 17	NW¼ NW¼	Road/Utility Corridor	(1)
		NE¼ NW¼	Road/Utility Corridor	(1)
		SW¼ NW¼	Road/Utility Corridor	(1)
		SE¼ NW¼	Road/Utility Corridor	(1)
		NW¼ NE¼	Road/Utility Corridor	(1)
		SW¼ NE¼	Road/Utility Corridor	(1)
		NW¼ SW¼	Road/Utility Corridor	(1)
		SW¼ SW¼	Road/Utility Corridor	(1)
		SE¼ SW¼	Road/Utility Corridor	(1)
		NW¼ SE¼	Road/Utility Corridor	(1)
T7S, R97W	Section 18	SW¼ SE¼	Road/Utility Corridor	(1)
		NE¼ SE¼	Road/Utility Corridor	(1)
		SE¼ SE¼	Road/Utility Corridor	(1)

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Range and Township	Section	Quarter-Quarter Section	Project Feature	Land Action
T7S, R97W	Section 19	NW¼ NE¼	Road/Utility Corridor	(1)
		SW¼ NE¼	Road/Utility Corridor	(1)
		SE¼ NE¼	Road/Utility Corridor	(1)
		NE¼ NE¼	Road/Utility Corridor	(1)
		NW¼ SW¼	Road/Utility Corridor	(1)
		NE¼ SW¼	Road/Utility Corridor	(1)
		SE¼ SW¼	Road/Utility Corridor	(1)
		SW¼ SW¼	Road/Utility Corridor	(1)
		NW¼ SE¼	Road/Utility Corridor	(1)
		SE¼ SE¼	Road/Utility Corridor	(1)
T7S, R97W	Section 20	NW¼ NW¼	Road/Utility Corridor	(1)
		SW¼ NW¼	Road/Utility Corridor	(1)
T7S, R97W	Section 30	NW¼ SE¼	Road/Utility Corridor	(1)
		SW¼ SE¼	Road/Utility Corridor	(1)
		SE¼ SW¼	Road/Utility Corridor	(1)
		SW¼ SW¼	Reservoir & Road/Utility Corridor	(1)
T7S, R97W	Section 31	NW¼ NW¼	Reservoir	(1)
		SE¼ NW¼	Reservoir	(1)
		NE¼ NW¼	Road/Utility Corridor	(1)
T7S, R97W	Section 31	NW¼ NE¼	Road/Utility Corridor	(1)
		NE¼ NE¼	Road/Utility Corridor	(1)
		SW¼ NE¼	Road/Utility Corridor	(1)
		SE¼ NE¼	Road/Utility Corridor	(1)
		NE¼ SW¼	Reservoir	(1)
		NW¼ SE¼	Reservoir	(1)
		SW¼ SE¼	Reservoir	(1)
		SE¼ SE¼	Reservoir	(1)
T7S, R97W	Section 32	SE¼ NE¼	Road/Utility Corridor	(1)
		SW¼ NE¼	Road/Utility Corridor	(1)
		NE¼ SE¼	Road/Utility Corridor	(1)
		NW¼ SE¼	Road/Utility Corridor	(1)
		NW¼ SW¼	Road/Utility Corridor	(1)
		SW¼ SW¼	Reservoir & Road/Utility Corridor	(1)
T7S, R97W	Section 33	NW¼ SW¼	Road/Utility Corridor	(1)

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Range and Township	Section	Quarter-Quarter Section	Project Feature	Land Action
T7S, R98W	Section 36	SW¼ NW¼	Reservoir	(1)
		NE¼ SW¼	Reservoir	(1)
		SE¼ SW¼	Reservoir	(1)
		SW¼ SE¼	Reservoir	(1)
T8S, R98W	Section 1	NE¼ NE¼	Reservoir	(1)
		SE¼ NE¼	Reservoir	(1)
		SW¼ NE¼	Reservoir	(1)
		NE¼ SE¼	Reservoir	(1)
		SE¼ SE¼	Reservoir	(1)
		SW¼ SE¼	Reservoir	(1)
		NW¼ SE¼	Reservoir	(1)
T8S, R97W	Section 5	NW¼ NW¼	Reservoir & Road/Utility Corridor	(1)
		SW¼ NW¼	Road/Utility Corridor	(1)
		SE¼ NW¼	Road/Utility Corridor	(1)
		NE¼ NW¼	Reservoir & Road/Utility Corridor	(1)
		NW¼ SW¼	Reservoir & Road/Utility Corridor	(1)
		SW¼ SW¼	Road/Utility Corridor	(1)
		NE¼ SW¼	Road/Utility Corridor	(1)
		NW¼ NE¼	Road/Utility Corridor	(1)
		SW¼ NE¼	Road/Utility Corridor	(1)
T8S, R97W	Section 6	NE¼ NE¼	Reservoir	(1)
		SE¼ NE¼	Reservoir	(1)
		SW¼ NE¼	Reservoir	(1)
		NW¼ NE¼	Reservoir	(1)
		NE¼ SE¼	Reservoir	(1)
		SE¼ SE¼	Reservoir	(1)
		NW¼ SE¼	Reservoir	(1)
		SW¼ SW¼	Reservoir	(1)
T8S,97W	Section 7	NE¼ NE¼	Reservoir	(1)
		SE¼ NE¼	Reservoir	(1)
		NE¼ SE¼	Reservoir & Road/Utility Corridor	(1)
		SE¼ SE¼	Reservoir & Road/Utility Corridor	(1)

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Range and Township	Section	Quarter-Quarter Section	Project Feature	Land Action
T8S, R97W	Section 8	SW¼ SW¼	Road/Utility Corridor	(1)
T8S, R97W	Section 17	NE¼ SE¼	Road/Utility Corridor	(1)
T8S, R97W	Section 21	SE¼ NW¼	Road/Utility Corridor	(1)
		NE¼ NW¼	Road/Utility Corridor	(1)
T8S, R97W	Section 27	NE¼ NW¼	Road/Utility Corridor	(1)

(1) Land action may be one of three options including land trade, land purchase, or BLM right-of-way. The specific action will be determined at a later date.

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CS-2.5

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The Colorado Mountain Club

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Tom Coe, Regulatory Section
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814

March 19, 1984

Dear Mr. Coe,

Following are comments from the Colorado Mountain Club regarding the Getty and Cities Service Shale Oil Projects Draft Environmental Impact Statement. The Colorado Mountain Club is a recreation and conservation organization of over 7,000 members which takes hiking, climbing, camping, skiing, bicycling and general recreational trips into the Colorado rockies and to other states and countries. We are interested in protecting long-range visibility and preventing harmful acid deposition in the Colorado Rockies. We are concerned that oil shale development be planned in a manner compatible with existing tourism and outdoor recreational uses of the affected lands. With our interest in public lands management, we are concerned that documents, such as the DEIS under discussion, be accurate and give the public a clear and fair picture of potential impacts from the proposed operations. With these concerns in mind, the following comments have been developed.

1) The Purpose and Need section, pages 1-3 and 1-4 contains the following statement: "The jobs, income, expenditures, and general economic growth and development of this region, resulting from the proposed developments, would satisfy the economic needs of Colorado and the United States." 1

We find this statement very unbalanced and meaningless in that there is no supporting evidence to justify the conclusion. Up to the present time oil shale has had more adverse than positive economic benefits for Colorado. Proposed oil shale development is fraught with adverse economic and social impacts for the state and for the local communities involved as well as for the financial community that would have to support the development. The experience with the Exxon and Union development indicated that local workers did not necessarily get jobs, local businesses did not necessarily profit and people came from across the United States looking for jobs that did not exist. These people created severe social problems in the area. 1

Furthermore, this statement makes no recognition of the existing tourism/vacation/outdoor recreation industry which is the <u>second</u> largest industry in Colorado and which provides a stable, state-wide lacking for most of the communities in the state. This industry depends on clean air, good visibility, clean water, healthy fish and wildlife populations and scenic recreational areas for its existance. According to this DEIS and numerous other oil shale documents, Colorado air, water and wildlife will be severely impacted by oil shale development if this development proceeds as presently proposed. Any federal agency, such as the Corps of Engineers, writing an EIS for an oil shale proposal should recognize the existing tourism/recreation industry and should emphasize ways inwhich oil shale and tourism can be compatible. 2

Tom Coe
3/19/84
- 2 -

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We request that this section be rewritten in the FEIS to incorporate the above concerns. As supporting documentation for our concerns, enclosed is a report recently released by the Colorado Mountain Club describing the economic benefits to Colorado of the state's natural recreational resources. 2

2) Tables 2.2-1 and 2.2-2, pages 2-2 to 2-5, discuss alternatives considered and eliminated from analysis. 3

a) The Union B technology is described as developed commercially. There is no supporting evidence for this as Union is currently changing its technology because existing operations do not work. The Lurgi technology is desoriped asdeveloped and demonstrated. However, federal tract C-a found Lurgi too expensive for commercial development. The rosy description of these technology is not accurate and is misleading to the public. The current situation with these technologies should be listed in this brief description. 3

b) Regarding siting of retorts it is interesting that the valley sites were rejected for both Getty and Cities Service on the basis of projected unacceptable air quality impacts. There will be the same emissions whether the retorts are in the valley or on the mesa. Why are the emissions acceptable on the mesa. This choice appears to support the concept "dilution is the solution to polution". This concept is what has given the United States, Canada, Germany and the Scandinavian countries the current major problems of deforestation, fish kills, dead lakes, etc. associated with acid deposition. Knowing that dilution is not the answer requires a zero emission or recycled emissions or greatly reduced emissions alternative. Without such an alternative the Carps and Getty and Cities Service are clearly saying to the Colorado public and the national and international public which vacations in Colorado either that visibility and acid deposition impacts in this state are not important or that Colorado is different from the rest of the world and it will not happen here. We request that there be a thorough discussion of a "recycled emissions", "zero emissions" or "greatly reduced emissions" alternative. 3a

3) Section 2.3.1.1, page 2-6: What does the phrase "If economically justified", mean? At what point in the development of an operation should the company decide if the operation is economically justified? How far should the public go in paying for state and federal agencies to review, comment on and rereview proposed operations which may or may not be economically justified. This go-ahead decision should be made by the operator before the public is asked to spend considerable public funds on pre-development reviews. 4

4) For both the Getty and Cities Service proposals, why are Lurgi retorts considered as an alternative? What are the comparative advantages and disadvantages, economically and environmentally, of the two technologies. Is this stated clearly somewhere in the DEIS? 5

5) Pge 2.43 states that for the Cities Service retorts emission data has been provided by Union and is based on BACT. The Union technology is currently undergoing changes and the BACT concept is frequently updated to reflect the most recent control technology. This document does not give an accurate indication of potential emissions. In order to complete the NEPA process Cities Service should decide on its technology, get some current test data and write a supplement to this EIS. The requirement for a supplement in areas where the proponent is uncertain about technology and data should be part of the Corps decision notice. The same is true for VMIS data from Cathedrale Bluffs. 6

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6) Pg. 2-62, section 2.4.3.1.2, states that under the Getty proposed action 80% of the SO_2 PSD Class I increment in Flattops will be consumed. Pg. 2-77, section 2.4.3.2.2, states that the Cities Service proposed action will consume 60% of the 24hr. Class I PSD increment in Flattops. Assuming that the Getty figure is also the 24 hr. increment, 60% and 80% add up to 120%. However, the discussion of cumulative impacts, pg. 4-166 states that only the Mt. Zirkel 24hr. SO_2 Class I increment will be consumed and the Colorado National Monument Category I increment will be consumed. What about the 120% in Flattops plus all the developments included in the cumulative section? Please clarify. 7

7) Pg. 4-81 states that for the Cities Service operation no information is available for the contents, pile design or reclamation plans for the waste rock disposal pile or the shale fines stockpile. These areas could significantly affect air quality. The information should be included in the FEIS. 8

8) Table 4.3-11, page 4-109, gives the proposed action for Cities Service as 50,000 bpd. The table on the following page gives the proposed action as 100,000 bpd. Which is it? Please clarify. 9

9) The discussion of atmospheric deposition for Getty, pgs. 4-34 and 4-35, and for Cities Servise, pg. 4-103, indicate that each separate operation has the potential to lower the pH in poorly buffered lakes in Class I areas. These sections should state that lakes in the Flattops and Mt. Zirkel areas, particularly higher lakes, are poorly buffered. This information should be in the section describing the existing environment.as well. 10

10) Pg. 4-103 describes acid deposition as an air quality related value. It is not. Water, air and wildlife are air quality related values that are protected in Class I areas. Water, air and wildlife are also wilderness values which are protected in any Wilderness area whether Class I or Class II. Please contact Dennis Haddow, Forest Service Region 2 Air Quality Specialists, to clarify this term. 11

11) Pg. 4-166, under Air Quality, discusses cumulative impacts which will consume the Class I PSD 24 hr. SO_2 increment in the Mt. Zirkel Wilderness. The section states that about half of the increment consumption is due to the Hayden Power Plant, "a non-increment consuming source". The Hayden power plant does not fall under the PSD program, but it is definitely an increment consuming source. Every source, permitted or not, consumes increment. Please contact Gary McCutchin, Colorado Air Quality Control Division, for clarification. 12

12) Table 4.4-6, pg. 4-167 indicates that the Grand Mesa area will be impacted above the Class I levels as far as the SO_2 24hr. and 3hr. increments are concerned. While Grand Mesa is a Class II area, it is as valuable as wilderness with regard to scenic, recreational, tourism and general ecological attributes. Grand Mesa is a unique landmark in Colorado. The FEIS should contain an analysis of the impacts on this special area. 13

13) Pages 4-168 and 4-169 give a brief discussion of cumulative acid deposition impacts. This section should state that poorly buffered lakes may have a lowered pH and that some lakes in the Flattops and Mt. Zirkel Wilderness areas are poorly buffered. 14

14) Table 4.4-7, pg. 4-168, and the predicted visibility impacts from SO_2 plus cumulative acid deposition impacts present present a very disturbing picture of potential adverse air quality impacts from the Getty and Cities Service developments 15

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as well as the other oil shale developments presumably coming before Getty and Cities Service. These severe impacts in a region where air quality and water quality are of the upmost importance, should be a signal to the permitting agency to encourage and, in fact, insist upon alternatives which lessen these impacts. The Corps has analyzed various levels of development. The Corps should also consider alternatives requiring greatly reduced emission levels due to technology rather than lower production levels. 15

In conclusion, the Colorado Mountain Club requests: 16

1) The fact that the tourism/vacation/outdoor recreation industry is the second largest industry in the state be recognized in the purpose and needs statement and the section on existing environment. The impacts to tourism and recreation should be recognized throughout the document and become an integral part of the analysis. 16

2) A zero emission, recycled emission and greatly reduced emission alternative, based on technology, should be included. 17

3) Getty and Cities Service should clarify specific aspects of their operations. 18

4) The air quality information - visibility and acid deposition impacts and increment consumption - should be clearly presented both in table and narrative form so that the impacts are understandable to the public. As the DEIS currently stands, it is difficult to get a clear picture of the economic and environmental impacts on those values and industries which depend on clean air and clean water 19

The Colorado Mountain Club appreciates the opportunity to comment on the DEIS.

Sincerely,

Anne Vickery

Anne Vickery
Conservation Director

Inc.

The Colorado Mountain Club
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COLORADO'S NATURAL RECREATIONAL RESOURCES
AN UNRECOGNIZED ECONOMIC ASSET

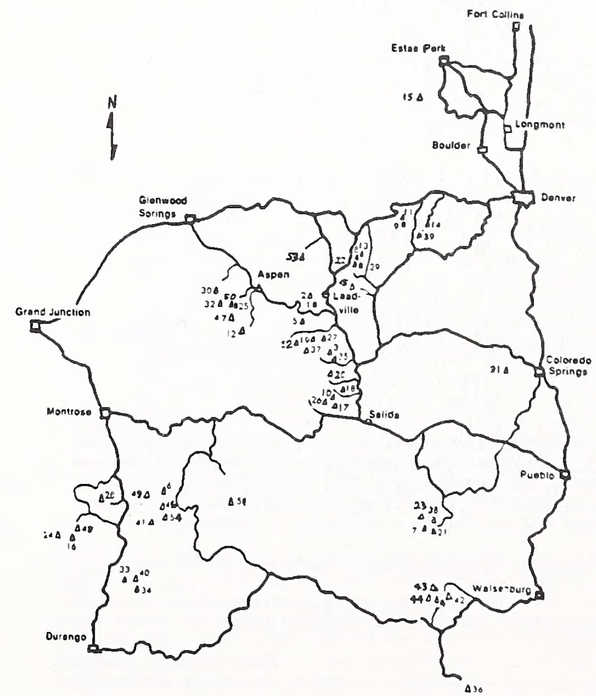
Introduction

Colorado has a wealth of natural recreational resources - high peaks, scenic areas, clean air, good visibility, forest and grasslands, wildlife and fish populations, clean water, streams and lakes. These resources support a stable, state-wide vacation, tourism and outdoor recreation industry which is a major economic asset to the state. During the past twenty years there has been a constant growth in this industry as the number of people using Colorado for outdoor recreation continues to rise. In 1983 tourism, including some aspects of outdoor recreation was estimated as a 3.9 billion industry.

A cohesive recreational management policy is needed for these resources most of which are on public lands managed by diverse agencies. The economic importance of the vacation-tourism-outdoor recreation industry and the economic value of the natural recreational resources which foster this industry need to be recognized. Protection of these resources must become a major factor in planning and development for the state. Following is a partial list of these resources with a discussion of the economic benefits of each.

The Fourteen-Thousand-Foot Peaks

Colorado has 54 peaks over 14,000 feet high. These peaks are located throughout the state (see Figure 1) from Long's Peak in the north to Culebra in the southeast and the Wilson Peaks and El Oiente in the southwest. Thirty-five of these peaks are in National Wilderness areas and are protected by federal Wilderness legislation. Nineteen peaks are outside the Wilderness and do not have this protection. It has become a state, national and even international challenge to climb as many of the 14,000 foot peaks as possible. The economic benefits from recreation associated with these peaks are statewide. Each climber needs equipment, transportation, food and lodging and each climber goes home to tell relatives and friends about the climb - a volunteer Colorado Chamber of Commerce.



COLORADO
Roads and 14,000' Peaks
KEY

1	Mount Elbert	14.433
2	Mount Massive	14.421
3	Mount Harvard	14.420
4	Blanca Peak	14.345
5	La Plata Peak	14,336
6	Uncompahgre Peak	14.309
7	Crestone Peak	14.294
8	Mount Lincoln	14.286
9	Grays Peak	14.270
10	Mount Antero	14.269
11	Torreys Peak	14,267
12	Castle Peak	14,265
13	Quandary Peak	14,265
14	Mount Evans	14.264
15	Longs Peak	14,256
16	Mount Wilson	14,246
17	Mount Shavano	14.229
18	Mount Princeton	14,197
19	Mount Belford	14,197
20	Mount Yale	14,196
21	Crestone Needle	14.191
22	Mount Bross	14.172
23	Kit Carson Peak	14.165
24	El Oiente	14.159
25	Maroon Peak	14.156
26	Tabeguache Mtn.	14.155
27	Mount Oxford	14.153
28	Mount Sneffels	14.150
29	Mount Democrat	14,148
30	Capitol Peak	14.130
31	Pikes Peak	14.110
32	Snowmass Mountain	14,092
33	Mount Eolus	14,083
34	Windom Peak	14,082
35	Mount Columbia	14,073
36	Culebra Peak	14.069
37	Missouri Mountain	14.067
38	Humboldt Peak	14.064
39	Mount Bierstadt	14.060
40	Sunlight Peak	14.059
41	Handies Peak	14.048
42	Mount Lindsey	14,042
43	Ellingwood Peak	14.042
44	Little Bear Peak	14.037
45	Mount Sherman	14.036
46	Redcloud Peak	14.034
47	Pyramid Peak	14.018
48	Wilson Peak	14,017
49	Wetterhorn Peak	14,017
50	North Maroon Peak	14.014
51	San Luis Peak	14.014
52	Huron Peak	14.005
53	Mount of the Holy Cross	14.005
54	Sunshine Peak	14.001

Figure 1. Colorado roads and 14,000 foot peaks.

In preparation for this report, the Colorado Mountain Club reviewed registers which it maintains on top of the 14,000 foot peaks. Some registers are chewed by pikas and marmots, soaked by rain and snow and even blown off the peaks. Some are spirited away as souvenirs. It is never known what will be returned to the clubhouse. Analysis of register data shows the 14,000 foot peaks to be a unique attraction in the state (see Table 1). Here are consistent findings:

1. A surprisingly large number of people climb the fourteens;
2. Almost every state in the United States is represented;
3. Many foreign countries are represented;
4. Many climbers come back year after year eventually climbing them all;
5. In recent years the number of climbers has increased dramatically.

For example:

Gray's Peak, near Loveland Pass, 50 miles from Denver, was climbed by 243 people over a 14-day period in August 1981. In a similar 22-day period ending September 5, 1983, 596 people made the ascent. This is a 192% increase in ascents per day. Altogether, over this combined period of 36 days, climbers came from 36 states and 5 foreign countries.

Uncompahgre Peak, near Lake City, was climbed by 744 people between September 6, 1981 and September 4, 1982. These climbers came from 43 states and 7 foreign countries - England, Canada, Holland, El Salvador, Japan, Australia and South Africa.

Crestone Needle, a remote and difficult peak near Westcliff, was climbed by 30 climbers during six days between August 29, 1981 and September 12, 1981. The climbers, from eight different states, had used the back of a section of a map as an innovative register.

Table 1

Selected Summit Register Data

Peak	Nearest Town	Register Dates	Ascents
Gray's Peak	Georgetown	8/6/81 - 8/20-81	243 25 states 1 foreign country
		8/14/83- 9/5/83	596 30 states 7 foreign countries
Uncompahgre Peak	Lake City	9/6/81 - 9/4/82	744 43 states 7 foreign countries
Crestone Needle	Westcliff	8/29/81- 9/12/81	30 8 states
Mt. Columbia	Buena Vista	7/14/82- 8/19/83	475 43 states 6 foreign countries
Mt. of the Holy Cross	Minturn	8/1/82 - 9/6/82	315 27 states 8 foreign countries
Mt. Sneffels	Ouray	9/13/81- 8/11/82	471 34 states 2 foreign countries
San Louis Peak	Creede	6/26/82- 9/19/82	164 21 states 2 foreign countries
Castle Peak	Aspen	9/5/80 - 7/9/83	881 40 states 11 foreign countries
Capitol Peak	Aspen	8/1/81 - 8/7/83	511 34 states 4 foreign countries
Mt. Elbert	Leadville	9/1/81 - 7/17/82	508 32 states 5 foreign countries
Mt. Oxford	Buena Vista	9/25/82- 11/5/83	470 30 states 5 foreign countries

The conclusion of this review is that the fourteen-thousand-foot peaks are a state, national and international tourist attraction and therefore a major economic asset to the state. It is vital that access to these peaks be maintained and that the high quality of visibility from the tops of the peaks be protected.

Hunting and Fishing

There have been a number of studies of the economic value of fish and wildlife to the state of Colorado. Results generally indicate that the preservation of fish and wildlife, through protection of habitat, is of major importance for the state. In 1981 hunters and fishermen spent over one billion dollars (McKean and Nobe, 1983). 81.9% of this was spent by Colorado residents and the remainder by residents of other states who came to Colorado expressly for the purpose of hunting or fishing. The report did not include out-of-state holders of two and ten-day fishing permits. The figure included "fixed" expenditures - money spent on such permanent or long term equipment as guns, fishing tackle or recreational vehicles used primarily for access to hunting and fishing areas, as well as "variable" expenditures, which include gasoline, food, lodging and auto repairs while traveling.

The McKean and Nobe study breaks down expenditures and activities by the State Management and Planning Regions (see Figure 2). A major conclusion of the

Region	% of Total
1	1.4
2	6.8
3	48.6
4	6.7
5	0.2
6	1.5
7	2.5
8	2.8
9	3.8
10	7.4
11	6.3
12	8.6
13	2.9

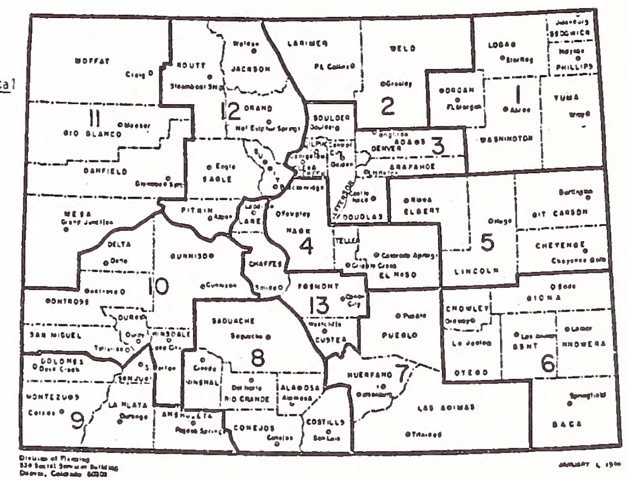


Figure 2. State Planning and Management Regions

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report is that fishing and hunting benefit the entire state, not only the areas in which the activity occurs. For example, big game hunters spent a considerable amount of money in the field, but they spent more in Denver preparing for the trip than they did in pursuit of the game. Antelope hunters spent $8.238 million in Denver and $1.091 million in region 11, where most of the antelope hunting occurred. Most small game hunting took place in region 1, the northeast section of the state, but most expenditures by small game hunters took place in Denver (region 3) and in Larimer and Weld counties (region 2). $478 million, almost half of the total statewide expenditure, was spent in region 3.

McKean and Nobe determined that 62% of the total was spent by fishermen. Another study (Jentzen, 1982) indicates that most Colorado fishermen, 86.6%, are seeking trout. A study of the economics of instream flow (Walsh, et al., 1980) estimated a 2% per year increase in user days of fishing through 1985. According to this study, 30% of the 12,500 miles of rivers in Colorado have been destroyed or substantially altered (dewatered, inundated or polluted).

If the economic value of recreational fishing is to be maintained in Colorado, the river and stream mileage available for fishing as well as the quality of these rivers and streams must be preserved. It is also apparent from these studies that a healthy wildlife population and lakes and streams which support viable fish populations are major economic assets to the state. Serious threats to wildlife such as reduction of habitat and threats to water quality such as acid deposition could have major economic impacts on the state. Denver legislators and legislators in other population centers need to be aware that the economic repercussions would be greatest in their areas.

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White Water Boating

Visitors from throughout the United States have found white water boating on Colorado's free flowing rivers to be some of the best in the nation. In 1982 commercial white water boating generated $25 million in Colorado. This was based on some 300,000 recreational days spent on Colorado rivers. The Western River Guides Association predicts that by 1986 the recreational days will be as high as 500,000. In small river side communities this sport has become an important economic resource to complement skiing, hunting and summer visitor use. Ski resorts such as Vail, Steamboat Springs, Aspen, Breckenridge, Winter Park and Keystone all have strong whitewater programs for early summer months.

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Skiing

Colorado is blessed with rugged mountain valleys, an abundance of snow, crystalline air quality and scenic long-distance views. These natural resources have given birth to an internationally acclaimed ski industry (see Figure 3). In the winter of 1981-82 over seven and one-half million downhill ski tickets were sold in Colorado and the ski industry generated over one billion dollars in retail sales. In 1982-83 ski ticket sales increased to 8.2 million. On the west slope the ski industry provides stability to an economy historically characterized by boom and bust patterns of mining development (Frick and Coddington, 1982). During the 1981-82 season, the ski industry accounted for 22% of the employment and 18% of the personal income on the west slope. Skiing in Colorado has grown at a fast pace and retail sales related to the ski industry has increased eight-fold in the past ten years.

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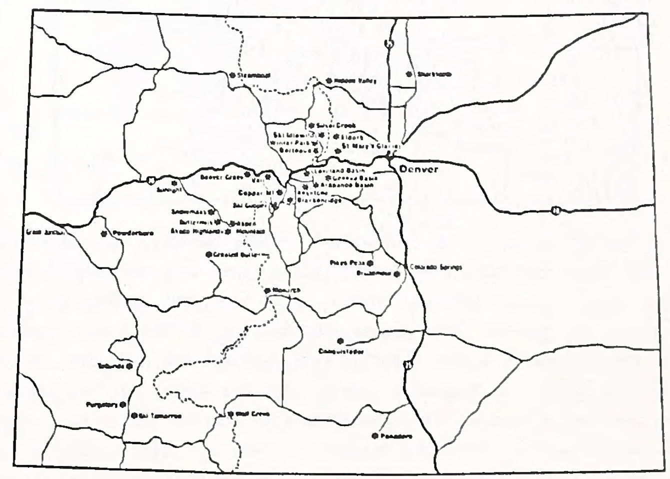

Source: Colorado Ski Country USA

Figure 3. Location of Major Colorado Ski Areas, 1982.

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The National Forests offer endless possibilities for cross-country skiing - wide valleys, broad ridge tops and forest trails and roads. Many ski areas have taken advantage of these surrounding resources and developed their own cross-country ski programs.

While excellent snow and a variety of slopes attract the skiers, good air quality is an integral part of the appeal. Skiers pause at the top of the Pallavicini lift at Arapaho Basin to spot Mt. of the Holy Cross in the distance. A decidedly Texas accent was heard to say at the top of the Iron Horse Lift at the Mary Jane Ski Area: "This has to be the most beautiful view in all of Colorado!" The ski towns, recognizing that crystalline air and good visibility are vital to skiers' enjoyment, have taken strong measures to protect mountain air quality.

Outdoor Recreation on Federal Lands

About one-third of Colorado's federal lands in the western half of the state are managed for multiple use by the Bureau of Land Management under the Department of Interior. These BLM lands contain 60 areas under evaluation for Wilderness designation and three of the popular 14,000 foot peaks, Redcloud, Sunshine and Handies near Lake City. 20 The Department of Interior also has jurisdiction over Colorado's two National Parks, five National Monuments and four National Wildlife Refuges, which are managed for preservation and recreation. The Department of Agriculture administers eleven National Forests, twenty-four National Wilderness Areas, two National Grasslands and one National Recreation Area. The Forest Service, while managing its lands for multiple use, states in its planning documents that recreation is the major use of the forests in Colorado.

These federal lands are spread throughout the state (see Figure 4) and are major tourist and recreational attractions. Economic benefits from recreational visits to these areas are state-wide. In 1982 there were over five million visitors to the National Parks and Monuments. The Forest Service, in 1982, estimated 1.8 million visitor days (a 12-hour period) for the Wilderness areas. Traveling to these and other federal recreational lands requires food, transportation and lodging. Often extensive hunting, fishing, camping and climbing gear are purchased for the visit. As with the high peaks, in-state and out-of-state visitors return home to tell friends and relatives of their experiences.

Visits to these areas are increasing. In the national parks there are many people on the trails, campsites are full and back-country permits have to be obtained

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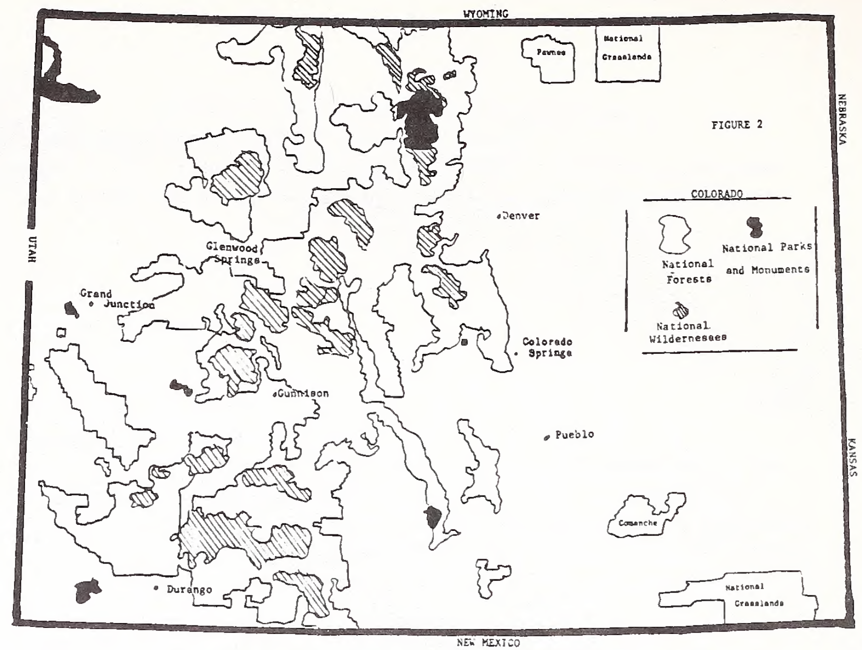

Figure 4. Location of Federal Lands (BLM Lands not shown).

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in advance. Those who visit the Wilderness areas know that even parking lots in remote areas with difficult access are often full to overflowing. The demand for Wilderness is so high that the Forest Service is considering permits to limit use in some areas.

Why do visitors come to these areas? What do they value? The Forest Service has sponsored three studies on what attributes visitors value most in Wilderness areas. These studies, based on the Indian Peaks, Eagle's Nest, Rawah and Weminuche Wilderness areas, indicated that clean fresh air, protection of water quality wildlife habitat and air quality and enjoying the sights and sounds of nature were desired most by Wilderness visitors (Brown, et al., 1977; Brown and Haas, 1980;

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Walsh, et al., 1982). The Colorado Air Quality Control Commission also recognizes the economic value of clean air. Preserving and protecting clean air "is particularly important for the scenic and recreational areas of the state, where. . . tourism represents a vital . . . segment of the economy. The common link in tourism throughout the State is the scenic view or vista, consistently ranked in visitor opinion polls as one of the most important attributes of the area" (Fiscal Impact Statement, Colorado Prevention of Significant Deterioration Regulation).

Recreational use of federal lands provides a significant day-to-day contribution to most local Colorado economies supporting hotels, motels, restaurants, hardware and sporting goods stores, automobile service stations and guide services. It is essential for the economy that the state protect those resources which draw the visitors: visibility, clean air, clean water, fishable lakes and streams, wildlife and fish populations and popular scenic recreation areas.

Colorado State Parks and Recreation Areas

Colorado has 27 State Parks and Recreation Areas which are widely dispersed throughout the state. These areas offer a broad diversity of activities including boating, fishing, water skiing, rockclimbing, camping and wildlife observation. Many of the areas are close to urban centers and provide excellent recreational opportunities for families and nearby urban populations (see Figure 5). 20

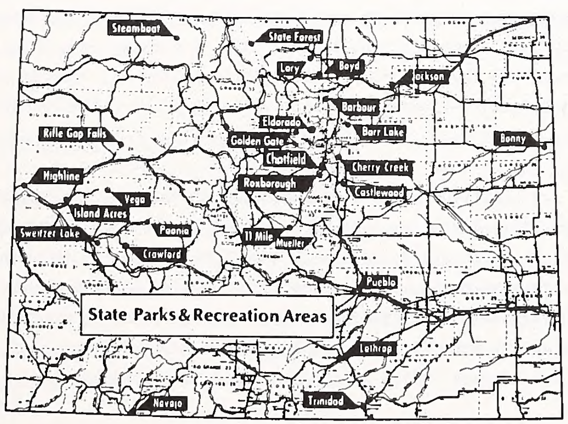

Figure 5. State Parks & Recreation Areas.

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During the 1982-83 fiscal year, these areas attracted almost 5 million in-state visitors and 1.3 million out-of-state visitors. These visits generated approximately $54 million to Colorado businesses, with over half, $30 million, coming from out-of-state tourists.

Conclusion

The above information clearly indicates that the vacation-tourism outdoor recreation industry is one of the state's most important, stable, widespread and fastest growing industries. The economic benefits of this industry touch every part of the state. The industry depends for its existence on Colorado's natural recreational resources - high peaks, scenic areas, clean air and good visibility, forests and grasslands, wildlife and fish populations, clean water, streams and lakes. At present the management of these resources is in the hands of many different state, federal and even local and private agencies. The contribution of outdoor recreation and tourism to the Colorado economy, based on these natural resources, is not always a major consideration in management decisions. It is therefore an economic necessity that Colorado: 20

1. begin to take into account and calculate this contribution;
2. in its planning, and development recognize these natural recreational resources and set policy to protect them from ecological degradation and access restrictions;
3. request that all state, federal and local management agencies and entities do likewise.

This document has been prepared by the Conservation Committee of the Colorado Mountain Club. Principal authors are Anne Vickery, Conservation Director and Jeremy Kaplan, Boulder Group.

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United States Department of the Interior
OFFICE OF SURFACE MINING
Reclamation and Enforcement
BROOKS TOWERS
1020 15TH STREET
DENVER, COLORADO 80202

MAR 20 1984

Mr. Tom Coe
Regulatory Section
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814

Dear Mr. Coe:

The Office of Surface Mining Reclamation and Enforcement (OSM), Western Technical Center, has reviewed the draft environmental impact statement (EIS) on the Getty and Cities Service Shale Oil Projects. It does not appear that there would be any significant impact or serious conflict with this agency's responsibilities should this action be undertaken.

OSM is currently preparing an EIS on Dorchester Coal Company's proposed Fruita Mines Complex, which involves the placement of surface facilities in Big Salt Wash. There could be a conflict between these facilities and the alternative power-transmission route in Big Salt Wash as discussed in your EIS. 1

Thank you for the opportunity to review this statement.

Sincerely,

for Allen D. Klein
Administrator
Western Technical Center

(10)

Union Energy Mining Division

Union Oil Company of California
2717 County Road 215, P.O. Box 76
Parachute, Colorado 81635
Telephone (303) 285-7600

UNION 76

James S. Cloninger
Manager of Administrative Services

March 23, 1984

Mr. Tom Coe
U. S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Dear Mr. Coe:

The comments below are transmitted to you in response to the Getty and Cities Services Draft EIS. These are intended to constructively highlight a few areas of concern, primarily as the analysis might relate to the Union Oil Parachute Creek Shale Oil Program.

1. Revegetation of retorted shale - The DEIS quotes Redente and Cook (1981) in several locations, with the statement that "Research has generally failed to show this type of material to be capable of supporting plant life without continued irrigation and soil amendment applications." With regard to Union B retort process retorted shale, this statement should be modified. Studies have shown successful revegetation of Union B retorted shale. For a summary of study results and references refer to the Union Oil Phase II Mined Land Reclamation Application, Exhibit E. (Union 1982 b in the GCC references.) 1

2. The reference to Union (1982a) in the Phase II PSD permit application apparently inadvertently refers to the Shale Oil Upgrading PSD application, rather than the Retort PSD application. It is presumed that the Retort application was actually used in estimating emissions from the proposed Getty and Cities' Union B retorts. 2

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Mr. Tom Coe
March 23, 1984
Page Two

3. The base budget year used for projections should be stated in the discussions of fiscal methodology (pp. 4-63 and 4-142). Fiscal projections of this nature are a reflection of the base year budget's structure; thus, knowing the base year is necessary for evaluation and perspective. 3

4. Additional capital facilities which are triggered by the impact population should be identified (pp. 4-68 and 4-145). 4

5. In Table 4.4-10, p. 4-172, the summation of the first three columns is misleading. Each of these columns represent annual employment levels. Summing these columns leads the reader to conclude there would be 570,472 project employees under the cumulative scenario; this is not the case. Substantial double counting has taken place to arrive at this figure. Removal of the totals for the first three columns is recommended. 5

Thank you for consideration of these items.

Sincerely,

Terrence L. Larson
Environmental Administrator

TLL:cmh

(11)

FIS / RC

U.S. Department of Housing and Urban Development
Denver Regional Office, Region VIII
Executive Tower
1405 Curtis Street
Denver, Colorado 80202

March 2, 1984

Mr. Tom Coe
Regulatory Section
U.S. Army Corps of Engineers
Sacramento District
Sacramento, CA 95814

Dear Mr. Coe:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement (DEIS) for the Getty and Cities Service Shale Oil Project in Garfield County, Colorado.

Your draft has been reviewed with specific consideration for the areas of responsibility assigned to the U.S. Department of Housing and Urban Development. This review considered the proposal's compatibility with local and regional comprehensive planning and impacts on urbanized areas. One of the impacts you note in the DEIS is the demand for "an additional 44,000 housing units in the study area." Such a substantial increase in housing in this area would require additional public services such as water, sewer, health care, roads, schools, police service, fire protection and many others which are already in short supply in the impacted area. These impacts and proposed mitigative measures should be addressed in the final Environmental Impact Statement. With this exception, this DEIS is adequate for our purposes. 1

If you have any questions regarding these comments, please contact Mr. Howard S. Kutzer of my staff, at (303) 837-3102.

Sincerely,

Robert J. Matuschek
Director
Office of Community Planning
and Development, 8C

(12)

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 84/253

APR 3 1984

Mr. Tom Coe
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814

Dear Mr. Coe:

We have reviewed the Draft Environmental Impact Statement (DEIS) for the Getty and Cities Service Shale Oil Projects, Garfield County, Colorado. Two Department of Interior (DOI) bureaus, the Bureau of Land Management (BLM) and the U.S. Fish and Wildlife Service (FWS) are cooperating agencies on the EIS. The CE action is approval of a Section 404 Dredge and Fill permit for a joint water supply system to serve two adjoining but separate proposed shale oil developments, Getty Oil Company and Cities Service Oil and Gas Corporation, referred to as the GCC Joint Venture. Construction of the water supply system, and development of the shale oil properties will require various land use actions or authorizations from BLM.

We have two serious concerns as set forth in this letter and our enclosed specific comments. The first is that because input from BLM was not reflected in the DEIS, the detail of analysis is not adequate for our approval actions. There is little or no analysis of impacts from probable right-of-way corridors on the public lands. Unless this is corrected, BLM will have to require full compliance with NEPA when necessary land use authorizations are sought. 1 The second problem is the lack of commitment as to mitigation for wildlife impacts. FWS - recommended mitigation is discussed and the lack of commitment is acknowledged in the analysis. Without appropriate mitigation for wildlife resource losses, we feel the proposal will have an unacceptable level of impacts on this resource. 2

Scope of EIS

No attempt has been made to analyze impacts directly on public lands. In fact, it appears that corridors may have been omitted which could affect hundreds of acres of public lands. The confusion may be the result of the reliance upon impact analysis from other oil shale and transmission line EIS's. As noted in our comments on Chapter 2, powerlines, pipelines interconnects and other ROWs are not shown or detailed and most often, totally ignored. We are enclosing a map showing the public lands being requested by the companies; it is clearly evident that the lands shown do not constitute the entire sale or right-of-way needs for the property. Without a complete project description and a baseline, the impact analysis is incomplete. 3

We are enclosing copies of correspondence from the BLM to the Army Corps of Engineers (CE) which detailed BLM's NEPA requirements as a cooperating agency. Besides these

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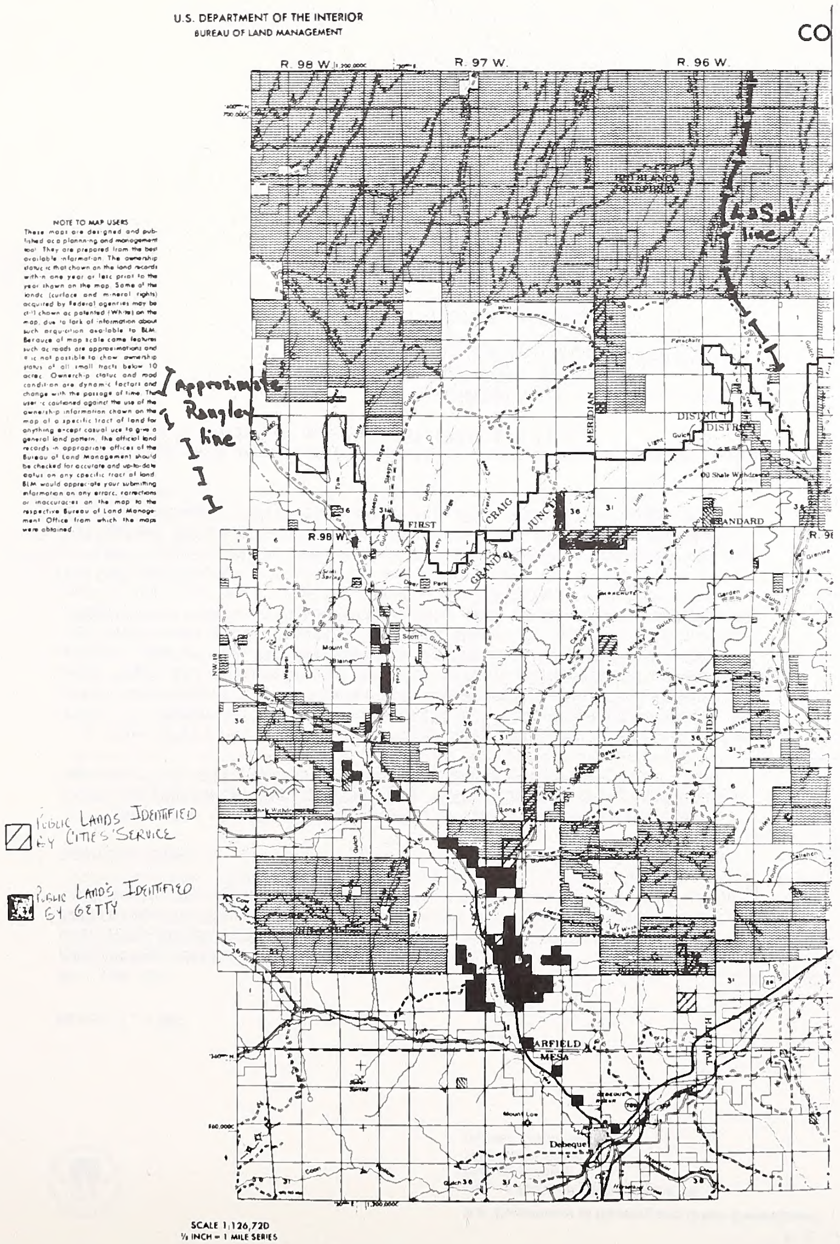

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letters, BLM has also discussed the matter with the CE by phone, and in meetings. We note that our concerns are echoed by both state and county agencies. 3

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Socioeconomic Discussion

The narrative description of the socioeconomic environment, impacts and mitigation is very brief. While brevity has the advantage of making the material more "accessible" to the public, this particular narrative is too brief and does little more than highlight information on the Tables. Few things are explained (e.g., the reasons for the area's tremendous population growth during the 1970's), misimpressions are created (e.g., that Mesa County's mining sector is entirely made up of office personnel or that Mesa County is the sole recipient of revenues from the 2% county sales tax), and there are significant omissions (e.g., several water and sanitation districts were apparently not included in the fiscal analysis). A socioeconomic technical report by the subcontractor, incorporated by reference, may address some of these deficiencies. If it does, some format should be worked out to make that report available for review. This would be especially helpful in giving more definition to the reasons for/timing of, and most affected parties of negative fiscal impacts. 4

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There are two major problem areas which probably would not be addressed in the technical report, the residential allocation of the work force and failure to address the effects of premature project shutdown.

In regard to the residential allocation of the work force, both Getty and Cities Service allocate 49% of the nonlocal construction work force to single status camps. This is high, both as a portion of the total work force and in absolute terms (1,600 workers for Getty and 1,000 for Cities Service). The limited history of single-status camps suggests that the companies would have to take extraordinary measures to induce that amount of the transitory work force to live in single-status camps. This should be discussed, including company commitments in this regard. Because the residential choice of transitory construction workers can significantly influence short-term socioeconomic impacts, a "worst case" analysis would include lower allocations to single-status camps. Also, the document contains no discussion of the location of the single status camps. It is not clear whether the companies have sufficient fee land or would expect to make use of public lands.

The Getty analysis may have a more significant problem with residential allocation of the work force. Getty identifies De Beque as the area where its socioeconomic "growth and mitigation efforts would be concentrated" (4.8.2 Mitigation). However, the residential allocation assumptions made for the socioeconomic analysis ignored De Beque as a focal point for "growth and mitigation efforts." This discrepancy should be clarified. 5

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The authors appear to be aware of the possibility of premature project shutdown; there are repeated references in the discussion of the affected socioeconomic environment to the negative effects of the slowdown in 1982 and 1983 of energy development projects in the area. However, the evaluation of the Getty and Cities Services projects does not discuss the potentially severe impacts of possible premature closure. Increasingly, that possibility looks like the major source of risk and negative socioeconomic impact for local governments, businesses, and workers. 6

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Wildlife Resources

Overall, we believe that the EIS would adequately portray the impacts of the projects on wildlife resources if it contained specific commitments to the mitigation measures that are presently only acknowledged as ones that should be carried out. However, we also would qualify the previous statement by pointing out that baseline wildlife information and engineering background information were put together in a relatively short time period. For that reason the analysis may not adequately reflect the extent of impacts that will actually be realized. Therefore, it is of paramount importance that a wildlife monitoring program be implemented at least 2 years prior to project construction and that mitigation flexibility be assured so that unanticipated wildlife impacts can be identified timely and appropriate measures taken to alleviate those impacts.

We believe that commitments to wildlife mitigation or a discussion of the likelihood of mitigation implementation must be included in the EIS to ensure its adequacy. Inclusion of such a discussion is essential if wildlife impacts are to be characterized accurately. As discussed below, the FWS proposes to develop a mitigation summary document to address specific mitigation concerns. This document will be proposed in consultation with the project proponents so it may be included as part of the FES. 7

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As a general comment, we also do not believe that the relationship of shared project features and respective EIS analyses between the Clear Creek Shale Oil Project (CCSOP) EIS and the present Getty/Cities Service EIS is adequately identified. A map is needed showing those shared features, and a description of how and where (in which EIS) impacts are evaluated is essential. In addition, we believe further discussion is needed to address proportionate impacts of water depletions and increases in impacts by multiple use of project features (e.g., access corridors). We believe that any mitigation commitments made by Chevron for project features that will be jointly shared must be similarly committed to by Getty and Cities Service to provide credence to the impact mitigation addressed in the CCSOP EIS. Recognition, assessment and reduction of these significant impacts by Getty and Cities Service should be a major aspect of this EIS. 8

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Project impacts to important wildlife habitats are summarized on pages 4-28 and 4-29 (Getty), and on pages 4-96 and 4-97 (Cities Service). These summaries indicate that some 4,100 and 3,000 acres of wildlife habitat, respectively, would be affected directly by the projects, and that an additional 16,480 and 23,550 habitat acres would be affected indirectly. These habitats include raptor nesting habitat; big game habitats; riparian, aspen woodland, and conifer habitats, and valley, cliff, and plateau shrub shrublands. FWS-recommended mitigation strategies for reducing these losses based on the mitigation policies of the FWS, are detailed. There are, however, no commitments to ensure implementation of the identified mitigation measures, the EIS acknowledges this lack of commitment. The FWS has stressed, and continues to do so, the need for commitments to such mitigation. 9

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In summary, we are extremely concerned about the lack of committed mitigation. The FWS is actively pursuing agreements for a committed mitigation plan; however, final decisions rest with the project sponsors and permitting agencies. Should adequate mitigation not be provided for in the EIS, we view this as a candidate for referral to the Council on Environmental Quality, as provided for in 40 CFR 1504. 10

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Endangered Species Comments

Two major concerns involve threatened and endangered species (T&E) and rare/sensitive species which are or may become candidate species for future listing. Consultation under Section 7 of the Endangered Species Act has been segmented into two separate components: one for terrestrial species, and the other for listed fishes. A final Biological Opinion has been delivered to the CE that considers terrestrial impacts to federally listed species as a result of upland project developments proposed by Getty and Cities Service. That Biological Opinion (Getty-Cities Service Terrestrial Consultation, FWS File #6-5-84-002) finds that upland developments are not likely to jeopardize the continued existence of any federally listed terrestrial species. Similarly, a Biological Opinion has been issued to the BLM concerning the CCSOP proposal (Terrestrial Consultation, FWS File #6-5-83-0016). That document finds that full development of the water system is not likely to jeopardize that continued existence of any federally listed terrestrial species.

It should be noted that the impacts to listed Colorado River fishes, as a result of proposed water withdrawals by the water system, are presently being reviewed by FWS under a third Section 7 consultation (GCC/CCSOP Aquatic Consultation, FWS File #6-5-84-0003) with BLM. A "No Jeopardy" Biological Opinion or "Jeopardy" Biological Opinion, in which reasonable and prudent alternatives are agreed to, should precede final Federal approvals for development of the GCC Joint Venture. 11

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The locations of eight special interest plant species are identified with statements of "potential adverse impacts" in Section 4 of the DEIS. The FWS is concerned that measures to reduce these potential adverse impacts are not clearly identified. We believe serious considerations to reducing these impacts should be addressed in the EIS. 12

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VMIS Retort Discussion

From the limited discussion of ground water impacts, it appears that the baseline data for onsite ground water is not adequate to analyze the potential dangers of ground water contamination. Too much reliance is placed on baseline data from adjacent projects. In addition, we also feel that the likelihood of subsidence has been glossed over. From experiences at Logan Wash and Federal Tract Ca, the subsidence rate was 92 feet at the first and 70 feet at the latter. Obviously, a subsidence rate of this magnitude has a potential major impact on upper level aquifers. In addition, no analysis has been performed on the abandonment of the VMIS retort. Our experience at Tract Ca is that

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water quality on entering the closed retort measures 900 milligrams of salts per liter. The water leaving the retort measures at least 5,000 milligrams per liter. This salinity 13
change would certainly constitute a major impact.

Water Resources 14

The statement should discuss monitoring plans for surface water and ground water, and should indicate mitigating or remedial measures if the monitoring program detects significant pollution. For example, the potential for leachate pollution of ground water is considered to be small or negligible if liners do not fail (e.g., p. 4-13, 4-19, 4-87). However, the impact analysis should address corrective measures if monitoring reveals that failure has indeed occurred. Similarly, corrective measures should be planned to minimize pollution of both surface water and ground water in case of failure of the 14
downstream collection system.

The analysis identifies possible degradation of surface water drainages into the Colorado 15
River. The Colorado River downstream from the proposal flows through Canyonlands National Park, Glen Canyon National Recreation Area, Grand Canyon National Park, and Lake Mead National Recreation Area. The cumulative effects from this and other proposed energy development have the potential for altering the natural aquatic regime in these areas, yet the document does not go into this detail. We believe it should. 15

An alternate source, suggested for at least part of the necessary water supply for 16
CCSOP, would be equally applicable for the GCC Joint Venture. A pressurized 15,000 acre-feet/year saline water pipeline is currently under planning investigation by the Bureau of Reclamation's Glenmont-Dotsero Springs salinity control unit. The low quality water from this salinity control project, and agricultural drainage from the Grand Valley, may be available for use by the GCC Joint Venture. Consideration should be given to the possibility of substituting some of this low quality waste water for diversions from the Colorado River. This would have the dual benefit of assisting in desalinization efforts 16
and relieving pressure on agricultural water supplies.

Air Quality 17

The document also endeavors to address cumulative effects of air quality. We are concerned with the fact that the SO_2 increment has already been exceeded in Colorado National Monument's airshed. Given the relatively poor quality of the airshed in the adjacent Grand Valley in general, we are concerned that the secondary impacts of incresed numbers of workers will aggravate an existing poor situation. Increased residential firewood burning as well as an increase in the number of motor vehicles (both of which have been identified as significant contributors to the valley's poor quality 17
airshed) would aggravate the existing situation.

In this light, we believe it is difficult for the reader to evaluate all relevant air quality 18
issues. We suggest that the adequacy of the assessments cannot be judged due to lack of descriptions of specific methodologies and documentation of critical assumptions. Specifically, in the air quality discussion under cumulative impacts (Section 4.4.8), no

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information is given on the meteorological conditions used for the TAPAS model. The 18
application of the TAPAS model is not routine and the model assumptions and
interpretation must be carefully presented. Also, it is impossible to determine how the 19
visibility analyses in Section 4.4.8 constitute a regional haze analysis or how the determination of no significant impact (page 4-168) was made. Even if these details are contained in a referenced document, the fundamental assumptions should be reproduced 19
in the EIS with a discussion of how other analyses may apply.

Rocky Mountain National Park, well to the east, is a Class I air quality area. Colorado 20
National Monument has been recommended for Class I status. The EIS should address the impacts of project emissions on air quality related values (AQRVs) in these areas. On page 3-24 the DEIS states that an assessment of impacts on AQRVs will be discussed in the prevention of significant deterioration of air quality permit application. Since these impacts are project related impacts, they should be discussed in the EIS. 20

Mineral Resources 21

In the past, this region of Colorado has produced moderate to large quantities of minerals. Since 1971 deposits in Garfield County have yielded vanadium, uranium, sand and gravel, natural gas, stone, pumice, and coal. Some clay, gypsum, mica, and fluorspar deposits are known. Oil shale is abundant. Gasfields are found near the Colorado River southwest of Rifle and several gasfields (containing some petroleum) are known 30 to 40 miles north of the projects in Rio Blanco County. In addition, widespread, shallow coalfields are located 15 to 20 miles southwest of the projects. An occurrence of mica with some gold and fluorspar is reported in sec. 29 (?), T. 7 S., R. 97 W. About 10 miles northeast of Rifle, the Rifle-Elk Creek Mining District has yielded major quantities of vanadium and uranium and minor amounts of gold, silver, copper, lead, and zinc.

The document discusses the effects of the projects on the geology and paleontology of the region and notes potential geologic hazards, but does not address possible effects on mineral resources other than oil shale. These two projects cover large areas of western Colorado. Because of the large acreages involved and the mineral resources present in surrounding areas, we suggest that a survey be made of mineral resources in the 21
immediate project vicinities. The EIS should describe local and regional resources and
discuss the effects of these projects upon the resources. The environmental statement 22
should address the effects of subsidence on any mineral deposits in the Uinta Formation and describe the effects of water consumption by these projects on the possible development of other mineral resources in the area. Locations for disposal of waste rock and spent oil shale should be chosen so that potential mineral deposits will not be buried. Public land acquired by the companies through land exchange, purchase, lease, or right-of-way acquisition also should be evaluated for mineral resources. 22

Summary 23

We are informed that field staff from both BLM and FWS are actively working with CE and the applicants to provide assistance in the areas where we have expressed concern. To ensure that the EIS meets our needs for the land use authorizations or transfers

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necessary for the GCC Joint Project and provides adequate mitigation for anticipated wildlife impacts, we ask that we have an opportunity to review a preliminary draft of the statement before publication in final form. This review may be arranged through Tom Loomis of my staff on FTS 343/8661. 23

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

Enclosures

(12)

SPECIFIC COMMENTS

Page 1-2 (Sec. 1.3.1)

As a cooperating agency, BLM desires that this EIS fulfill all its NEPA requirements for land sales, exchanges or rights-of-way. BLM is listed here as a reviewer that does not require prior preparation of an EIS. Please change the statement and list our requirements. 24

Reference is made here and throughout the DEIS to U.S. Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act of 1958 and to impact assessments performed by FWS. These wildlife impact assessments were performed jointly by FWS and the Colorado Division of Wildlife. All such statements should be revised to reflect this cooperative effort. 25

Section 1.3.2. Add the Colorado Division of Wildlife as a reviewer under the Fish and Wildlife Coordination Act of 1958. 26

27
Pages 2-2 through 2-5, Table 2.2-1 and Table 2.2-2, footnotes. Further explanation of the Corps' jurisdiction is needed. The footnotes of these tables can be interpreted to mean that the Corps has no jurisdiction over selection of some project alternatives. It is our understanding, however, that if a particular project feature has unacceptable environmental impacts, Corps permits can be denied. Selection of an alternative feature, therefore, could circumvent permit denial. 27

28
Table 2.3-2 - The list of public lands potentially affected by the Getty project is incomplete. The list could be improved by showing the lands action preference by the company. The action could include sales, exchange or rights-of-way. It would also help to group the public lands in parcels (A,B,C, etc.) thereby displaying one total use. A map depicting the affected lands and the use (pipeline, powerline, mining) is mandatory for a basic understanding of the impacts. Also, the sections of the EIS which discuss the impacts should be listed. 28

Page 2-11 - A footnote to table 2.3-2 and 2.3-9 states that "Roan Creek corridor is different than that shown in the CCSOP EIS (BLM 1983a)." Nowhere in the EIS is the difference explained. Since there is a difference, the analysis that is done in the CCSOP EIS cannot be considered valid for Getty or Cities Service. 29

When an analysis in another NEPA document is referenced, a summary of the impacts should be included for the benefit of the reader. For the analysis to remain valid, any committed mitigation which has been made in the referenced document must also be committed to by the new proponent. 30

31
Page 2-12 - Public lands should be shown on the map. It would also benefit the analysis if the map would be extended to show the corridors to tie in the product pipeline connecting loops with the LaSal and Rangely corridors.

Pages 2-13, 16, 21 - Please show on these maps all the affected public lands. 31

32
Pages 2-22, 2-46, 4-15, 4-18, 4-83, 4-85, and 4-89, Spent Shale Disposal. Failure of the integrity of spent shale disposal sites and resultant effects on surface and ground water

are major concerns. Commitment and/or liability of Getty and Cities Service for leachate control should extend beyond final project decommissioning. 32

33 Pages 2-23 through 2-24 and Page 2.51, Seed Mixture. Basically we believe that the seed mixtures proposed by both Getty and Cities Service are favorable for wildlife use and are adequate. However, we suggest that seed mixtures would best be determined a year or so prior to reclamation so that current state-of-the-art reclamation knowledge can be applied. The seed mixtures should be tailored to consider site specific soil, slope and moisture variations. 33

34 Page 2-24, (Sec. 2.3.1.2.3) - We are very concerned with this statement. BLM's scoping letter, comments on the PDEIS and other correspondence with your office outlined the need for analysis of public lands.

Land use applications will require detailed project siting and engineering design at the time they are filed. While this detail may not now be available, the EIS must show the approximate location of the support facilities and analyze the anticipated impacts of these facilities.

We are asking that this analysis be done in this EIS so that when the land use authorizations are filed we can act on them with only minor additional analyses. If this is not done, extensive NEPA review with attendant delays, would be required before land use authorizations can be issued. 34

35 Page 2-24 - Transportation System

As above, we ask that sufficient information be included so that the analysis in this EIS will suffice for our NEPA requirements. We strongly support Getty's plans for mass transportation of workers by rail. 35

36 Page 2-25 - Water Sources and Supply Systems

Summarize the analysis of the water supply system in the CCSOP EIS. Committed Mitigation by Chevron Shale Oil Company must be accepted by Getty if the analysis is to be valid. Also, the Roan Creek corridor should be shown on a map in enough detail to demonstrate the difference proposed by Getty as opposed to what was analyzed in the CCSOP. 36

37 Page 2-25 - Transmission Lines

The route for the transmission line must be mapped out and the public lands identified. A major corridor such as this has to be a part of the analysis of the EIS. 37

38 Pages 2-26 and 2-52, Transmission Line Structures. Recent conflicts with nesting raptors, resulting in generation failures, have occurred on metal 345 kv H-frame transmission line structures. Careful consideration should be given to the degree to reduce these conflicts.

39 Page 2-26 - Product Pipeline

No attempt has been made to tie in the LaSal or Rangely product pipelines with the Getty property. It appears that to connect into either line, hundreds of acres of public lands could be affected. Those lands appear to be in the Craig District of the BLM. Notification should be given to the Craig District and time should be allowed for them to review the document. Include pipeline size and ROW needed. 39

Page 2-26 - Waste Disposal

40 List the known byproducts and catalysts involved in all the stream flows. Give the estimated quantities of each.

Page 2-28 - Product Pipeline Route

41 Show the route required to connect from Getty's property to the analyzed corridor. Detail the ROW needed and give as much engineering detail as available.

42 Page 2-29 - Water Supply System

Include maps of the routes and pumping stations and give as much engineering detail as available. Analyze the impacts or the differences if other analysis is to be used. Also, justification for West Fork Parachute Creek Reservoir is not clear. The reasons and circumstances under which development of this alternative would occur should be described. It appears to be an additional and possibly unnecessary impact. 42

43 Page 2-29 - Power Supply

As before, show the connecting lines from Getty's property to the proper corridor. Identify the public lands that will be a part of the ROW.

Figure 2.3-13 - Show public lands. 43

44 Pages 2-33 to 35 - As under Table 2.3-2. Please check the following lands as they do not appear to be public lands.

T.7S., R.97W., Sec. 4: NW1/4NW1/4 and
T.8S., R.97W., Sec. 1: NE1/4NE1/4, SW1/4NE1/4, SE1/4NE1/4.

We suggest that you do not use land status maps since they cannot be kept current. Instead, our Colorado State Office has up to date Master Title Plats which are available.

Figure 2.3-15, 16 and 17

Show public land. Show all ROW corridors for product lines, interconnects, water-lines and powerlines. See comments page 2-11. 44

45 Page 2-50 (Sec. 2.3.2.2.3)

See comments page 2-24, (Sec. 2.3.1.2.3).

Page 2-50 - Transportation System

Where would the facilities be constructed near De Beque for the transfer of workers and equipment? Detail the "new highway" corridor (Figure 2.3-15). What public lands will be affected? 45

46 Pages 2-50, 2-54, 2-55, 2-88, 2-89 and 4-99, Worker/Material Transportation. We strongly suport Cities Service's mass transportation plan. In consideration of the number of transportation round trips depicted in the alternative comparison (Table 2.3-14 and Table 2.3-15), we recommend adoption of a rail transport system. 46

Page 2-52 - Transmission Lines, Product Pipelines, Waste Disposal. See comments page 2-24 (Sec. 2.3.1.2.3) and page 2-25. 47

Pages 2-56 and 2-86 through 2-87, Page 4-84, Larkin Ditch. Further discussion on this alternative is needed. It is not clear whether water currently available for agricultural purposes would still be available once Cities Service began withdrawal from Larkin Ditch, nor is it clear whether Larkin Ditch is permitted and capable of supporting sufficient volume to accommodate the current level of agricultural uses and Cities Service's proposed needs as well. This alternative is tied to development of the Roan Creek Reservoir (for storage), so the reasons for developing the Larkin Ditch alternative need to be explained. 48 48

Pages 2-62 and 2-63 (Table 2.24-3) and Page 2-64, Spent Shale Alternatives. It is our understanding that the surface spent shale alternative for Getty includes simultaneous disposal in Buck/Doe Gulch and Tom Gulch. Wildlife impacts on Page 2-64 are discussed based on this combination, but that discussion is inconsistent with Table 2.4-3, where these sites are listed separately. Alternative surface disposal sites were not evaluated independently, and therefore an accurate, comparative wildlife impact analysis for each site does not exist. As spent shale disposal constitutes a major project impact, and will influence FWS recommendations, we suggest this discrepancy be reconciled and addressed in the FEIS. 49 49

Page 2-67 (Sec. 2.4.3.1.6) 50

The comparison of alternatives is confusing because the impacts are generalized by comparing powerline corridors and product pipelines. There is no comparison between the common powerline corridor in Roan Creek and the proposed loop system to Parachute and De Beque. 50

Page 2-72 and 2-89, No Action Alternatives, last statements both pages. The beneficial impacts to environmental components (as depicted) have not been clearly demonstrated and, we believe, are nebulous at best. 51

Page 3-8 - Colorado River Cutthroat Trout have been found in Carr Creek. They are a State Threatened Species. 52

Page 3-11 - The FWS's most recent supplement on plant status review is dated November 28, 1983. There are several changes in candidate plant species that need to be incorporated throughout the EIS. 53

Page 3-29 - The BLM no longer divides its extensive Grand Junction Recreation Management Area into six subdivisions. It is just one unit. 54

Page 3-29 - South Shale Ridge is an "Intensive Study Unit Under Appeal" and not a WSA.

Table 3.1-10 - Demaree Canyon should be included in this table.

Page 4-10 - The BLM does not manage any of the listed Wilderness Areas and therefore will not monitor visitor use. 54

Page 4-21, Alternative Water Supply. The West Fork Parachute Creek Reservoir would have beneficial impacts to fishery resources only if commitments are made by Getty for fishery management, including public access. The reservoir might contain an inadvertent 55

oil spill as suggested here; however, such a spill would play havoc with any fishery in the West Fork Parachute Creek drainage and reservoir. Dewatering and/or spills could also have adverse effects upon riparian/terrestrial habitat and merits discussion. 55

Page 4-21, Section 4.2.4.4 and Page 4-89, Section 4.3.4.3, Secondary Impact. We concur that extensive direct and indirect gravel development in the Colorado River floodplain will occur as a result of Getty and Cities Service shale oil development. Fisheries and a variety of critical wildlife habitats could be significantly impacted. Given the resources potentially affected (which include several T&E species), we believe further evaluation of these impacts is warranted. 55a 55a

Page 4-28, Wildlife, second paragraph. A citation of the CCSOP Technical Assistance Report, as a source of information on computer based geographic information system analysis methods, should be included. 56

Page 4-28, Section 4.2.7.1 and Page 4-96, Section 4.3.7.1. The first statement should be reworded as follows: "Construction and operation of the proposed action would directly affect about (4,100 or 3,000) acres of specific wildlife habitats. This figure does not take into consideration overlapping wildlife habitats." The second sentences of these sections should be similarly worded. 56

Page 4-158, Surface Water Cumulative Impacts - Salinity. It is not clear how the figure of 8.6 mg/l was obtained, or whether it is based on operational water consumption by all projects in Table 4.4.-1. Preliminary assessment of GCC's total withdrawal alone indicated that substantially higher salinity levels would result. Given the extreme costs associated with projects being planned to reduce Colorado River salinity levels, we believe that the public interest would best be served by further comparative analyses between oil shale projects and proposed Bureau of Reclamation salinity control projects. 57 57

Page 4-185, Section 4.8.2.7 and Page 4-191, Section 4.8.3.7; Wildlife Mitigation. Commitment to, or the likelihood of commitment to, mitigation measures in the EIS is necessary to portray accurately the overall impact of these projects on wildlife. Although our principal mitigation recommendations are addressed in the text of these sections, most are prefaced by "should" or "could." We believe that a mitigation summary for wildlife should be prepared and appended (with committed concurrences) in the FEIS. The intent of specific mitigation recommendations can be described more accurately as can provisions for determining mitigation feasibility. We would be happy to assist in development of this summary to ensure its completion within the FEIS time frame. 58 58

Page 4-187, 4-193 59

BLM will contact SHPO and the Advisory Council on Historic Preservation concerning impacts to cultural resources on public lands, not the companies.

We also suggest changing the first paragraph of 4.1.10 Cultural Resources to read: "Inventory for Cultural Resources will be required prior to any surface disturbing activities. If Cultural Resources sites are located that are eligible for National Register Listing, final approval to proceed with an undertaking will not be granted until BLM consultation with the Colorado State Historic Preservation Officer has taken place. In cases where an effect is determined, additional review is required by the Advisory Council on Historic Preservation to satisfy requirements pursuant to Section 106 (and section 110f) of the National Historic Preservation Act (16 U.S.C. 470) and its implementing regulations, "Protection of Historic and Cultural Properties (36 CFR 800)." 59

(13)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

OFFICE OF THE ADMINISTRATOR

March 20, 1984

Colonel Arthur E. Williams
District Engineer - Sacramento District
US Army Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Williams:

This is in reference to your draft environmental impact statement on Getty and Cities Service Company Shale Oil Projects, Garfield County, Colorado. Enclosed are comments from the National Oceanic and Atmospheric Administration.

We hope our comments will assist you. Thank you for giving us an opportunity to review the document. We would appreciate receiving four copies of the final environmental impact statement.

Sincerely,

Joyce M. Wood
Chief, Ecology and
Conservation Division

Enclosures

DC:das

(13)

Comments: Getty Oil/Cities Service DEIS

The Air Quality Studies of the DEIS are generally well done, although some further effort by the concerned companies to obtain field data to fill the many mentioned gaps would seem appropriate. 1

Ozone should be given more careful consideration. The Aeronomy Laboratory of NOAA/ERL is modeling and doing field studies of the generation of ozone (O_3) at a high Rocky Mountain field site. They find tropospheric ozone generated from the photochemical transformation of NO_x reaching the site in diluted plumes from Front Range cities. Their results show that, under the high altitude incoming solar radiation, NO_x concentrations as low as 1 - 10 ppbv can lead to substantial production of ozone in concentrations of ~30 - 100 ppbv at the mountain site (see attached figure). The DEIS reports possible NO_2 concentrations of about 70 $\mu g/m^3$ (0.035 ppm or 35 ppb) from the anticipated emissions (Table 4.2-7). These annual average concentrations of NO_x could photochemically yield a median O_3 concentration of about 40-60 ppbv (0.04-0.06 ppm) which is one third to one half the national air quality standard of 0.12 ppm stated in Table 3.1-7 for 1-hour values of ozone. Aside from the chemical problem, the NO_x annual average data are not compatible with the 1-hour O_3 averages. One-hour values of NO_2 should be expected to reach much greater extremes and therefore might produce O_3 that frequently exceeds the 1-hour standard, although the relationship between NO_2 and O_3 is not linear. This problem of ozone production should be carefully examined. A contact for the NOAA O_3 information is Dr. Dan Albritton, Aeronomy Laboratory, R/E/AL, NOAA/ERL, 325 Broadway, Boulder, CO 80303.

(13)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Washington, D.C. 20034

N/MB21:VLS

March 8, 1984

TO: PP2 - Joyce M. Wood

FROM: N - Paul M. Wolff

SUBJECT: DEIS 8401.25 - Getty and Cities Service Shale Oil Projects, (Sacramento District, Corps of Engineers)

The subject statement has been reviewed within the areas of the National Ocean Service's (NOS) responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

2

Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, NOS requires not less than 90 days' notification in advance of such activity in order to plan for their relocation. We recommend that funding for this project includes the cost of any relocation required for NOS monuments. For further information about these monuments, please contact Mr. John Spencer, Chief, National Geodetic Information Branch (N/CG17), or Mr. Charles Novak, Chief, Network Maintenance Section (N/CG162), at 6001 Executive Boulevard, Rockville, Maryland 20852.

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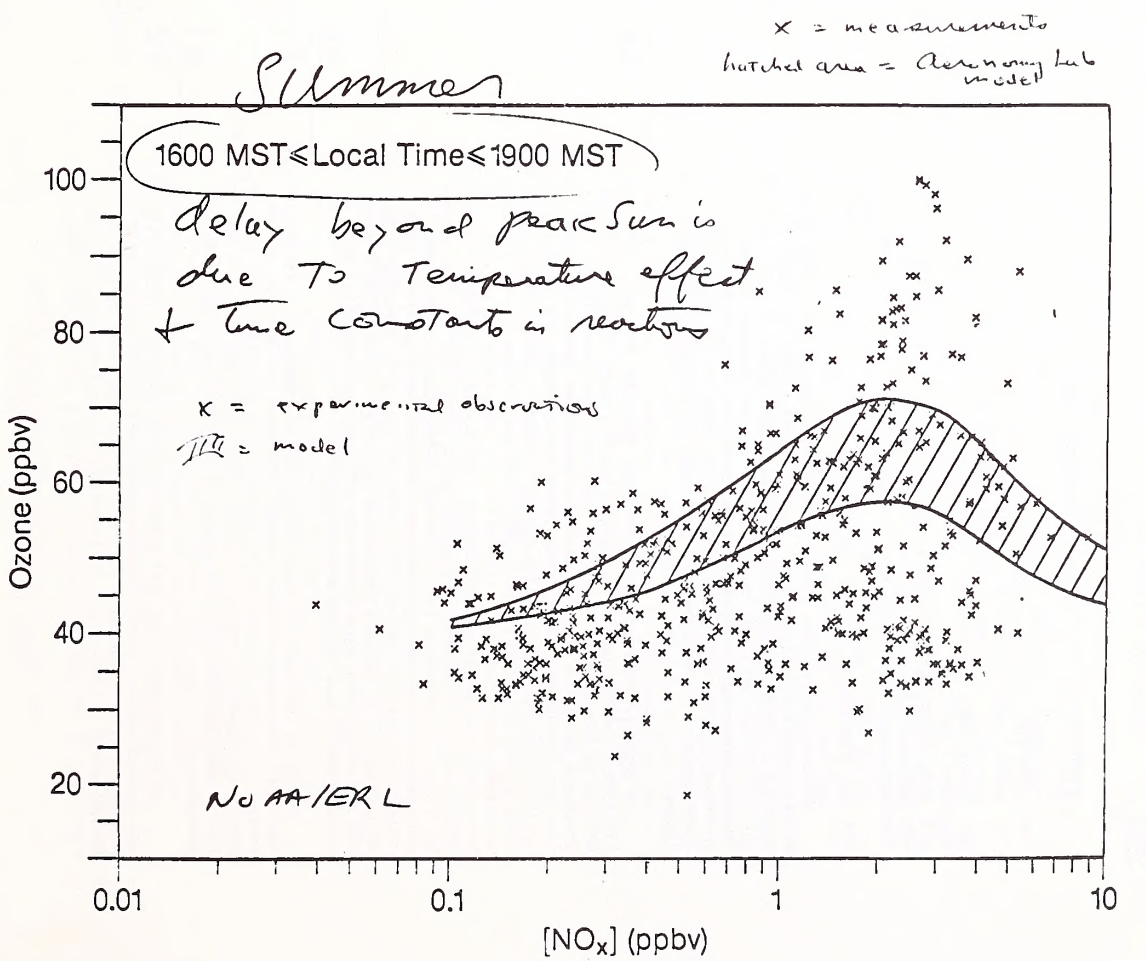
1



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
1?60 LINCOLN STREET
DENVER, COLORADO 80295

[illegible]

Ref: 8PM-OPA

Mr. Thomas Coe
Regulatory Section
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Dear Mr. Coe:

We have reviewed the Draft Environmental Impact Statement (DEIS) on the Getty/Cities Service oil shale projects. We are pleased at your response to some of the comments and concerns raised in our review of the Preliminary DEIS and transmitted to you on December 9, 1983. However, there are a number of major unresolved issues and concerns which we believe must be addressed in the Final or revised DEIS. These concerns are enumerated in the detailed comments attached to this letter.

In summary, our review has indicated that the DEIS does not contain 80
sufficient information to evaluate fully the potential environmental effects of the proposed oil shale projects. Specifically, we are concerned about the lack of information on waste stream characteristics from the various retorting, processing and upgrading facilities to be used in both of the proposed projects. Without specific information on waste stream characteristics (identification, volume, chemical composition, disposal, plans, potential release) it is impossible to evaluate fully the potential impacts on surface and ground water resources. Apparently, neither Getty nor Cities Service can be specific at this time regarding the retorting/upgrading facilities and associated waste streams, control technology and waste disposal methods to be used for each respective project. We recognize the difficulty in defining these project-specific issues without more definite site-specific plans. However, any effort to evaluate the potential environmental effects is
rendered deficient without the information. 80

We expressed these concerns to you in our comments on the preliminary 81
draft EIS and requested that the DEIS include this information and analysis. As an alternative we suggested the possibility of a supplemental environmental impact statement (SEIS) at some point in the future when specific information can be obtained from the project
sponsors. 81

Given the absence of sufficient data and anaysis in the DEIS, we 82
see several options that will produce meaningful evaluation of the proposed actions. The most desirable option, pursuant to Council on Environmental Quality (CEQ) implementing regulations (specifically Parts 1502.9 and 1508.28), would be to issue a revised DEIS once

the necessary data has been collected. This would be most practical if
Getty and Cities Service already have the information that is needed. 82
If the information needed to evaluate the projects is not currently
available, this National Environmental Policy Act (NEPA) action could 83
be "tiered" according to CEQ regulations Part 1508.28(b). Thus, this DEIS would only cover those issues that are ripe for decisions, such as project need and site selection. A subsequent EIS or SEIS would be required at a later stage to provide information on specific waste stream characteristics and associated details on design and environmental impacts. In this case, the 404 permit for the reservoir should include a condition that would require a full SEIS on the oil shale projects prior to start of construction. If you want to consider tiering, we would like to work together to develop a list of topics and specific
questions to be addressed in the second tier. 83

It is my understanding that my staff met with you, your contractor, 84
and Getty/Cities Service representative on March 1, 1984 to discuss our preliminary DEIS comments and to agree on a constructive approach in responding to our concerns. My staff is encouraged by the willingness of all parties to prepare an improved FEIS. I am hopeful that this cooperation will continue and that a document will be prepared consistent
with the purpose and interest of NEPA, implementing regulations and 84
the 404(b)(1) guidelines. Pursuant to CEQ and EPA guidelines, we have
given this DEIS a rating of 3. We believe that insufficient information
has been provided in the document to evaluate properly the full potential 85
environmental effects of the proposed actions.

It is important that we sustain an effective dialogue between our 86
agencies on this issue. We are pleased with the cooperation and communication we have developed with your well-qualified staff. I consider our effective dialogue an asset as we approach some very difficult
decisions on the EIS for these two important regional oil shale projects. 86

If you have any questions please contact me at FTS: 327-3895 or Larry Svoboda of my staff at FTS: 327-2351.

Thanks for your cooperation.

Sincerely yours,

John G. Welles
Regional Administrator

NOTE: Final letter received after original comments were bracketed

DETAILED COMMENTS ON THE DRAFT EIS
FOR THE GETTY/CITIES SERVICE SHALE OIL PROJECT

GENERAL COMMENTS

1. The DEIS does not contain sufficient information on retorting and 1
upgrading facilities and the associated pollution control, emissions, and waste disposal plans to evaluate the potential impacts of the projects. This information along with detailed identification and characterization of waste streams is necessary to estimate the potential environmental effects on surface and ground water resources. 1

2. The spent shale appears to have very high soluble salt content as 2
well as trace metals and organic contaminants. Despite the fact that the water management plan is based on zero discharge to surface waters, there is a high probability that both surface runoff and leachate generation from spent shale piles will occur. Consequently, the DEIS should include information on mitigative measures and best management practices for controlling this source of water pollution. Such practices should include drainage control systems, leachate collection systems, and accidental spill plans. Additionally, fencing around any spent shale retention should be considered to protect wildlife and the public from exposure to any potential hazardous pollutants. 2

3. The DEIS fails to mention the possibility of using more saline water 3
in their industrial process rather than taking it directly from the Colorado River. For example, the Bureau of Reclamation plans to run a pipeline containing very poor quality water from Glenwood-Dotsero to a site near the Colorado-Utah border. The DEIS should discuss the alternative of using the water from the pipeline. While potential salinity impacts are noted, it is unclear if those impacts refer just to salt loading or if the figures are both loading and concentrating effects. In summary, the report does not adequately address quantification of potential salinity impacts nor adequately discussed opportunities to mitigate adverse water quality impacts. 3

4. There is no discussion of impacts of the project on riparian habitat, 4
wetlands, and other waters of the United States which are regulated pursuant to Section 404 of the Clean Water Act. All information required for a review of the project for compliance with the Section 404(b)(1) Guidelines (40 CFR Part 230) should be identified in the DEIS. Probable impacts affecting the aquatic environment which will result from the placement of dredged or fill material and measures which will mitigate these impacts should be identified. The DEIS should include a detailed assessment of this issue. 4

5. The EIS was triggered by the proposal for the GCC joint venture 5
reservoir. Therefore, the document should evaluate thoroughly the impacts and alternatives to constructing this reservoir. Yet the EIS fails to discuss alternatives such as the Ruedi Reservoir, other proposed or existing reservoirs, ground water, or a combination of these sources. All these alternatives are summarily dismissed without adequate explanation as to why they are not reasonable. 5

6. The discussion on the Regional Geologic setting should include a General Map showing the surface Geology of the basin and the major structural fractures e.g. faults, folds, etc. This report should include a more detailed discussion of structural features. 6

7. The information on the Regional ground water systems should be 7
revised to include general maps showing the approximate water level contours in the major aquifers. A more detailed discussion on recharge to these units and the impact of major structural features on ground water flow should be added. (Where is Recharge occurring?) 7

8. The project descriptions should be expanded to give a better picture 8
of waste streams. This should include some schematic flow charts which identify each of the waste streams including approximate chemical composition, estimated volumes for each waste stream and how each stream will be handled from generation to disposal. This analysis should also discuss the transport and fate of waste streams to the environment and provide detailed information on potential surface and ground water impacts. 8

9. The Regional water quality section should be expanded to provide a clearer picture of the variations in ground water quality throughout the region. Some maps should be included showing the location and quality of springs and seeps. 9

10. The section describing the site-specific ground water should be 10
expanded to provide more details on the ground water flow system including maps showing all wells and springs in the immediate vicinity. A table giving specific data on the wells and springs (water levels, discharge rates, depth, etc.) should be included. Water quality data for the wells and springs should be shown in a table. 10

11. There should be a detailed discussion of the competency of the 11
various aquitards in the project vicinity. Is there data to show that the Mahagoney zone is unfractured to act as an impermeable barrier between the A and B Grooves? Further, the Section on ground water quality impacts should provide more details on the potential magnitude of changes brought about by increased infiltration caused by subsidence cracks, and by the removal of the Mahagoney zone. 11

12. The plan does not discuss the possible need for an underdrain system 12
below and above the compacted shale liner to collect spring discharge and leachate. The EIS should provide information in sufficient detail to determine the basic design, type and location of any and all underdrain systems. The importance of these underdrain systems in the overall analysis must not be underestimated and the plans for these underdrains must be included in the EIS. The EIS should provide information on the possible impacts of spring underflow and how specific underdrain systems would lower risks. 12

13. The DEIS should include a detailed assessment of the hazardous waste 13
management plans for the various hazardous waste stream components. The assessment should identify the hazardous material by type and volume and describe the ultimate disposal (on-site or off-site) of these wastes. 13

(14)

14. The air quality technical support document for both the Getty and the Cities Service projects should be provided to permit effective review of the EIS in regard to potential air emissions and impact. We are unable to comment on the validity of emission estimates and emission modeling techniques without copies of the documents that describe how the final results were determined. 14

15. While a certain increase in sediment and silt buildup in the streams during construction is unavoidable, the DEIS should include information on best management practices (e.g., avoidance of streams crossings, culverts, revegetation, etc.) which could reduce these impacts. 15

16. Page 2-20 - The potential generation of leachate is a key concern on these projects. Hence, the EIS must include an analysis of the water balance of the proposed disposal site on at least a monthly basis and estimates on the quality and quantity of leachate generated within the pile and released to the environment. The water balance should also evaluate the dynamics of pile construction as well as final pile configuration. This type of analysis is a necessary prerequisite to an evaluation of potential impacts on water resources. The conceptual plans for any and all underdrain systems should also be provided in sufficient detail to determine the type, size and location of the underdrains being proposed. 16

18. The use of two different meteorological data sets, the Chevron data for the annual analysis and the Pacific data for the short term, is inconsistent. The maximum receptor for one meteorological data set will rarely be duplicated with the use of another data set that was collected at another time and location. For the final EIS, one representative meteorological data set for both the short term and annual analyses should be used. This does not mean that both sites use the same meteorological data set, but only that the hourly and annual data are consistent. Additionally, in the PSD permitting of these facilities, actual on-site data should be collected and used otherwise. A representiveness study should be undertaken to prove that the off-site data used in this draft analysis is representative of conditions at the actual lease sites. 17

19. EPA has an improved version of the ISC models used in this analysis. These models, Short Z and Long Z are virtually identical to the ISC models expect that they are able to address impacts in complex terrain receptors above stack height. This will improve and refine the analysis presented. The final EIS should also include refined Level 2 visibility analysis since numerous Class I plume blight impacts are predicted by the conservative Level analysis. The refined Level 2 analysis will better define the potential adverse visibility impacts. The use of the TAPAS model for the long range impacts has not been approved by this EPA Region. Any application of this model for regulatory purposes should include a detailed performance evaluation, since this is a non-guideline model. 18

20. Based on the DEIS analysis, the development of the Getty and Cities Services oil shale lease will cause certain PSD Class II 24-hour TSP violations due to fines stock pile and retorted shale emissions. Nitrogen oxides (NO_x) and TSP stack emissions will cause degradation of visibility at several Class I areas. Some mitigating measures to control these emissions will have to be developed in order for these facilities to be permitted. 19

(14)

SPECIFIC COMMENTS

Section 2.0 Proposed Action and Alternatives

Page 2-2 to 2-5 — Tables 2.2-1 and 2.2-2 still are not completely accurate in describing retorting technologies and alternatives. Occidental Petroleum has tested MIS technology and has shipped raw shale to Germany for testing by Lurgi. However OXY has not yet tested combined surface and MIS technologies. Missing from Getty's alternatives is raw shale fines processing, burning of carbonaceous spent shale, and mesa top disposal. Missing from Cities alternatives is the combustion of carbonaceous spent shale to recover energy if the Union B retorting process is selected. These topics are discussed only briefly later in the EIS. 20

Page 2-17 — Getty refers to the possibility of using a Lurgi retort for oil shale fines, if the quantity of fines justifies this approach. What quantity of fines does Getty estimate will be produced and subsequently disposed or retorted? 21

Page 2-19 — Getty is proposing the use of wastewater from the upgrading plant for spent shale conditioning similar to Union Phase I. This raises the question of codisposal of an upgrading process stream and spent shale waste under RCRA and TSCA. The PDEIS should discuss the potential problems and implications of this circumstance. Figure 2.3-9 indicates that upgrading plant wastewater will be treated and reused. More specific information is necessary on this subject including: estimated volumes, approximate quality of wastewater and intended reuse. 22

Page 2-20 — The design and supporting information describing spent shale disposal to 2-31 and reclamation is incomplete. Getty mentions a 10 ft. thick Zone 1 liner of spent shale (presumably highly compacted), a moderately compacted Zone II, and an uncompacted Zone IV spent shale fill. How compacted are each of these zones? How will compaction be achieved? What is optimum moisture content? What is the permeability of each zone? Critical to the disposal of the spent shale are drains both above and below the liner. Without such drains, water may collect above or below the liner and produce pile failure. It also would appear that the retention dams below the shale piles will combine leachate, retorted shale runoff, and other runoff thereby combining contaminated and noncontaminated waters. If leachate is combined with runoff will severe storms and heavy snowmelt cause a discharge? What will happen to these retention structures upon site closure? The EIS includes some additional information to what was found in the preliminary DEIS. However, the document still does not cite the degree of compaction for each zone or the permeability of the shale at that compactive effort. The information on settlement is informative and illustrates the need for thick (10 feet plus) drains and liners. It is not clear what will happen to the runoff/leachate dam following site closure. Will it be removed and the waters discharged? Will it remain in place and be maintained? The EIS needs further elaboration on these plans. 23

14

Page 2-27 — It is not clear that economies of scale apply to a 100,000 bbl/day project. In fact there may be greater economy of scale at 50,000 bbl/day as well as reduced environmental impact. 24

Page 2-27 — It should not be assumed that Lurgi spent shale will require more water for disposal. Getty refers to 16 percent water by weight for the Union B shale (page 2-20). Requirements for Lurgi spent shale will likely range between 10 and 20 percent, based on preliminary tests. The potential environmental advantages and disadvantages of the Lurgi process vs the Union B process should be discussed to include air emissions, spent shale characteristics and water requirements. 25

Page 2-28 — Underground disposal of spent shale could actually increase resource recovery by providing roof support to allow for mining of the pillars. Such technology has been in use in coal mines for many years. Further, water requirements may be less since the area for surface disposal is reduced. Underground disposal would, however, be technologically difficult to coordinate with mining activity. 26

Page 2-29 — The properties of Lurgi spent shale are greatly different than the properties of Union B spent shale especially regarding cementation, erosion, permeability, compaction, and ability to support vegetation. Hence, the same disposal methods that are proposed for Union B spent shale are not appropriate for Lurgi spent shale. Further the environmental impacts may be quite different. The EIS must include a detailed discussion of each technology and the associated environmental effects of each. 27

Page 2-52 — What are the non-hazardous wastes that would be deposited in the spent shale disposal area? Would not a separate, non-hazardous, disposal site be a good alternative to consider? The OEIS needs to discuss ths issue further. We strongly recommend a flow chart in the EIS to depict all waste streams, approximate volume, estimated quality, disposal plans for each and the current and/or potential applicability of the RCRA or TSCA to each stream. 28

Page 2-27 — If the Union B retorting technology is used then Getty should consider burning the carbon on the spent shale as an energy source for recycle gas heating or power generation. This would produce a very different spent shale for disposal and have a much better overall energy balance. Since this process would substantially change the plans for spent shale disposal, it should be discussed in the EIS if Getty considers it as a possible future option. 29

Page 2-29 — The DEIS indicates that approximately one-half of the total volume of spent shale could be dispersed in the underground mine, thereby potentially lessening the total disturbed area for spent shale disposal, and lessening the depth of spent shale at 30

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the surface sites. This alternative disposal method should be fully explored as a viable option rather the cursory mentioning. If 1/2 of the approximately 245,000 tons of spent shale generated per day would be put back in the mine, it may reduce the spent shale piles and reservoirs needed and thus result in less environmental impact on the area. 31

Page 2-29 — It is not clear why the alternative of water supply from Ruedi Reservoir is eliminated by Getty (page 2-3A) without being discussed on page 2-29. Both Mobil and Pacific considered Ruedi as a reasonable alternative for 100,000 bbl/day projects. 32

Page 2-47 — Cities proposes the use of upgrading plant wastewater for spent shale conditioning (as does Getty) thereby raising the issue of co-disposal of process or waste streams with the spent shale under TSCA or RCRA. Further discussion of this issue is warranted. 33

Page 2-47 — Figure 2.3-23 idicates that wastewater from the upgrading plant will be treated and reused. Treated how or to what quality? Will arsenic-laden upgrade plant wastewaters be applied to spent shale? 34

Page 2-49 — It appears that part of the description of the spent shale disposal plan has been accidently omitted. The intention was probably to repeat the description provided for the Getty project including provision of drains above and below the spent shale liner. The comments for pages 2-20 therefore would apply. 35

Page 2-53 — Same comment as for page 2-27 regarding economy of scale. 36

Page 2-53 — Same comment as for page 2-27 regarding use of the Lurgi process. 37

Page 2-55 — Same comment as for page 2-29 regarding properties and disposal of Lurgi process spent shale. 38

Pages 2-36 to 2-52 — The spent shale disposal design for Cities is the same as for Getty. Reference comments for pages 2-20 to 2-29 as they apply equally to Cities. 40

Page 2-52 — Oisposal of non-hazardous wastes in a site separate from the spent shale disposal site should be considered as an alternative. Cities should specify what these non-hazardous wastes are and their estimated volume. Uncertain regulatory requirements should not preclude a full analysis of both hazardous and nonhazardous wastes. 41

Page 2-55 — Why does Cities not consider the Ruedi Reservoir a viable alternative for water supply? Both Mobil and Pacific considered it reasonable. 42

Note: Comment 39 deleted from draft to final

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Page 2-56 Retorting of raw shale fines should be considered whether Union B retorts or Lurgi retorts are used. A few retorts of an appropriate type to process fines could be used in conjunction with the Union B retorts. The potential value of this resource appears to be too large to ignore. 43 43

Page 2-62 It is not clear that Lurgi spent shale would require more water for moistening. The chemical nature of leachates from Lurgi spent shale are different than those from Union B spent shale. 44 Erosion rates would also be different. Discussion of air quality impacts should also consider burning the carbon off the Union B spent shale to improve the energy balance. 45

Page 2-70 Same comment as for page 2-29 regarding consideration of Ruedi reservoir. 46

Page 2-77 The analysis of the Lurgi retorting alternative is incomplete. Lurgi spent shale may require no more water for moistening, has a tendency to set up like cement reducing erosion, increasing stability and possibily reducing leachate. 47

Page 2-77 The analysis of the Lurgi retorting alternative is incomplete. Lurgi spent shale may require no more water for moistening and, has a tendency to set up like cement, reducing erosion, increasing stability and possibly reducing leachate.

Page 2-78 The Lurgi process should show a more favorable energy balance than the Union B because raw shale fines are retorted, not wasted, and the carbon on the spent shale is burned to produce energy. 48

Section 4.0 Environmental Consequences

Page 4-13 Subsidence, even if limited to one foot, can significantly alter the hydrologic flow pattern in overlying strata. Hence to avoid significant impact, the objective should be to prevent disrupting of overlying strata rather than accepting one foot of subsidence. Further discussion of this issue is necessary including the possible inflow of water to the mine workings. 49 49

Page 4-13 Getty concludes that "no significant geological impacts would be expected" in view of the spent shale design provided - yet the design details are not firm and even the use of drains to prevent saturation of the spent shale fill are not necessarily included (see page 2-20). 50 50

Page 4.14 Reference to Bates 1983 is not listed in section 8 references. 51

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Page 4-15 References to EPA 1977 should be specific to a, b, or c as listed on page 8-11. 52

Page 4-16 It is not clear that Lurgi spent shale will require more water for moistening. Why would downstream water quality impacts be greater for Lurgi technology? Erosion and leachate may be less from a Lurgi disposal site. 53

Page 4-18 Getty addresses the impact of the raw shale stockpile on ground water by saying that stockpiling is a transient phenomenon. However, the stockpile will last for the life of the project and hence is not transient. 54

Page 4-18 Getty mentions collecting flow from springs in the spent shale disposal area in pipes for later use in make-up water systems. What happens to the water after site closure and who maintains these drainage pipes after closure is left to future discussions during permitting. Pipes will collect only point discharges. Perhaps a better approach would be to place a rock drain (properly screened) under the disposal pile liner. The risk of the pipe system failing and resultant saturation of bottom of the pile would appear greater. As designed, it is very questionable that the pile has been designed to minimize the potential for failure and environmental impact as claimed by Getty. 55 55

Page 4-81 The comment for page 4-13 regarding subsidence applies to Cities as well as Getty. 56

Page 4-84 Same comment as for page 4-16 regarding water for moistening and downstream impacts. 57

Page 4-86 The raw shale stockpile is not a transient phenomenon. It will exist for the life of the project. 58

Page 4.2-1 Getty should provide supporting documentation and calculations to support the claim of only one foot of subsidence. Even if subsidence of the surface amounts to only one foot, the impact on overlying strata could be severe. 59

Page 4-14 Getty should evaluate the impact of potential mass failure of the spent shale disposal pile. Since no drains above or below the spent shale liner are included in the design, the risk of saturating the bottom of the pile and subsequent failure are increased. 60

Page 4-14 Use of Lurgi retorting technology could change the potential for mass failure of the disposal pile if the Lurgi shale sets up as a solid mass. 61

Page 4-15 Runoff from exposed retorted shales will also contain large amounts of dissolved salts. 62

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Page 4-17 — Before Getty can conclude that no additional impacts could result from disposal of non-hazardous wastes in the spent shale pile, they should identify and characterize the wastes, provide estimates of amount and explain the proposed disposal method (e.g., co-mixed uniformly, disposed in cells, etc.). 63 63

Page 4.2-13 — Getty addresses the impact of the raw shale stockpile on ground water by saying that stockpiling is a transient phenomenon. However, the stockpile will last for the life of the project and hence is not transient. 64

Page 4-81 — Cities should provide supporting documentation and calculations to support the claim of only one foot of subsidence. Even one foot of subsidence at the surface implies substantial fracturing and impact to the strata overlying the mine especially the hydrology. 65 65

Page 4-82 — Cities fails to mention impacts that would result from mass failure of the spent shale disposal pile - yet the risk of such failure is increased by Cities' failure to incorporate rock drains both above and below the spent shale liner to remove water that may collect at the liner interface. 66 66

Pagea 4-82 — The use of the Lurgi retorting alternatives could significantly affect the risk of spent shale pile mass failure. Lurgi spent shale tends to set which may create a solid mass much less likely to fail. Further discussion and analysis are needed in the EIS. 67 67

Pages 4-83 — Raw shale fines as well as retorted oil shales can produce a very salty runoff and leachate. These potential heavy salt loads have not been adequately addressed. 68

Page 4-84 — The discussion of alternative Lurgi technology ignores the potential cementation of Lurgi spent shale which would reduce erosion, increase stability and possibly reduce leachate. Cities fails to explain why more water is needed to moisten Lurgi spent shale. 69 69

Page 4-85 — Cities should provide additional supporting information on the projected inflow of water into the mine based on a surface subsidence of one foot. 70

Page 4-86 — The raw shale stockpile is not a transient phenomenon. It will exist for the life of the project. 71

Page 4-86 — Cities provides a brief but fairly good discussion regarding possible generation of leachate from and saturation of the bottom of the spent shale pile. However, they fail to take the appropriate design measures which are rock drains to remove leachate or ground water before pile saturation and failure occur. More detailed information is needed in the EIS. 72 72

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Page 4-160 — The EIS includes a good listing of projects for a cumulative air quality impact analysis. The results should be presented for each wind condition then added for the cumulative impact. 73

Page 4-161 — With the construction of impoundments, diversions, and reservoirs to control the spent shale runoff and leachate, certain drainages will be severely impacted and aquatic biota will suffer. For example, there is a trout population currently existing in the West Fork of Parachute Creek and below the proposed reservoir there will be habitat loss. There will be less cover from the riparian changes and reduction in benthic invertebrates. Mitigation could perhaps include such actions as cooperation with the Colorado Division of Wildlife for stocking the reservoir to increase the recreational opportunities in the area. Page 4-175 and 4-176 refer to periods of "flow interruption" as unavoidable adverse impacts on surface waters. This is somewhat misleading because in most cases flow would be completely stopped. 74 74

Page 4-164 — There will also be certain unavoidable wildlife losses that will occur but these losses can be reduced with the identification and use of certain mitigating practices. Such practices may include but not be limited, to the avoidance of unique and irreplacable habitat (such as sage grouse strutting grounds or raptor nests), replacement or enhancement of scarce wildlife habitat (such as providing artificial cliff and nest sites for raptors), construction scheduling to avoid key wildlife use areas during critical periods (such as elk calving and critical winter range), reclamation of disturbed lands with vegetation types favorable to wildlife and reseeding shoulder roadways with vegetation unpalatable to wildlife, and construction of protected power lines to prevent accidental electrocution of raptors. 75 75

Page 4-174 — There is no discussion of the possible use of mass transport and this alternative should be explored. Such a program could do much to eliminate direct mortality of big game and should include such items as an information and education program for the employees, a ban on firearms, and speed limits. 76 76

Page 4-158 — It is stated that impacts on surface water do not apply to post-operations if reclamation efforts do not afford permanent stabilization. This is not acceptable as the state of the art exists for revegetation on spent shale piles. A possible source of information may be the Upper Environmental Plant Center located in Meeker, Colorado. 77 77

Page 4-184 — Use of properly installed rock drains above and below the spent shale liner is recommended to increase fill stability and reduce leachate generation. What will be done with impoundments when the site is closed? 78 78

Page 4-190 — Use of properly installed rock drains above and below the spent shale liners are recommended to increase fill stability and reduce leachate generation. 79

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DEPARTMENT OF HEALTH & HUMAN SERVICES

Office of the
Regional Director

Region VIII
Federal Office Building
1961 Stout Street
Denver CO 80294

February 22, 1984

Re: Draft, Environmental Impact Statement
Getty and Cities Service Shale Oil Projects

Mr. Tom Coe
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814

Dear Mr. Coe:

The draft EIS addresses the need for social services in a general way of the peak influx of approximately 12,000 construction workers and then, ultimately, 6300 production workers. Both companies indicate their willingness to work with the local governments to meet these needs. A firmer commitment from the applicants would enhance the future availability of social services. 1

Sincerely yours,

E.W. McIntire
Director, ROFEC

(16)

Bluestone Properties Inc.
Dennis O. Bradley
P.O.Box 163
Silt, Colo. 81652

February 8,1984

Mr. Tom Coe, Regulatory Section
U.S.Army Corps of Engineers
650 Capitol Mall
Sacramento, Ca. 95814

Re: Draft Environmental Impact Statement on Getty and Cities Service
Shale Oil Projects:

Dear Mr. Coe:

In reviewing your EIS on Getty and Cities Service Shale Oil Projects, Jan. 20, 1984, and recant review of the Chevron Clear Creek Shale Oil Project EIS draft and final by BLM 1983, I have some concern in projections for the DeBeque area.

Neithe EIS predicts or projects much activities for the Town of DeBeque which I assume is all based on the existing utility deficits with inadequate revenue bases through service fees and tax bases to offset the deficit. 1 I also assume no Shale Oil Projects in the Clear Creek basen will assist the town directly to improve their utilities except through tax bases. In 1976 the Town of Silt was under similar circumstances but they pulled through the energy impact crisis and now capable of providing additional utilities, as you state in your EIS. Do any of the Clear Creek Shale Oil Projects have plans to assist the Town of DeBeque directly in improvements to their utilities? 1

If the Town of DeBeque was capable of maintaining their utilities with little to no deficit, and could provide additional services, would your projections for the town change? and if so, what percentage do you believe could occure? 2

The main reason for this litter is that I have been working on a proposed land development project 2 miles South of the Town of DeBeque on the East side of the Colorado River along I-70. This development would provide approximatly 1,200 units with the first P.U.D. Phase. It is not designed entirely on Shale Oil Impact but the general potentials this area could offer. However, the Shale Oil Impact would be an asset to the development. The build out plan is based on a 20 to 25 years, and 10 to 15 years with Shale Oil Impact.

This proposed land development will construct and instal a new water treatment and storage tank system, and a new sewage treatment system. Both systems will be designed in phases to meet the demands of the PUD, with the capabilities for enlargements and extentions to provide services throughout the valley East of the Colorado River. Also these systems could be capable of serving the Town of DeBeque if needed in the future.

Durring the development and construction of this project, we plan to promote retail, industrial and other businesses, which we foresee in the near future to utilize the frontage roads of I-70, along with other residential developments throughout the valley.

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page 2 cont.

Now, if this proposed land development was under construction, could provide housing for the energy impact, and provide additional services throughout the valley, including the Town of DeBeque, would your projections change? and if so, what percentage would you assume? 3

Your immediate respons to this letter would be appreciated very much, which may assist us in our planning. If you have any questions pertaining to this proposed land development, which may assist you in your final EIS, please do not hesitate to call, (303-876-2222)

Sincerely

Dennis O. Bradley, proj. mgr./planner
Bluestone Properties Inc.

cc Planning Dept.
Mesa County
DeBeque
BLM Clear Cr. EIS G.J.
Getty
Cities Service
Chevron
Pacific

Harden, Tackett, Combs

7.0

Glossary

7.0 GLOSSARY

The following words have been defined for purposes of the FEIS.

ASTM Dxxx - American Standard Testing Materials; the D and the numbers which follow it signify the particular test.

De minimis - Insignificant; of minimum importance.

Indirect above ground retort - A retort in which the energy requirement for retorting is provided by a means external to the retort (such as the recycled gas heater for the Union B process).

Infiltration - The process whereby water passes into or through the soil; in this FEIS it refers to water entering the spent shale pile.

Leachate - A liquid which passes through a porous medium such as soil — in this instance it refers to the leaching of water in the post-reclamation stage.

Melting point - That point where a substance changes from a solid to a liquid state; in this context it refers to the transition of snow to water at 32°F.

Permanent wilting point percentage - Lowest soil moisture content at which a plant can extract water from the soil.

Specific retention - Field capacity; the quantity of water held in pore spaces against the force of gravity.

8.0

References

8.0 REFERENCES

The references which follow include only (1) those which are cited in reprinted sections in the FEIS; (2) those which are cited in the FEIS comments and responses; and (3) those which have been corrected or updated since publication of the DEIS. As shown below, many additional references supplement those shown in the DEIS. Both lists should be used in combination as sources of information regarding the Getty and Cities Service shale oil projects.

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Appendix

APPENDIX C

WILDLIFE IMPACT RATINGS

United States Department of the Interior
FISH AND WILDLIFE SERVICE
COLORADO FIELD OFFICE
730 SIMMS STREET
ROOM 292
GOLDEN, COLORADO 80401

IN REPLY REFER TO:

November 15, 1983

Ms. Linda Brown
Camp, Dresser and McKee, Inc.
11455 West 48th Avenue
Wheatridge, CO 80033

Dear Ms. Brown:

With this letter, we are transmitting results of wildlife impact analyses for the Getty and Cities oil shale projects.

Impact assessments were performed using a modified Geographic Information System approach similar to the technique described in the Chevron, Fish and Wildlife Coordination Act technical assistance report. Please refer to the Chevron report for specific analysis methodology.

As previously discussed, we believe the attached results should be incorporated in the Getty/Cities DEIS and should be used to develop mitigation recommendations. The Chevron technical assistance report can provide further guidance in devising mitigation measures. We are also prepared to provide you with any additional assistance you may need in developing mitigation strategies for the DEIS.

If you have any questions regarding mitigation or the attached analyses, please feel free to call either myself or Mike Lockhart.

Sincerely,

Energy Project Leader

cc: COE, Sacramento, CA

Attachment

MATRIX AND TABLE KEY

*( ) = acres
bz = .5 mile buffer zone

<u>Getty</u>

Mine Bench and Plant Site (318)*	= GEPRT & MNPT
Mine Bench and Plant Site-bz (1357.5)	= GPRT & MNB2
Additional Retort Site (234)	= GEPRTADD
Additional Retort Site-bz (1227)	= GPRTADDB2
Tom Creek Reservoir (174)	= GEPRESTCRK
DeBeque Silt Pond (55.5)	= GEPSILTPD
Roan Creek Re-reg Reservoir (44.28)	= GERESNEW
Proposed Shale Disposal Site (2220)	= GEPSDSITE
Proposed Shale Disposal Site-bz (2869.5)	= GPSDSITEB2
Buck Gulch Corridor (124.58)	= GPCOR1
Buck Gulch Corridor-bz (1468.5)	= GCOR1B2
Road Corridor A (292.5)	= GEPCORR2
Road Corridor A-bz (2731.5)	= GPCOR2B2
Road Corridor B (64.90)	= GPCOR8
Road Corridor B-bz (1159.5)	= GPCOR8B2
Road Corridor C (328.22)	= GPCOR4
Road Corridor C-bz (2670.0)	= GCOR4B2
Product Corridor A (66.09)	= GPCOR3
Product Corridor A-bz (1029.0)	= GCOR3B2
Product Corridor B (159.81)	= GPCOR5
Product Corridor B-bz (1968.0)	= GPCOR5B2
Alt. Shale Disposal Site (1579.5)	= GEASDSITE5
Alt. Shale Disposal Site-bz (4126.5)	= GASDSITEB2
W. Fk. Parachute Reservoir (283.5)	= GEARESWFPC
Pipeline Corridor W. Fk. Parachute (174.62)	= GPCOR9
Pipeline Corridor W. Fk. Parachute-bz (1978.5)	= GPCOR9B2
Upper Roan Creek Corridor (1076.29)	= GPCOR7
Upper Roan Creek Corridor-bz (8316.0)	= GPCOR7B2
Lower Roan Creek Corridor (2105.04)	= GPCOR6
Lower Roan Creek Corridor-bz (6633.0)	= GPCOR6B2
Dry Fork Reservoir (1758)	= DRYCRKRES

MATRIX AND TABLE KEY (continued)

Cities

Cities Mine Bench (3.0)	= CTPMNBENCH
Cities Mine Bench-bz (540.0)	= CPMNBENB2
Retort & Plant Site (195.0)	= CTPRT & MNPL
Retort & Plant Site-bz (1135.5)	= CPT & MNB2
Shale Fines Site (418.5)	= CTPSHALEFN
Shale Fines Site-bz (1572.0)	= CPSHALEFB2
Proposed Shale Disposal Site (777.0)	= CTPSDSITE
Proposed Shale Disposal Site-bz (2530.5)	= CPSDSITEB2
Waste Rock Pile (84.0)	= CTPWSROCKP
Waste Rock Pile-bz (961.5)	= CPWSROCKB2
Road Corridor A (475.17)	= CPCOR2
Road Corridor A-bz (5118.0)	= CPCOR2B2
Road Corridor B (255.0)	= CTPCORR3
Road Corridor B-bz (2404.5)	= CPCOR3B
Road Corridor C (130.61)	= CPCOR5
Road Corridor C-bz (1509.0)	= CPCOR5B2
Product Corridor A (414.35)	= CPCOR4
Product Corridor A-bz (3513.0)	= CCOR4B2
Product Corridor B (159.81)	= GPCOR5
Product Corridor B-bz (1968)	= GPCOR5B2
Alt. Shale Disposal Site (1506.0)	= CTASDSITE1 & CTASDSITE2
Alt. Shale Disposal Site-bz (3982.5)	= CASDSIT1B2 & CASDSIT2B2
Pipeline Corridor A (67.33)	= CPCOR1
Pipeline Corridor A-bz (1096.5)	= CCOR1B2
Pipeline Corridor B (90.73)	= CPCORGNG
Pipeline Corridor B-bz (1198.5)	= CPCORGNGB2
Alternate Product Pipeline (840.06)	= CTACORR2
Alternate Product Pipeline-bz (4485.0)	= CACOR2B2
Larkin Ditch Pond (8.33)	= LDSEDPD
Dry Fork Reservoir (1758)	= DRYCRKRES

Wildlife/Habitat Types

MDWR = Mule Deer Winter Range = MDD41.WR82

MDWCA = Mule Deer Winter Range Concentration Area = MDD41WCA82

Wildlife/Habitat Types (cont.)

MDCH	=	Mule Deer Critical Habitat = MDD41CH83
EKWR	=	Elk Winter Range = EKE10WR83
EKWCA	=	Elk Winter Concentration Area = EKE10WCA82
EKCH	=	Elk Critical Habitat = EKE10CH83
RAREPL	=	Rare Plant Populations = GCEP
RAREP-1	=	Rare Plant .5 mi. Buffer Zone = GEEPB1
SAGR	=	Sage Grouse Leks = SG58.S.83
SAGR-1	=	Lek Buffer Zone .5 mile = SAGELEKB2
SAGR-2	=	Lek Buffer Zone 2 mile = SAGELEKB4
ACCI	=	Inactive Accipiter Nest and .25 mile buffer zone = SAGELEKB4
COHA-1	=	Active Cooper's Hawk Nest and .25 mile buffer zone = CHOAB1A
COHA-2	=	Active Cooper's Hawk Nest and .5 mile buffer zone = CHOAB2A
RTHI	=	Inactive Red-tailed Hawk Nest and .25 mile buffer zone = RTHIB1A
RTHA-1	=	Active Red-tailed Hawk Nest and .25 mile buffer zone = RTHAB1A
RTHA-2	=	Active Red-tailed Hawk Nest and .5 mile buffer zone = RTHAB2A
GOEI-1	=	Inactive Golden Eagle Nest and .25 mile buffer zone = GOEIB1
GOEI-2	=	Inactive Golden Eagle Nest and .5 mile buffer zone = GOEIB2
GOEA-1	=	Active Golden Eagle Nest and .25 mile buffer zone = GOEAB1
GOEA-2	=	Active Golden Eagle Nest and .5 mile buffer zone = GOEAB2
GOEA-3	=	Active Golden Eagle Nest and 1 mile buffer zone = GOEAB3
KEST	=	Active kestrel and .25 mile buffer zone = CTRPAAMK
ASPEN	=	Aspen Cover Type = HBASPEN
ASPEN-1	=	Aspen Cover Type, .25 buffer zone = HBASPENB2
DFIR	=	Doug Fir Cover Type = HBDOUGFIR
DFIR-1	=	Doug Fir Cover Type, .25 buffer zone = HBDOUGFB2
RIP	=	Riparian Cover Type = HBRIPARIAN
RIP-1	=	Riparian Cover Type, .25 buffer zone = HBRIPB2
CLIFF	=	Cliff = HBCLIFF

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT

Project Feature	Wildlife/Habitat Values							
	MDWR	MDWCA	MDCH	EKWR	EKWCA	EKCH	RAREPL	RAREP-1
Mine Bench & Plant Site	0	0	0	94.5	0	0	46.5	235.5
Mine Bench & Plant Site-bz	0	0	0	562.5	61.5	61.5	378.0	780.0
Additional Retort Site	0	0	0	0	0	0	0	0
Additional Retort Site-bz	0	0	0	0	0	0	0	0
Tom Creek Reservoir	0	0	0	174.0	174.0	174.0	22.5	124.5
DeBeque Silt Pond	55.5	55.5	55.5	0	0	0	0	0
Roan Creek Re-reg Reservoir	45.0	45.0	45.0	0	0	0	0	0
Proposed Shale Disposal Site	0	0	0	0	0	0	0	0
Proposed Shale Disposal Site-bz	0	0	0	0	0	30.0	0	55.5
Buck Gulch Corridor	0	0	0	124.5	84.0	84.0	34.5	120.0
Buck Gulch Corridor-bz	127.5	0	0	1359.0	868.5	868.5	505.5	999.0
Road Corridor A	0	0	0	270.0	61.5	61.5	160.5	187.5

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	SAGR	SAGR-1	SAGR-2	ACCI	COHA-1	COHA-2	RTHI	RTHA-1
Mine Bench & Plant Site	0	0	0	0	0	13.5	0	0
Mine Bench & Plant Site-bz	0	0	43.5	0	13.5	298.5	51.0	30.0
Additional Retort Site	0	0	0	0	0	0	0	0
Additional Retort Site-bz	0	0	0	0	0	64.5	0	0
Tom Creek Reservoir	0	0	0	0	0	0	0	0
DeBeque Silt Pond	0	0	0	0	0	0	0	0
Roan Creek Re-reg Reservoir	0	0	45.0	0	0	0	0	0
Proposed Shale Disposal Site	0	0	0	249.0	124.5	751.5	150.0	111.0
Proposed Shale Disposal Site-bz	0	0	0	124.5	0	396.0	174.0	135.0
Buck Gulch Corridor	0	0	24.0	0	37.5	82.5	0	0
Buck Gulch Corridor-bz	0	0	616.5	0	84.0	738.0	0	0
Road Corridor A	0	0	85.5	0	0	0	0	33.0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	RTHA-2	GOEI-1	GOEI-2	GOEA-1	GOEA-2	GOEA-3	KEST	ASPEN
Mine Bench & Plant Site	48.0	0	15.0	0	0	0	0	0
Mine Bench & Plant Site-bz	346.5	16.5	292.5	0	0	0	0	0
Additional Retort Site	0	0	0	0	0	0	0	0
Additional Retort Site-bz	10.5	0	0	0	0	0	0	19.5
Tom Creek Reservoir	0	0	61.5	0	0	0	0	0
DeBeque Silt Pond	0	0	0	0	0	0	0	0
Roan Creek Re-reg Reservoir	0	0	0	0	0	0	0	0
Proposed Shale Disposal Site	817.5	0	0	0	0	0	0	0
Proposed Shale Disposal Site-bz	997.5	0	174.0	0	0	0	0	18.0
Buck Gulch Corridor	0	0	16.5	0	0	0	0	0
Buck Gulch Corridor-bz	0	13.5	322.5	0	0	0	0	0
Road Corridor A	76.5	82.5	144.0	0	0	0	0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values					
	ASPEN-1	DFIR	DFIR-1	RIP	RIP-1	CLIFF
Mine Bench & Plant Site	0	0	0	0	0	0
Mine Bench & Plant Site-bz	0	0	0	0	0	0
Additional Retort Site	0	0	0	0	0	0
Additional Retort Site-bz	159.0	0	0	4.5	91.5	0
Tom Creek Reservoir	0	0	0	0	0	0
DeBeque Silt Pond	0	0	0	1.5	54.0	0
Roan Creek Re-reg Reservoir	0	0	0	0	0	0
Proposed Shale Disposal Site	0	0	0	0	0	0
Proposed Shale Disposal Site-bz	144.0	0	0	0	3.0	0
Buck Gulch Corridor	0	0	0	0	0	0
Buck Gulch Corridor-bz	0	0	0	0	0	0
Road Corridor A	0	0	0	0	0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	MDWR	MDWCA	MDCH	EKWR	EKWCA	EKCH	RAREPL	RAREP-1
Road Corridor A-bz	0	0	0	1822.5	504.0	504.0	694.5	1732.5
Road Corridor B	0	0	0	67.5	57.0	57.0	43.5	24.0
Road Corridor B-bz	0	0	0	1123.5	766.5	766.5	261.0	529.5
Road Corridor C	0	0	0	0	0	0	0	0
Road Corridor C-bz	0	0	0	9.0	0	0	15.0	171.0
Product Pipeline A	0	0	0	0	0	0	0	0
Product Pipeline A-bz	0	0	0	0	0	0	0	0
Product Pipeline B	0	0	0	0	0	18.0	0	0
Product Pipeline B-bz	0	0	0	0	0	646.5	0	0
Alt. Shale Disposal Site	1.5	0	0	1563.0	582.0	582.0	916.5	1176.0
Alt. Shale Disposal Site-bz	178.5	0	0	2241.0	1020.0	1020.0	450.0	2253.0
W. Fk. Parachute Reservoir	0	0	0	0	0	0	0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	SAGR	SAGR-1	SAGR-2	ACCI	COHA-1	COHA-2	RTHI	RTHA-1
Road Corridor A-bz	0	0	829.5	0	0	192.0	120.0	91.5
Road Corridor B	0	0	0	0	0	0	0	0
Road Corridor B-bz	0	0	216.0	0	0	0	0	0
Road Corridor C	0	0	0	0	0	0	55.5	42.0
Road Corridor C-bz	0	0	0	0	0	240.0	117.0	79.5
Product Corridor A	0	0	0	0	0	57.0	0	0
Product Corridor A-bz	0	0	0	0	102.0	397.5	0	45.0
Product Corridor B	0	0	0	0	0	58.5	0	0
Product Corridor B-bz	0	0	0	0	112.5	472.5	115.5	51.0
Alt. Shale Disposal Site	0	0	501.0	0	111.0	412.5	69.0	106.5
Alt. Shale Disposal Site-bz	0	0	1663.5	0	10.5	531.0	51.0	18.0
W. Fk. Parachute Reservoir	0	0	0	0	0	0	0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	RTHA-2	GOEI-1	GOEI-2	GOEA-1	GOEA-2	GOEA-3	KEST	ASPEN
Road Corridor A-bz	712.5	367.5	1230.0	0	0	0	0	0
Road Corridor B	0	0	28.5	0	0	0	0	0
Road Corridor B-bz	75.0	109.5	448.5	0	0	0	0	0
Road Corridor C	88.5	0	0	0	0	0	0	0
Road Corridor C-bz	853.5	0	0	0	0	0	0	0
Product Pipeline A	42.0	0	0	0	0	0	0	0
Product Pipeline A-bz	333.0	0	0	0	0	0	0	13.5
Product Pipeline B	49.5	0	0	0	0	0	0	24.0
Product Pipeline B-bz	375.0	0	0	0	0	0	0	417.0
Alt. Shale Disposal Site	291.0	271.5	949.5	0	0	0	0	0
Alt. Shale Disposal Site-bz	747.0	301.5	1497.0	0	0	7.5	0	0
W. Fk. Parachute Reservoir	0	0	0	0	0	0	0	6.0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Value					
	ASPEN-1	DFIR	DFIR-1	RIP	RIP-1	CLIFF
Road Corridor A-bz	0	0	0	0	0	0
Road Corridor B	0	0	0	0	0	0
Road Corridor B-bz	0	0	0	0	0	0
Road Corridor C	0	0	0	0	0	0
Road Corridor C-bz	0	0	0	0	0	0
Product Pipeline A	0	0	0	0	0	0
Product Pipeline A-bz	165.0	0	0	6.0	88.5	0
Product Pipeline B	106.5	0	0	0	63.0	0
Product Pipeline B-bz	1167.0	0	0	21.0	402.0	0
Alt. Shale Disposal Site	0	0	0	0	0	0
Alt. Shale Disposal Site-bz	0	0	0	0	0	0
W. Fk. Parachute Reservoir	202.5	0	0	55.5	222.0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued) Page 3a

Project Feature	Wildlife/Habitat Values							
	MDWR	MDWCA	MDCH	EKWR	EKWCA	EKCH	RAREPL	RAREP-1
Pipeline Corridor W. Fk. Parachute	0	0	0	0	0	0	0	0
Pipeline Corridor W. Fk. Parachute	0	0	0	0	0	0	0	0
Upper Roan Creek Corridor	918.0	754.5	745.5	249.0	147.0	147.0	0	24.0
Upper Roan Creek Corridor-bz	6340.5	5100.0	4939.0	2598.0	1710.0	1710.0	99.0	462.0
Lower Roan Creek Corridor	2097.0	1674.0	1581.0	0	0	0	0	0
Lower Roan Creek Corridor-bz	6316.5	5841.0	5784.0	0	0	0	0	0
Dry Fork Reservoir (GCC)	1758.0	1758.0	1758.0	0	0	0	0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	SAGR	SAGR-1	SAGR-2	ACCI	COHA-1	COHA-2	RTHI	RTHA-1
Pipeline Corridor W. Fk. Parachute	0	0	0	0	0	27.0	0	0
Pipeline Corridor W. Fk. Parachute-bz	0	0	0	0	66.0	336.0	0	12.0
Upper Roan Creek Corridor	0	0	555.0	0	0	6.0	0	0
Upper Roan Creek Corridor-bz	0	0	4687.5	0	4.5	322.5	0	0
Lower Roan Creek Corridor	0	0	0	0	0	0	0	0
Lower Roan Creek Corridor	0	0	18.0	0	0	0	0	0
Dry Fork Reservoir (GCC)	0	0	0	0	0	0	0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	RTHA-2	GOEI-1	GOEI-2	GOEA-1	GOEA-2	GOEA-3	KEST	ASPEN
Pipeline Corridor W. Fk. Parachute	6.0	0	0	0	0	0	0	54.0
Pipeline Corridor W. FK. Parachute-bz	267.0	0	0	0	0	0	0	277.5
Upper Roan Creek Corridor	0	0	0	0	0	108.0	0	0
Upper Roan Creek Corridor-bz	0	0	6.0	0	172.5	733.5	0	0
Lower Roan Creek Corridor	0	0	0	0	0	0	0	0
Lower Roan Creek Corridor-bz	0	0	0	0	0	0	0	0
Dry Fork Reservoir (GCC)	0	0	0	0	0	0	0	0

Table C-1 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE GETTY SHALE OIL PROJECT (Concluded) Page 3d

Project Feature	Wildlife/Habitat Values					
	ASPEN-1	DFIR	DFIR-1	RIP	RIP-1	CLIFF
Pipeline Corridor W. Fk Parachute	124.5	0	0	45.0	133.5	0
Pipeline Corridor W. Fk. Parachute-bz	1248.0	0	0	66.0	924.0	0
Upper Roan Creek Corridor	0	0	0	0	49.5	0
Upper Roan Creek Corridor-bz	0	0	0	153.0	879.0	10.5
Lower Roan Creek Corridor	0	0	0	169.5	891.0	0
Lower Roan Creek Corridor-bz	0	0	0	246.0	1806.0	64.5
Dry Fork Reservoir (GCC)	0	0	0	138.0	981.0	0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT

Project Feature	Wildlife/Habitat Values							
	MDWR	MDWCA	MDCH	EKWR	EKWCA	EKCH	RAREPL	RAREP-1
Cities Mine Bench	0	0	0	0	0	0	3.0	3.0
Cities Mine Bench-bz	0	0	0	27.0	0	0	301.5	505.5
Retort & Plant Site	0	0	0	0	0	0	0	0
Retort & Plant Site-bz	0	0	0	0	0	0	4.5	187.5
Shale Fines Site	0	0	0	0	0	0	0	27.0
Shale Fines Site-bz	0	0	0	19.5	0	0	102.0	264.0
Proposed Shale Disposal Site	6.0	0	0	762.0	0	0	124.5	307.5
Proposed Shale Disposal Site-bz	210.0	0	0	1612.5	0	0	649.5	1192.5
Waste Rock Pile	0	0	0	0	0	0	0	0
Waste Rock Pile-bz	0	0	0	0	0	0	0	0
Road Corridor A	342.0	246.0	225.0	279.0	0	0	31.5	46.5
Road Corridor A-bz	3024.0	2314.5	2067.0	2545.5	0	0	370.5	772.5

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	SAGR	SAGR-1	SAGR-2	ACCI	COHA-1	COHA-2	RTHI	RTHA-1
Cities Mine Bench	0	0	0	0	0	3.0	0	0
Cities Mine Bench-bz	0	0	0	0	64.5	327.0	3.0	0
Retort & Plant Site	0	0	0	52.5	0	169.5	133.5	0
Retort & Plant Site-bz	0	0	0	70.5	123.0	397.5	249.0	0
Shale Fines Site	0	0	0	4.5	0	0	144.0	22.5
Shale Fines Site-bz	0	0	166.5	118.5	0	201.0	147.0	102.0
Proposed Shale Disposal Site	0	0	0	0	0	21.0	28.5	0
Proposed Shale Disposal Site-bz	0	0	108.0	0	28.5	315.0	93.0	0
Waste Rock Pile	0	0	0	0	0	0	0	10.5
Waste Rock Pile-bz	0	0	0	0	0	43.5	0	238.5
Road Corridor A	0	0	325.5	0	0	0	0	0
Road Corridor A-bz	0	0	2847.0	0	0	0	154.5	0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	RTHA-2	GOEI-1	GOEI-2	GOEA-1	GOEA-2	GOEA-3	KEST	ASPEN
Cities Mine Bench	0	3.0	0	0	0	0	0	0
Cities Mine Bench-bz	0	120.0	420.0	0	0	0	0	61.5
Retort & Plant Site	0	0	0	0	0	0	0	10.5
Retort & Plant Site-bz	282.0	0	174.0	0	0	0	0	271.5
Shale Fines Site	208.5	0	0	0	0	0	0	76.5
Shale Fines Site-bz	547.5	0	112.5	0	0	219.0	0	235.5
Proposed Shale Disposal Site	0	127.5	598.5	0	217.5	355.5	40.5	0
Proposed Shale Disposal Site-bz	0	393.0	1363.5	112.5	367.5	615.0	82.5	19.5
Waste Rock Pile	73.5	0	0	0	0	0	0	4.5
Waste Rock Pile-bz	708.0	0	0	0	0	96.0	0	238.5
Road Corridor A	0	31.5	63.0	1.5	93.0	75.0	0	0
Road Corridor A-bz	0	247.5	1029.0	123.0	646.5	900.0	108.0	0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values					
	ASPEN-1	DFIR	DFIR-1	RIP	RIP-1	CLIFF
Cities Mine Bench	3.0	0	0	0	3.0	0
Cities Mine Bench-bz	283.5	12.0	126.0	57.0	339.0	46.5
Retort & Plant Site	147.0	0	0	0	18.0	0
Retort & Plant Site-bz	595.5	0	24.0	58.5	523.5	0
Shale Fines Site	292.5	0	0	72.0	336.0	0
Shale Fines Site-bz	553.5	0	0	36.0	570.0	7.5
Proposed Shale Disposal Site	0	12.0	376.5	93.0	552.0	6.0
Proposed Shale Disposal Site-bz	180.0	214.5	1192.5	51.0	649.5	250.5
Waste Rock Pile	79.5	0	0	0	7.5	0
Waste Rock Pile-bz	672.0	0	0	39.0	450.0	0
Road Corridor A	0	7.5	117.0	9.0	225.0	3.0
Road Corridor A-bz	13.0	145.5	1042.5	159.0	1489.5	238.5

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	MDWR	MDWCA	MDCH	EKWR	EKWCA	EKCH	RAREPL	RAREP-1
Road Corridor B	0	0	0	141.0	0	0	153.0	169.5
Road Corridor B-bz	0	0	0	870.0	0	0	627.0	1437.0
Road Corridor C	0	0	0	0	0	0	0	0
Road Corridor C-bz	0	0	0	0	0	0	0	0
Product Pipeline A	0	0	0	0	0	0	0	0
Product Pipeline A-bz	0	0	0	0	0	0	0	0
Product Pipeline B	0	0	0	0	0	18.0	0	0
Product Pipeline B-bz	0	0	0	0	0	646.5	0	0
Alt. Shale Disposal Site	0	0	0	498.0	0	0	171.0	321.0
Alt. Shale Disposal Site-bz	60.0	0	0	1069.5	0	0	468.0	1131.0
Pipeline Corridor A	0	0	0	0	0	0	27.0	48.0
Pipeline Corridor A-bz	0	0	0	144.0	0	0	195.0	471.0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	SAGR	SAGR-1	SAGR-2	ACCI	COHA-1	COHA-2	RTHI	RTHA-1
Road Corridor B	0	0	0	0	4.5	117.0	39.0	0
Road Corridor B-bz	0	0	90.0	57.0	121.5	751.5	307.5	0
Road Corridor C	0	0	0	21.0	0	1.5	0	0
Road Corridor C-bz	0	0	0	102.0	1.5	217.5	213.0	162.0
Product Corridor A	0	0	0	0	0	25.5	0	0
Product Corridor A-bz	0	0	0	0	90.0	336.0	0	124.5
Product Corridor B	0	0	0	0	0	58.5	0	0
Product Corridor B-bz	0	0	0	0	112.5	472.5	115.5	51.0
Alt. Shale Disposal Site	0	0	0	6.0	0	169.5	126.0	208.5
Alt. Shale Disposal Site-bz	0	0	0	117.0	129.0	760.5	202.5	66.0
Pipeline Corridor A	0	0	0	0	0	10.5	0	0
Pipeline Corridor A-bz	0	0	160.5	39.0	22.5	267.0	343.5	0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	RTHA-2	GOEI-1	GOEI-2	GOEA-1	GOEA-2	GOEA-3	KEST	ASPEN
Road Corridor B	0	60.0	204.0	0	0	64.5	42.0	12.0
Road Corridor B-bz	136.5	418.5	1483.5	0	115.5	402.0	81.0	186.0
Road Corridor C	90.0	0	0	0	0	0	0	51.0
Road Corridor C-bz	958.5	0	0	0	0	0	0	511.5
Product Pipeline A	67.5	0	0	0	0	0	0	27.0
Product Pipeline A-bz	798.0	0	0	0	0	0	0	544.5
Product Pipeline B	49.5	0	0	0	0	0	0	24.0
Product Pipeline B-bz	375.0	0	0	0	0	0	0	417.0
Alt. Shale Disposal Site	501.0	133.5	499.5	0	0	220.5	0	399.0
Alt. Shale Disposal Site-bz	969.0	241.5	1435.5	0	229.5	405.0	115.5	844.5
Pipeline Corridor A	0	0	15.0	0	0	0	0	0
Pipeline Corridor A-bz	4.5	45.0	313.5	0	0	27.0	0	54.0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued) Page 2d

Project Feature	Wildlife/Habitat Values					
	ASPEN-1	DFIR	DFIR-1	RIP	RIP-1	CLIFF
Road Corridor B	57.0	0	103.5	9.0	144.0	42.0
Road Corridor B-bz	625.5	90.0	594.0	165.0	1102.5	94.5
Road Corridor C	78.0	0	0	0	54.0	0
Road Corridor C-bz	985.5	0	0	85.5	696.0	0
Product Pipeline A	238.5	0	0	0	57.0	0
Product Pipeline A-bz	1651.5	0	0	37.5	744.0	0
Product Pipeline B	0	0	0	0	0	0
Product Pipeline B-bz	106.5	0	0	0	63.0	0
Alt. Shale Disposal Site	540.0	61.5	334.5	136.5	963.0	63.0
Alt. Shale Disposal Site-bz	1644.0	136.5	876.0	177.0	1600.5	159.0
Pipeline Corridor A	13.5	0	0	6.0	40.5	0
Pipeline Corridor A-bz	322.5	1.5	76.5	57.0	429.0	16.5

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	MDWR	MDWCA	MDCH	EKWR	EKWCA	EKCH	RAREPL	RAREP-1
Pipeline Corridor B	0	0	0	0	0	0	9.0	36.0
Pipeline Corridor B-bz	0	0	0	84.0	0	0	153.0	396.0
Alternate Product Pipeline	0	0	0	0	0	0	0	0
Alternate Product Pipeline-bz	0	0	0	0	0	201.0	0	0
Larkin Ditch Pond	0	0	0	0	0	0	0	0
Dry Fork Reservoir	1758.0	1758.0	1758.0	0	0	0	0	0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued) Page 3b

Project Feature	Wildlife/Habitat Values							
	SAGR	SAGR-1	SAGR-2	ACCI	COHA-1	COHA-2	RTHI	RTHA-1
Pipeline Corridor B	0	0	70.5	0	0	0	0	0
Pipeline Corridor B-bz	0	0	714.0	0	0	16.5	70.5	0
Alternate Product Pipeline	0	0	0	0	0	0	0	0
Alternate Product Pipeline-bz	0	0	0	0	0	0	0	30.0
Larkin Ditch Pond	0	0	0	0	0	0	0	0
Dry Fork Reservoir (GCC)	0	0	0	0	0	0	0	0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Continued)

Project Feature	Wildlife/Habitat Values							
	RTHA-2	GOEI-1	GOEI-2	GOEA-1	GOEA-2	GOEA-3	KEST	ASPEN
Pipeline Corridor B	0	0	10.5	0	0	0	0	0
Pipeline Corridor B-bz	0	9.0	385.5	0	0	112.5	0	10.5
Alternate Product Pipeline	21.0	0	0	0	0	0	0	147.0
Alternate Product Pipeline-bz	277.5	0	0	0	0	0	0	790.5
Larkin Ditch Pond	0	0	0	0	0	0	0	0
Dry Fork Reservoir (GCC)	0	0	0	0	0	0	0	0

Table C-2 PROJECT COMPONENT/WILDLIFE VALUE ACREAGE OF THE CITIES SERVICE SHALE OIL PROJECT (Concluded) Page 3d

Project Feature	Wildlife/Habitat Values					
	ASPEN-1	DFIR	DFIR-1	RIP	RIP-1	CLIFF
Pipeline Corridor B	0	0	0	1.5	18.0	0
Pipeline Corridor B-bz	115.5	0	24.0	40.5	304.5	13.5
Alternate Product Pipeline	517.5	0	0	52.5	459.0	0
Alternate Product Pipeline-bz	2580.0	0	0	343.5	2542.5	0
Larkin Ditch Pond	0	0	0	0	9.0	0
Dry Fork Reservoir (GCC)	0	0	0	138.0	981.0	0

Table C-3 ACRES OF DISTURBED AND POTENTIALLY DISTURBED WILDLIFE HABITATS ASSOCIATED WITH THE PROPOSED GETTY SHALE OIL PROJECT AND ALTERNATIVES

Wildlife/Habitat Feature	Proposed Action		/Alternative Shale Disposal Site		/West Fork Parachute Creek Reservoir	
	Disturbed	Potentially Disturbed	Disturbed	Potentially Disturbed	Disturbed	Potentially Disturbed
MDWR	105.0	127.5	106.5	306.0	105.0	127.5
MDWCA	105.0	0	105.0	0	105.0	0
MDCH	105.0	0	105.0	0	105.0	0
EKWR	730.5	4876.5	2293.5	7117.5	730.5	4876.5
EKWCA	376.5	2200.5	958.5	3220.5	376.5	2200.5
EKCH	394.5	2877.0	976.5	1384.5	394.5	2877.0
RAREPL	307.5	1854.0	1224.0	2304.0	307.5	1854.0
RAREP-1	691.5	4267.5	1867.5	6465.0	691.5	4267.5
SAGR	0	0	0	0	0	0
SAGR-1	0	0	0	0	0	0
SAGR-2	154.5	1705.5	655.5	3369.0	0	1705.5
ACCI	249.0	124.5	0	0	0	124.5
COHA-1	162.0	312.0	148.5	322.5	162.0	378.0
COHA-2	963.0	2799.0	624.0	2934.0	990.0	3135.0
RTHI	205.5	577.5	124.5	454.5	205.5	577.5
RTHA-1	186.0	432.0	181.5	315.0	186.0	444.0
RTHA-2	1122.0	3703.5	595.5	3453.0	1128.0	3970.5
GOEI-1	82.5	507.0	354.0	808.5	82.5	507.0
GOEI-2	265.5	2467.5	1215.0	3790.5	265.5	2467.5
GOEA-1	0	0	0	0	0	0
GOEA-2	0	0	0	0	0	0
GOEA-3	0	0	0	7.5	0	0
KEST	0	0	0	0	0	0
ASPEN	24.0	448.5	24.0	430.5	84.0	726.0
ASPEN-1	106.5	1635.0	106.5	1491.0	433.5	2883.0
DFIR	0	0	0	0	0	0
DFIR-1	0	0	0	0	0	0
RIP	1.5	31.5	1.5	31.5	102.0	97.5
RIP-1	117.0	585.0	117.0	582.0	472.5	1509.0
CLIFF	0	0	0	0	0	0
Project Area	4081.88	16,480.5	3441.38	17,737.5	4540.0	18,459.0

Table C-4 ACRES OF DISTURBED AND POTENTIALLY DISTURBED WILDLIFE HABITATS ASSOCIATED WITH THE PROPOSED CITIES SERVICE SHALE OIL PROJECT AND ALTERNATIVES

Wildlife/Habitat Feature	Proposed Action		/Alternative Shale Disposal Site		/Alternative Product Pipeline	
	Disturbed	Potentially Disturbed	Disturbed	Potentially Disturbed	Disturbed	Potentially Disturbed
MDWR	348.0	3225.0	342.0	3084.0	348.0	3225.0
MDWCA	246.0	2314.5	246.0	2314.5	246.0	2314.5
MDCH	225.0	2067.0	225.0	2067.0	225.0	2067.0
EKWR	1182.0	5302.5	918.0	4759.5	1182.0	5302.5
EKWCA	0	0	0	0	0	0
EKCH	18.0	646.5	18.0	646.5	0	445.5
RARE PL	348.0	2403.0	394.5	2221.5	348.0	2403.0
RAREP-1	637.5	5226.0	651.0	5164.5	637.5	5226.0
SAGR	0	0	0	0	0	0
SAGR-1	0	0	0	0	0	0
SAGR-2	396.0	4086.0	396.0	3978.0	396.0	4086.0
ACCI	78.0	387.0	84.0	504.0	78.0	387.0
COHA-1	4.5	564.0	4.5	664.5	4.5	301.5
COHA-2	406.5	3345.0	555.0	3790.5	322.5	2536.5
RTHI	345.0	1696.5	442.5	1806.0	345.0	1581.0
RTHA-1	33.0	678.0	241.5	744.0	33.0	532.5
RTHA-2	489.0	3810.0	990.0	4779.0	393.0	2914.5
GOEI-1	222.0	1233.0	228.0	1081.5	222.0	1233.0
GOEI-2	891.0	5281.5	792.0	5353.5	891.0	5281.5
GOEA-1	1.5	235.5	1.5	123.0	1.5	235.5
GOEA-2	310.5	1129.5	93.0	991.5	310.5	1129.5
GOEA-3	495.0	2371.5	360.0	2161.5	495.0	2371.5
KEST	82.5	271.5	42.0	304.5	82.5	271.5
ASPEN	205.5	2550.0	604.5	3375.0	301.5	2379.0
ASPEN-1	1015.5	7170.0	1555.5	8634.0	1188.0	6931.5
DFIR	19.5	463.5	69.0	385.5	19.5	463.5
DFIR-1	597.0	3079.5	555.0	2763.0	597.0	3079.5
RIP	190.5	807.0	234.0	933.0	243.0	1092.0
RIP-1	1518.0	7699.5	1929.0	8650.5	1857.0	9096.0
CLIFF	51.0	667.5	108.0	576.0	57.0	667.5
Project Area	3070.5	23,547.0	3799.5	24,999.0	3336.4	22,551.0

Table C-5 WILDLIFE/HABITAT INDEX VALUES OF THE GETTY SHALE OIL PROJECT[a]

Project Feature	Big Game (10)[b]	Rare Plants (20)	Sage Grouse (5)	Raptors (10)	Sensitive Habitats (10)	Index Values	Adjusted Index Values[c]
Mine Bench and Plant Site (10)[b]	472.5	1,642.5	0	382.5	0	27.10	5.27
Mine Bench and Plant Site-bz (5)	4,042.5	7,680.0	43.5	5,542.5	0	113.63	64.91
Additional Retort Site (10)	0	0	0	0	0	0	0.00
Additional Retort Site-bz (5)	0	0	0	375.0	490.5	2.37	2.37
Tom Creek Reservoir (10)	4,350.0	847.5	0	307.5	0	35.89	24.62
De Beque Silt Pond (10)	1,387.5	0	0	0	69.0	8.32	8.32
Roan Creek Re-reg Reservoir (10)	1,125.0	0	45.0	0	0	10.27	10.27
Proposed Shale Disposal Site (10)	0	0	0	13,440.0	0	99.56	99.56
Proposed Shale Disposal Site-bz (5)	300.0	277.5	0	11,302.0	327.0	29.46	27.70
Buck Gulch Corridor (5)	2,302.5	945.0	24.0	870.0	0	16.61	10.33
Buck Gulch Corridor-bz (1)	24,802.5	10,050.0	616.5	6277.0	0	20.24	7.49
Road Corridor A (10)	2,580.0	2,542.5	85.5	2,257.5	0	72.31	38.51
Road Corridor A-bz (5)	19,192.5	15,607.5	829.5	15,862.5	0	156.86	57.86
Road Corridor B (10)	1,477.5	555.0	0	142.5	0	16.02	8.64
Road Corridor B-bz (5)	20,947.5	5,257.5	216.0	3,712.5	0	91.91	58.56
Road Corridor C (10)	0	0	0	1,140.0	0	8.44	8.44
Road Corridor C-bz (5)	45.0	1,005.0	0	6,847.5	0	22.46	16.09
Product Corridor A (5)	0	0	0	495.0	0	1.83	1.83
Product Corridor A-bz (1)	0	0	0	5,122.5	448.5	2.67	2.67
Product Corridor B (5)	180.0	0	0	540.0	409.5	6.00	6.00
Product Corridor B-bz (1)	6,465.0	0	0	6,450.0	5,949.0	7.54	7.54
Alternate Shale Disposal Site (10)	19,462.5	15,045.0	501.0	13,500.0	0	450.0	250.00
Alternate Shale Disposal Site-bz (5)	32,497.5	15,765.0	1,663.5	17,437.5	0	178.16	78.16
West Fork Parachute Creek (10)	0	0	0	0	1,039.5	17.96	17.96
Pipeline Corridor W. Fk. Parachute (5)	0	0	0	165.0	1,248.0	11.39	11.39
Pipeline Corridor W. Fk. Parachute-bz (1)	0	0	0	3,795.0	5,607.0	5.19	5.19
Upper Roan Creek Corridor (10)[d]	23,775.0	120.0	555.0	138.0	49.5	181.02	179.42
Upper Roan Creek Corridor-bz (5)[d]	179,287.5	3,300.0	4,687.5	4,146.0	2,514.0	225.47	204.54
Lower Roan Creek Corridor (10)[d]	43,035.0	0	0	0	2,586.0	265.79	265.79

Table C-5 WILDLIFE/HABITAT INDEX VALUES OF THE GETTY SHALE OIL PROJECT[a] (continued)

Project Feature	Big Game (10)[a]	Rare Plants (20)	Sage Grouse (5)	Raptors (10)	Sensitive Habitats (10)	Index Values	Adjusted Index Values[b]
Lower Roan Creek Corridor (5)[d]	147,832.0	0	18.0	0	4,911.0	118.22	118.22
Dry Fork Reservoir (10)[d]	43,950.0	0	0	0	2,361.0	266.61	266.61

[a] The wildlife/habitat index values in this table were generated for the DEIS, represent a worst case analysis, and are intended for comparative purposes only. Wildlife impacts associated with the Getty Oil Shale Project will be significantly reduced as a result of the Operator's committed mitigation. See Section 2.3.1.2.5 for a list of committed mitigation measures specific to wildlife.
[b] Numbers in parentheses depict weighting factors.
[c] Without rare plant index values.
[d] Previously analyzed in the CCSOP EIS (BLM) 1983.

TOTAL INDEX VALUES:

	With Rare Plants	Without Rare Plants
Proposed Action		
Disturbed Lands	302.35	221.79
Potentially Disturbed Lands	447.14	245.19
/Alternate Shale Disposal Alternative		
Disturbed Lands	652.79	372.23
Potentially Disturbed Lands	595.84	295.65
West Fork Parachute Creek Reservoir Alternative		
Disturbed Lands	331.7	221.79
Potentially Disturbed Lands	452.33	245.19

Table C-6 WILDLIFE/HABITAT INDEX VALUES OF THE CITIES SERVICE SHALE OIL PROJECT[a]

Project Feature	Big Game (10)[b]	Rare Plants (20)	Sage Grouse (5)	Raptors (10)	Sensitive Habitats (10)	Index Values	Adjusted Index Values[c]
Cities Mine Bench (10)[b]	0	45.0	0	45.0	30.0	1.45	0.85
Cities Mine Bench (5)	135.0	5,542.5	0	5,595.0	2,518.5	56.02	20.86
Retort and Plant Site (10)	0	0	0	2,040.0	270.0	19.78	19.78
Retort and Plant Site-bz (5)	0	982.5	0	7,447.5	4,443.0	37.19	30.96
Shale Fines Site (10)	0	135.0	0	2,032.5	2,113.5	51.75	49.96
Shale Fines Site-bz (5)	97.5	2,340.0	166.5	7,464.0	3,838.5	45.53	30.69
Proposed Shale Disposal Site (10)	3,840.0	2,782.5	0	7,045.5	2,038.5	144.12	107.13
Proposed Shale Disposal Site-bz (5)	9,067.5	12,457.5	108.0	18,487.5	7,377.0	152.04	73.02
Waste Rock Pile (10)	0	0	0	472.5	132.0	5.78	5.78
Waste Rock Pile-bz (5)	0	0	0	6,238.5	3,897.0	26.46	26.48
Road Corridor A (10)	7,815.0	547.5	325.5	1,650.0	537.0	101.42	94.14
Road Corridor A-bz (5)	71,662.5	7,567.5	2,847.0	16,987.5	7,980.0	187.07	139.07
Road Corridor B (10)	705.0	2,377.5	0	2,509.5	934.5	69.96	38.35
Road Corridor B-bz	4,350.0	13,455.0	90.0	20,922.0	7,677.0	161.54	76.19
Road Corridor C (10)	0	0	0	667.5	642.0	16.04	16.04
Road Corridor C-bz (5)	0	0	0	9,600.0	7,651.5	45.75	45.75
Product Pipeline A 95)	0	0	0	465.0	565.5	6.61	6.61
Product Pipeline A-bz (1)	0	0	0	7,815.0	8,215.5	8.65	8.65
Product Pipeline B (5)	180.0	0	0	540.0	409.5	6.00	6.00
Product Pipeline B-bz (1)	6,465.0	0	0	6,450.0	5,949.0	7.54	7.54
Pipeline Corridor A (5)	0	510.0	0	127.5	114.0	4.85	1.46
Pipeline corridor A-bz (1)	720.0	4305.0	160.5	5,734.5	2,118.0	9.82	4.36
Pipeline Corridor B (5)	0	270.0	70.5	10.5	33.0	5.64	3.85
Pipeline Corridor B-bz (1)	420.0	3,510.0	714.0	2,565.0	1,089.0	7.63	3.18
Alternate Product Pipeline (5)	0	0	0	105.0	2,971.5	26.06	26.06
Alternate Product Pipeline-bz (1)	2,010.0	0	0	1,687.5	16,462.5	11.07	11.07
Alternate Shale Disposal Site 1 (10)	0	300.0	0	6,105.0	5,788.5	149.21	145.22
Alternate Shale Disposal Site 1-bz (5)	0	3,540.0	0	12,532.5	11,371.5	86.37	63.92
Alternate Shale Disposal Site-2 (10)	2,490.0	3,015.0	0	4,075.5	2,649.0	128.83	88.75
Alternate Shale Disposal Site-2-bz (5)	5,647.5	6,795.0	0	12,540.0	5,919.0	94.42	51.32
Lower Roan Creek Corridor (10)[d]	43,035.0	0	0	0	2,586.0	265.79	265.79

Table C-6 WILDLIFE/HABITAT INDEX VALUES OF THE CITIES SERVICE SHALE OIL PROJECT[a] (Continued)

Project Feature	Big Game (10)[b]	Rare Plants (20)	Sage Grouse (5)	Raptors (10)	Sensitive Habitats (10)	Index Values	Adjusted Index Values[c]
Lower Roan Creek Corridor-bz (5)[d]	147,832.0	0	18.0	0	4,911.0	118.22	118.22
Dry Fork Reservoir (10)[c]	43950.0	0	0	0	2361.0	266.61	266.61
Larkin Ditch	--	--	--	--	--	0.16	0.16

a The wildlife/habitat index values in this table were generated for the DEIS, represent a worst case analysis, and are intended for comparative purposes only. Wildlife impacts associated with the Cities Service Shale Oil Project will be significantly reduced as a result of the Operator's committed mitigation. See Section 2.3.2.2.5 for a list of committed mitigation measures specific to wildlife.
b Numbers in parentheses depict weighting factors.
c Without rare plant index values.
d Previously analyzed in the CCSOP EIS (BLM) 1983.

TOTAL INDEX VALUES:

	With Rare Plants	Without Rare Plants
Proposed Action		
Disturbed Lands	433.4	350.11
Potentially Disturbed Lands	745.24	466.73
/Alternate Shale Disposal Alternative		
Disturbed Lands	567.32	480.18
Potentially Disturbed Lands	773.99	392.17
/Alternative Product Pipeline Alternative		
Disturbed Lands	446.85	350.11
Potentially Disturbed Lands	740.12	466.73

APPENDIX D

BIOLOGICAL OPINIONS

D-1 Final Terrestrial Opinion - Getty/Cities Service Projects, February 13, 1984

D-2 Final Terrestrial Opinion - GCC/CCSOP Projects, March 7, 1984

D-3 Final Aquatic Opinion - GCC/CCSOP/Getty/Cities Service Projects, August 24, 1984

Note: Full texts of the above opinions are on file in Corps, USFWS, and BLM offices.

APPENDIX D-1

EXCERPT FROM

FINAL TERRESTRIAL OPINION

GETTY/CITIES SERVICE PROJECTS

FEBRUARY 13, 1984

BIOLOGICAL OPINION

The Getty and Cities oil shale projects as described below, with the implementation of conservation measures designed to aid in the survival and recovery of the peregrine falcon (Falco peregrinus anatum), black-footed ferret (Mustela nigripes) and Uintah Basin hookless cactus (Sclerocactus glaucus), is not likely to jeopardize the continued existence of these three species.

Conservation Measures

The Corps will insure that the Getty and Cities projects, as described above, will comply with the following conservation measures designed to protect and insure the continued survival and recovery of federally listed species.

Peregrine falcon - In an attempt to re-establish nesting peregrine falcons in the area, it is suggested that the two oil companies, Getty and Cities, consider participting in a peregrine falcon hacking effort in the future. This hacking effort should take place in the Roan cliffs area and at a point in time when these cliffs are considered the logical next location for hack-sites in Colorado. The determination for the need for such an effort as well as details such as specific hack-sites will be made jointly between the Colorado Division of Wildlife (CDOW) and the Peregrine Falcon Recovery Team, and will be coordinated with The Peregrine Fund. It is felt that it will be a number of years before hacking efforts in this area will be an appropriate priority item for falcon recovery efforts in Colorado.

Uintah Basin hookless cactus - Presently, negotiations are underway for conservation measures for those individuals of the species that will be impacted by either the GCC Water System or the Roan valley transportation corridors identified in association with the GCC Water System. Additional survey efforts planned for the DeBeque area may reveal other, previously unknown populations of the species. Also, off-site transportation corridors specifically delineated at some future planning stage should be inventoried for the cactus. Should other populations or individuals be found and it is shown that these plants will be adversely impacted by future development of the Getty or Cities projects, FWS will require that Section 7 Interagency Consultation be initiated.

Black-footed ferret - All prairie dog towns which will be effected by features of the Getty and Cities oil shale projects should be inventoried (at an appropriate time in the future prior to disturbances) for black-footed ferrets using the latest inventory procedures which are now being developed by the FWS. If black-footed ferrets are discovered, it will be necessary for the Corps to reinitiate interagency Section 7 Consultations. If black-footed ferrets are discovered as a result of surveys triggered by federal applications, such as a BLM Right of Way, Land Trade or Exchange or other proposed federal actions, the lead agency shall initiate Section 7 Consultation.

APPENDIX D-2

EXCERPT FROM
FINAL TERRESTRIAL OPINION
GCC/CCSOP PROJECTS

MARCH 7, 1984

BIOLOGICAL OPINION

The Chevron Clear Creek Shale Oil Project (CCSOP) and GCC Water System (GCC) as described below are not likely to jeopardize the continued existence of the peregrine falcon (Falco peregrinus anatum), black-footed ferret (Mustela nigripes) and Uinta Basin hookless cactus (Sclerocactus glaucus). Conservation measures designed to aid in the survival and recovery of these three species have been agreed to by GCC/CCSOP and BLM and should be implemented to satisfy the responsibilities of BLM and the project sponsors concerning the ESA.

Conservation Measures

The BLM has agreed to insure that the CCSOP and GCC Water System projects, as described above, will comply with the following conservation measures designed to protect and insure the continued survival and recovery of federally-listed species. By complying with these conservation measures, BLM and the GCC/CCSOP project sponsors satisfies its responsibilities for these three terrestrial species.

Peregrine falcon - In an attempt to re-establish nesting peregrine falcons in the area, it is suggested that the CCSOP project sponsors consider participating in a peregrine falcon hacking effort at an appropriate time in the future. Getty and Cities have already agreed to consider such an effort in the Final Getty-Cities Terrestrial Biological Opinion (FWS file number 6-5-84-0002). This hacking effort should take place in the Roan Cliffs area at a site that is not only compatible with future project development but also is the next logical location for hack-sites in Colorado. The determination for the need for such an effort, as well as details such as specific hack-sites, will be made jointly between the Colorado Division of Wildlife (CDOW) and the Peregrine Falcon Recovery Team and will be coordinated with The Peregrine Fund. It is felt that it will be a number of years before hacking efforts in this area will be an appropriate priority item for falcon recovery efforts in Colorado. It is clearly understood that future hack activities in this area should not encumber future development of identified

Black-footed ferret - All prairie dog towns which will be affected by features of the CCSOP and GCC Water System projects should be inventoried for black-footed ferrets using the latest inventory procedures which are now being developed by the FWS.

These surveys must be done within one year of the actual distribution of a prairie dog town. The need for additional surveys could be triggered by future federal actions. An "effect" on prairie dog communities is defined as any activity that physically disturbs occupied habitat. If black-footed ferrets are discovered, it will be necessary for the lead agency to initiate Interagency Section 7 Consultation.

Uinta Basin hookless cactus - Conservation measures for Sclerocactus glaucus consist of four major approaches: (1) A two year, committed scientific study of the species for purposes of finding out more about micro-habitat requirements and reproductive characteristics; (2) a commitment by BLM to survey all public lands in the greater DeBeque area that are identified as likely habitat for the occurrence of the species; (3) a commitment by BLM to consider special status designation for areas where important population centers have been identified, or are found as a result of the survey efforts mentioned in (2) above; and (4) commitments by the GCC to consider protection measures for those individuals and populations of Sclerocactus glaucus that are now known to exist on GCC property and are unaffected by identified project features, including construction and operation. A brief expansion of these four categories of conservation measures is given below:

(1) A study proposal entitled "An Ecological Study of Sclerocactus glaucus in Roan Creek Valley, with Emphasis on Methods to Maintain Genetic Viability" is attached to this opinion. This proposal was reviewed by FWS, BLM and the project proponents, and was deemed acceptable to all in terms of addressing needed areas of research for the species. The GCC participants have agreed to fund this study, with a contract to be signed at such time as final federal approvals are given for issuance of the Corps Section 404 dredge and fill permit for the GCC Water System. Funding of the attached study concludes GCC obligations for those Sclerocactus glaucus individuals now identified as being impacted by development and operation of the water system. Study results will be reported to FWS and BLM, with the GCC participants remaining in an advisory capacity only. Federal collection permits will be required for certain study activities (such as the collection of seed), and application for such permits should be made 120 days prior to any collection activities.

(2) BLM has agreed to conduct additional surveys in the greater DeBeque area for new population centers of Sclerocactus glaucus. Such surveys will take place on all BLM lands in the DeBeque area that are considered potential habitat for the species. The intensity of survey efforts each year will vary according to funding levels appropriated by Congress. CCSOP or GCC permits will not be conditioned upon BLM conducting or completing the above surveys.

The greater DeBeque area to be surveyed by BLM is defined as those BLM lands that are identified as suitable habitat for Sclerocactus glaucus, and that fall within the following boundaries:

North boundary: From Roan Creek Valley to the base of the Shale Cliffs.

South boundary: From Plateau Creek near Molina, Colorado, west to the confluence of Plateau Creek and the Colorado River.

East boundary: From Plateau Creek near Molina, Colorado, along the Sunnyside Road to DeBeque, Colorado, including three miles east of DeBeque along the Colorado River.

West boundary: From the confluence of Plateau Creek and the Colorado River north to South Shale Ridge and Coon Hollow.

(3) BLM has agreed to consider, through their planning processes, special status designation for all areas on their lands near DeBeque where Sclerocactus glaucus occurs, including all unknown populations at this time which may be discovered through survey efforts outlined in (2) above. Other areas, such as the 480 acre Pyramid Rock area, have already been included in BLM's resource management planning process. Pyramid Rock is suggested in one alternative to be designated as an Area of Critical Environmental Concern (ACEC). It is thought that special status designation for additional areas will afford a greater degree of protection for the species.

(4) The GCC have agreed to provide protection for those Sclerocactus glaucus plants that remain on GCC committed properties and are unaffected by construction and operation of identified project features. Suggestions for protection measures will be a part of the report on ecological studies. FWS and BLM may make additional suggestions for protection measures.

Removal of Sclerocactus glaucus

It is anticipated that full development of the GCC Water System will result in the direct loss of some Sclerocactus glaucus plants. It is possible, however, that individuals to be directly impacted may be salvaged for scientific or horticultural uses.

For purposes of accounting and directing the disposition of those individuals that may otherwise be destroyed as a result of project construction or operation, the following terms and conditions apply:

1. The number of Sclerocactus glaucus individuals to be removed shall not exceed 325. No specimens will be removed that will not be otherwise destroyed by project activities.

2. The FWS shall be contacted at least one year prior to the time that removal occurs.

3. Specific reasonable procedures for handling and disposal of specimens will be defined by FWS prior to removal actions.

4. BLM shall document and report to FWS the disposition of those individuals involved in removal actions.

APPENDIX D-3

EXCERPT FROM

FINAL AQUATIC OPINION

GCC/CCSOP/GETTY/CITIES SERVICE PROJECTS

AUGUST 24, 1984

BIOLOGICAL OPINION

The water withdrawals and subsequent depletions from the Three Projects described in this opinion, with the inclusion of conservation measures designed to aid in the conservation of the Colorado squawfish (Ptychocheilus lucius), humpback chub (Gila cypha) and bonytail chub (Gila elegans), are not likely to jeopardize the continued existence of these three federally-listed fishes.

CONSERVATION MEASURES

The sponsors of the Three Projects have agreed to carry out the following conservation measures designed to protect and ensure the continued survival and recovery of federally-listed species. This biological opinion finds that, in order to avoid the likelihood of jeopardy for these federally-endangered fishes, certain conservation actions should occur. FWS requests that the Army Corps of Engineers (Corps) develop stipulations so that your federal approvals will be appropriately conditioned to ensure that conservation measures are carried out. Since this opinion involves future actions by three separate entities with both joint and separate facilities, such stipulations or permit conditions should be designed to be enforceable (if needed) against any single company or group of companies that may fail to carry out the conservation measures. Conservation measures agreed to by the project proponents will be both general (contributing to offsetting adverse effects on the species basin-wide) and specific (measures designed to offset primary impacts in the 15-mile reach of immediate concern). By complying with these conservation measures, the Corps and project sponsors satisfy their responsibilities for these federally-listed species.

General conservation measures are designed to offset the adverse impacts of water depletion from the Colorado River, and contribute to the conservation of the Colorado squawfish, humpback chub, and bonytail chub in the upper Colorado River basin above Lake Powell. FWS believes that the fact that water is depleted from the rivers reduces the flexibility of the system to withstand additional water losses without detrimental impacts to essential areas. Creation of habitats favorable to introduced species is an example of how changes in flow regimen may shift the balance from habitats favorable to rare endemic fishes to habitat conditions that may favor introduced fishes.

The FWS has determined, as a result of intensive research and inventory of the endemic Colorado River fishes, that the Colorado squawfish, humpback chub, and bonytail chub are diminishing in their native habitat and may become extinct unless active conservation measures are taken to enhance current habitat and population numbers.

FWS believes that major causes for the decline of the Colorado squawfish, humpback chub and bonytail chub include the effect of impoundments on and water depletion from the Colorado River and its tributaries. Using information presently available, the FWS believes that additional depletions of water may contribute to the extinction of these fishes unless offset by active conservation measures to provide for the continued existence of these species in their native habitats. Based on current knowledge, FWS believes that it is possible legally and physically to deplete an additional 1.675 million acre-feet/year (maf) in the Green and upper Colorado River sub-basins. FWS believes that for population levels of listed fishes to be maintained with such additional depletions, it is essential to implement conservation measures.

Funding levels for conservation measures to be funded by any particular project are based upon the amount of water that the project would, on the average, annually deplete from the upper Colorado River system in proportion to the 1.675 maf available for development. It has been estimated by the Bureau of Reclamation that a total of 1.906 maf remains available for development in the upper basin under the Colorado River Compact. Of this amount, 231,000 af are allocated to Arizona and New Mexico and will eventually be diverted from the San Juan River and would not affect areas currently occupied by the endangered fishes in the Colorado and Green River sub-basins. This leaves 1.675 maf in a portion of the upper Colorado River basin as the value against which project depletions are assessed in calculating a project's proportion of the conservation measure costs.

The effects of depletions that bring present day flows down to lower levels are to be offset by project sponsors funding these measures which are outlined in active research and management plans. FWS has identified certain conservation measures that are currently considered necessary. These measures include but are not limited to monitoring known populations and attempting to locate new areas containing the fish; further analyzing the potential effects of water depletions and associated flow regimen modifications; locating existing and potential spawning and YOY rearing areas; researching and constructing various fish passage and habitat restoration features; and producing the fish in a hatchery facility for research and restocking of individuals in existing and historical habitat.

Since such measures will develop critically important data on the needs of the fish, funding of these activities by project sponsors is considered a reasonable conservation measure designed to compensate for the adverse effects of water depletion. Under a procedure developed by the FWS, upper basin project sponsors are assessed a proportion of the total cost needed to support these conservation measures, currently estimated at 25 million dollars.

Project proponents will provide funding in the near future for a conservation measure to offset adverse impacts due to upstream depletions of the Three Projects in the 15-mile reach of the Colorado River currently occupied by Colorado squawfish. This conservation measure is to participate in funding of a fish passage structure at the Redland's Water and Power Company diversion (located at RM 3 of the Gunnison River) with the consent and cooperation of the Redland's company. FWS believes that successful squawfish passage upstream and downstream of this barrier could restore over 40 miles of the Gunnison River to viable use by Colorado squawfish. It is believed that this action would offset the potential loss due to partial dewatering from RM 170 to RM 185 on the upper Colorado River.

Conservation measures will be carried out to offset other specific impacts. As noted in this opinion, the Clear Creek Shale Oil Project plans a water system which includes an intake structure on the mainstem Colorado River near Loma, Colorado. This intake will be located within currently occupied habitat of the Colorado squawfish, and all life stages are known to occur near the proposed intake site. In order to minimize possible direct impacts to Colorado squawfish due to operation of the intake, CCSOP project proponents have agreed to construct the intake using a passive screen design that greatly reduces the possibility of impingement or entrainment of fishes in all life stages.

Based upon the water use projection that is being evaluated in this consultation, 73,042 af/yr for the Three Projects, the cost of the conservation measures funded by the project proponents that offset total impacts will not exceed $1,090,517. This dollar amount, when applied to funding of conservation measures identified in this biological opinion will offset all of the impacts of the depletions of water analysed in this opinion on the Colorado squawfish, humpback chub, and bonytail chub. The FWS has been notified in writing that the project proponents for the Three Projects agree to fund conservation measures in this total amount.

Should there be any increases in the amount of water depletion or any other project change from that which was evaluated in this opinion which may adversely impact any endangered or threatened species, or if there is failure to commit and carry out the Conservation Measures outlined above, then the FWS should be contacted to determine if further consultation is required. Significant changes in the project may require reinitiation of consultation under the Endangered Species Act.

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Form 1279—3
(June 1984)

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