COLORADO RIVER BASIN

SALINITY CONTROL PROJECT

Paradox Valley Unit

FINAL

ENVIRONMENTAL STATEMENT

UNITED STATES
DEPARTMENT OF THE INTERIOR
Cecil D. Andrus, Secretary

BUREAU OF RECLAMATION
R. Keith Higginson, Commissioner

DEPARTMENT OF THE INTERIOR
(INT FES 79-14)

FINAL
ENVIRONMENTAL STATEMENT

Authorized

PARADOX VALLEY UNIT,
COLORADO RIVER BASIN SALINITY CONTROL PROJECT

Prepared by

Upper Colorado Regional Office, Salt Lake City, Utah
Bureau of Reclamation
Department of the Interior

R. Keith Higginson
Commissioner

SUMMARY

( ) Draft (X) Final Environmental Statement

Department of the Interior, Bureau of Reclamation, Upper Colorado Region

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

2. Description of the proposal: The Paradox Valley Unit of the Colorado River Basin Salinity Control Project would be located in Montrose and San Miguel Counties in southwestern Colorado. The unit would involve pumping brine ground water from a series of wells along the Dolores River in Paradox Valley, thus reducing the influx of salt to the river by an estimated 180,000 tons annually below the present level of 205,000 tons. The brine would be piped to a nearby hydrogen sulfide stripping plant for the removal of toxic hydrogen sulfide gas, then piped to Radium Evaporation Pond in Dry Creek Basin, located about 20 miles southwest of the well field. Land would be acquired and developed as a wildlife area around the pond to compensate for losses caused by the inundation of habitat. A 6-year construction period would be required.

3. Summary of environmental impacts and unavoidable adverse effects: By reducing the salinity of Colorado River water, the unit would have beneficial economic impacts of about $4,186,000 annually for water users in the Lower Colorado River Basin. In the local unit area, construction would place temporary strains on community facilities and services, but no long-term impacts would result. Two ranchers who own grazing land and have grazing permits on public land at the evaporation pond would be adversely affected, one quite severely, by the necessary acquisition and withdrawals if suitable replacement lands were not available.

   The unit would reduce the average annual flows of the lower Dolores and Colorado Rivers by about 3,950 acre-feet. The salinity of the Colorado River at Imperial Dam would be decreased by a net value of 18.2 mg/l, resulting from a decrease of 18.6 mg/l because of salt removal and an increase of 0.4 mg/l because of stream depletion.

   The existing warm water fishery in the Dolores River would be enhanced significantly for the first 7 miles below the well field and enhanced slightly for an additional 63 miles to the confluence with the Colorado River. A slight enhancement would also occur in the Colorado River downstream from the confluence. Wildlife habitat would be permanently reduced by 3,630 acres from inundation at the pond and by 28 acres from the construction of other unit structures. These losses would be largely compensated for by the acquisition and development of 3,660 acres for a wildlife area and the revegetation of about 218 acres temporarily disturbed during construction. In addition it is estimated that about 60 acres of riparian habitat along about 7 miles of the Dolores River downstream from the well field would be slowly improved because of the reduction of salts in the river water.

   Two archaeological sites would be inundated by the evaporation pond. Prior to inundation, a program to collect information would be conducted.

4. Alternatives considered:
   1. One alternative evaporation pond site.
   2. A lined bypass channel for the Dolores River, with an evaporation pond adjacent to the channel.
   3. Nondevelopment.
   4. Five plans for smaller scales of development.

5. List of entities from whom comments have been requested or received: See list on next page.

6. Date made available to E.P.A. and the public:
   Draft statement: May 11, 1978
   Final statement: MAR 29 1979

DISTRIBUTION LIST FOR FINAL ENVIRONMENTAL STATEMENT
PARADOX VALLEY UNIT

This list includes all Federal, State, and local agencies and private entities that received copies of the draft environmental statement, with those who responded in writing or who testified at the public hearing indicated by "*." Only those who responded or who testified will automatically receive this Final Environmental Statement.

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*Advisory Council on Historic Preservation, Washington, D.C.
*Department of Agriculture, Washington, D.C.
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Department of Energy, Lakewood, Colo.
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    Land Use Commission
    Water Conservation Board
    State Historical Society
    State Archaeologist
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    Department of Health
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    Department of Natural Resources
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    Division of Wildlife
    Soil Conservation Board
    Department of Education
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    Division of Employment and Training
    Division of Commerce and Development
    State Forest Service
    Public Utilities Commission
*Planning Department, Montrose County, Montrose, Colo.
Planning Department, San Miguel County, Telluride, Colo.
Town Hall, Norwood, Colo.
*Town Clerk, Nucla, Colo.
*Town Clerk, Naturita, Colo.
Superintendent, West End School District, Naturita, Colo.
*Union Carbide Corporation, Uravan and Grand Junction, Colo.
*Upper Colorado River Commission, Salt Lake City, Utah
*Colorado River Board of California, Los Angeles, Calif.
Southwestern Water Conservation District, Durango, Colo.
*San Miguel Water Conservancy District, Norwood, Colo.
*State of Utah, Division of Health, Environmental Health Services
  Branch, Salt Lake City, Utah
Sierra Club, Rocky Mountain Chapter, Denver, Colo.
Sierra Club, National Water Resources Commission, Santa Fe, N. Mex.
Rocky Mountain Center on the Environment, Denver, Colo.
Colorado Open Space Council, Denver, Colo.
*Colorado River Water Conservation District, Glenwood Springs, Colo.
National Audubon Society, Rocky Mountain Chapter, Boulder, Colo.
National Wildlife Federation, Region X Director, Fort Collins, Colo.

Trout Unlimited, Denver, Colo.
Colorado Mountain Club, Denver, Colo.
Colorado Wildlife Federation, Inc., Boulder, Colo.
Izaak Walton League of America, Inc., Colorado Division, Westminister, Colo.
The Nature Conservancy, Colorado Chapter, Denver, Colo.
The Wilderness Society, Denver, Colo.
Colorado Field Ornithologists, Boulder, Colo.
Defenders of Wildlife, Rock Springs, Wyo.
Colorado Water Congress, Denver, Colo.
Club 20, Grand Junction, Colo.
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*Marshall Hughes, Norwood, Colo.
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J. L. Matthews, Tulsa, Okla.

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CHAPTER A

DESCRIPTION OF THE PROPOSAL

A. DESCRIPTION OF THE PROPOSAL

1. Introduction

This statement has been prepared on the environmental aspects of the Paradox Valley Unit of the Colorado River Basin Salinity Control Project, which would be located in Montrose and San Miguel Counties in southwestern Colorado. The unit is planned to reduce the inflow of brine springs to the Dolores River in Paradox Valley, which has been identified as one of the major natural sources of salinity in the Colorado River Basin, and thereby improve the quality of Colorado River water for use in the lower basin States and the Republic of Mexico.

The unit was authorized for construction by the Colorado River Basin Salinity Control Act of 1974 (Public Law 93-320) as part of a basinwide program for the enhancement and protection of the quality of water available in the Colorado River for use in the United States and Republic of Mexico. This program would help to control salinity levels in the Colorado River while the Colorado River Basin States continue to develop and use their apportioned shares of water from the river and its tributaries. Title I of the Act authorized the construction of a desalting complex and associated measures to control the salinity of water available below Imperial Dam. Title II authorized the construction of the Paradox Valley Unit and three other units above Imperial Dam as the initial stage of the Colorado River Basin Salinity Control Project. It also directed that planning reports be expedited on 12 additional units above Imperial Dam. A thirteenth unit has been added for study since the passage of the Act.

Preliminary information and cumulative impacts for Paradox Valley and the other 16 units in Title II have been presented in a final environmental statement on the Colorado River Water Quality Improvement Program (FES 77-15). The statement was prepared by the Bureau of Reclamation of the Department of the Interior and the Soil Conservation Service of the Department of Agriculture. A final environmental statement, Colorado River Basin Salinity Control Project, Title I (INT FES 75-57), has been prepared by the Bureau of Reclamation on the desalinization plant and associated measures.

2. Plan of Development

The Paradox Valley Unit would be constructed along the Dolores River, which crosses the valley near its midpoint perpendicular to the valley's axis, and in Dry Creek Basin, which is approximately 20 miles southeast (see the General Map). Under unit operations, brine ground water presently seeping in along the banks and bottom of the Dolores

River in Paradox Valley would be pumped from wells along the river and conveyed by a pipeline to a stripping plant, where it would be treated for the removal of toxic and highly corrosive hydrogen sulfide gas. The brine would then be pumped in a pipeline to the crest of the divide separating Paradox Valley and Dry Creek Basin and then conveyed by gravity flow to Radium Evaporation Pond for disposal (See Figure A-1).

As a result of the development, salts entering the Dolores River and subsequently the Colorado River from Paradox Valley would be reduced by about 180,000 tons a year, or about 88 percent of the present average annual inflow of 205,000 tons. The unit would deplete the average annual flow of the Dolores and Colorado Rivers by a maximum of about 3,950 acre-feet.

The salinity of the Colorado River at Imperial Dam would be reduced by an estimated 18.2 milligrams per liter (mg/l), or about 1.6 percent of the 1976 modified base[1/] salinity level of 1,102 mg/l at the dam. The reduction of 18.2 mg/l represents a net change resulting from a decrease of 18.6 mg/l from the reduction in salt loading and an increase of 0.4 mg/l from the concentrating effect of the stream depletion.

An important aspect of unit development would be a plan for the acquisition, development, and management of lands around the evaporation pond to mitigate the loss of wildlife that would otherwise occur with construction and operation of the evaporation pond. Following initial development these lands would be turned over to the State to be managed as an integral part of the State's wildlife management program. Since the wildlife area was not included in the unit plan when it was authorized, the approval of the appropriate congressional committees would be required before the plan could be implemented. A program for the preservation of prehistoric and historic resources would also be carried out during construction.

3. Project Features

a. Introduction

A brine well field is now being installed as part of a design data collection program which is scheduled for completion in 1980. The purposes of the program are to design and test a well field that would effectively reduce the brine inflow to the river and to determine a design pumping rate for each well and for the entire well field. The testing program is estimated to extend over 2 years and until the program is completed, sufficient information will not be available to determine the final design capacities of unit features. Consequently, the estimates used and the impacts assessed in this report are based

1/ The 1976 modified base is a hypothetical preproject condition which takes into consideration all Reclamation projects constructed or under construction as of 1976. For further explanation see Cumulative Impacts Section C-11.f.

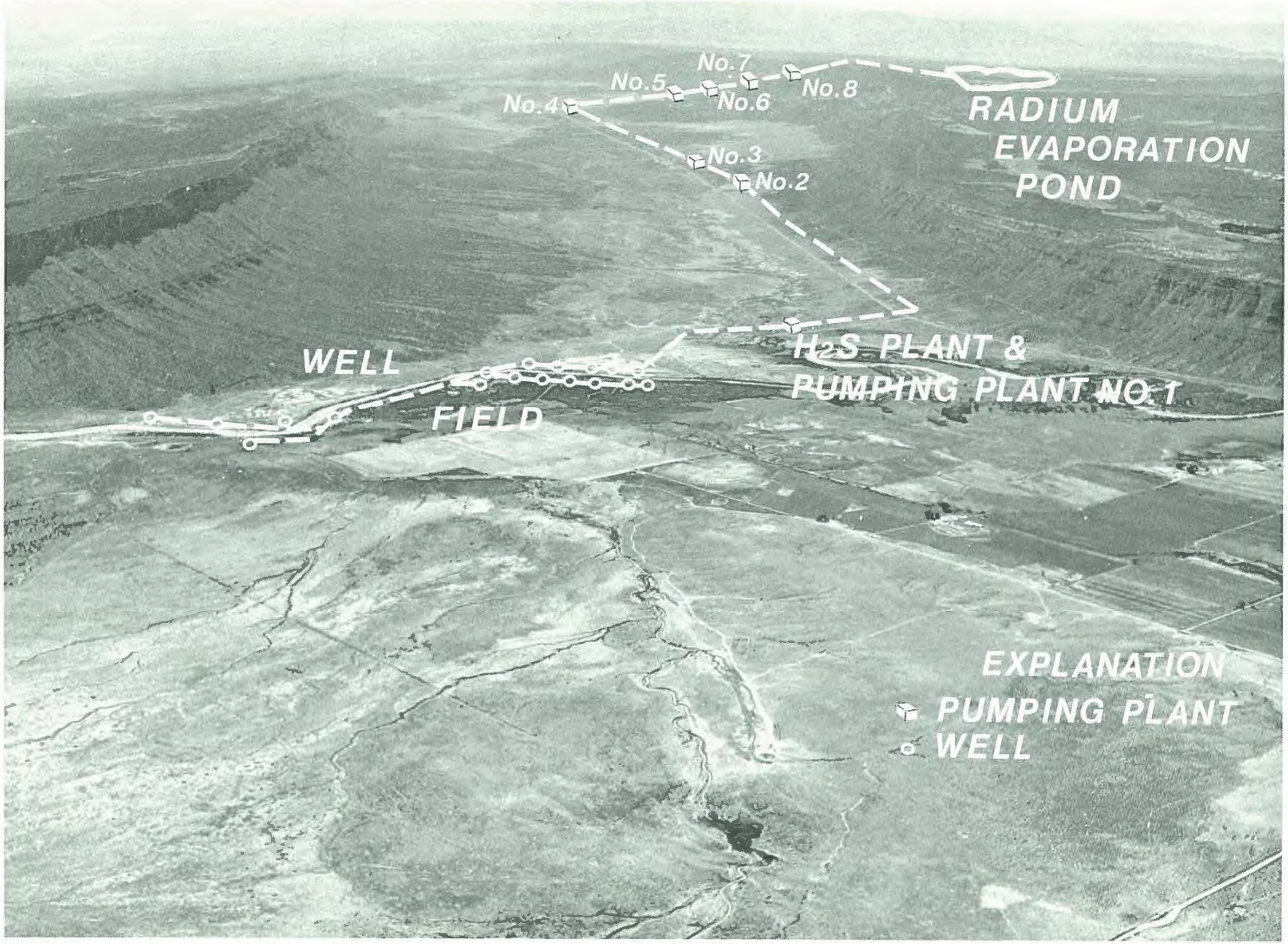


Figure A-1--Artist's concept of major project features upon the extreme condition that 5 cubic feet per second (cfs) of brine must be pumped constantly during the 100-year life of the unit. Furthermore, because of the necessity for extended testing to determine the most efficient pumping rate and pattern, construction of major project features other than the well field would not commence until the results of the testing program had been fully documented and analyzed. Since the possibility exists that a pumping rate substantially less than 5 cfs may be warranted following analysis of the testing data, an array of alternatives at lesser pumping rates is presented in Chapter H, Alternatives. These alternatives will be given the utmost consideration for brine disposal if a pumping rate of less than 5 cfs proves feasible.

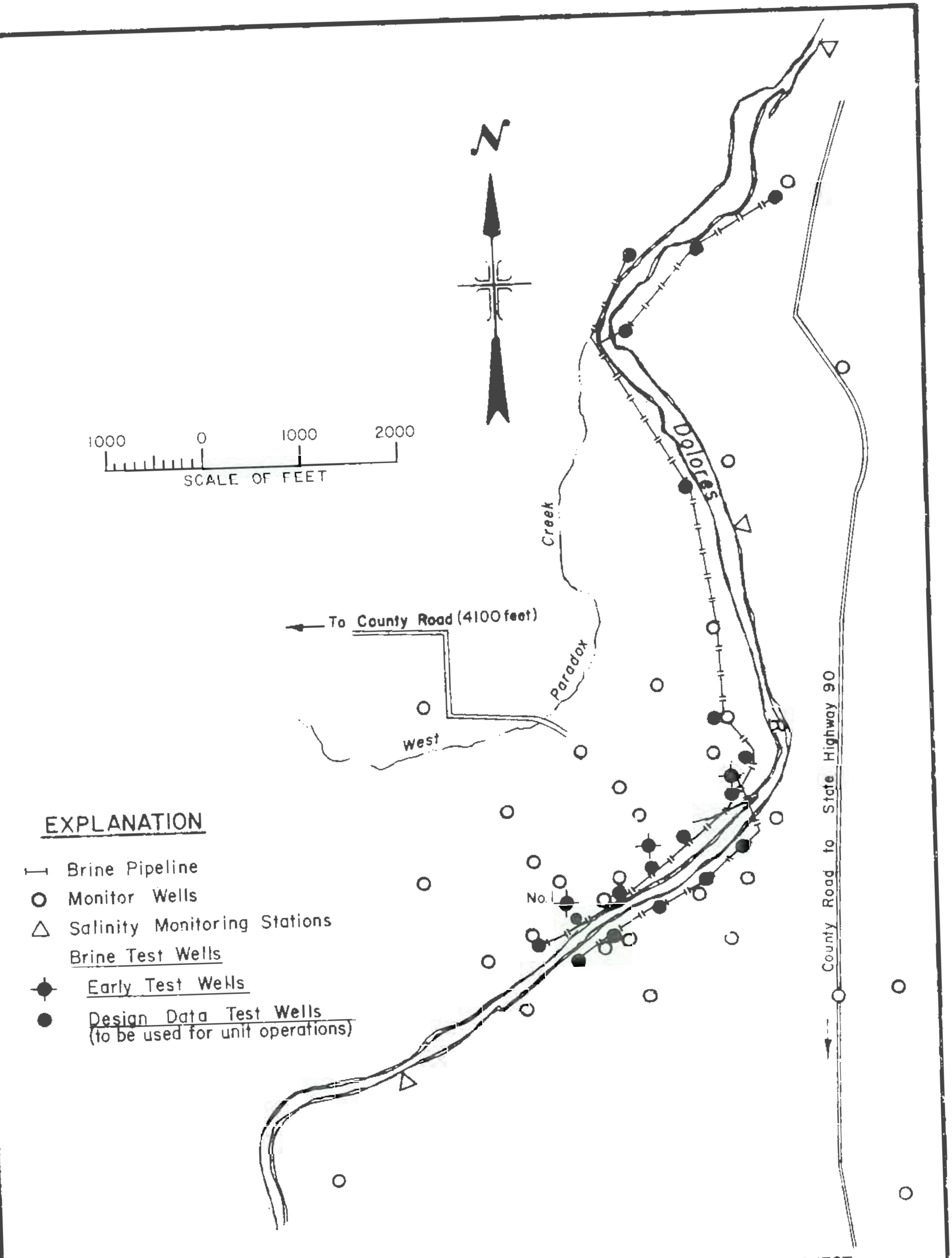
b. Design

(1) Brine Well Field

The brine well field, as shown in Figure A-2, would consist of approximately 18 brine production wells, 68 monitoring wells, stream gaging and water quality sampling stations, and a buried pipeline leading from the well field to the hydrogen sulfide stripping plant (Bureau of Reclamation 1978a). The well field would be located on both sides of the Dolores River from about midway in the river's course through Paradox Valley to its exit from the valley, where advanced planning studies (Bureau of Reclamation, 1978b) have shown that the bulk of the brine ground water enters the river. The Bureau, with the approval of the Federal Environmental Protection Agency, has drilled 18 test wells as part of its design data collection program. It is anticipated that these wells, with only slight modifications, would serve as brine production wells under actual operational conditions. The 68 wells that would form the ground water monitoring system, as well as the water quality and stream gaging stations, have all been installed as part of earlier investigations in the valley and would also be used for permanent operations. During design and testing of the wells, the brine would be discharged into a temporary disposal pond located north of the well field on the west side of the river. Testing is expected to be completed in 1980, at which time the pond would be filled in, covered with topsoil separated and set aside during excavation, and then seeded. Based on an environmental assessment, a negative determination has been prepared for the various stages of this work in compliance with the National Environmental Policy Act of 1969 (Bureau of Reclamation, February 17, 1977.)

(a) Brine Production Wells

The 18 test wells, which are expected to serve as brine production wells, have been drilled along a 1.7-mile reach of the river, with 10 on the west side and 8 on the east. All of the wells except one extend into the alluvial aquifer of sand and gravel to depths of between 48 and 77 feet. The remaining well has been drilled into brine-filled cavities that have been identified in bedrock at depths of about 133 to 155 feet. The pump chamber casing of each of the 18



COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT~COLORADO
SKETCH MAP OF WELL FIELD
FIGURE A-2

wells has an inside diameter of about 12 inches. A screen forming the lower 15 to 40 feet of the casings allows brine to enter the wells and is surrounded by gravel packing to prevent pumping fine sands from the aquifer. A flow meter, control valves, a tap for sampling the chemistry of the brine, and a pump sized for the design capacity of each well would be installed at each well for both the test program and long-term operations. The Bureau has applied to the State of Colorado for use permits for the 18 wells and has also begun consultation with the State for the necessary water rights for the unit.

To modify the wells for long-term production, the wellheads would be enclosed by concrete structures about 8 feet high and nearly 9 feet long on each side to prevent damage from weather, floods, and vandalism. The roofs provided for these structures would be removable so that the well pumps could be easily repaired or replaced. Pipelines along both sides of the river would collect the brine from the pump discharge lines at the wells and convey it to the hydrogen sulfide stripping plant. The lines would have a total length of about 3.1 miles. Constructed of reinforced plastic mortar or some other material resistant to corrosion, the lines would be buried with a minimum cover of 3 feet.

(b) Ground Water Monitoring Wells

The 68 monitoring wells drilled during unit investigations would form a grid around the production wells and would be used to monitor the water table, the interface between the brine and a thin layer of relatively fresh water that overlies the brine, and the brine pressure head at various points in the aquifer. The information obtained would be used to modify whenever necessary the pumping rates and patterns for the production wells. In addition to the 68 wells, other wells drilled during previous investigations would be monitored.

The monitoring wells include 39 shallow wells and 29 deep wells. The shallow wells have been drilled to depths of about 25 feet, with screens placed from 10 to 25 feet deep. These wells would be used to monitor the elevation of the water table and, with the use of electrical conductivity meters inserted in the pipes, to determine the depth of the brine-freshwater interface. The deeper wells generally contain three pipes, each extending to a different depth and screened at the bottom to determine the ground water pressure head from three general zones. A shallow pipe, screened from the 10- to 25-foot zone, would be used to observe the water table and the brine-freshwater interface; a second pipe, screened near the base of the alluvial aquifer between 56 and 80 feet deep, would be used to measure the brine pressure head in that zone; a third, screened in the gypsum bedrock between 215 and 300 feet deep, would also be used to measure the brine pressure head. A grout seal has been placed between the pipes to prevent the water in these three zones from intermixing in the well. Electrical conductivity meters and occasional samples would be used to monitor water quality in the various zones.

(c) River Monitoring System

The monitoring system includes facilities for assessing the effectiveness of pumping in lowering the salt influx to the river. Five electrical conductivity meters, which have been placed along the side of the stream, would continuously indicate the conductivity of the riverflows above, within, and below the well field. Water samples taken each week at two stream gaging stations where the river enters and leaves the valley would be used to substantiate the accuracy of the meters and to measure the changes in the chemical makeup of the water in the river.

(2) Hydrogen Sulfide Stripping Plant

Because of the toxic and corrosive nature of the hydrogen sulfide gas found in the pumped brine (at concentrations in excess of 100 mg/l), it would be necessary to remove it. For this purpose, a hydrogen sulfide stripping plant would be constructed approximately 1 mile south of the well field and just north of State Highway 90. About 0.4 mile of an existing county road would be paved to provide access.

The site of the facility, surrounded by a chain link fence 600 feet long, 400 feet wide, and 8 feet high, would contain offices, the stripping plant, a parking area, a switchyard, a shop and equipment storage building, and the first pumping plant for the pipeline to Radium Evaporation Pond (see Figure A-3). Fresh water for the site would be provided by a shallow well drilled near the adjacent rimrock of the valley walls.

In the treatment plant, which could be operated automatically or manually, an aeration process would oxidize the hydrogen sulfide in the brine, producing water and elemental sulfur. Prior to oxidation, a solution of nickel sulfate would be added to the brine as a catalyst to assist in the process. Up to a maximum of 5 cfs of brine would flow into four aeration tanks, where compressed and filtered air would be diffused throughout the brine to oxidize the hydrogen sulfide. High pressure air would be released through an outside vent to dissipate harmlessly in the atmosphere. Elemental sulfur, totaling approximately 760 pounds daily based on the maximum pumping rate, and detoxified brine would be discharged together into the forebay reservoir of the first pumping plant for the pipeline to the evaporation pond. The aeration process would reduce the concentration of hydrogen sulfide from about 100 mg/l to about 0.02 mg/l. Provisions would be made for continuous monitoring to prevent H_2S gas from reaching toxic levels in enclosed work areas at the plant. (Bureau of Reclamation, 1978a).

(3) Brine Pipeline and Pumping Plants

The brine pipeline, with a diameter of from 15 to 18 inches, would extend about 20.5 miles from the hydrogen sulfide stripping plant to Radium Evaporation Pond. The pipe would he buried at depths of from 3 to 5 feet. For the first 14.3 miles to the top of the divide between Paradox Valley and Dry Creek Basin, the brine would be

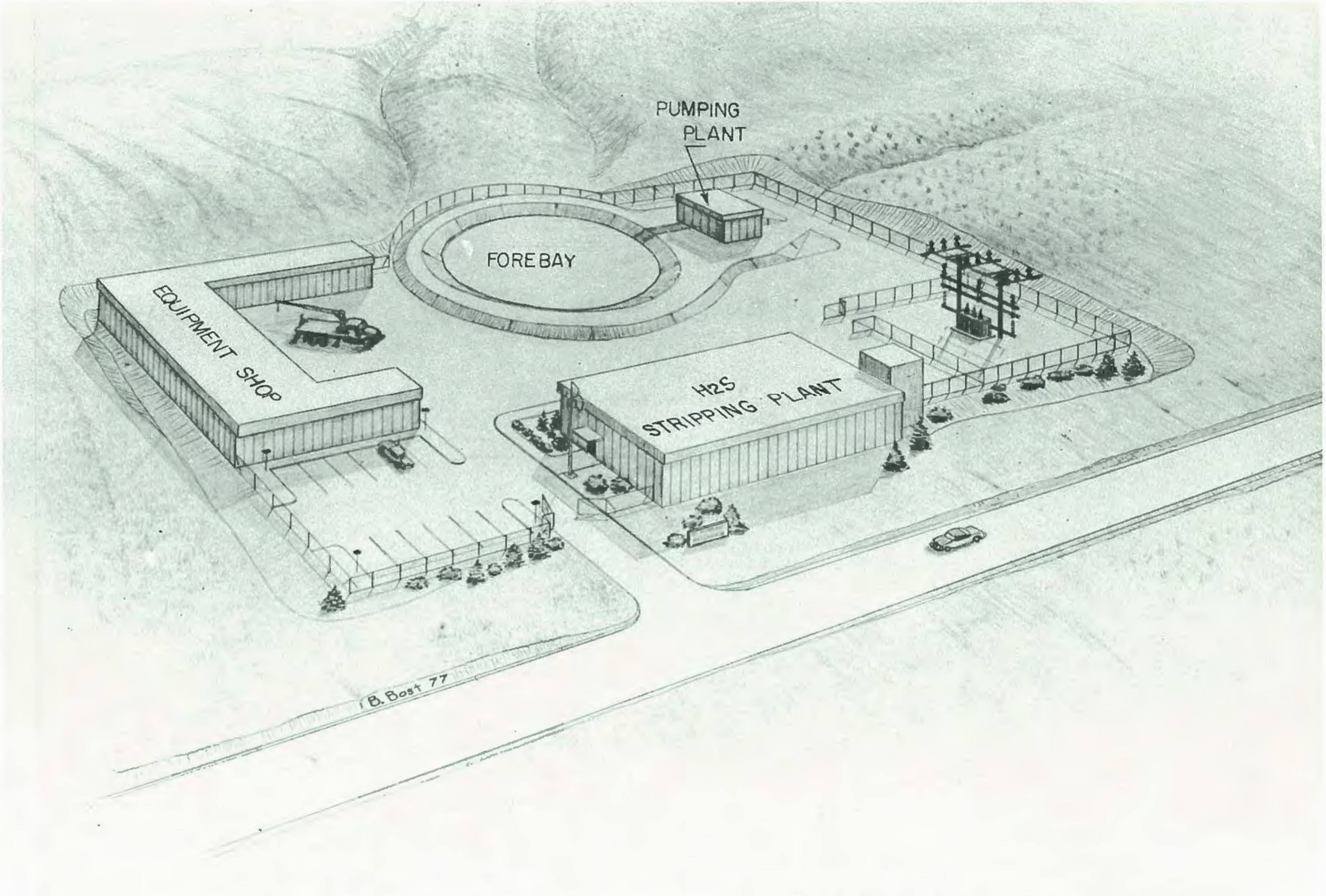


Figure A-3--Artist's concept of hydrogen sulfide stripping plant.

pumped through the pipeline. The remaining 6.2 miles of pipeline would convey the brine by gravity into the pond.

Eight fully automatic pumping plants would be constructed to lift the brine from an elevation of 4,960 feet at the stripping plant to 7,000 feet at the divide. The first, as explained previously, would be located at the stripping plant. The others would be located as shown on the General Map. The plants along the valley floor would be spaced at intervals of from 3 to 4 miles, while those on the valley slopes would be about 0.5 to 1.5 miles apart. The dynamic pumping head (brine) would be 366 feet at the first plant and 275 feet at each of the others. Each plant would consist of a one-story building for the pumps, a substation, a forebay, and an air chamber. The entire yard at each plant, covering an area of 140 feet by 100 feet, would be enclosed by a chain link fence 8 feet in height.

Pumping Plant No. 1 would have a forebay reservoir with a diameter of 71 feet and a volume of 2 acre-feet. The reservoir would be lined with polyvinyl chloride to prevent leakage into the surrounding ground water. The other plants would have forebay regulating tanks constructed of reinforced fiberglass. Each of these tanks would have a height of 26 feet, a diameter of 31 feet, and a capacity of 0.5 acre-foot. The air chambers, or surge tanks, would vary from 4 to 9 feet in diameter and 7 to 15 feet in height and would be used to absorb pressure changes caused by variations in brine flow. Should an emergency or a breakdown in the system require draining any section of the pipeline, the forebays located at the pumping plants would be able to contain all the brine in the 14.3-mile pumped section of pipe.

The brine line would be constructed of reinforced plastic mortar pipe with the sections of the pump stations constructed of aluminum bronze pipe. Corrosive damage from the brine solution would be most severe at the valves and meter couplings on the brine pipe network. Accumulations of mineral encrustations at these points would accelerate the deterioration of these fittings. The estimated service life of the pipeline is 50 years and of the fittings 10 years. The pumping units on the brine line also have an estimated service life of 10 years.

Supervisory control of the stripping plant and brine line pumping stations would provide a nearly constant monitoring of the operations (Bureau of Reclamation 1978a, pp. 40-41). Part of the duties of the permanent operating force would be to inspect the operation of the valves and meters on the brine line periodically.

Malfunctions of the pumping units, breaks in the pipeline, or stripping plant breakdowns would be automatically picked up by the centralized control station and alarms would notify the operating personnel. Maintenance or replacement of any damaged fitting could be made during temporary shutdowns of the unit without jeopardizing the overall operation. Standby in-line pumping units would also be provided at each pumping station to facilitate maintenance on the units. Dewatering of the pipeline or hydrogen sulfide stripping plant would be provided by being able to drain the pipeline into the forebay reservoir at Pumping Plant No. 1 and the forebay tanks at Pumping Plants 2 to 8. These tanks would also make it possible to isolate and drain segments of the pipeline.

Existing roads would provide access to the pipeline and to all of the pumping plants except No. 2, where a gravel access road 12 feet wide and 1,000 feet long would be constructed south of State Highway 90 (Bureau of Reclamation, 1978a).

(4) Radium Evaporation Pond

Radium Evaporation Pond would be located in Dry Creek Basin and would be formed by a dam on an intermittent tributary of the West Fork of Dry Creek and a dike on an intermittent tributary of the main stem of the creek (see Figure A-4). Covering an area extending across a low saddle between the forks, the pond would have a surface area of 3,630 acres and a total storage capacity of 86,800 acre-feet, consisting of 65,700 acre-feet for the disposal of brine and deposited salts, 2,400 acre-feet for sediments from storm runoff over a 100-year period of unit operations, and 18,700 acre-feet for flood storage, which would protect the dam against the design maximum annual inflow of 22,200 acre-feet with an anticipated minimum evaporation during that year of 3,500 acre-feet. The flood storage would be large enough to retain and evaporate all inflows entering the pond from the surrounding drainage area after the 100-year life of the unit, since no water must be allowed to spill and possibly contaminate local ground or surface water. Even though the pond would contain enough capacity to store and evaporate all inflows, including floods, a spillway and a surcharge capacity of 6,540 acre-feet would be provided on top of the flood control pool as standard Reclamation policy to protect the dam and dike against a design flood having a peak flow of 39,300 cfs and a 3-day volume of 6,600 acre-feet.

Nearly all of the pond area is underlain by impervious Mancos Shale, which would prevent seepage of brine into ground or surface waters. Permeability tests conducted in drill holes in the area indicate that the shale is extremely watertight (Bureau of Reclamation, 1976a). Two areas on the northeast side between the dam and dike, however, are underlain by generally fractured Dakota Sandstone and would be lined with a blanket of impervious material having a thickness of 5 feet, a total area of 640 acres, and a volume of 5,200,000 cubic yards (Bureau of Reclamation, 1978).

Radium Dam and Dike would be rolled earthfill structures with riprap on the upstream faces and sand and gravel on the downstream faces to protect against erosion. A combined spillway and outlet works would be located in the left abutment of the dam. The spillway would include an intake structure near the crest of the dam, a vertical conduit leading to the base of the dam, and a horizontal conduit under the base of the dam discharging into the intermittent tributary of the West Fork. The inlet of the spillway would be at the base of the surcharge capacity. The outlet works would consist of an intake structure at the

CHAPTER A

DESCRIPTION OF THE PROPOSAL

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2. Plan of Development

The Paradox Valley Unit would be constructed along the Dolores River, which crosses the valley near its midpoint perpendicular to the valley's axis, and in Dry Creek Basin, which is approximately 20 miles southeast (see the General Map). Under unit operations, brine ground water presently seeping in along the banks and bottom of the Dolores

River in Paradox Valley would be pumped from wells along the river and conveyed by a pipeline to a stripping plant, where it would be treated for the removal of toxic and highly corrosive hydrogen sulfide gas. The brine would then be pumped in a pipeline to the crest of the divide separating Paradox Valley and Dry Creek Basin and then conveyed by gravity flow to Radium Evaporation Pond for disposal (See Figure A-1).

As a result of the development, salts entering the Dolores River and subsequently the Colorado River from Paradox Valley would be reduced by about 180,000 tons a year, or about 88 percent of the present average annual inflow of 205,000 tons. The unit would deplete the average annual flow of the Dolores and Colorado Rivers by a maximum of about 3,950 acre-feet.

The salinity of the Colorado River at Imperial Dam would be reduced by an estimated 18.2 milligrams per liter (mg/l), or about 1.6 percent of the 1976 modified base[1/] salinity level of 1,102 mg/l at the dam. The reduction of 18.2 mg/l represents a net change resulting from a decrease of 18.6 mg/l from the reduction in salt loading and an increase of 0.4 mg/l from the concentrating effect of the stream depletion.

An important aspect of unit development would be a plan for the acquisition, development, and management of lands around the evaporation pond to mitigate the loss of wildlife that would otherwise occur with construction and operation of the evaporation pond. Following initial development these lands would be turned over to the State to be managed as an integral part of the State's wildlife management program. Since the wildlife area was not included in the unit plan when it was authorized, the approval of the appropriate congressional committees would be required before the plan could be implemented. A program for the preservation of prehistoric and historic resources would also be carried out during construction.

3. Project Features

a. Introduction

A brine well field is now being installed as part of a design data collection program which is scheduled for completion in 1980. The purposes of the program are to design and test a well field that would effectively reduce the brine inflow to the river and to determine a design pumping rate for each well and for the entire well field. The testing program is estimated to extend over 2 years and until the program is completed, sufficient information will not be available to determine the final design capacities of unit features. Consequently, the estimates used and the impacts assessed in this report are based

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1/ The 1976 modified base is a hypothetical preproject condition which takes into consideration all Reclamation projects constructed or under construction as of 1976. For further explanation see Cumulative Impacts Section C-11.f.

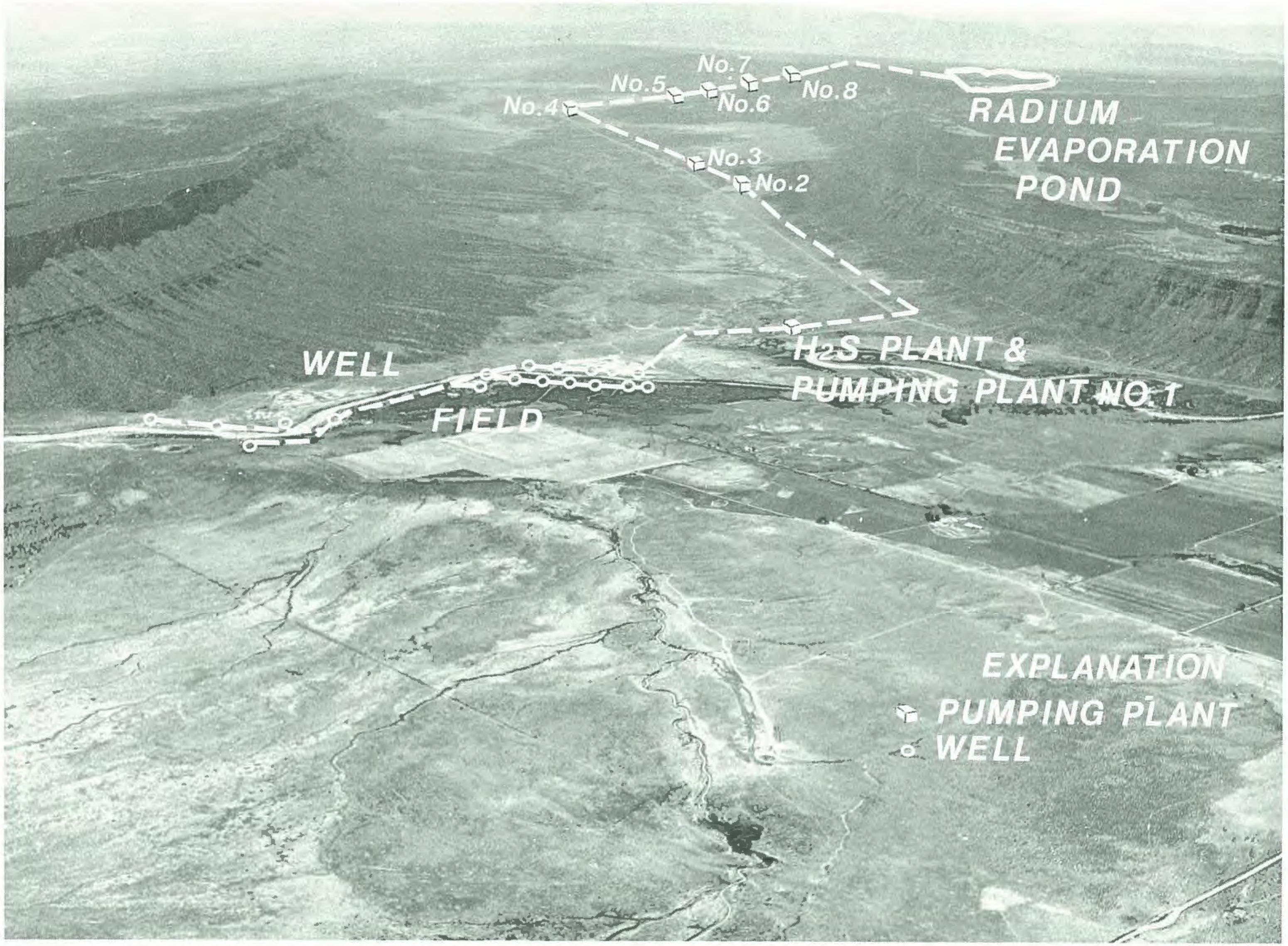


Figure A-1--Artist's concept of major project features upon the extreme condition that 5 cubic feet per second (cfs) of brine must be pumped constantly during the 100-year life of the unit. Furthermore, because of the necessity for extended testing to determine the most efficient pumping rate and pattern, construction of major project features other than the well field would not commence until the results of the testing program had been fully documented and analyzed. Since the possibility exists that a pumping rate substantially less than 5 cfs may be warranted following analysis of the testing data, an array of alternatives at lesser pumping rates is presented in Chapter H, Alternatives. These alternatives will be given the utmost consideration for brine disposal if a pumping rate of less than 5 cfs proves feasible.

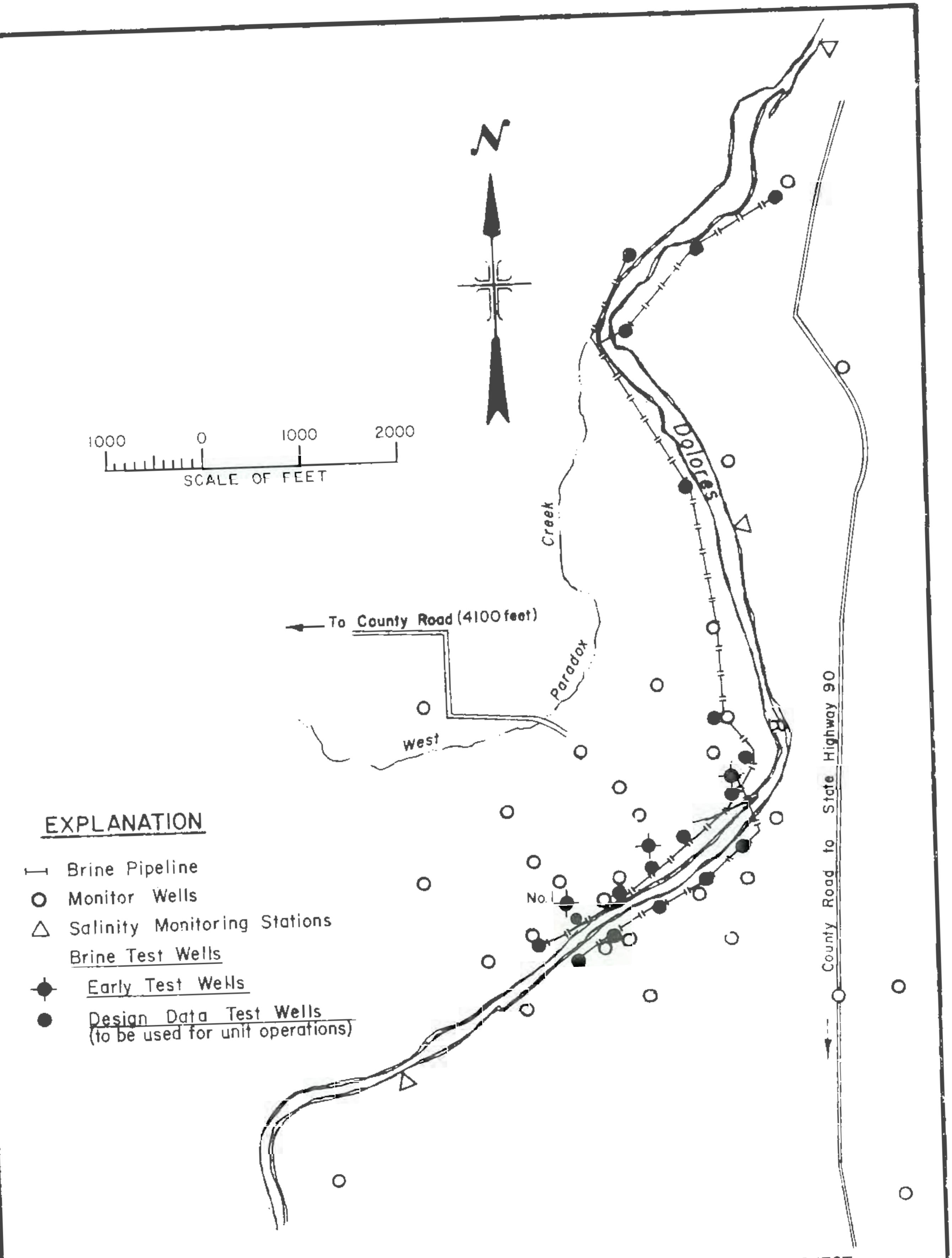
b. Design

(1) Brine Well Field

The brine well field, as shown in Figure A-2, would consist of approximately 18 brine production wells, 68 monitoring wells, stream gaging and water quality sampling stations, and a buried pipeline leading from the well field to the hydrogen sulfide stripping plant (Bureau of Reclamation 1978a). The well field would be located on both sides of the Dolores River from about midway in the river's course through Paradox Valley to its exit from the valley, where advanced planning studies (Bureau of Reclamation, 1978b) have shown that the bulk of the brine ground water enters the river. The Bureau, with the approval of the Federal Environmental Protection Agency, has drilled 18 test wells as part of its design data collection program. It is anticipated that these wells, with only slight modifications, would serve as brine production wells under actual operational conditions. The 68 wells that would form the ground water monitoring system, as well as the water quality and stream gaging stations, have all been installed as part of earlier investigations in the valley and would also be used for permanent operations. During design and testing of the wells, the brine would be discharged into a temporary disposal pond located north of the well field on the west side of the river. Testing is expected to be completed in 1980, at which time the pond would be filled in, covered with topsoil separated and set aside during excavation, and then seeded. Based on an environmental assessment, a negative determination has been prepared for the various stages of this work in compliance with the National Environmental Policy Act of 1969 (Bureau of Reclamation, February 17, 1977.)

(a) Brine Production Wells

The 18 test wells, which are expected to serve as brine production wells, have been drilled along a 1.7-mile reach of the river, with 10 on the west side and 8 on the east. All of the wells except one extend into the alluvial aquifer of sand and gravel to depths of between 48 and 77 feet. The remaining well has been drilled into brine-filled cavities that have been identified in bedrock at depths of about 133 to 155 feet. The pump chamber casing of each of the 18



COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT ~ COLORADO
SKETCH MAP OF WELL FIELD
FIGURE A-2

wells has an inside diameter of about 12 inches. A screen forming the lower 15 to 40 feet of the casings allows brine to enter the wells and is surrounded by gravel packing to prevent pumping fine sands from the aquifer. A flow meter, control valves, a tap for sampling the chemistry of the brine, and a pump sized for the design capacity of each well would be installed at each well for both the test program and long-term operations. The Bureau has applied to the State of Colorado for use permits for the 18 wells and has also begun consultation with the State for the necessary water rights for the unit.

To modify the wells for long-term production, the wellheads would be enclosed by concrete structures about 8 feet high and nearly 9 feet long on each side to prevent damage from weather, floods, and vandalism. The roofs provided for these structures would be removable so that the well pumps could be easily repaired or replaced. Pipelines along both sides of the river would collect the brine from the pump discharge lines at the wells and convey it to the hydrogen sulfide stripping plant. The lines would have a total length of about 3.1 miles. Constructed of reinforced plastic mortar or some other material resistant to corrosion, the lines would be buried with a minimum cover of 3 feet.

(b) Ground Water Monitoring Wells

The 68 monitoring wells drilled during unit investigations would form a grid around the production wells and would be used to monitor the water table, the interface between the brine and a thin layer of relatively fresh water that overlies the brine, and the brine pressure head at various points in the aquifer. The information obtained would be used to modify whenever necessary the pumping rates and patterns for the production wells. In addition to the 68 wells, other wells drilled during previous investigations would be monitored.

The monitoring wells include 39 shallow wells and 29 deep wells. The shallow wells have been drilled to depths of about 25 feet, with screens placed from 10 to 25 feet deep. These wells would be used to monitor the elevation of the water table and, with the use of electrical conductivity meters inserted in the pipes, to determine the depth of the brine-freshwater interface. The deeper wells generally contain three pipes, each extending to a different depth and screened at the bottom to determine the ground water pressure head from three general zones. A shallow pipe, screened from the 10- to 25-foot zone, would be used to observe the water table and the brine-freshwater interface; a second pipe, screened near the base of the alluvial aquifer between 56 and 80 feet deep, would be used to measure the brine pressure head in that zone; a third, screened in the gypsum bedrock between 215 and 300 feet deep, would also be used to measure the brine pressure head. A grout seal has been placed between the pipes to prevent the water in these three zones from intermixing in the well. Electrical conductivity meters and occasional samples would be used to monitor water quality in the various zones.

(c) River Monitoring System

The monitoring system includes facilities for assessing the effectiveness of pumping in lowering the salt influx to the river. Five electrical conductivity meters, which have been placed along the side of the stream, would continuously indicate the conductivity of the riverflows above, within, and below the well field. Water samples taken each week at two stream gaging stations where the river enters and leaves the valley would be used to substantiate the accuracy of the meters and to measure the changes in the chemical makeup of the water in the river.

(2) Hydrogen Sulfide Stripping Plant

Because of the toxic and corrosive nature of the hydrogen sulfide gas found in the pumped brine (at concentrations in excess of 100 mg/l), it would be necessary to remove it. For this purpose, a hydrogen sulfide stripping plant would be constructed approximately 1 mile south of the well field and just north of State Highway 90. About 0.4 mile of an existing county road would be paved to provide access.

The site of the facility, surrounded by a chain link fence 600 feet long, 400 feet wide, and 8 feet high, would contain offices, the stripping plant, a parking area, a switchyard, a shop and equipment storage building, and the first pumping plant for the pipeline to Radium Evaporation Pond (see Figure A-3). Fresh water for the site would be provided by a shallow well drilled near the adjacent rimrock of the valley walls.

In the treatment plant, which could be operated automatically or manually, an aeration process would oxidize the hydrogen sulfide in the brine, producing water and elemental sulfur. Prior to oxidation, a solution of nickel sulfate would be added to the brine as a catalyst to assist in the process. Up to a maximum of 5 cfs of brine would flow into four aeration tanks, where compressed and filtered air would be diffused throughout the brine to oxidize the hydrogen sulfide. High pressure air would be released through an outside vent to dissipate harmlessly in the atmosphere. Elemental sulfur, totaling approximately 760 pounds daily based on the maximum pumping rate, and detoxified brine would be discharged together into the forebay reservoir of the first pumping plant for the pipeline to the evaporation pond. The aeration process would reduce the concentration of hydrogen sulfide from about 100 mg/l to about 0.02 mg/l. Provisions would be made for continuous monitoring to prevent H_2S gas from reaching toxic levels in enclosed work areas at the plant. (Bureau of Reclamation, 1978a).

(3) Brine Pipeline and Pumping Plants

The brine pipeline, with a diameter of from 15 to 18 inches, would extend about 20.5 miles from the hydrogen sulfide stripping plant to Radium Evaporation Pond. The pipe would he buried at depths of from 3 to 5 feet. For the first 14.3 miles to the top of the divide between Paradox Valley and Dry Creek Basin, the brine would be

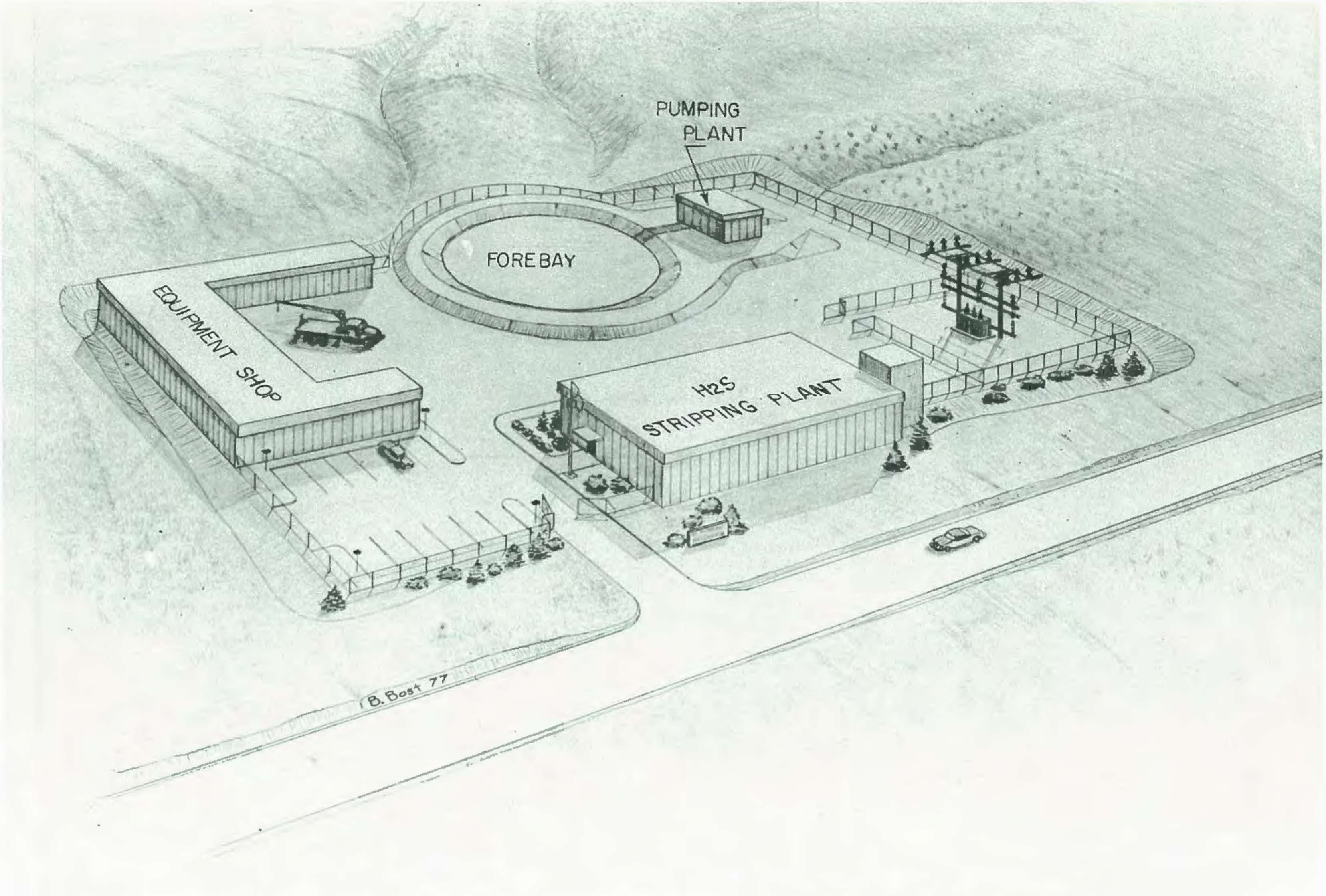


Figure A-3--Artist's concept of hydrogen sulfide stripping plant.

pumped through the pipeline. The remaining 6.2 miles of pipeline would convey the brine by gravity into the pond.

Eight fully automatic pumping plants would be constructed to lift the brine from an elevation of 4,960 feet at the stripping plant to 7,000 feet at the divide. The first, as explained previously, would be located at the stripping plant. The others would be located as shown on the General Map. The plants along the valley floor would be spaced at intervals of from 3 to 4 miles, while those on the valley slopes would be about 0.5 to 1.5 miles apart. The dynamic pumping head (brine) would be 366 feet at the first plant and 275 feet at each of the others. Each plant would consist of a one-story building for the pumps, a substation, a forebay, and an air chamber. The entire yard at each plant, covering an area of 140 feet by 100 feet, would be enclosed by a chain link fence 8 feet in height.

Pumping Plant No. 1 would have a forebay reservoir with a diameter of 71 feet and a volume of 2 acre-feet. The reservoir would be lined with polyvinyl chloride to prevent leakage into the surrounding ground water. The other plants would have forebay regulating tanks constructed of reinforced fiberglass. Each of these tanks would have a height of 26 feet, a diameter of 31 feet, and a capacity of 0.5 acre-foot. The air chambers, or surge tanks, would vary from 4 to 9 feet in diameter and 7 to 15 feet in height and would be used to absorb pressure changes caused by variations in brine flow. Should an emergency or a breakdown in the system require draining any section of the pipeline, the forebays located at the pumping plants would be able to contain all the brine in the 14.3-mile pumped section of pipe.

The brine line would be constructed of reinforced plastic mortar pipe with the sections of the pump stations constructed of aluminum bronze pipe. Corrosive damage from the brine solution would be most severe at the valves and meter couplings on the brine pipe network. Accumulations of mineral encrustations at these points would accelerate the deterioration of these fittings. The estimated service life of the pipeline is 50 years and of the fittings 10 years. The pumping units on the brine line also have an estimated service life of 10 years.

Supervisory control of the stripping plant and brine line pumping stations would provide a nearly constant monitoring of the operations (Bureau of Reclamation 1978a, pp. 40-41). Part of the duties of the permanent operating force would be to inspect the operation of the valves and meters on the brine line periodically.

Malfunctions of the pumping units, breaks in the pipeline, or stripping plant breakdowns would be automatically picked up by the centralized control station and alarms would notify the operating personnel. Maintenance or replacement of any damaged fitting could be made during temporary shutdowns of the unit without jeopardizing the overall operation. Standby in-line pumping units would also be provided at each pumping station to facilitate maintenance on the units. Dewatering of the pipeline or hydrogen sulfide stripping plant would be provided by being able to drain the pipeline into the forebay reservoir at Pumping Plant No. 1 and the forebay tanks at Pumping Plants 2 to 8. These tanks would also make it possible to isolate and drain segments of the pipeline.

Existing roads would provide access to the pipeline and to all of the pumping plants except No. 2, where a gravel access road 12 feet wide and 1,000 feet long would be constructed south of State Highway 90 (Bureau of Reclamation, 1978a).

(4) Radium Evaporation Pond

Radium Evaporation Pond would be located in Dry Creek Basin and would be formed by a dam on an intermittent tributary of the West Fork of Dry Creek and a dike on an intermittent tributary of the main stem of the creek (see Figure A-4). Covering an area extending across a low saddle between the forks, the pond would have a surface area of 3,630 acres and a total storage capacity of 86,800 acre-feet, consisting of 65,700 acre-feet for the disposal of brine and deposited salts, 2,400 acre-feet for sediments from storm runoff over a 100-year period of unit operations, and 18,700 acre-feet for flood storage, which would protect the dam against the design maximum annual inflow of 22,200 acre-feet with an anticipated minimum evaporation during that year of 3,500 acre-feet. The flood storage would be large enough to retain and evaporate all inflows entering the pond from the surrounding drainage area after the 100-year life of the unit, since no water must be allowed to spill and possibly contaminate local ground or surface water. Even though the pond would contain enough capacity to store and evaporate all inflows, including floods, a spillway and a surcharge capacity of 6,540 acre-feet would be provided on top of the flood control pool as standard Reclamation policy to protect the dam and dike against a design flood having a peak flow of 39,300 cfs and a 3-day volume of 6,600 acre-feet.

Nearly all of the pond area is underlain by impervious Mancos Shale, which would prevent seepage of brine into ground or surface waters. Permeability tests conducted in drill holes in the area indicate that the shale is extremely watertight (Bureau of Reclamation, 1976a). Two areas on the northeast side between the dam and dike, however, are underlain by generally fractured Dakota Sandstone and would be lined with a blanket of impervious material having a thickness of 5 feet, a total area of 640 acres, and a volume of 5,200,000 cubic yards (Bureau of Reclamation, 1978).

Radium Dam and Dike would be rolled earthfill structures with riprap on the upstream faces and sand and gravel on the downstream faces to protect against erosion. A combined spillway and outlet works would be located in the left abutment of the dam. The spillway would include an intake structure near the crest of the dam, a vertical conduit leading to the base of the dam, and a horizontal conduit under the base of the dam discharging into the intermittent tributary of the West Fork. The inlet of the spillway would be at the base of the surcharge capacity. The outlet works would consist of an intake structure at the

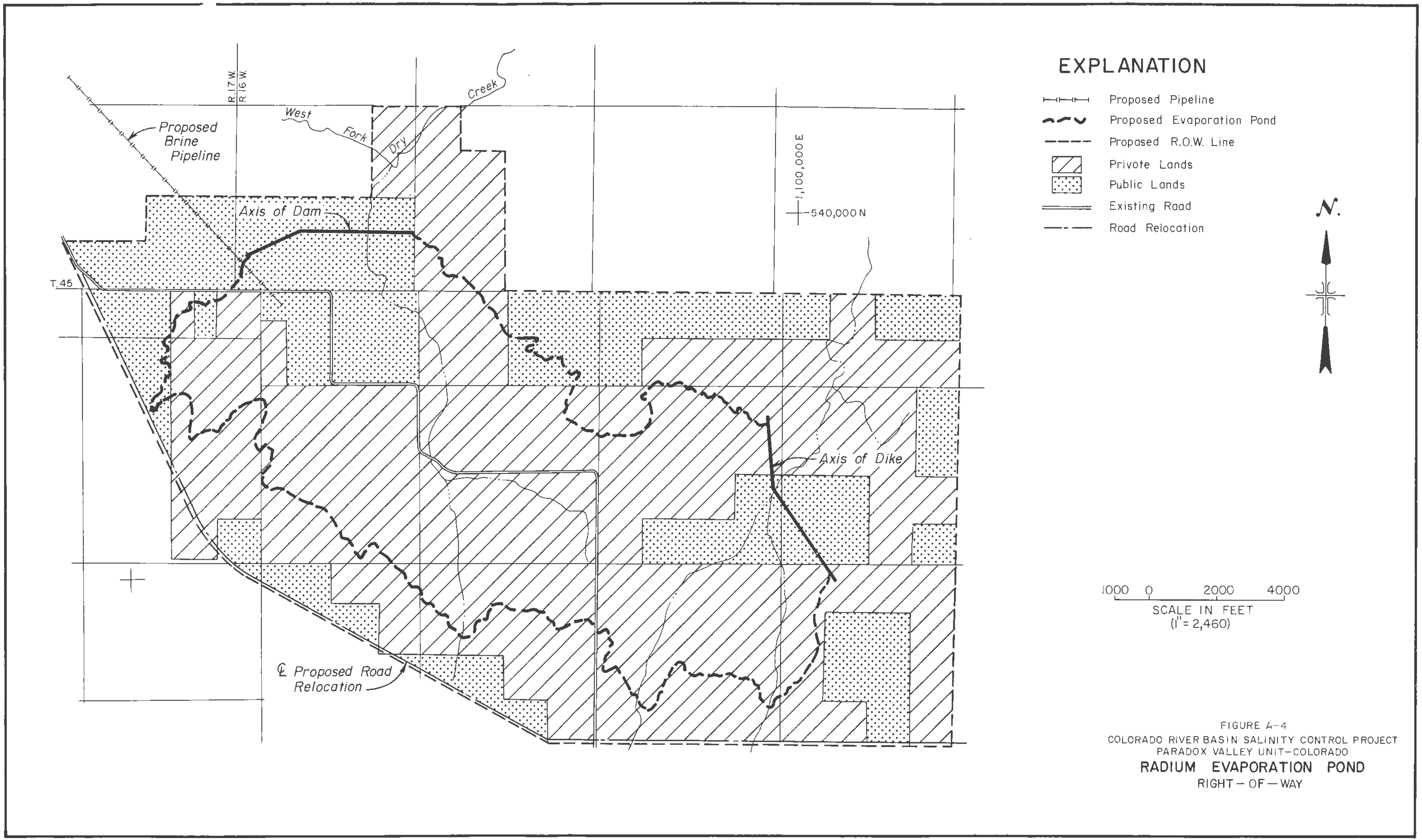


FIGURE A-4
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT-COLORADO
RADIUM EVAPORATION POND
RIGHT-OF-WAY

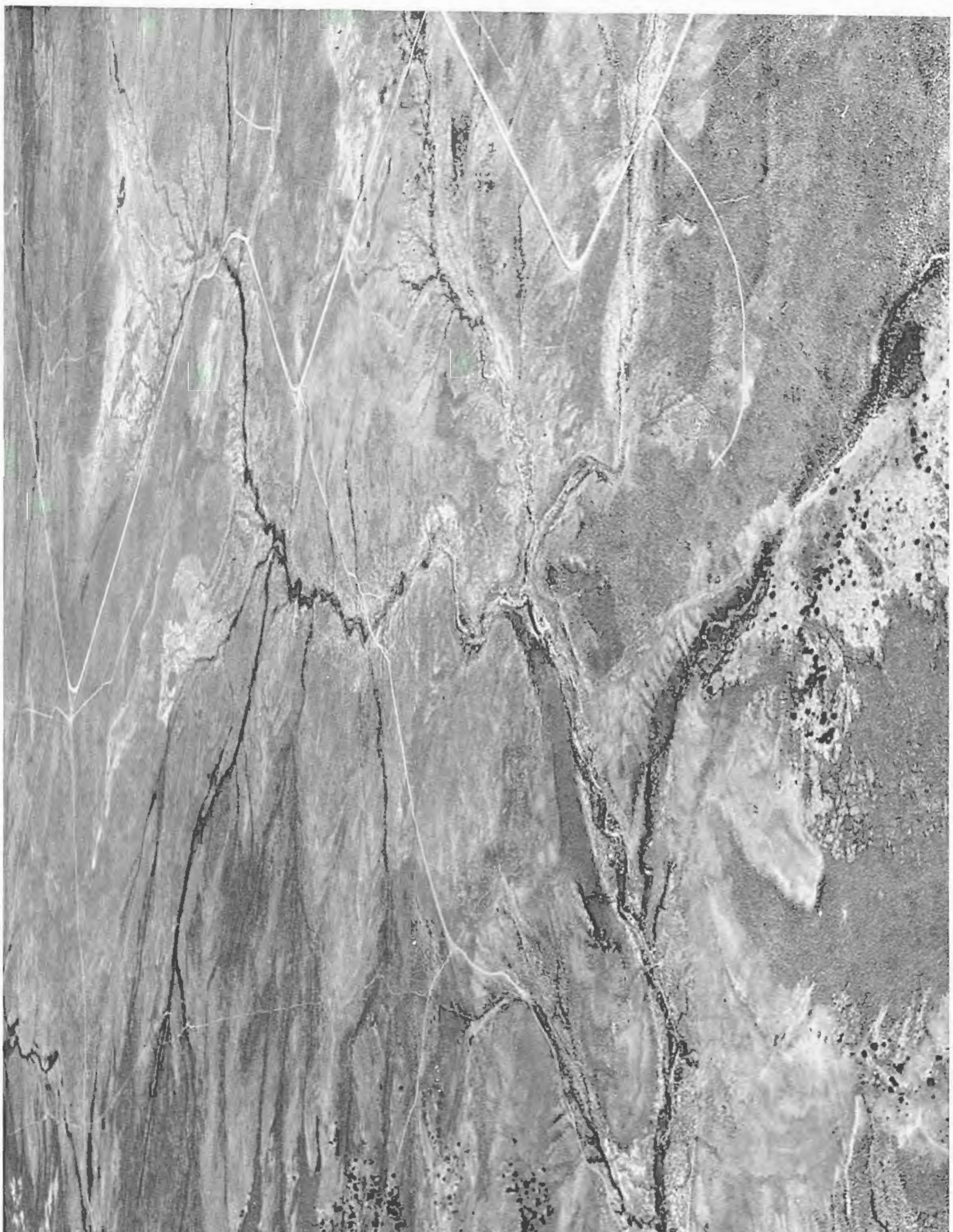


Figure A-5--Aerial photo of Radium Evaporation Pond site.

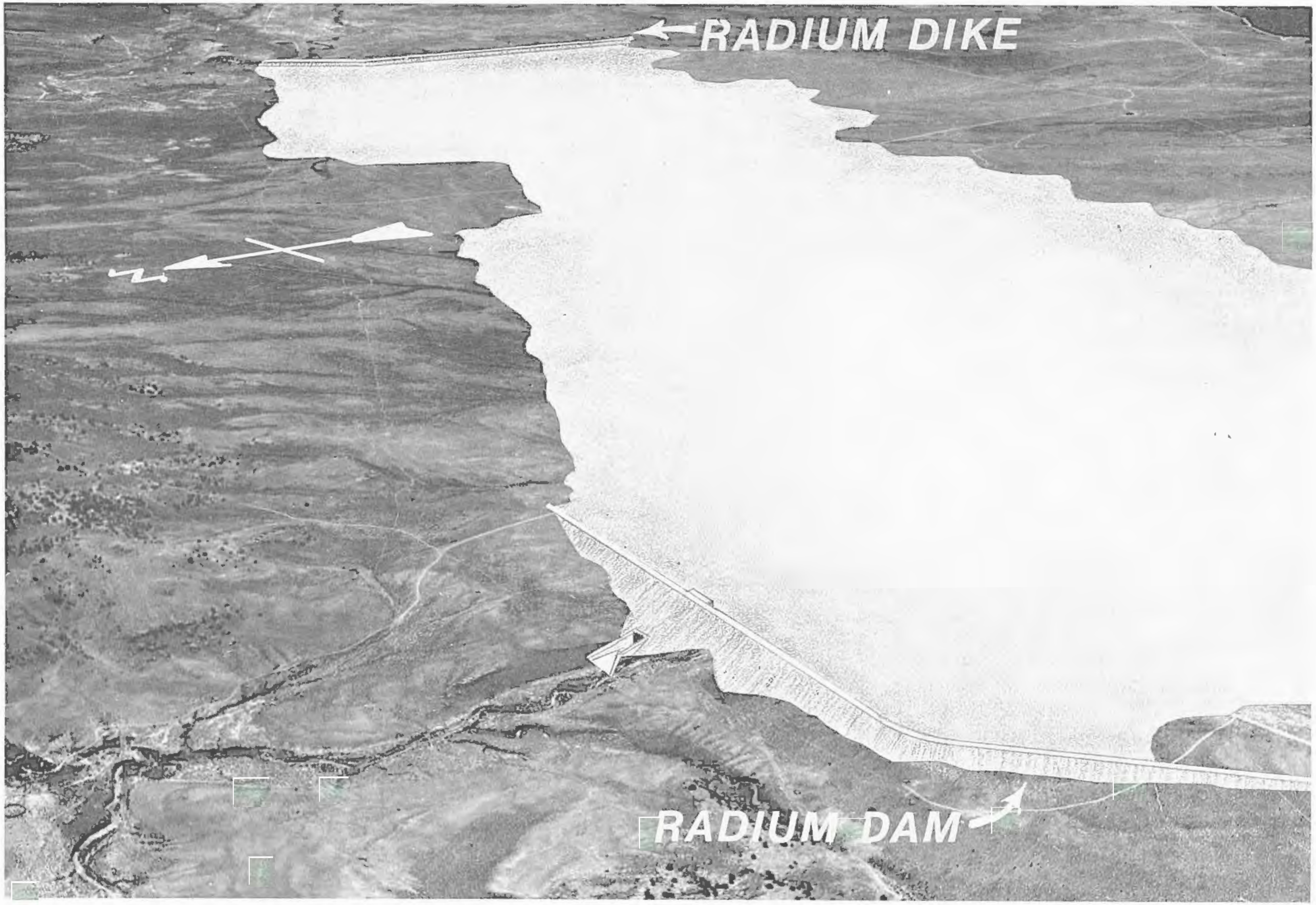


Figure A-6--Artist's concept of Radium Evaporation Pond.

base of the dam and a conduit that would connect with the horizontal spillway conduit. This facility would be required temporarily for drainage during construction but would eventually be covered with salt deposits and thereafter become inoperable. Technical data pertaining to the dam and dike are shown in the following table.

Table A-1
Radium Dam and Dike

	Radium Dam	Radium Dike
Crest (feet)		
Height	87	56
Length	8,300	7,500
Width	30	30
Material volume (cubic yards)	1,480,000	1,004,000
Discharge capacity (cubic feet per second)		
Outlet works	810	
Spillway	50	

Eight ground water monitoring wells would be drilled around the pond to monitor water quality, thereby indicating whether brine was seeping into the ground water downstream. Two wells would be located immediately downstream from the dam on either side of the tributary to the West Fork, and two would be located immediately downstream from the dike on either side of the tributary to Dry Creek. Three wells would be drilled between the dam and dike on the north side of the pond, and another would be located on the south side of the pond. Each well would consist of one pipe 25 feet deep that would permit observation of the water table and another 60 feet deep that would measure the hydraulic pressure at that depth. The shallow pipe would have a screen permitting observation from 5 to 25 feet, and the deep pipe would have a 5-foot screen on the bottom. If any leakage occurred through the dam or abutments, it would be collected and recycled back into the pond.

A gravel county road about 4.1 miles long would be relocated to pass around the evaporation pond on the south and west sides and would be constructed according to current county standards. In addition, two gravel roads 12 feet wide would be constructed to provide access from the relocated county road to the dam and dike. The road to the dam would be 2.6 miles long, including a section crossing the crest of the dam; and the road to the dike would be 1.5 miles long, including a section crossing the crest.

Vegetation, primarily sagebrush, would be cleared at the sites of the dam, dike, and impervious blanket. The material would be disposed of according to Federal, State, and local standards (Bureau of Reclamation, 1978a).

(5) Construction Headquarters and Permanent Operating Facilities

A government construction headquarters and a temporary government housing camp would be located near the hydrogen sulfide stripping plant site. The construction headquarters would consist of an office-laboratory, garage, and warehouse. The housing camp would consist of about 17 mobile housing units to accommodate government construction personnel. Wells would be drilled along the rimrock southeast of the camp to obtain water of suitable quality for domestic use, and a sewage disposal unit would be constructed.

Following construction, the trailers would be removed and the construction headquarters would be converted for use as the permanent operating headquarters. To house permanent operating personnel, four houses would be constructed just south of the plant site. The water and sewage systems constructed for the camp would be readily adaptable for the permanent housing units.

(6) Transmission Facilities

Power to operate the brine well field, hydrogen sulfide stripping plant, pipeline pumping plants, construction camp, and permanent housing would be obtained from the Colorado River Storage Project and wheeled to the unit area by Colorado Ute Electric Association and then to unit facilities through an existing 46-kV transmission line owned by the San Miguel Power Association. Overhead taplines to the well field and buried lines to the stripping plant and pumping plants would be constructed from the existing line; since the line roughly parallels all proposed facilities requiring power, the longest tapline needed would be about 1,000 feet. The taplines would be designed to prevent hazards (Bureau of Reclamation, 1978a). Construction has begun on the taplines to the well field so that the testing program there can proceed. The construction of these lines was included in the environmental assessment of the well field (Bureau of Reclamation, February 17, 1977).

(7) Wildlife Program

To compensate for wildlife population losses which would otherwise occur with the construction and operation of Radium Evaporation Pond for a 100-year period, land adjacent to the pond would be acquired and initially developed for wildlife as a unit cost. The development would be made substantially as recommended by the Fish and Wildlife Service in a memorandum of January 21, 1977. Consisting of about 1,320 acres within the minimum take line and about 2,340 acres acquired specifically for wildlife, this area would be improved by constructing five small water retention structures of about 2 acres each to collect runoff for vegetation and wildlife and by planting and fertilizing a mixture of species that are desirable for forage, such as wheatgrass, Indian ricegrass, wild rye, smooth brome, and fourwing saltbush. Fences would be installed around the outer perimeter of the area to exclude unmanaged livestock. It is estimated that those measures would increase the carrying capacity of the land sufficiently to compensate for the anticipated population losses of many species now found within the pond area. The area would be made available to the Colorado Division of Wildlife specifically for wildlife management. The Division has informally expressed a desire to manage the area, which has consequently been designed to adjoin land already under the Division's jurisdiction and thus facilitate an integrated management program.

All sites disturbed during construction, including the pipeline rights-of-way and construction access roads, would be revegetated with plants that would benefit wildlife. An estimated 218 acres, consisting of 199 acres along the brine pipeline and 19 acres at the well field, would be restored. Topsoil removed from the areas to be disturbed would be replaced, shaped, and contoured to blend with the landscape and to facilitate the growth of new vegetation. The plant species used would be selected for their wildlife value, and to ensure establishing a vegetative cover, fertilizer and water would be applied.

(8) Cultural Resource Program

Under a contract with the Bureau of Reclamation, archaeologists from Fort Lewis College surveyed the area of unit influence and identified 22 archaeological sites. The proposed locations of facilities have been adjusted to avoid 20 of the sites, and a program of data collection and evaluation would be conducted for the other two sites. At one site, an area of prehistorical lithic scatter in the proposed evaporation pond, the program would consist of collecting materials from the surface, testing for the depth of the materials, and determining cultural affiliations if possible. The second site, the remains of a homestead ranch, is also located within the proposed pond area. The program for this site would consist of gathering historical information and mapping and photographing the site. If the results were to indicate that either site would yield significant information, or should the sites be determined eligible for inclusion in the National Register of Historic Places, the Bureau of Reclamation would comply with Section 106 of the National Historic Preservation Act of 1966 which provides for Advisory Council comment on Federal undertakings, and would follow the "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800) which have been established by the Advisory Council on Historic Preservation to implement the aforementioned law.

The Bureau of Reclamation would mitigate the impact of the project on any significant cultural resource property located as a result of construction. Sites located during construction would be evaluated by an archaeologist or other appropriate professional. A determination would be made in consultation with the Office of the State Archaeologist of Colorado or the State Historic Preservation Officer, as appropriate, regarding the property's eligibility for inclusion in the National Register of Historic Places. Should the property be eligible, 36 CFR 800 would be followed.

(9) Source of Construction Materials

The required construction materials for building the unit features would include 7,400,000 cubic yards of impervious fill, 164,000 cubic yards of pervious fill, 120,000 cubic yards of riprap, and undetermined quantities of concrete aggregate and ready-mix concrete (Bureau of Reclamation, 1978a). The impervious materials for the dam, dike, and blanket would be available within the maximum waterline of the evaporation pond.

Pervious materials, concrete aggregate, and riprap would be available at a site about 13 road miles southeast of the evaporation pond site. The pervious material and concrete aggregate would consist of gravel deposits that have already been opened and used for highway construction. The riprap would be obtained from a hard, dense, crystalline limestone exposed in massive but moderately broken beds. Existing roads would provide access to the site. Ready-mix concrete would be bought from commercial suppliers.

(10) Unit Rights-of-Way

The unit rights-of-way would be obtained from both privately owned and public land. Table A-2 shows the rights-of-way according to feature and present ownership. The pipeline right-of-way is based on an 80-foot width for the public land to be withdrawn, with a 40-foot permanent easement and 40-foot temporary construction easement for private land.

Table A-2
Land acquisition (acres)

	Land ownership (acres)		
Feature	Bureau of Land Management	Private	Total
Brine well field 1/			
Withdrawn	60		60
Fee title		285	285
Easements		20	20
Hydrogen sulfide plant		6	6
Brine pipeline			
Withdrawn	125		125
Easements		74	74
Brine pipeline pumping plants	5	2	7
Radium Dam, Dike, and Evaporation Pond	1,250	3,700	4,950
Construction materials easements	20		20
Operating facilities		4	4
Wildlife area	1,050	1,290	2,340
Total	2,510	5,381	7,891

1/ Permits have been obtained from landowners to conduct the design data collection program. The land would be acquired by fee title or easements for permanent operations.

c. Operations

(1) Brine Removal

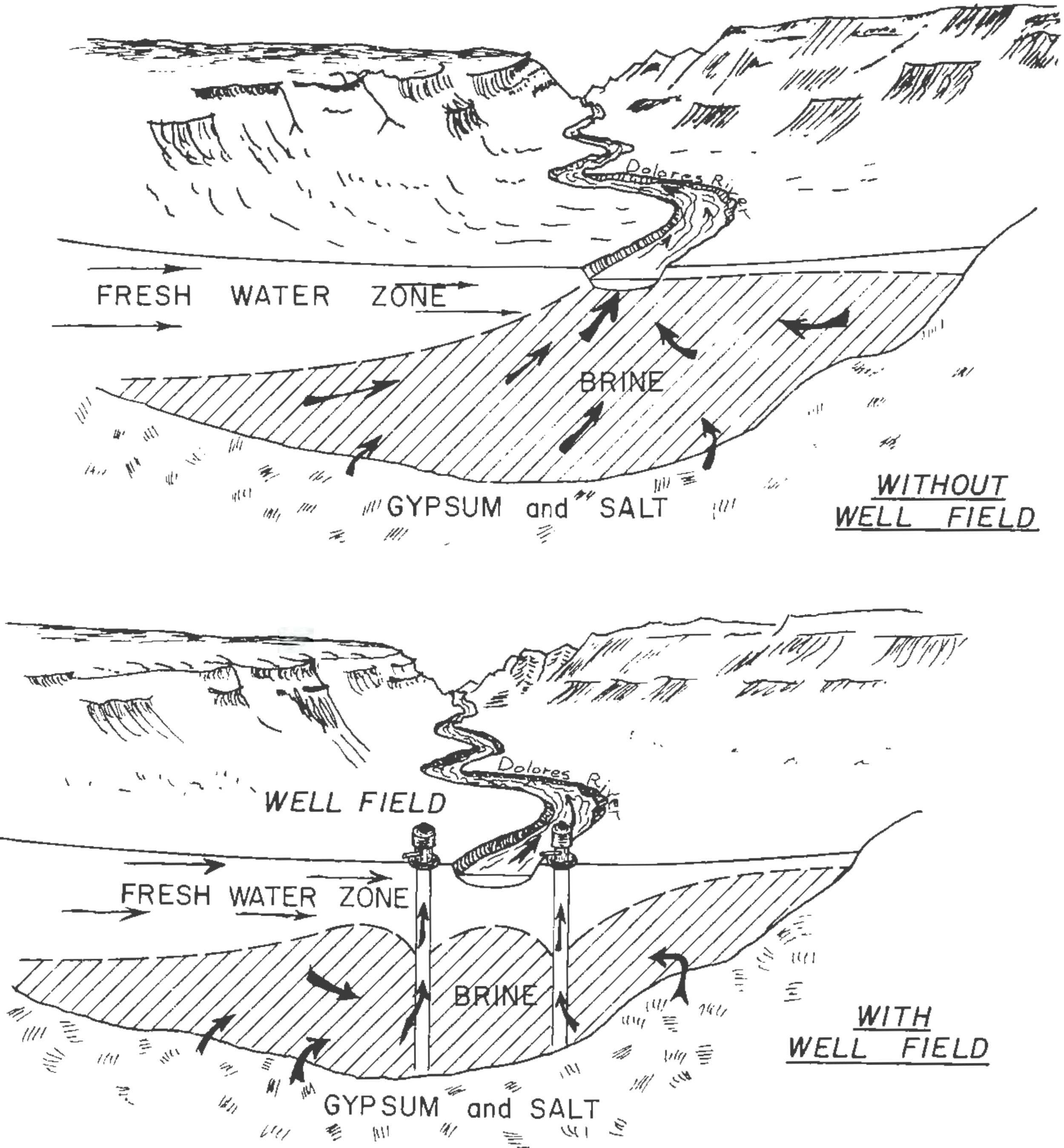
The operation of the well field would lower the level of the brine ground water to an elevation below the bottom of the stream channel and thereby reduce the flow of brine into the channel, as illustrated in Figure A-7. To maintain the lowered brine water table, the pumping rates would be continuously coordinated on the basis of information obtained from the ground water monitoring wells and the river monitoring system.

As explained in the introduction to this section, the unit's designs are based upon a maximum pumping rate of 5 cfs, which could be required to initially lower the level of the brine ground water and to adjust for possible fluctuations in ground water movement caused by seasonal and annual variations in recharge or other circumstances. Yet, once the brine was lowered, a reduced pumping rate would probably be sufficient as a long-term average to maintain the lower level, since the brine inflow is estimated to average only about 0.8 cfs.

Both the overall rate and the pattern of pumping are critical for effective unit operation. The pumping rate must be sufficient to lower the brine and keep it at the lower level, but not so large as to excessively lower the brine and draw the overlying layer of fresh ground water down into the pumping zone, which would result in unnecessarily high pumping rates. The pumping pattern is important, since lowering the interface too much in one part of the well field and too little in another would also result in inefficient operations by unnecessarily pumping fresh water in one area while still allowing brine to enter the river in another.

The evaporation pond would be designed for 100 years of operation based upon an average annual inflow of about 6,200 acre-feet. The inflow would consist of 3,600 acre-feet of brine, assuming a constant pumping rate of 5 cfs, and an average of 2,600 acre-feet of precipitation on the pond surface and runoff from the surrounding drainage area. Only 3,950 acre-feet of the 6,200-acre-foot total would constitute a depletion of the Dolores and Colorado Rivers, however, since only about 350 acre-feet of the precipitation and runoff would have reached the river under natural conditions--the remainder having been lost to evapotranspiration before ever reaching the river.

In the early years, the pond would grow fairly rapidly because the surface area would not be large enough for annual evaporation to exceed annual inflow. After about 25 years, over 50 percent of the total volume and over 75 percent of the total area would be occupied by brine and deposited salts. As the pond filled, however, the expanding surface area would cause a gradual increase in evaporation, and the rate of filling would consequently decline. The pond would grow to about 70 percent of its total volume and 85 percent of its total area after 50 years and to 75 percent of the volume and 90 percent of the area after 75 years.



BRINE - FRESHWATER INTERFACE

Colorado River Basin Salinity Control Project
Paradox Valley Unit, Colorado
Figure A-7

Evaporation rates for saturated brine vary considerably from seasonal variations in weather, but are estimated at an average of about 29 inches annually, about 85 percent of which occurs from April through October. After about the 30th year of operations, the annual evaporation would exceed the annual inflow, and the brine accumulated in earlier years would slowly be evaporated until it disappeared in about the 75th year. After this time, essentially all water reaching the pond each year would be evaporated, although there would be some carryover from year to year because of low evaporation rates in the winter. During the summers, the higher rate of evaporation would result in the exposure of a salt flat over much of the area. When full after 100 years, the pond would have an average evaporation potential of about 8,000 acre-feet annually to dispose of storm inflows.

Evaporation would increase the salinity of the brine from 260,000 mg/l initially to saturation at about 350,000 mg/l. This concentration would be reached after about 6 years and would be maintained during the remainder of unit operations, with only minor short-term changes from seasonal fluctuations in evaporation rates and from high storm runoff diluting the salts. Deposition would begin when the brine reached saturation, and the volume of the salts in the flooded area would gradually increase with respect to the volume of brine until the pond became essentially filled with salts and occasionally covered by only a thin layer of water.

(2) Water and Mineral Rights

The operation of the unit would deplete the Dolores River at a rate of up to 5 cfs. During periods of normal or high riverflows, this depletion would not affect diversions downstream by holders of senior water rights, since the flows would still be sufficient to fulfill their rights. In periods of low riverflows, however, the unit depletion would prevent the fulfillment of all the rights. Consequently, provisions would be required to compensate the users for reductions in their diversions, to obtain senior water rights for project operations, or to augment the streamflow by exchange or some other means. The method would be selected in coordination with the State of Colorado.

In addition, the Bureau would file with the State of Colorado for storage rights at Radium Evaporation Pond. The San Miguel Water Conservancy District holds a conditional storage right at the site, since the Bureau proposed in a 1966 feasibility report on the San Miguel Project to build Radium Reservoir for irrigation and fish and wildlife users (Bureau of Reclamation, 1966). Although the project was authorized by the Colorado River Basin Act of September 30, 1968 (Public Law 90-536) and is now in advance planning stages, the Bureau's project plan no longer includes any developments in Dry Creek Basin.

Appropriate action would also be taken to acquire whatever minerals or mineral rights were determined to be necessary for project operations. These acquisitions could include the mineral rights to the sodium at the wellfield.

(3) Power Use

The peak electrical capacity and average annual energy use of the unit facilities are shown in Table A-3 (Bureau of Reclamation, 1978a). Power needs for the hydrogen sulfide plant and the permanent operation and maintenance housing would be only incidental and have consequently not been listed.

Table A-3
Unit power use
(Pumping rate of 5 cfs)

Feature	Peak electrical capacity (kW)	Average annual energy use (kWh)
Brine well field	124	1,081,000
Pumping plants		
No. 1	260	2,270,000
No. 2	200	1,720,000
No. 3	200	1,750,000
No. 4	200	1,720,000
No. 5	200	1,720,000
No. 6	200	1,720,000
No. 7	190	1,700,000
No. 8	190	1,670,000
Total	1,764	15,351,000

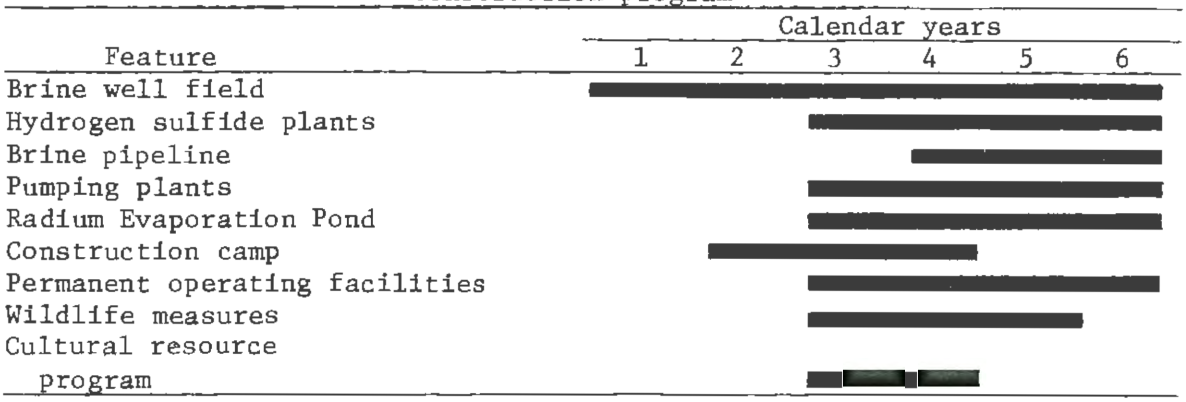
4. Administration, Operation, and Maintenance

The Bureau of Reclamation, from offices in Durango, Colo., would administer the Paradox Valley Unit. The unit would be operated year-round and would require four full-time personnel and additional temporary help during major equipment repairs (Bureau of Reclamation, 1978a). It is anticipated, as explained earlier, that the Colorado Division of Wildlife would administer the wildlife management area around Radium Evaporation Pond.

5. Construction Program

The construction of the unit would take 6 years. As shown in Figure A-8, the first 2 years of the construction program would be devoted almost exclusively to the testing program at the well field. Construction on the remaining major project features would only commence after the data collected had been analyzed to determine the most efficient pumping rate and environmentally sound disposal method. Construction would require an estimated average of 162 private and government employees annually, based on a 9-month construction season. The work force would be largest in the fifth year, when about 340 employees would be needed.

Figure A-8
Construction program



CHAPTER B

DESCRIPTION OF THE ENVIRONMENT

B. DESCRIPTION OF THE ENVIRONMENT

1. Conditions in the Lower Colorado Basin

Because of its total salt contribution of 205,000 tons annually, Paradox Valley is a major source of salinity in the Colorado River and increases the salinity of the river by about 21 mg/l at Imperial Dam. The 1976 modified salinity level at Imperial Dam is estimated by the Bureau to be 1,102 mg/l.[1/] The high salt concentrations in the Lower Colorado River Basin adversely affect more than 14 million people and about 1 million acres of irrigated farmland in the southwestern United States. The most severely affected are municipal and industrial users in the Los Angeles-San Diego area and irrigators in southern California and Arizona. Overall, the damages attributable to salinity were estimated at $53 million in 1973 and may reach an annual level of $124 million by the year 2000 with continued development of water resources and no measures for salinity control (Bureau of Reclamation and Soil Conservation Service, 1977).

According to a recent study by the Bureau of Reclamation, water users in the lower basin have annual economic losses of $230,000 for each increase of 1 mg/l at Imperial Dam, consisting of $188,000 for direct impacts and $42,000 for indirect impacts (Kleinman, et al, 1974). Consequently, the damages to users resulting from the salt contribution of 21 mg/l from Paradox Valley are estimated to be $4,830,000 annually. The losses connected with municipal and industrial use come primarily from increased water treatment costs, accelerated pipe corrosion and appliance wear, increased soap and detergent needs, and decreased drinking water potability. For irrigators, the higher concentrations result in decreased crop yields, altered crop patterns, increased leaching and drainage requirements, and increased management costs.

2. General Unit Setting

The Paradox Valley Unit area consists of Paradox Valley on the main stem of the Dolores River and the northern part of the Dry Creek Basin to the southeast in the San Miguel River drainage. The San Miguel River is a tributary of the Dolores River, which in turn is a tributary of the Colorado River.

1/ The 1976 modified salinity level is a hypothetical preproject condition which takes under consideration all Reclamation projects constructed or under construction as of 1976. For further explanation see Cumulative Impacts, Section C-11-f.

Paradox Valley is 3 to 5 miles wide and 24 miles long on a northwest-southeast axis. The valley floor is relatively flat and is enclosed by steep, sometimes nearly vertical, walls of sandstone and shale. Elevations vary from under 5,000 feet along the river in the valley to about 7,000 feet on the divide between the valley and Dry Creek Basin.

The valley has a distinctive scenic quality. Contrasting with the reddish hues of the rugged sandstone walls are the green hues of riparian growth along the river and West Paradox Creek, irrigated land in the western part of the valley, and juniper stands on some of the valley's side slopes. The La Sal Mountains, which are located in the Manti-La Sal National Forest, border Paradox Valley on the northwest and rise to an elevation of about 12,000 feet. These mountains, forested on the lower slopes and often snow-capped, form a striking background to the valley.

Dry Creek Basin is a relatively broad, shallow valley that is approximately 15 miles long and 5 miles wide and varies in elevation from 6,300 feet in the center to about 7,000 feet on the northern edge. The northeast slope of the basin has been incised by the main stem and West Fork of Dry Creek, which drains northeast into the San Miguel River. The basin is more open than Paradox Valley, with predominantly gentle slopes covered by pinyon-juniper woods at higher elevations and sparse shrubs at lower ones. This area does not exhibit the distinctive color and topography that gives Paradox Valley its attractive quality.

The only communities in the valley are the very small farming towns of Paradox and Bedrock. Other communities in the vicinity are Nucla, Uravan, and Naturita, all located on or near the San Miguel River to the east of the valley. There are no communities in the northern part of Dry Creek Basin. The nearest commercial centers are Moab, Utah, 60 miles to the northwest of Bedrock; Montrose, Colo., 70 miles to the northeast; Grand Junction, Colo., 100 miles to the north; and Cortez, Colo., 100 miles to the south.

Although relatively isolated, the unit area is served by a network of Federal and State highways and county and local roads. Colorado State Highway 90, Utah State Highway 46, U.S. Highways 163 and 50, and Interstates 15 and 70 provide access to Moab and to Salt Lake City, Utah, about 300 miles northwest. Colorado State Highways 90 and 141, U.S. Highways 6 and 50, and Interstate 70 provide access to Montrose, Grand Junction, and Denver (about 260 miles east of Grand Junction).

The unit area is characteristic of the semiarid Southwestern United States, with low precipitation and humidity, abundant sunshine, high evaporation rates, and wide ranges between daily high and low temperatures. The prevailing winds are from the southwest and are fairly strong in the spring. The Bureau of Reclamation has maintained weather stations at Bedrock and in Dry Creek Basin since 1975. During this time, the average annual precipitation has been about 8 inches at both locations, occurring primarily from July through October in the form of afternoon thunderstorms. Temperatures have varied from daytime highs of about 100° F in the summer to nighttime lows of about -20° F in the winter.

3. Economic and Social Conditions

a. Population

Paradox Valley, Dry Creek Basin, and surrounding areas are very sparsely populated, and the population is generally concentrated in the small communities. Although census figures are unavailable, the Bureau of Reclamation estimates the population of Paradox Valley at roughly 300 people, including about 200 in Paradox and 80 in Bedrock, both of which are unincorporated farming communities. The northern part of Dry Creek Basin, where the evaporation pond would be located, has no population. The only incorporated towns in the general area are Naturita (pop. 1,000) and Nucla (pop. 1,000), located about 20 miles southeast of Bedrock. Another community in the area is Uravan (pop. 650), a company-owned mining town about 10 miles northeast of Bedrock.

b. Economic Development

The only significant economic activities in and near the unit area are agriculture and mining for uranium and coal. Agricultural development has been relatively stable compared to mining, which has undergone considerable fluctuation in uranium exploration and development.

In Paradox Valley the main economic activity is agriculture, which employs nearly all of the local residents. The western part of the valley contains about 2,500 acres of irrigated land, producing primarily livestock feeds. Livestock are grazed on the nearby La Sal Mountains during the summer and in eastern Paradox Valley and Dry Creek Basin during the late winter and early spring. Irrigated agriculture is also practiced outside the immediate unit area in the vicinity of Nucla, employing nearly half of the town's residents.

Uranium mining and processing, after a period of intense activity in the 1950's and a substantial decline in the 1960's, has rapidly expanded in recent years in the general area of the unit. Carnotite, a mineral containing vanadium and the radioactive elements uranium and radium, is mined on mesas around Paradox Valley and Dry Creek Basin, and most of the ore is trucked to a processing plant operated by Union Carbide in Uravan. The plant uses brine piped from a well in Paradox Valley, and local drilling operations use brine purchased from a second well in the valley (see Figure B-1). Undeveloped mining claims blanket the site of Radium Evaporation Pond. A new uranium ore processing mill is in the planning stage for construction in the vicinity of Slick Rock, Colo., about 40 miles southwest of Nucla. The project would bring a maximum of about 840 temporary residents into the area in 1981, the projected peak construction year; up to 170 new residents would remain in the area to work in the mill through 1988. (Western Montrose County Comprehensive Development Plan, Regional Planning Commission, 1978.) Coal is strip-mined in the vicinity of Nucla for a small powerplant located on the San Miguel River southeast of the town. There is some discussion of expanding the strip mining operation. Colorado Ute Power is currently studying the feasibility of a coal-fired, steam-generating plant near the project area, but the venture is highly speculative at this time because of the quality of coal in the area. On the basis of what is known at present, the plant could employ a maximum of 6,320 persons in 1985 for construction, a number that would decline to a maximum of 840 once the plant becomes operational. The precise location of the plant is highly uncertain at this time (Western Montrose County Comprehensive Development Plan, Regional Planning Commission, 1978). Overall, mining employs directly and indirectly nearly all of the people in Uravan and Naturita, as well as over half of the population of Nucla.

Other types of development are generally of minor significance. Two small sawmills in the town of Paradox are supported by logging in the La Sal Mountains and other areas to the east, but do not provide substantial employment.

c. Availability of Housing and Utilities

Housing and utilities are generally adequate for the existing population but could not handle any population growth without expansion. Although in some cases new construction could meet the demands of moderate, long-term growth, the area lacks the flexibility to accommodate short-term fluctuations without straining facilities. Essentially all of the housing units and mobile home hookups are occupied, and only the town of Nucla has plans for future growth. Based primarily upon the possibility of increased coal mining northwest of town, these plans call for a 35-unit mobile home park and an 89-unit subdivision.

The residents of Paradox and Bedrock use private wells and septic tanks. In the other communities, public utilities provide water and sewage but are already operating at their capacity. Naturita has a new water treatment plant, but the distribution system has serious leakage problems. The town has received Federal funds to rehabilitate its existing system and to add service for about 1,000 customers. The sewage system is old and operating at capacity. To accommodate its planned housing expansion, Nucla plans to expand its domestic water system by 160 taps by adding a 500-gallon storage tank, lining an existing reservoir, and replacing the distribution system. The town also plans to include funds in its 1978 budget for installing an aeration unit at its open sewage lagoon, which would double its capacity (it now serves about 440 houses). The company-owned town of Uravan has adequate water and sewage facilities, and no expansion is expected. If any modifications are made, they will be closely tied to increased operations at the uranium processing plant.

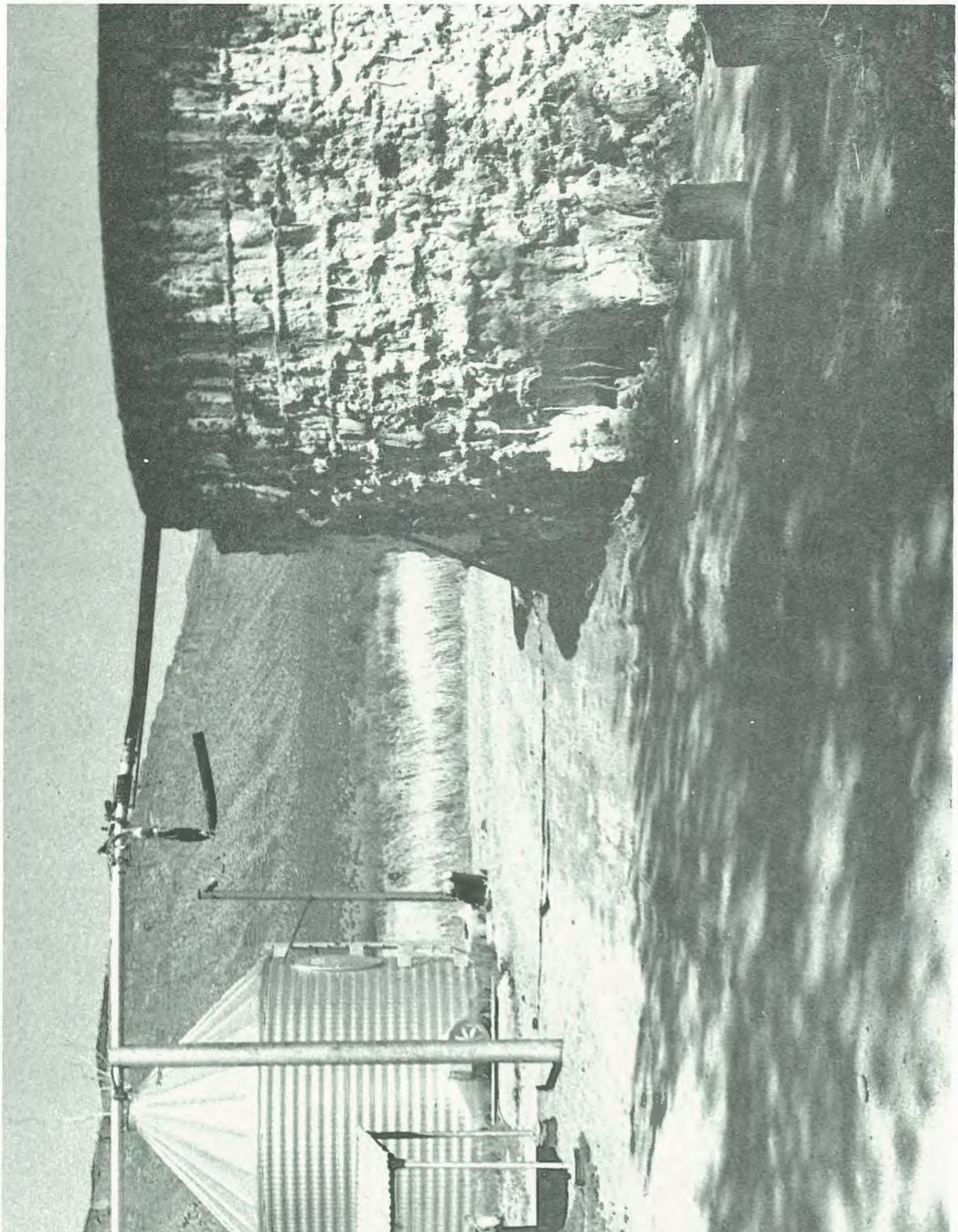


Figure B-1--Existing brine well and storage tank encrusted with crystallized salts.

The unit area is served by the Nucla-Naturita Telephone Company, the San Miguel Power Association, the Northwest Pipeline Company (natural gas), and the Arrow Propane Company. The facilities are all adequate for the present and could also respond to moderate growth with no problems.

d. Facilities and Services

(1) Education

The unit area lies within the West End School District in Montrose County and the Norwood School District in San Miguel County. The West End District contains elementary schools at Paradox, Nucla, and Uravan; a junior high school at Naturita; and a senior high school at Nucla. All of these facilities are in good condition. With a total enrollment of 923 students and a staff of 53 teachers, the student-teacher ratio is about 17 to 1. The district considers a ratio of 25 to 1 to be ideal and estimates that a ratio of up to 30 to 1, while not desirable, could be accommodated by the existing system. A special education program is available for children with learning disabilities. The Norwood School District has one elementary school, with grades kindergarten through 8th grade, and one high school with grades 9 through 12. There are 25 teachers and 335 students in all grades, giving a student to teacher ratio of 14 to 1. In addition, a small school with grades kindergarten through 3rd grade is located in Dry Creek Basin. This school presently has 1 teacher and an average of 3 to 5 students. The school has had as many as 10 students in the past. At present the school district operates a 62-passenger bus into the Dry Creek area where it picks up 20 children.

(2) Medical Care

Medical personnel and facilities are extremely limited in the area. A general practitioner is located in Nucla, and a company doctor for Union Carbide in Uravan also maintains a private practice. In addition, two county nurses make periodic visits to the area. Two ambulances are located in Nucla. The nearest hospitals are in Moab, Grand Junction, Montrose, and Cortez.

(3) Police and Fire Service

Police protection for the local area is provided by the Montrose County Sheriff's Office, town marshals in Nucla and Naturita, and volunteer sheriff's posses in both towns. The nearest jail is located in the county seat of Montrose.

A volunteer fire department of about 50 men serves the Nucla-Naturita area, with two engines at Nucla and one at Naturita. Uravan has a company fire department operated by Union Carbide. No organized fire units are located in Paradox Valley or Dry Creek Basin.

(4) Transportation

No daily passenger service to the area is provided by commercial airlines, buses, or railroads. A small airport at Nucla handles small private and chartered planes, and the Gateway-Uravan Stage (a large station wagon) offers daily mail and passenger service between the area and Grand Junction.

(5) Recreation

Recreational facilities in the communities are limited to a bowling alley, indoor theater, and park in Nucla and a drive-in theater in Naturita. In both towns, residents may participate in or view activities at the junior high and high schools. Residents may also take part in the various hunting seasons and may fish year-round in lakes and streams in the area.

(6) Retail Trade

Retail trade is quite limited and generally directed toward essential items, with local residents travelling to commercial centers outside the area for a significant amount of shopping. Nucla and Naturita each have one grocery store, one pharmacy, one hardware store, and two cafes.

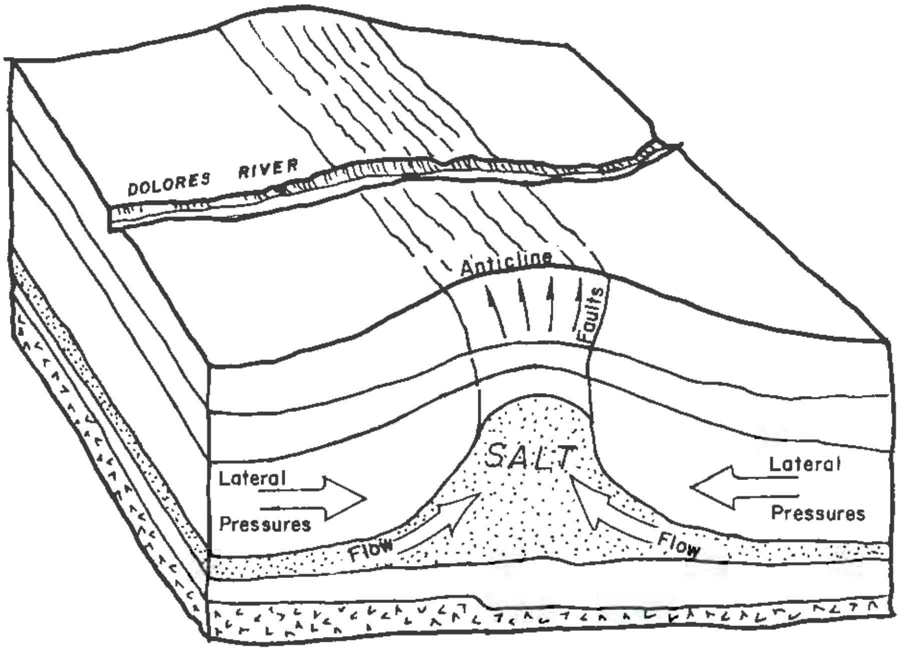
4. Air Quality

Because Paradox Valley and surrounding areas are sparsely populated, with few industries to affect air quality, the major sources of suspended particulates are generally limited to wood waste-disposal areas and open-burning disposal areas. The two small lumber mills in the town of Paradox produce a visible plume from burning waste but are not large enough to deteriorate the general air quality. The nearest industries are a coal-fired generating plant at Nucla and a uranium mill at Uravan. Although only partial air quality data are available, the Colorado Department of Health indicates that the plant and mill have no significant effect on Paradox Valley or Dry Creek Basin (Telecommunication, Colorado Department of Health, Denver, Colo., 10/31/77).

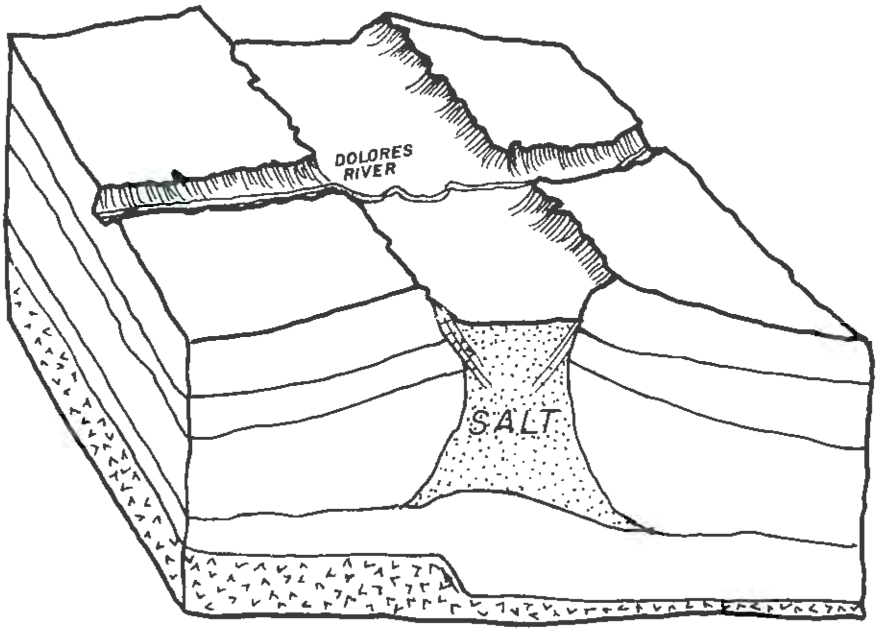
5. Geology

a. Paradox Valley

Paradox Valley lies along one of five major salt anticlines that have been identified in southwestern Colorado and southeastern Utah. The valley was formed by the erosion of faulted and uplifted sandstone and shale formations, exposing a residual gypsum cap that covers approximately 14,000 feet of salt and salt-rich shale (Cater, 1970). Figure B-2 illustrates the development of the valley, which may have begun as long ago as 250 million years. The emergence of distant



EARLY STAGE



PRESENT STAGE

PARADOX ANTICLINE STAGES OF DEVELOPMENT

Colorado River Basin Salinity Control Project

Paradox Valley Unit

FIGURE B-2

mountains on each side of the area placed lateral pressures on the intervening sedimentary formations, resulting in warping and fracturing along weak zones. Consequently, a deeply buried layer of salt began to flow upward into the fractured area, creating an elongated swell known as an anticline. The crest of the anticline has gradually collapsed as a result of the fracturing, and the Dolores River has combined with East and West Paradox Creeks and other erosional forces to remove the collapsing upper materials and give the valley its present form. A General Geology Map for the unit is shown in Figure B-3.

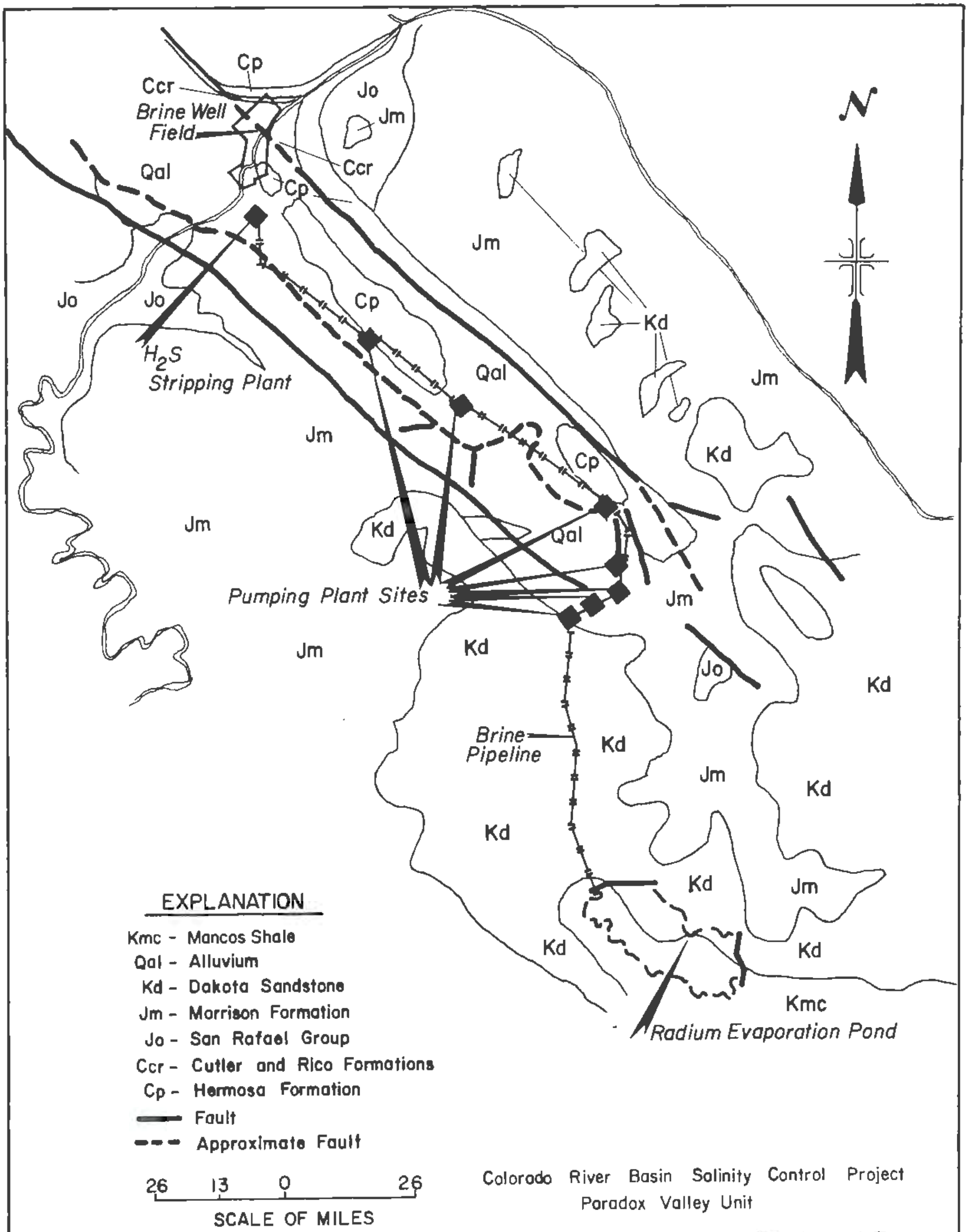
b. Unit Features

The brine well field would be located on a flood plain composed of an average of about 10 feet of poorly graded sand underlain by clay-filled gravels and cobbles sometimes extending to depths of over 100 feet. The soils in the well field area are nonplastic silts and very fine sand. These materials are unconsolidated and completely saturated part of the year, but judging from the heavy drill rigs that have been at the well site, they have very good bearing strength. The hydrogen sulfide stripping plant, located just outside the flood plain, would be underlain by silty sand, lean clay, and caliche to a depth of almost 15 feet. The brine pipeline and pumping plants would be constructed in soil varying from silty sand to lean clay, with occasional alluvial gravels and rocky slopewash deposits. Although the pipeline would cross fault blocks on the slopes of the divide between Paradox Valley and Dry Creek Basin, they are apparently inactive. The soils in Paradox Valley are predominantly reddish-brown eolian, with moderate permeability and low salinity.

At Radium Evaporation Pond the abutments and foundation of the dam would be located on the relatively tight, good foundation of Mancos Shale and Dakota Sandstone. Part of the dike would be located on a tight foundation of clay derived from Mancos Shale, and part would be located on a tight bed of shale which is part of the Dakota Sandstone Formation. Water tests conducted by the Bureau at a number of drill holes in the pond basin indicated that the underlying material was entirely impervious (Bureau of Reclamation, 1978b). This condition is also evident from the artesian flow produced in nearby stock wells drilled into an aquifer which underlies the Mancos Shale. The soils of the pond area and surrounding land within the proposed right-of-way are characterized by a relatively thin mantle of reddish-brown eolian soil and grayish-brown residual soil underlain by clay derived from Mancos Shale. The reddish-brown soil has moderate permeability and low salinity, while the grayish-brown soil has moderately slow permeability and high salinity (Bureau of Reclamation, 1978b).

c. Mineral Resources

The unit area lies within the Uravan Mineral Belt, an extensive mineralized region in eastern Utah and western Colorado. The belt has for decades been Colorado's leading source of uranium and the



GENERAL GEOLOGY MAP

FIGURE B-3

associated minerals vanadium and radium. Most of the mineralization occurs in the Salt Wash Member of the Morrison Formation, which has been extensively mined on mesa tops and outcrops in the vicinity of the unit area. The Salt Wash Member reportedly lies about 900 to 1,500 feet beneath the site of Radium Evaporation Pond, and the area is blanketed in mining claims (Ward, 1977). Claims have also been staked on the north side of the divide between Paradox Valley and Dry Creek Basin. Although no development has occurred, Union Carbide Corporation is at present conducting exploratory drilling in the basin to determine if the deposits are great enough to warrant development. The corporation reports that an extremely large ore deposit would have to be found in order to make its recovery economically feasible. To date, ore bodies of substantial size have not been delineated, but the company is sufficiently encouraged to continue exploration through 1978 (Letter, Union Carbide Corporation, Grand Junction, Colo., October 5, 1977).

The edges of Paradox Valley and Dry Creek Basin are favorable geologic structures for oil and gas accumulation, and small gas fields are located about 5 miles north and 3 miles south of the evaporation pond site (Ward, 1977). No producing wells have been drilled, however, although exploration has been conducted in the basin. The pond site itself, centrally situated over the trough of the syncline, is not a likely location for gas accumulation.

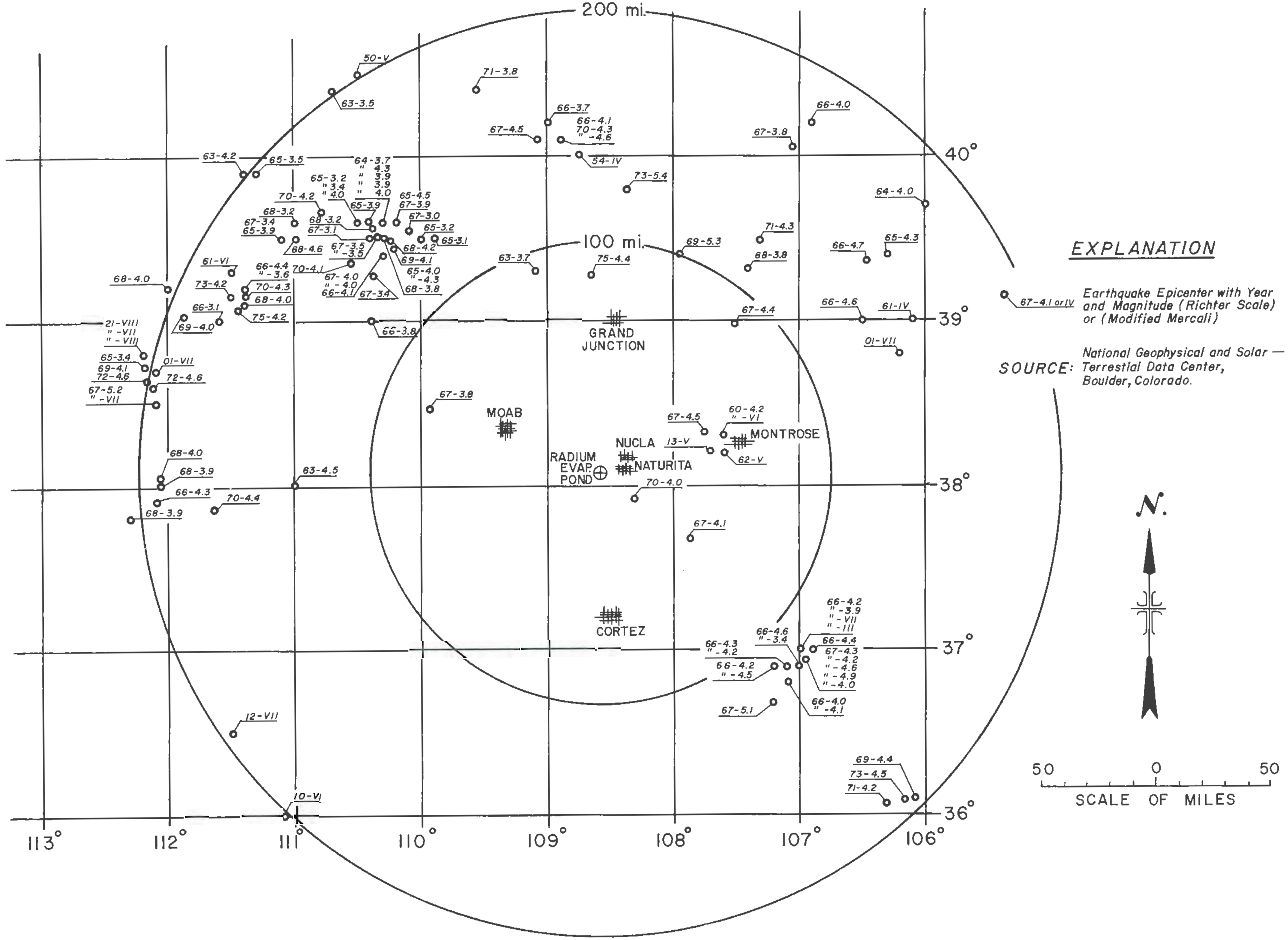
d. Seismicity

The Paradox Valley Unit would be located in an area of minimal seismic risk in which very little damage could be anticipated from earthquakes. No known epicenters have been recorded within the immediate unit area; however, tremors from other areas may be felt. According to the National Geophysical and Solar-Terrestrial Data Center, earthquakes within a 200-mile radius of the unit area have had recorded magnitudes ranging from approximately 3.0 to 5.4 on the Richter Scale and a range of Mercalli intensity from III to VIII. No known epicenters have been located within 19 miles of the unit area (see Figure B-4).

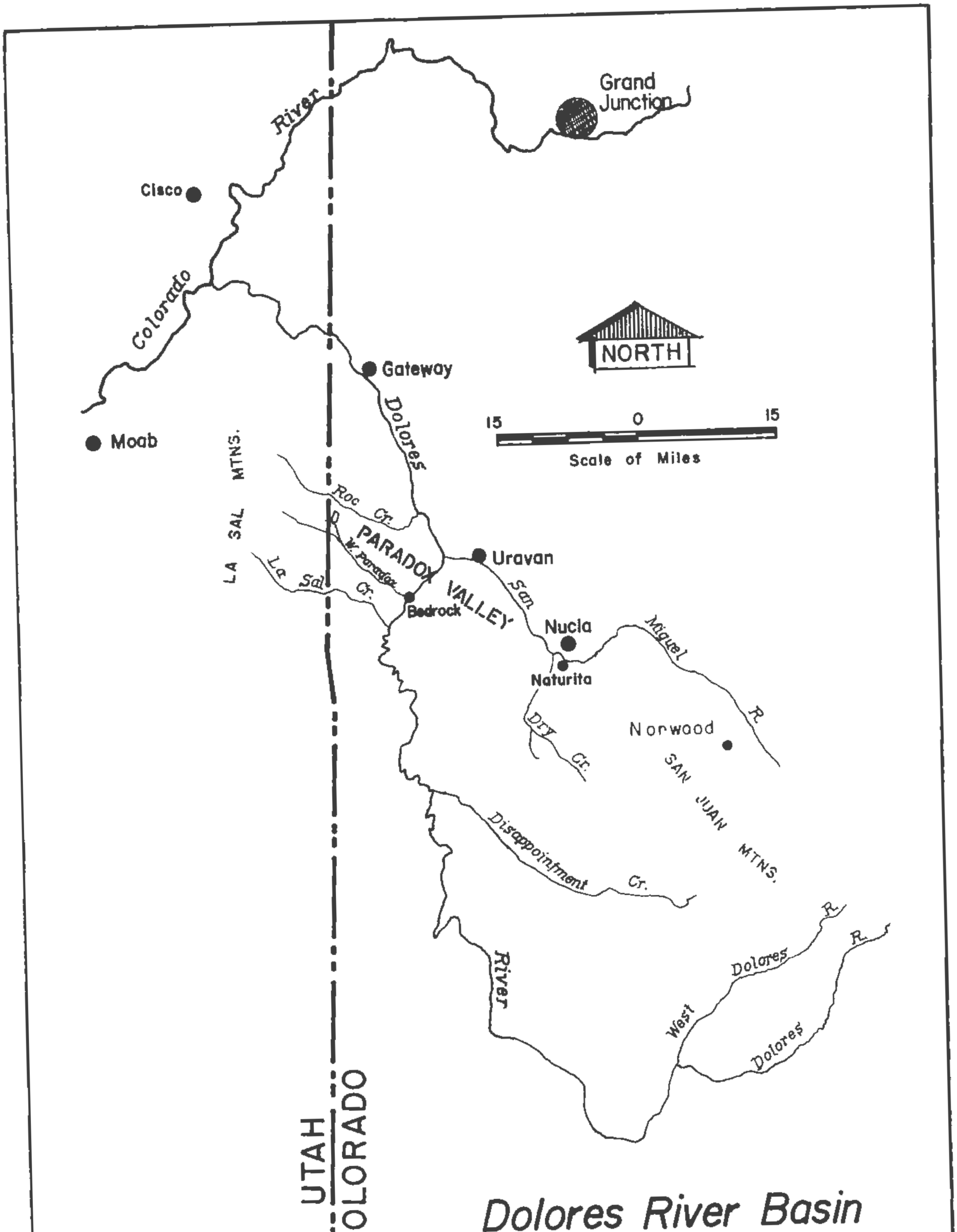
6. Water Resources

a. Stream Systems

The major streams in the unit area are the Dolores River and its largest tributary, the San Miguel River (see Figure B-5). Both exhibit the large seasonal fluctuations characteristic of streams in southwestern Colorado, with very high runoff during the spring because of melting snow in the mountains and very low flows after midsummer. The Dolores River is normally low and occasionally dry in Paradox Valley during the late summer and fall as a result of declining snowmelt runoff and large irrigation diversions in the upper part of the basin. Occasional high flows of very short duration occur in the summer and fall, however, from afternoon thunderstorms. Smaller tributaries of the



SEISMIC MAP
PARADOX VALLEY UNIT - COLORADO
FIGURE B-4



Dolores River Basin
Colorado River Basin Salinity Control Project
Paradox Valley Unit

FIGURE B-5

Dolores include La Sal Creek, which enters from the northwest about 5 miles upstream from Paradox Valley, and West Paradox Creek, which enters from the northwest within Paradox Valley. East Paradox Creek, which drains the southeastern part of the valley, is intermittent and has essentially no effect on the river. The only tributary of the San Miguel River in the area is Dry Creek, which is also intermittent and has little effect on the riverflow.

The Dolores River originates in the San Juan Mountains of Colorado to the southeast of the unit area and flows for about 165 miles to Paradox Valley, which it crosses perpendicular to the valley's axis. The river then flows another 70 miles to its confluence with the Colorado River northeast of Moab. Since 1971, when the Bureau installed a gaging station at Bedrock (where the river enters Paradox Valley), the average annual flow has been 299,400 acre-feet (Bureau of Reclamation, 1978b). About 83 percent of the flows in the Dolores River have occurred during April, May, and June. Daily flows have varied from a maximum of about 9,280 cfs in April to no flow in September. A small amount of water is diverted just above the stream gaging station at Bedrock for irrigation in the valley, but flows are also contributed from West Paradox Creek, irrigation return flows, and saline ground water. Consequently, the average annual flow at the exit from the valley from 1971-76 has been about 313,500 acre-feet. Recorded daily flows have varied from a maximum of 9,500 cfs in April to a minimum of 0.5 cfs in August.

The flows of the river will be altered by the Bureau of Reclamation's Dolores Project, on which construction was begun in September of 1977. The Final Environmental Statement was filed with the Council on Environmental Quality (CEQ) on May 9, 1977 (INT FES 77-12). The project involves the construction of McPhee Dam on the river about 110 miles upstream from Paradox Valley to store water for irrigation, municipal and industrial use, and a stream fishery. This development will reduce the average annual flow by about 105,200 acre-feet, or 35 percent of the flow at Bedrock and 20 percent at the mouth of the river. Generally, the reductions will occur during the high spring runoff. In the summer, fall, and winter, when the river is normally low, releases made at the dam to improve the stream fishery will increase the flow downstream. Averaging 25,400 acre-feet annually, these releases will be maintained at minimums of 20 cfs in dry years, 50 cfs in normal years, and 78 cfs in wet years. It is estimated that the releases will provide increased flows in Paradox Valley in normal and wet years, or about 3 out of every 4 years. In dry years the releases will probably be entirely depleted by evapotranspiration before reaching the valley.

Portions of the Dolores River have been recommended for inclusion in the National Wild and Scenic River System, based upon studies made pursuant to a 1975 amendment to the Wild and Scenic Rivers Act of October 2, 1968. A final environmental statement on the proposed inclusion was prepared by the Bureau of Outdoor Recreation, U.S. Department of the Interior, and the Forest Service, U.S. Department of Agriculture, and filed with CEQ in 1976 (INT FES 76-56). Paradox Valley was specifically excluded from the studies, which were conducted by the U.S. Departments of Agriculture and the Interior and the Colorado Department of Natural Resources. These agencies recommended that a 105-mile reach of the river immediately above Paradox Valley be included in the system and that the reach from just below the valley to the Utah State line not be included until further studies were completed.

West Paradox Creek, originating on the southeast slopes of the La Sal Mountains, flows to the southeast through Paradox Valley to its confluence with the Dolores River. The creek contributes an average of about 6,600 acre-feet annually to the river, with recorded flows varying from about 2.5 to 82 cfs. The flow is partially regulated by Buckeye Reservoir, a 1,600-acre-foot facility located on the upper part of the drainage, where water stored during spring runoff is released in the summer to irrigate land in western Paradox Valley.

The San Miguel River also originates in the San Juan Mountains and flows to the northwest for about 65 miles, joining the Dolores about 3 miles downstream from Paradox Valley. The average flow at Uravan, 4 miles above the confluence, is estimated at 107,500 acre-feet annually and 83,200 acre-feet during April through July.

b. Ground Water

Brine ground water appears to underlie the entire length of Paradox Valley at varying depths (Bureau of Reclamation, 1978b). This ground water is very close to the surface along the Dolores River and is in contact with the bottom and sides of the river channel for about 1.5 miles, beginning at the middle of the valley and extending downstream to near the river's exit from the valley. The depth to the top of the brine appears to increase upstream and to the west. Concentrated brine has been measured in a well at a depth of more than 100 feet about a mile west of the well field. To the east of the river the brine remains near the surface.

The brine surfaces at several locations in and adjacent to the streambed. Although it is impractical to directly measure this inflow, since it occurs in the form of many small springs and seeps, the Bureau estimates that it varies from 0.2 to 2.1 cfs and averages 0.8 cfs. The flow seems to exhibit a certain degree of seasonal fluctuation, being at its lowest during the spring or summer and at its highest during the fall or winter.

A layer of comparatively fresh water overlies the brine in West Paradox Valley and also surfaces in the river. The top of this water lies from 10 to 40 feet below the surface, depending upon location, and is pumped from wells for irrigation. The closest irrigation well is about 1 mile from the river. Known to be at least 100 feet thick about a mile from the river, the layer gradually thins out closer to the river. This water, in addition to the brine, results in a total contribution to the river of between 1.5 and 4 cfs from seeps and springs (Bureau of Reclamation, 1978b).

7. Water Quality

a. Stream Systems

Information on water quality in the area is available from several sources. The Bureau of Reclamation, as part of its investigations for the unit, has collected samples from the Dolores River at Bedrock, at its exit from Paradox Valley, and at a point about 5 miles below the confluence with the San Miguel River. The Bureau has also collected samples from West Paradox Creek. In addition, the Environmental Protection Agency has provided data on water samples collected by various other agencies from the Dolores River in the vicinity of the unit area and from the San Miguel River. Attachment 1 at the back of this environmental statement summarizes this information.

The quality of the streams varies considerably on a seasonal basis because of fluctuations in runoff and in the volume of brine ground water entering the Dolores River channel. Salt concentrations are low during the high spring runoff but increase drastically as the flow drops, particularly in the Dolores River below the area of surfacing brine. Heavy metals, conversely, are normally at higher levels during the spring, when the high rates of flow scour sediments from the riverbed. Turbidity is also high at this time. The Dolores and San Miguel Rivers also contain low levels of radioactive particles derived from natural sources and from the extensive uranium mining that has occurred in the area.

Analysis of samples collected by the Bureau during a 5-year period from 1971 to 1976 indicated the concentration of total dissolved solids (TDS) in the Dolores River where it enters the valley at Bedrock (above the brine well field) varied from 140 to 3,700 mg/l and averaged 697 mg/l (Bureau of Reclamation, 1978b). The predominant constituents were sulfate, bicarbonate, chloride, sodium, and calcium. The annual salt load averaged about 107,000 tons. Samples collected at the same general location by the Colorado State Department of Health from 1969 through 1972 contained radioactive particles, but only one sample exceeded the Public Health Service's acceptable limits for drinking water.

The Bureau's samples collected from the river at its exit from Paradox Valley (below the brine well field) during the same period had TDS concentrations varying from 170 to 166,000 mg/l and averaging about 12,280 mg/l. At the times of high salinity, nearly all of the water in the river originated from surfacing brine and irrigation return flows. Particularly high were the average concentrations of sodium, which increased from 117 to 4,309 mg/l as the river crossed the valley, and chloride, which increased from 148 to 6,911 mg/l. Significant but smaller increases occurred in the levels of sulfate, potassium, magnesium, and calcium. The annual load of dissolved solids averaged about 312,000 tons, indicating that the river picked up about 205,000 tons in crossing the valley. The estimated daily pickup averaged 560 tons and varied from a minimum of 115 tons to a maximum of 1,430 tons. The

Bureau's samples were not analyzed for radioactivity, but samples collected by the Colorado State Department of Health from 1970 to 1976 about 5 miles downstream did have low levels of radioactive particles. These samples also contained heavy metals and selenium in low concentrations.

Table B-1 shows the average concentrations of major chemical constituents of the Dolores River at Bedrock (above the brine area) and near Bedrock (below the brine area) during the Bureau's 5-year period of sampling. As the table indicates, the levels of sodium and chloride increased substantially between these two locations, while sulfate, potassium, magnesium, and calcium underwent smaller increases.

Table B-1
Major chemical constituents
Dolores River, 1971-76
(mg/l)

	At Bedrock	Near Bedrock
Total dissolved solids	697	12,282
Sodium	117	4,309
Chloride	148	6,911
Sulfate	204	618
Potassium	6	225
Magnesium	25	109
Calcium	80	165
Bicarbonate	176	189

Below the mouth of the San Miguel River the salinity of the Dolores River decreases considerably during periods of low flow because of the inflow of comparatively fresh water. During periods of high flow, the San Miguel is much smaller than the Dolores River but similar in salt concentration and, consequently, has little effect on salinity. Samples collected by the Bureau from 1974 to 1976 about 5 miles below the confluence had an average salinity of about 2,230 mg/l, with extremes of 170 mg/l and 7,920 mg/l. As was typical with other reaches, the predominant salts were chloride, sodium, and sulfate. Samples collected somewhat farther downstream by other agencies indicated low to moderate levels of heavy metals, selenium, and radioactivity.

West Paradox Creek, which joins the Dolores River in the brine well field area, has a minor effect on the quality of the Dolores River, contributing about 19 tons of salt per day and 7,000 tons per year according to Bureau of Reclamation samples for 1971-76. The salinity of the creek, averaging about 800 mg/l during this period, has ranged from 260 to 1,970 mg/l and has consisted primarily of sulfate, bicarbonate, and calcium.

The San Miguel River, as indicated earlier, contributes relatively fresh water to the Dolores River. Based upon samples collected by the Colorado State Department of Health, the estimated TDS concentration has averaged about 700 mg/l. The salinity of the river consists primarily of sulfate, calcium, chloride, sodium, and magnesium. Radioactivity and heavy metals have been low to moderate.

b. Ground Water

Seeps and springs along the banks and bed of the Dolores River in Paradox Valley are of two general types: those with relatively fresh water varying from about 1,500 mg/l to 4,000 mg/l and those with brine of about 250,000 mg/l. Water pumped from test wells near the river has had a salinity of about 260,000 mg/l (Bureau of Reclamation, 1978). The brine, which is nearly 8 times as saline as sea water, consists almost entirely of sodium and chloride, with smaller amounts of sulfate, potassium, and other salts. Heavy metals, particularly iron and lead, and nonradioactive strontium are also present in limited amounts. Noticeable amounts of hydrogen sulfide gas in excess of 100 mg/l are released into the atmosphere as the brine surfaces, creating a noxious odor.

Bureau studies (Bureau of Reclamation, 1978b) indicate that ground water contributes a total salt load of about 198,000 tons annually to the river, with daily values of from 100 to 1,430 tons. The brine evidently accounts for essentially all of the salt, since the relatively fresh water could contribute only about 16 tons per day at a flow rate of 4 cfs, which is estimated to be the maximum flow of all ground water entering the river. The brine, however, at its estimated flow of 0.2 to 2.1 cfs and a salinity of 260,000 mg/l, could produce 100 to 1,430 tons daily.

8. Vegetation and Land Use

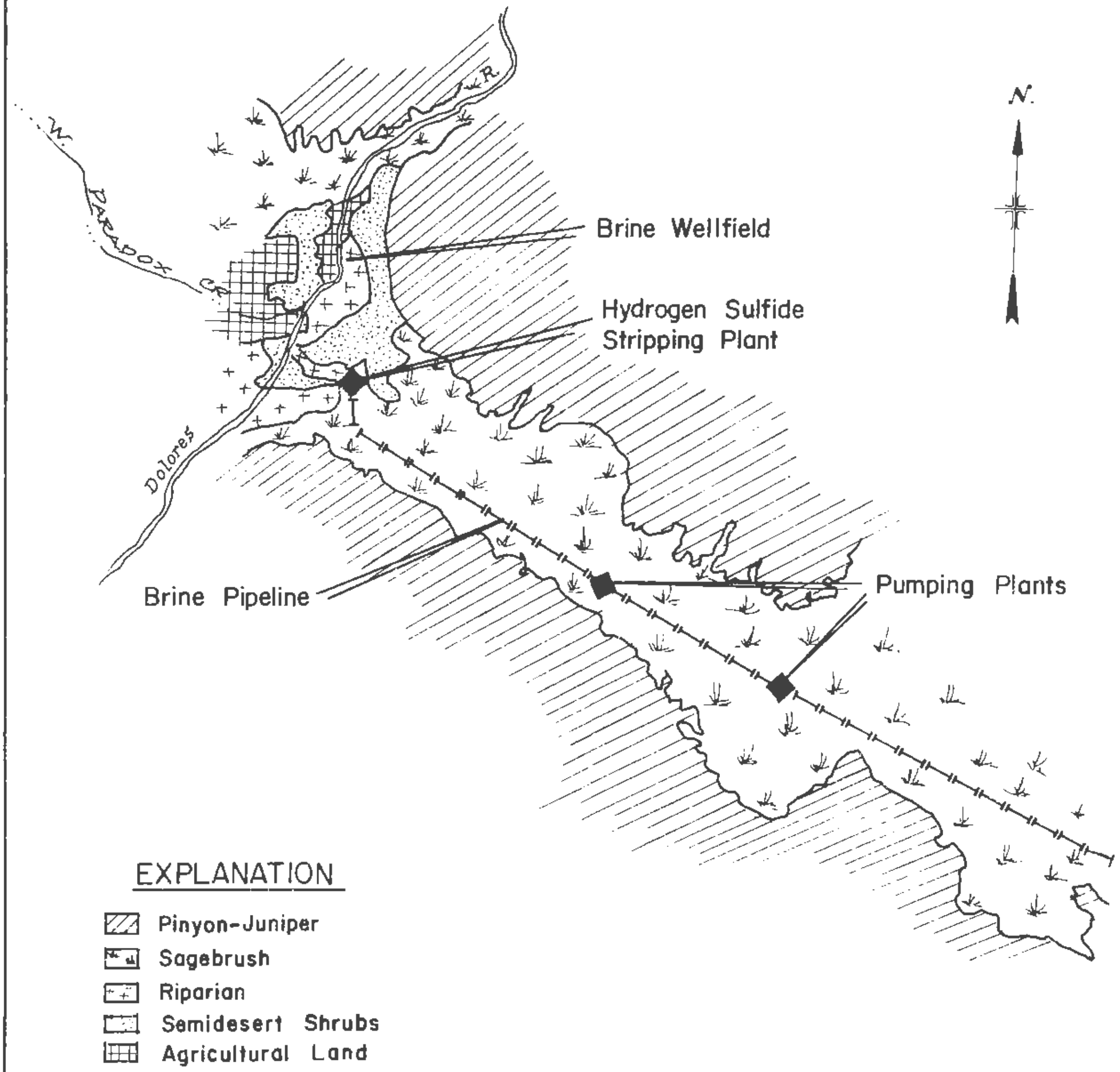
a. General

Information on the vegetation of the unit area has been obtained from reports prepared by the Bureau of Reclamation (Cressey and Gard, 1975) and Fort Lewis College under a contract with the Bureau (Somers, 1976). Varying largely according to the availability and quality of water and the type of soil, the vegetation communities include riparian growth along the Dolores River and West Paradox Creek; irrigated agricultural land (principally forage crops) in the western half of Paradox Valley; sagebrush and semidesert shrublands of greasewood, seablite, and winterfat-snakeweed in the eastern half of the valley and Dry Creek Basin; and pinyon-juniper woodland at the higher elevations on the sides of both the valley and the basin. Table B-2 gives the estimated acreage of each type within the proposed rights-of-way for unit facilities, and Figures B-6 and B-7 show the general locations of the various vegetation communities.

The riparian vegetation is dominated by tamarisk, which varies from sparse along the river to dense groves up to 100 yards wide along West Paradox Creek. Grasses, with rushes in marshy areas, form the understory on the west bank of the river, while no significant understory is found on the east bank. Stands of cottonwood trees are scattered along both sides of the river upstream from the confluence of the

Table B-2
Vegetative communities and unit features
(Unit--acres)

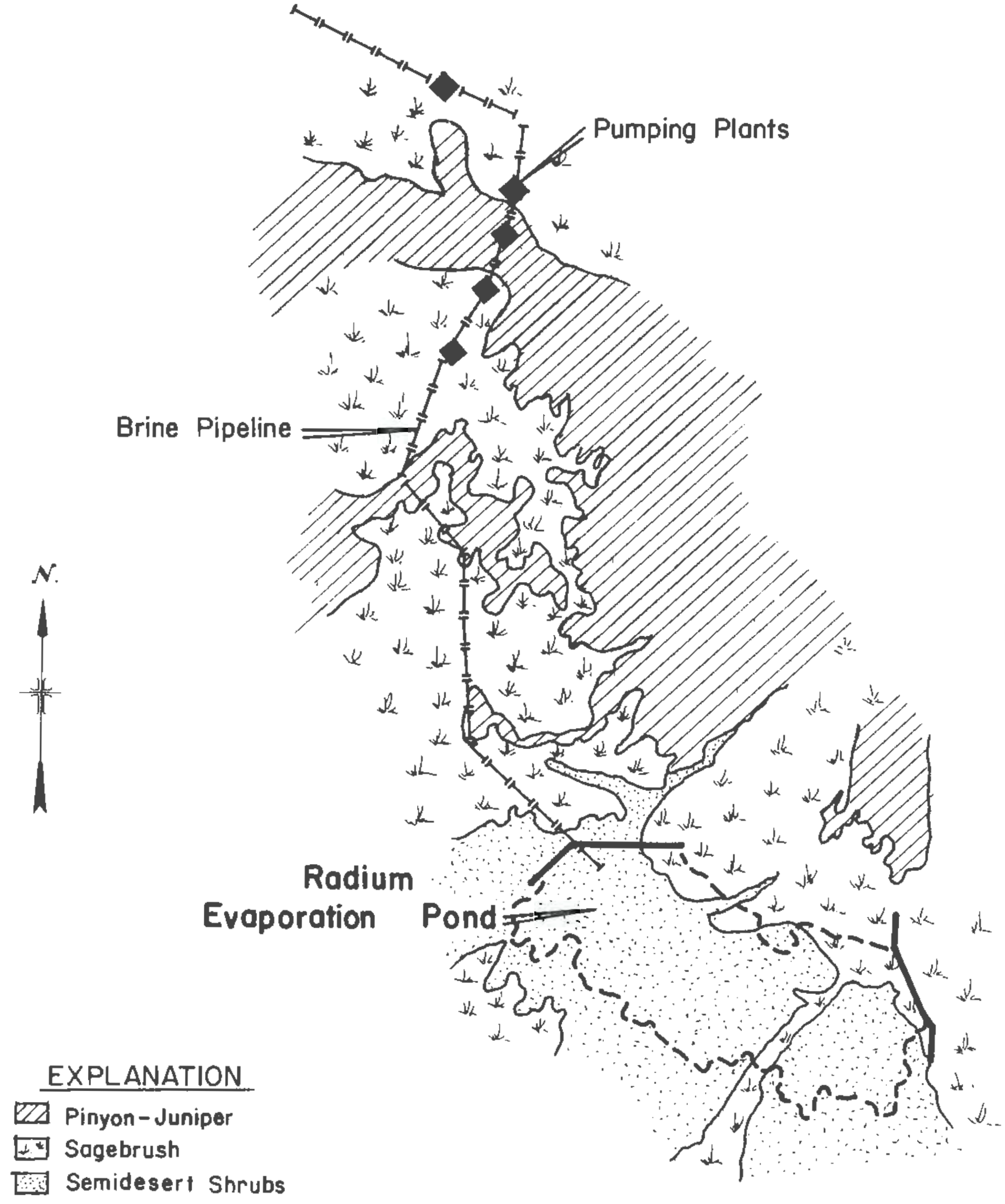
	Brine well field	H_2S plant	Operation and mainte- nance housing	Pipe- line and pumping plants	Radium Evapo- ration Pond	Radium wildlife area	Borrow area	Total
Riparian and grassland	83							83
Agricultural land	52							52
Sagebrush	24	6	4	165	472	2,011		2,682
Semidesert shrublands								
Greasewood	36				944	259		1,239
Seablite	108							108
Winterfat-snakeweed				5	2,214	1,208		3,427
Pinyon-juniper				36		182		218
River channel	62							62
Exposed gravel and riprap							20	20
Total	365	6	4	206	3,630	3,660	20	7,891



Colorado River Basin Salinity Control Project
Paradox Valley Unit

GENERAL VEGETATION MAP

FIGURE B-6



Colorado River Basin Salinity Control Project
Paradox Valley Unit

GENERAL VEGETATION MAP

FIGURE B-7

creek, with a tall shrub understory of New Mexico forestiera and a lower understory of grasses. Downstream from the area of surfacing brine the riparian vegetation consists almost entirely of tamarisk.

Irrigated land occupies much of the valley floor to the west of the river, with major crops consisting of alfalfa, small grains, and pasture. Near the river the pastures consist of almost marshy meadows and occasional thickets of rushes.

The sagebrush community occupies most of Paradox Valley east of the river and a large portion of Dry Creek Basin as well. The dominant plant in this community is big sagebrush, in association with other species such as four-wing saltbrush. Normally, the understory is sparse and consists of perennial grasses and mixed annual forbs. In many areas, overgrazing has reduced the understory to primarily cheatgrass.

The greasewood community is found in the vicinity of the brine well field, along East Paradox Creek, and in other intermittent drainages and arroyos in eastern Paradox Valley and Dry Creek Basin. The dominant plant is black greasewood which may be found in association with other species such as seablite and scattered big sagebrush. In most instances, the understory is very sparse or totally absent.

Seablite is the dominant plant in areas near the well field where greasewood is not found. In general, little or no understory of grasses is present in these areas, which are characterized by salt-encrusted ground.

The winterfat-snakeweed community is not found in Paradox Valley but occupies a significant portion of Dry Creek Basin at the evaporation pond site. The understory may consist of short grasses or may be absent. The presence of snakeweed generally indicates that overgrazing has occurred. Although winterfat may continue to provide grazing, particularly for sheep, snakeweed is unpalatable.

Pinyon-juniper woodland is found on the slopes of Paradox Valley, on the surrounding mesas, and at the higher elevations in Dry Creek Basin. Pinyon pine and Utah juniper predominate, although Rocky Mountain and common juniper are also present. The understory consists of woody shrubs, such as mountain snowberry, antelope bitterbrush, mountain mahogany, and serviceberry. Also found in this community are big sagebrush, rabbitbrush, prickly pear cactus, and various forbs and grasses.

b. Threatened or Endangered Vegetative Species

No threatened or endangered plant species have been identified in the unit area. One species on the proposed list of endangered and threatened wildlife and plants (Federal Register, Vol. 41), *Echinocereus triglochidiatus* Engelm. var. *enermis* Schum., has been identified in the Manti-La Sal National Forest approximately 6 miles northwest of Paradox, Colo.

9. Fish and Wildlife

a. Fish and Aquatic Invertebrates

The Colorado Division of Wildlife, under a contract with the Bureau of Reclamation, has prepared a report on the streams in the unit area (King, 1976). During its investigations, the Division identified predominantly warm-water, nongame fishes in La Sal Creek, the Dolores River, and West Paradox Creek. East Paradox Creek, an intermittent stream, may be inhabited temporarily by fishes from the Dolores River during spring runoff. Dry Creek, also an intermittent stream, does not support fish. Table B-3 shows the relative abundance of the fishes collected at each location during the study.

Table B-3
Fish collected in the unit area
(percent)

	La Sal Creek	Dolores River: Above Paradox Valley	Dolores River: Within and below Paradox Valley	Dolores River: Below the mouth of the San Miguel 1/	West Paradox Creek
Flannelmouth sucker	97	17	89	X	
Bluehead sucker		5	7	X	5
Mottled sculpin	2	8			50
Speckled dace	1	45			18
Roundtail chub		12		X	
Red shiner		6			
Fathead minnow		4	4		27
Black bullhead		3		X	
Cutthroat trout				X	
Rainbow trout				X	
Channel catfish				X	
Total	100	100	100		100

1/ Because the large volume of water in this reach restricted the collection techniques, the population composition has not been estimated.

La Sal Creek, entering the river about 5 miles above the valley, is a year-round stream but does not contribute enough flow to significantly alter the river habitat. Although the upper reaches of the creek support trout, the lower reaches are characterized by such species as the flannelmouth sucker and bluehead sucker, the mottled sculpin, and speckled dace. The stream bottom is silty, and the invertebrates are characterized by large numbers of black fly larvae.

Aquatic habitat in the Dolores River consists primarily of long pools with sand and silt bottoms which, during periods of low flow, are connected only by subsurface flows or short stretches of riffles. Fish cover in the form of boulders, undercut banks, and overhanging vegetation is found within and below Paradox Valley but is scarce immediately above it.

The most abundant fish in the river upstream from the valley is the speckled dace, followed by the flannelmouth sucker and the roundtail chub. Present in smaller numbers are the mottled sculpin, red shiner, bluehead sucker, fathead minnow, and black bullhead. Local residents report that a few catfish have been taken but fishing pressure is very light. The most abundant aquatic invertebrates are black flies, caddisflies, and midges.

In the valley and immediately downstream, the habitat for fish and aquatic invertebrates is adversely affected by the influx of saline ground water. Fishes inhabit this reach whenever the riverflow is sufficient to dilute the brine but generally move into other reaches or tributaries when low streamflow results in higher salinity. At low flow, dead fish have been observed floating in pools of brine. Nearly all of the fish are flannelmouth suckers, although small numbers of bluehead suckers and fathead minnows are also present. Although numerous samples for aquatic invertebrates were taken, none was found because of very high salinity.

Fish habitat is significantly altered by the San Miguel River, which discharges into the Dolores River about 3 miles below Paradox Valley and improves the water quality during the summer and fall, when the Dolores is very low and saline above the confluence. Fishes known to inhabit this reach include the flannelmouth and bluehead suckers, cutthroat and rainbow trout, channel catfish, black bullhead, and roundtail chub. Although not collected by the Division of Wildlife, the sand shiner, green sunfish, carp, and largemouth bass are also known to occur below the valley (Holden and Stalnaker, 1975). Samples of invertebrates were not collected, but it is assumed that the improved water quality is conducive to limited production of black fly larvae and midges.

West Paradox Creek, which has abundant fish cover because of beaver dams, aquatic vegetation, and overhanging vegetation, supports the mottled sculpin, fathead minnow, speckled dace, and bluehead sucker. Common invertebrates include black fly and caddisfly larvae, two species of snail, and one species of bivalve.

b. Threatened or Endangered Fishes

It is doubtful that the Dolores River has recently supported the Colorado River squawfish and humpback chub, which are listed as endangered, or the bonytail chub and humpback sucker, which have been proposed for endangered and threatened status, respectively (Holden and Stalnaker, 1975). The Dolores River does, however, enter a reach of the Colorado River about 70 miles downstream from Paradox Valley that has been recommended by the Colorado River Endangered Fishes Recovery Team as critical habitat for the Colorado squawfish. This reach totals nearly 200 miles, including about 87 miles upstream from the confluence of the Dolores River and 108 miles downstream to Lake Powell in southern Utah.

c. Wildlife

Information used in describing the terrestrial wildlife of the Paradox Valley Unit area and adjacent areas was derived from reports prepared by Colorado Division of Wildlife (1976) and Fort Lewis College (Somers, 1976) under cooperative agreements and contracts with the Bureau of Reclamation. These reports are available for public inspection at Bureau offices in Durango, Grand Junction, and Salt Lake City.

(1) Big Game

(a) Mule Deer

Paradox Valley, Dry Creek Basin, and surrounding areas support both resident and wintering herds of mule deer. The sizes of the herds fluctuate from time to time and have declined from a population peak reached in the early 1960's. The Colorado Division of Wildlife estimates that the deer population in and near the unit area consists of about 200 year-round residents, with wintering populations totaling approximately 700 animals.

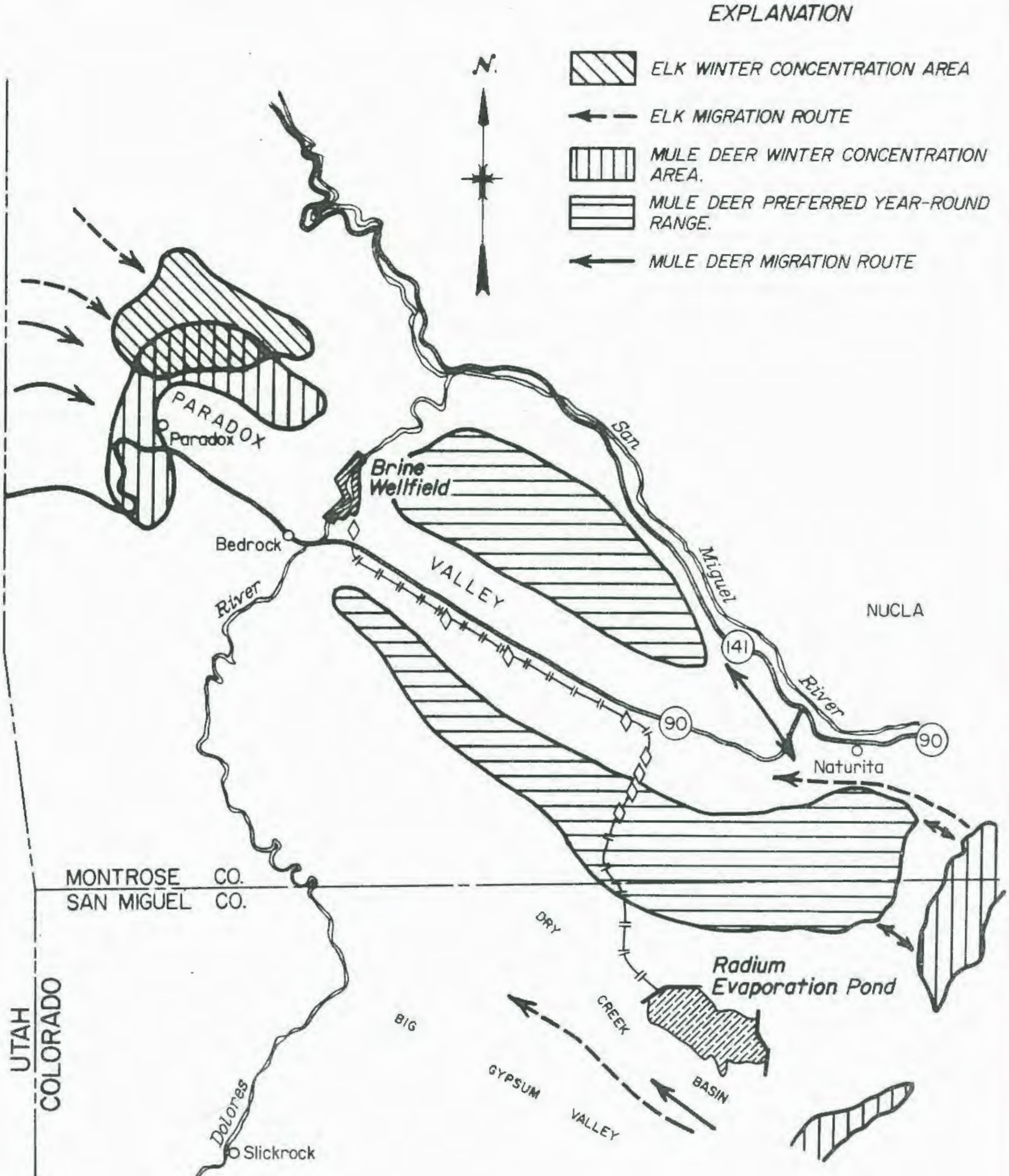
Probably the greatest value of the area is as winter range. During normal years, heavy snows in late fall force deer out of the eastern slopes of the La Sal Mountains and onto winter concentration areas on the ridges and mesas surrounding western Paradox Valley. Approximately 300 deer are known to utilize this area. Other significant wintering populations may be found along the northern edge of eastern Paradox Valley (less than 100) and on the mesas and ridges along the northern edge of Dry Creek Basin (approximately 300). These herds summer on the slopes of mountains to the south of the unit area. Wintering areas and migration routes are shown in Figure B-8.

Since most of the area is located below 8,000 feet in elevation, it also serves as a year-round range for deer, with the resident populations of about 200 deer concentrated along the Dolores River in Paradox Valley, on mesas surrounding the valley, and in the pinyon-juniper and sagebrush interface in northern Dry Creek Basin.

Few deer are harvested in and adjacent to the unit area, amounting to about 20 annually from western Paradox Valley and 25 annually from the mesas between the valley and Dry Creek Basin. The approximate annual harvest for nearby areas is estimated at 100 to 300 animals, occurring primarily on the eastern part of the La Sal Mountains and the eastern edge of Dry Creek Basin. Because a recent purchase of 8,733 acres of land within the basin for the Dry Creek Basin State Wildlife Area by the Colorado Division of Wildlife has increased hunter access, however, the harvest may increase slightly.

(b) Elk

Historically, elk have not used the area as extensively as deer, but their numbers have been increasing recently.



COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT-COLORADO

MULE DEER AND ELK
GENERAL RANGES

FIGURE B-8

Although nearly all of the land in the vicinity of the unit is potential winter range during years of abnormally high snowfall, only one area is consistently used. Herds that summer on the La Sal Mountains move to a winter concentration area north of the town of Paradox, and aerial surveys conducted during the winter of 1975 revealed 67 elk in this area. In addition, a few elk from mountains to the southeast of the area cross Dry Creek Basin to winter on its northern edge during years of abnormally heavy snowfall. The winter concentration area and migration routes are shown in Figure B-8.

Although the summer populations are concentrated in the mountains near the area, a few elk may occasionally be found along the southern side of Paradox Valley. During the hunting season there is no significant harvest in the area, since the animals are normally still on their summer range at higher elevations.

(c) Pronghorn

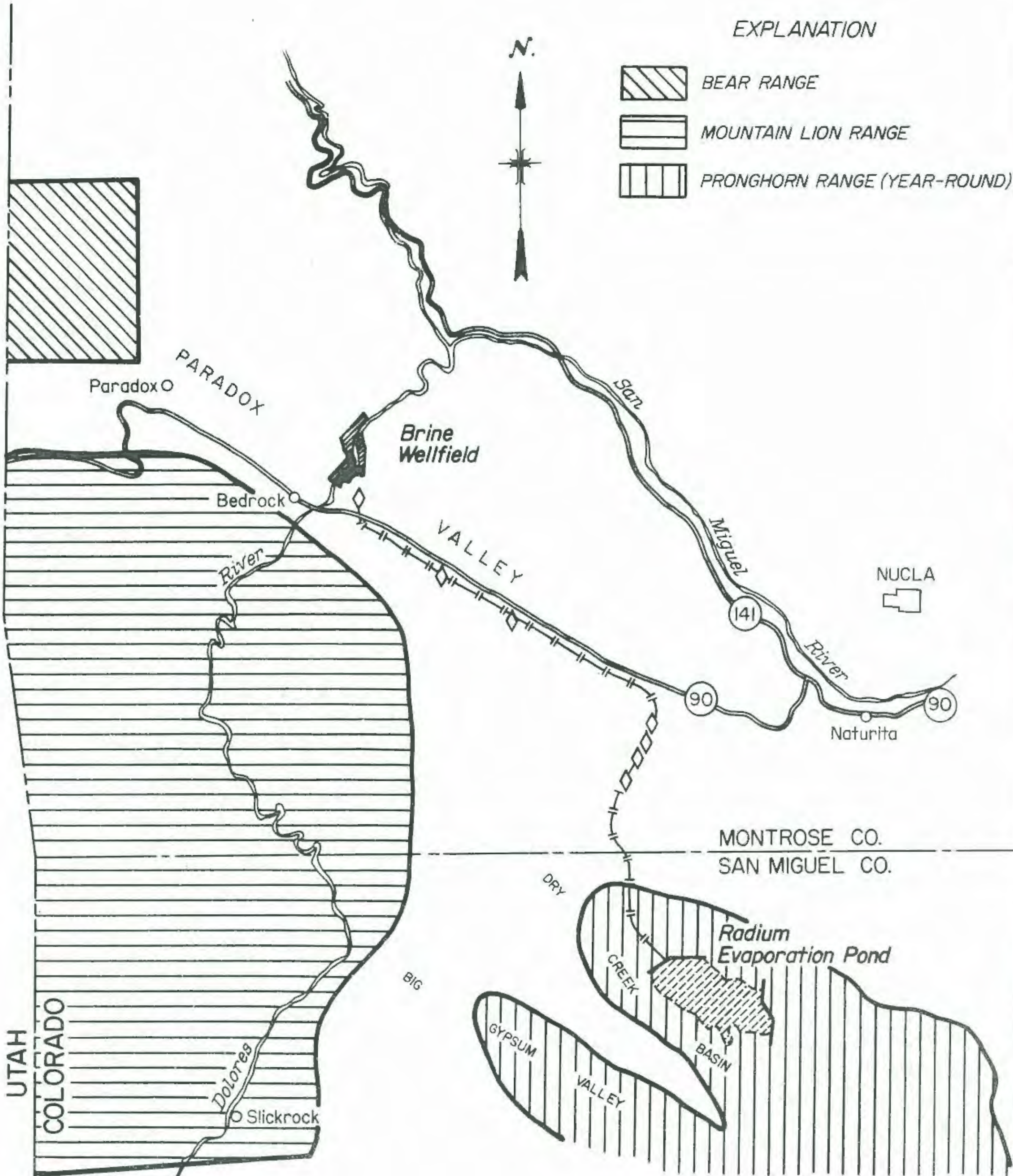
A few pronghorns are found throughout the southern part of the area, their year-round range encompassing most of Dry Creek Basin and adjacent valleys to the southwest. Although the wildlife study revealed only 1 to 3 pronghorns in the basin, the local Wildlife Conservation Officer reported that as many as 12 to 20 have been sighted over the past few years, most commonly observed in the area between the West Fork of Dry Creek and Big Gypsum Valley to the southwest. Pronghorn distribution is shown in Figure B-9.

Recent plans to transplant pronghorns from northwestern Colorado to Dry Creek Basin were abandoned because of livestock and predator problems. The basin will, however, receive strong consideration for future transplants if conditions permit (personal communication; Mr. Hal Burdick, Senior Wildlife Biologist, Colorado Division of Wildlife, March 3, 1977). The area is now closed to pronghorn hunting because of low populations.

(d) Black Bear and Mountain Lion

The black bear is an uncommon but occasional resident of the area, occurring primarily at higher elevations along the east side of the La Sal Mountains. This species was not observed during the study but has been reported in the west end of Paradox Valley in the past few years by local landowners. No bears have been reported to have been taken by hunters during recent years.

The mountain lion feeds extensively on deer, and its territories generally follow deer movements. The area receiving the greatest mountain lion use is shown in Figure B-9. During the study, mountain lion tracks were observed in the Dolores River Canyon southwest of Bedrock. Reports have also been received from local residents who have observed signs of lions in the canyon and mesa areas southwest of Paradox Valley. The Wildlife Conservation Officer's population estimate for 1975 was a minimum of six and a maximum of 10 lions in the general



COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT-COLORADO

BEAR, MOUNTAIN LION, AND PRONGHORN GENERAL RANGES

FIGURE B-9

vicinity of the unit area, based on observations of signs, harvest reports, and information from local residents.

Since 1965 the area has been open to mountain lion hunting, either in special seasons or in conjunction with regular deer and elk seasons. No lions are believed to have been harvested during the 1975 season.

(2) Small Game Mammals

The only small game mammal known to inhabit the unit area is the desert cottontail, which is common throughout the area and particularly abundant in the sagebrush habitat of eastern Paradox Valley and Dry Creek Basin and in riparian areas along the Dolores River. Although no harvest statistics are available, this species is known to receive moderate hunting pressure.

(3) Furbearers

Furbearers inhabiting the area include the beaver, muskrat, ringtail, marten, long-tailed weasel, badger, gray fox, striped skunk, and spotted skunk. The beaver and muskrat are by far the most common species and constitute the greatest part of the annual harvest, being trapped for commercial purposes and to prevent flooding or damage to ditches. Trapping pressure for the other furbearers is either light or nonexistent.

The beaver and muskrat occur primarily along streams in the area and may also be found in the open irrigation and drainage systems in western Paradox Valley. The ringtail is quite common in rocky areas along the lower Dolores and San Miguel Rivers but is rarely seen because of its strictly nocturnal and secretive nature. The marten is considered rare within the area, possibly found only in forests west of Paradox Valley. The population of the long-tailed weasel is quite small, since most of the area is too low in elevation to be considered good habitat. Badgers are not abundant but can be found in almost all habitats, particularly in open areas and areas around farms and meadows. The gray fox is common throughout the area, with the highest densities along stream bottoms and other riparian areas. Its presence was particularly noted along West Paradox Creek. The striped skunk is often sighted in the lower valleys along streams and in farm lands, being well adapted to living in association with man. Spotted skunks, which prefer lower elevations and rocky habitats, are considered rare in the area, and the trapping season is closed Statewide.

(4) Varmints

The Colorado Division of Wildlife classifies varmints as a sometimes damaging group of mammals offering favorable opportunities for sport harvest. Those found within the area include the coyote, bobcat, red fox, raccoon, porcupine, black-tailed jackrabbit, rock squirrel, and Gunnison's prairie dog.

The coyote is abundant throughout the area and was identified near all of the proposed unit features. During most of the year the range of the coyote is quite extensive; during the winter months, however, it tends to concentrate in the lower elevations, where small mammals are more active and deer are more abundant. Increasing in population over the past few years, it is hunted and trapped quite extensively and probably constitutes the most valuable fur resource in the area.

Bobcats are considered to be uncommon, preferring the bushy canyons along the Dolores River and along the mesas southwest of Paradox Valley. The red fox is considered rare in the area but may be found along West Paradox Creek near its confluence with the Dolores River. Raccoons are generally limited to a few specific areas along the Dolores River and West Paradox Creek, on the agricultural area in western Paradox Valley, and occasionally along the forks of Dry Creek.

The porcupine is found in small numbers in most of the area. It is common in pinyon-juniper habitats on the divide between Paradox Valley and Dry Creek Basin, and along portions of Dry Creek. The black-tailed jackrabbit is widely distributed, preferring grasslands, crop lands, and sagebrush flats located in Dry Creek Basin, on the divide between the basin and Paradox Valley, and in western Paradox Valley.

The rock squirrel is the most numerous varmint, providing an important food source for predators. This species is widely distributed but is particularly common in broken rocky terrain along stream bottoms. The Gunnison's prairie dog is considered uncommon. A few three- to five-mound colonies or single mounds may be observed within the western portion of Dry Creek Basin, on the divide between Paradox Valley and the basin, and in the western part of Paradox Valley.

(5) Small Nongame Mammals

Nongame mammals play an important role in the ecosystem of the area by providing a prey base which significantly affects populations of predators. Species found in the vicinity of the unit facilities include the valley pocket gopher, western harvest mouse, deer mouse, pinyon mouse, brush mouse, white-throated woodrat, Mexican woodrat, least chipmunk, Colorado chipmunk, white-tailed antelope ground squirrel, and Ord's kangaroo rat. Of these species, the deer mouse is the most abundant, and the white-tailed antelope ground squirrel is the least abundant.

(6) Raptors

At least 13 species of raptors are known to inhabit the study area. Year-round residents include the golden eagle, marsh hawk, goshawk, Cooper's hawk, sharp-shinned hawk, red-tailed hawk, American kestrel, prairie falcon, and great horned owl. The numbers of marsh hawks and American kestrels may substantially increase during the warmer months as breeding populations move into the area. Seasonal residents include the turkey vulture, northern bald eagle, and rough-legged hawk. The peregrine falcon has also been identified in the area, as discussed in a later section of this chapter.

The golden eagle is known to nest in the Dolores River Canyon and along Roc Creek, a tributary of the river below Paradox Valley. Hunting areas include essentially the entire area, but most birds seem to prefer the more open areas of Paradox Valley, Dry Creek Basin, and Big Gypsum Valley.

The Cooper's hawk, sharp-shinned hawk, and goshawk are found in riparian and pinyon-juniper areas but are relatively uncommon. The marsh hawk and red-tailed hawk are commonly found in open areas, although the latter may use a variety of habitats.

The American kestrel is the most common raptor in the area. The kestrel may be found in croplands, desert shrubs, pinyon-juniper and riparian habitats. It may be frequently observed on power lines and fences adjacent to roads in Paradox Valley and Dry Creek Basin.

The prairie falcon is rare in the area. An active aerie was located along the north rim of eastern Paradox Valley during the spring of 1976, and falcons were observed on both rims of the valley, in the valley, and in the Dolores River Canyon below the valley.

The rough-legged hawk usually inhabits the area only during the winter, and prefers the open habitat of croplands, grass-lands, or low desert shrubs containing prominent perching sites.

The great horned owl is fairly common in the area and prefers a riparian or pinyon-juniper habitat where nest and roost trees are available. The turkey vulture is common throughout the area in the late spring and summer. No nest sites were identified in the vicinity of the proposed unit.

(7) Gamebirds

Gamebirds inhabiting the area include the sage grouse, mourning dove, band-tailed pigeon, and ring-necked pheasant. The mourning dove and band-tailed pigeon are migratory species, arriving in the area during the spring and leaving in the fall, while the sage grouse and ring-necked pheasant are year-round residents. Doves are seasonally abundant, nesting along the Dolores River, West Paradox Creek, and the pinyon-juniper mesa tops and feeding on agricultural land and semidesert shrub lands. Doves received moderate hunting pressure throughout the area. Band-tailed pigeons are rare in the area, preferring higher elevations to the north of the valley. Sage grouse are very restricted in their range, occupying a relatively isolated tract of big sage and grass land habitat within and near the evaporation pond site in Dry Creek Basin. The habitat is now in poor condition because of grazing by sheep. Approximately 40 birds inhabit this area, and the Colorado Division of Wildlife does not allow hunting because of the low population. No strutting grounds were located in the basin. Ring-necked pheasants, although fluctuating in population, are common on the agricultural lands of western Paradox Valley and in the riparian areas of the Dolores River and West Paradox Creek. This species exists primarily on private lands with restricted access; therefore, hunting pressure is low.

(8) Waterfowl and Shore Birds

The Dolores River is an important resting and feeding area for many species of waterfowl and shore birds, although the populations undergo significant seasonal fluctuations. The mallard is the most numerous and widespread waterfowl species and may be found along the Dolores River throughout the year. Others known to inhabit the area, particularly the river and stock tanks in Paradox Valley, include the gadwall, Canada goose, pintail, green-winged teal, redhead, common merganser, and American coot. Waterfowl are subject to moderate hunting pressure during the fall and winter because adjacent public land provides relatively easy access to the Dolores River.

Although the killdeer, common snipe, and spotted sandpiper were the only shore birds identified, concentrations of many additional species are believed to frequent the wetland habitats, particularly along the river and West Paradox Creek, during spring and fall migrations.

(9) Nongame Birds

Approximately 150 species of nongame birds inhabit the area, 92 of which were identified during the wildlife inventories. Although nongame birds inhabit all vegetative types, the riparian habitat along West Paradox Creek and the Dolores River is probably the most important. Other communities--in descending importance with regard to total number of nongame species--include pinyon-juniper woodland, agricultural land, sagebrush, native grassland, and the single-species desert shrub habitats of seablite, winterfat-snakeweed, and greasewood. Commuuities consisting of a mixture of these desert shrubs would be slightly more desirable.

Most species of nongame birds identified are considered common in most areas of southwestern Colorado; some, however, are relatively uncommon and may be considered unique in both the unit area and southwestern Colorado. These species include the whippoorwill, ash-throated flycatcher, bank swallow, plain titmouse, common bushtit, Bewick's wren, rock wren, gray catbird, yellowthroat, blue grosbeak, Lazuli bunting, brown-capped and gray-crowned rosy finches, lark sparrow, sage sparrow, and Brewer's sparrow.

(10) Reptiles and Amphibians

Amphibians associated with streams, springs, and stock ponds in Paradox Valley include the red-spotted toad, Rocky Mountain toad, western leopard frog, and Hammond's spade-foot toad. The west fork of Dry Creek and arroyos draining the western end of Dry Creek Basin during periods of summer rainfall are inhabited by red-spotted toads, western spade-foot toads, and Arizona tiger salamanders.

Eleven species of reptiles inhabit land within or near the proposed unit rights-of-way. The wandering garter snake and short-horned lizard occur in Paradox Valley in the vicinity of the Dolores River. Sagebrush and pinyon-juniper habitats of western Paradox Valley and the divide between the valley and Dry Creek Basin contain species such as the northern sagebrush lizard, northern plateau lizard, plateau whiptail, short-horned lizard, Great Basin gopher snake, and midget faded rattlesnake. Semidesert shrublands and peripheral rocky outcrops in Dry Creek Basin are inhabited by species such as the short-horned lizard, northern sagebrush lizard, northern plateau lizard, northern tree lizard, Great Basin gopher snake, wandering garter snake, western yellow-bellied racer, and midget faded rattlesnake. Large numbers of midget faded rattlesnakes were observed during spring in the vicinity of the proposed Radium Dam site, suggesting the existence of a hibernation site.

d. Threatened or Endangered Wildlife

The studies of the unit area by the Colorado Division of Wildlife and Fort Lewis College revealed no wildlife species there on either the State or Federal list of threatened or endangered fauna. A recent report (July 1977) of a peregrine falcon sighting within the area has been confirmed, however, and it is known that a pair of peregrines successfully nested and produced a fledgling. In order to protect the site from future human disturbance, the Colorado Division of Wildlife has requested that the exact location of the aerie not be disclosed. Even more recently, the northern bald eagle, which was observed by the study teams along the Dolores River in Paradox Valley and in Dry Creek Basin, has been added to the list of Federally threatened or endangered fauna (Federal Register, Vol. 43, No. 41, February 14, 1978). It usually inhabits the unit area during the winter, and is but an infrequent visitor during the summer. No nesting areas were observed by the study teams, and the area is not considered to be essential for the species.

The Great Basin silverspot butterfly (*Speyeria nokomis nokomis*) was included in the July 3, 1978, Federal Register listing for proposed endangered or threatened status or critical habitat because of the present threatened destruction, modification, or curtailment of its habitat or range. This butterfly has been reported in the Paradox Valley about 5 miles northwest of the nearest unit feature proposed for construction. The larval stage exists solely on violets; the violets, in turn, need the environment of marshy meadows formed by an abundant and constant supply of water. The main threat facing this species, as given in the Federal Register, is the conflict between the violet's need for moist habitat and man's growing water needs.

10. Prehistorical and Historical Sites

No properties listed in or eligible for the National Register of Historic Places are found in the unit area (Federal Register, Vol. 42, No. 21, and all monthly supplements). Under a contract with the Bureau, archaeologists from Fort Lewis College inventoried areas within and near the proposed rights-of-way of the features and located 17 prehistorical and 5 historical sites (Applegarth, 1975 and 1976). The 17 prehistorical sites consist of lithic scatter that appears to be on the surface only, with little indication of subsurface structures. The sites most likely are connected with the latter part of the Ute Indians' occupation of the area, which ended in the 1880's, and probably represent temporary encampments or hunting stations. Only one of these sites, which lies within the high-water line of the evaporation pond, is located within the proposed site of a unit facility.

Of the five historical sites inventoried, one is within the high-water line of the evaporation pond, two are above the high-water line of the pond, and two are in the vicinity of the well field. The three sites in the vicinity of the pond consist of homestead ranch buildings and corrals that were probably settled between 1910 and 1920. A site north of the well field consists of a three-walled stone structure, which probably was part of a cabin, and associated trash. The other site, located southwest of the well field, includes a grave with a headstone inscribed with the year 1891. This site is surrounded by a pole and wire fence.

The brine pipeline alignment in the northern part of Dry Creek Basin crosses part of the Dominguez-Escalante Trail of 1776, which has been designated for study under the provisions of the National Trail System Act of 1976 (Public Law 94-527) to determine eligibility for inclusion in the system. Since no physical evidence of the trail itself exists, historians have interpreted its location primarily from a diary Friar Escalante kept during the expedition (Bolton, 1972). The trail is believed to cross Dry Creek Basin, probably passing just north of the evaporation pond site, and following the lower part of Dry Creek to the San Miguel River.

CHAPTER C

ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

C. ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

1. Lower Colorado Basin

By reducing salinity levels and helping to maintain salinity standards along the Colorado River, the Unit would benefit millions of water users. A major beneficial economic impact would occur for more than 14 million municipal and industrial water users in the Southwestern United States, particularly in the Los Angeles-San Diego area, and on about one million acres of irrigated farm land in southern California and Arizona. According to a recent Bureau of Reclamation study (Kleinman, 1974), reductions in salinity at Imperial Dam result in direct and indirect benefits totaling $230,000 for each decrease of 1 mg/l. Since the Paradox Valley Unit would reduce the average salinity at Imperial Dam by about 18.2 mg/l, water users in the Lower Colorado Basin would benefit by $4,186,000 annually. The savings associated with municipal and industrial use would occur primarily from decreased costs for treatment, reduced pipe corrosion and appliance wear, decreased use of soaps and detergents, and increased potability of drinking water. For irrigators, the lower salinity concentrations would result in increased crop yields, more uniform crop patterns, decreased leaching and drainage requirements, and decreased management costs.

Other Colorado River water users, both within and outside the basin, would also benefit from the salinity reductions of the Paradox Valley and other units of the basinwide salinity control program. Because of the widespread and diffuse nature of these benefits, however, they cannot be fully quantified in monetary terms. Some of the benefits would occur directly, such as those that would be realized by users of water for culinary purposes and for irrigation. Additional benefits, more difficult to identify, would also occur, particularly to users of fossil or other fuels processed with Colorado River water.

2. General Setting

The Paradox Valley Unit would have both short- and long-term impacts on the local setting. During construction work the use of heavy machinery, increased human activity, excavation, and clearing would detract from the natural landscape. Although revegetation would be accomplished by reseeding along the alignments of the buried pipelines and cleared areas surrounding surface structures, the recovery would occur slowly because of the arid climate, particularly where pinyon-juniper woodland would be removed along the pipeline.

The surface facilities of the unit, including the well field, stripping plant, and pumping plants, would alter the landscape over a long period of time and would detract from the scenery locally. Only the hydrogen sulfide stripping plant and brine pipeline pumping plants would be visible from highways and communities in the valley. The brine pipeline would create a long-term scar on the divide between the valley and Dry Creek Basin. The evaporation pond, although located in the more isolated Dry Creek Basin, would have the largest adverse effect, gradually creating a salt flat of about 3,630 surface acres at the end of the 100-year period of unit operation.

The unit would have a beneficial impact on the appearance of the area along the Dolores River within and downstream from the well field area. The removal of brine would eliminate the exposed salt flats and noxious hydrogen sulfide gas and promote the growth of riparian vegetation along the river's banks.

3. Economic and Social Conditions

a. Employment

The unit would provide a maximum of about 340 direct employment jobs per year for skilled and unskilled workers during the 6-year construction period, including 51 government jobs and 289 private contracting jobs. These estimates are based on the assumption that each job would be full time during a 9-month construction season. As Table C-1 shows, a total of 27 employees would be working the first year, 340 in the fifth year, and 181 in the sixth year. An annual average of approximately 141 of the workers, or about 89 percent, would come from outside the unit area, according to studies conducted by the Bureau of Reclamation (1977).

Based on the Bureau of Reclamation's past experiences, an estimated 30 percent of the total construction costs, or approximately $15 million, would be paid in salaries to direct employees in the unit area, reaching a peak of about $5 million in the fifth year.

Construction work and direct salaries would also create an estimated maximum of 170 indirect employment jobs, as shown in Table C-1, to provide goods and services for those directly employed. Because of the limited goods and services available in Naturita and Nucla, a maximum of about 25 percent of the indirect employment would occur in the unit area, and 75 percent would occur outside the area in communities with more extensive shopping facilities, like Cortez, Montrose, Grand Junction, and Moab. Because the lower salaries normally associated with such work would not encourage workers to move to the area, the indirect employment in the unit area is expected to be filled from the existing labor force and from households whose heads are directly employed on the unit. Outside of the unit area, the labor forces in the respective communities would fill the indirect employment jobs.

Table C-1
Estimated direct and indirect employment

	Construction year					
	1	2	3	4	5	6
Direct employment						
Contractors' employees	23	42	115	192	289	172
Government employees	4	6	18	32	51	29
Total	27	48	133	224	340	181
Indirect employment						
Inside unit area	3	6	17	28	42	23
Outside unit area	10	18	49	84	128	67
Total	13	24	66	112	170	90

On completion of construction, four full-time and four part-time employees would be directly employed operating and maintaining the facilities for the 100-year life of the unit. No indirect employment would result in the area from long-term unit operations.

b. Population

The unit would have a significant impact on population during the 6-year construction period as a result of direct employment, but it would have essentially no long-term effects after the completion of construction. No population increase is anticipated as a result of indirect employment because the local labor force would fill the available jobs.

The Bureau's experience with similar projects in relatively isolated areas indicates that of the directly employed government and contractor personnel coming from outside the local area (averaging 141 employees and reaching 302 during the peak year), a maximum of only about 29 percent would bring their families with them because of the isolation of the area, the lack of adequate shopping and recreational facilities, and the seasonal nature of the construction work (Bureau of Reclamation 1977). Therefore, the maximum population influx attributable to the unit would be 41 people in the first year, rise to 513 in the fifth year, and decrease to 273 in the sixth year. Of these, the influx of government employees and their families would be 4 people in the first year, 45 in the fifth year, and 24 in the sixth year. Table C-2 shows the population influx resulting from direct employment.

Table C-2
Population influx

	Construction year					
	1	2	3	4	5	6
Workers without families	17	34	84	141	215	114
Workers and families	24	42	117	197	298	159
Total	41	76	201	338	513	273

c. Housing

During the 6-year construction period the unit would have minimal impacts on permanent housing in the area because of the lack of housing vacancies to accommodate workers and the unlikelihood that any new housing would be built for only a short-term influx of people. As a consequence, the construction force coming from outside the area would have to rely on temporary housing units such as mobile homes or campers.

Up to 46 of these employees would be government personnel who would be housed at the temporary construction camp at the hydrogen sulfide stripping plant, which is described in Chapter A. A maximum of 230 workers would be required for Radium Evaporation Pond, and an estimated 204 of these employees would require housing. It is anticipated that the contractor for this facility would also provide a construction camp, based upon previous Bureau experience with similar situations. The camp would probably be located adjacent to Colorado State Highway 141, about 5 miles east of the pond site, where power and water would be available from existing transmission lines and wells. As an alternative, the camp could be located closer to the pond site, where power would also be available from existing lines, but water would have to be hauled in. For either site, the contractor would provide utility hookups, temporary leach fields for waste disposal, trailer sites, and trailers themselves if necessary.

Fifty-eight construction employees, including 52 from outside the area, would be required for the various contractors on the other unit facilities. Since each of these contractors would have a relatively small number of employees, it is not expected that any of them would provide temporary housing, although they may provide utility hookups for employees' trailers or campers. The hookups, as well as the contractors' headquarters, would probably be located near Bedrock, where water and power are available. Some of the employees, however, may find hookups in the nearby communities of Nucla and Naturita.

Long-term operations would also have minimal impacts on permanent housing. Only four permanent employees would be required for the unit, and housing would be constructed for them near the hydrogen sulfide stripping plant, as discussed in Chapter A.

The contractors and the Federal government would have to comply with the provisions of Colorado Senate Bill 35 on subdivisions and the Colorado State Standards and Regulations for Mobile Home Parks concerning sanitation, domestic water, the collection and treatment of sewage, electricity, access roads, maintenance, and street lighting. Rezoning approval would have to be sought with the San Miguel County government for the nongovernment construction camp near Radium Evaporation Pond; no zoning change would be required for the government construction camps in Montrose County. The contractors and Federal government would have to comply with county regulations on the number of mobile homes permitted per acre.

d. Facilities and Services

(1) Education

Unit construction would temporarily create a slight strain on educational facilities in the area; however, it is unlikely that any significant expansion would be required. The projected number of children would not increase the student-teacher ratio beyond acceptable limits. Children from the government camp would attend West End District Schools. The following numbers of children would be expected during construction years 3 through 6, and because the project influx is so small it would only fractionally change the district's present student-to-teacher ratio of 17 to 1.

	Construction year			
Age	3	4	5	6
5-11	3	4	6	4
12-14	1	1	2	1
15-17	1	1	2	1
Total	5	6	10	6

Children from the contractor's construction camp would probably attend Norwood schools. Although Norwood is generally outside the area that would be influenced by construction of the unit, the camp would probably be located in San Miguel County and in the Norwood School District. The following numbers of children would be expected.

	Construction year			
Age	3	4	5	6
5-11	15	25	37	22
12-14	5	8	11	7
15-17	5	8	11	7
Total	25	41	59	36

The projected influx of students during the peak year would change the student-to-teacher ratio from its present 14 to 1 to 16 to 1, still well below the generally accepted optimum of 25 to 1. Based on present conditions, the Norwood District might have to buy or lease one additional bus and hire one additional driver during the peak year of construction since the number of new students would exceed the available seating on the school bus that now serves the area.

Payment of the costs connected with the increased students, which could vary considerably depending on the methods the school district takes to handle a short-term influx, would be distributed among local taxes, State funds, and Federal impact aid funds available under Public Law 81-874 and subsequent amendments to alleviate the effects of Federal projects. After construction the temporary demand for increased educational facilities would end.

(2) Water and Sewage

Because the unit would have construction camps for most employees, no impact is anticipated on the water and sewage facilities in Nucla or Naturita. Those few employees who would prefer to live in trailers in those communities would not put a severe strain on the water and sewage facilities.

(3) Police and Fire

The expansion of police protection would be necessary to maintain the present level of service for the increased population, but it is unlikely that the towns would hire new personnel because of their limited budgets and the short duration of construction. A maximum of two new policemen would be needed in the area, most likely in Naturita or Nucla, based on a general planning rate of approximately two officers per 1,000 people. The existing volunteer fire units in Naturita and Nucla would probably not expand because the construction camps would be located outside any established fire districts.

(4) Transportation

Although there would be an increase in area truck and automobile traffic, particularly during the fifth year of construction, this increase would be well within the design capacities of affected highways and county roads, since present use on these roads is light and their condition is good. The construction camp, which the Bureau of Reclamation believes the primary contractor would almost certainly have to build, would probably be located about 5 miles from the work area. The 5-mile trip to and from work would be over a good quality county road that has low usage. During the peak year of construction traffic on the road could increase by over 100 cars during the early morning and evening hours.

Increased road use would also occur because of the hauls that would be necessary to obtain riprap and pervious materials for use at the pond site. The source for these materials is located about 13 miles southeast of the evaporation pond site, and hauling would be over adequate county roads in Dry Creek Basin and on Highway 141. An estimated 8,200 trips would be made for pervious material and 6,000 trips for riprap over the 4 years of primary construction activity. Safety measures to inform and to protect the public would be coordinated with the State Division of Highways and incorporated into contractor's specifications.

(5) Medical

The influx of people into the unit area would undoubtedly put a strain on the limited medical care now available. Most people would probably obtain medical services in the nearby commercial centers, which are capable of taking care of additional people.

(6) Recreation

The limited indoor recreational facilities and community parks in the unit area would be severely strained during construction. Because of increased competition for use, the facilities would meet far fewer of the needs of the local people. The effect of new people on outdoor activities such as hunting and fishing would be minimal. There could be, however, an increase in off-road recreational driving with the construction work force influx, which, over the short term, could increase management responsibilities on public land and create the possibility for a minor increase in the incidence of trespassing on private property.

(7) Retail Trade

Retail trade in the unit area would increase to meet the demands of construction personnel for goods and services in service stations, grocery stores, pharmacies, and cafes. As stated earlier, much of the incomes would probably be spent outside the unit area on goods and services such as vehicles, clothes, and major household items in commercial centers like Grand Junction, Montrose, Cortez, or Moab. The increased retail trade in these cities would not cause any recognizable direct or indirect adverse impacts.

Indirectly, retail trade would sustain some loss over the long term because of the conversion of 2,500 acres of public grazing land to project use. The monetary value from livestock production on this land is estimated at $2,500 annually, some of which undoubtedly filters into local business.

Although landowners of the private property that would be acquired for unit use would be paid the fair market value for their land, there could be some loss to local business over the long term, since payment from the Federal Government would be in lump sum, and this money, if not reinvested in the area, might not be available to local business on a sustained basis. Countervailing these potential adverse impacts would be the new retail demand created by the permanent work force at the hydrogen sulfide stripping plant. These workers would have a combined salary of about $69,000, annually, an undeterminable portion of which would be available to area business.

(8) Electrical Energy

At the maximum pumping rate of 5 cfs, the unit would use an annual average of 15,200,000 kilowatt-hours of electric power. This power, which would be available from the Colorado River Storage Project System, would thus become unavailable for other potential users in the basin. To give some idea of the magnitude of this requirement, it has been estimated that 15,200,000 kilowatt-hours would be sufficient to supply the noncommerical needs of a town of about 1,500 people.

4. Air Quality and Noise Levels

The unit would have short-term adverse effects on air quality because of the increased car and truck traffic along area roads and highways. Air quality and noise levels during the 6-year construction period would also be affected because of emissions and dust from construction equipment, blasting operations, and handling of earth or aggregate materials, and smoke from burning cleared timber and brush or rubbish. The actions would increase particulate levels and decrease air quality in the vicinity of the stripping plant and pipeline. The increase would be minimal and would disperse quickly. Another nuisance would be noise from construction equipment, vehicle traffic, and blasting. Much of the work, however, would occur at a distance from the local population.

The unit would not have long-term adverse impacts on ambient air quality or noise levels. Removal of the brine that now enters the river would reduce the noxious odor of hydrogen sulfide gas. The hydrogen sulfide stripping plant would not adversely affect air quality, since no gases would be emitted to the air except high pressure air released through an outside vent to dissipate harmlessly in the atmosphere. Because electric pumps would be used in the brine well field and for the pumping plants on the brine pipeline, noise levels in the vicinity would not rise appreciably.

Air quality would not be affected by the evaporation process at the pond itself, since the hydrogen sulfide gas would have already been removed and the severe osmotic pressure associated with the brine would restrict bacteriological growth and render the pond essentially lifeless.

Salt blowing from the pond would be minimal. Observations and consultations with others who have operated and are operating large brine evaporation ponds indicate that when the salt precipitates out it crystallizes and becomes a rock-hard mass. Two examples of this were observed, one on the Malaga Bend Experimental Salinity Alleviation Project in New Mexico and the other at Texas Gulf Sulfur at Moab, Utah. Both have a large pond with large amounts of precipitated salts around the edges. Vegetation around the two areas showed no sign that any salt had blown from the pond. In addition, the Union Carbide effluent ponds at Uravan, Colo., used for precipitating salt brine-uranium liquors, produce only large crystalline particles and are free of dust problems. The prevailing winds in the unit area, as measured at Bureau of Reclamation stations at Bedrock and Dry Creek Basin, are from the southwest. Any minor quantities of windblown salt would be carried to the north of the populated farm area in Dry Creek Basin and in the direction of the alkaline/saline-tolerant sagebrush and greasewood vegetation (see Figure B-7, Vegetation Map). Records show that the winds are at their most forceful in spring when the ground is dampest, further reducing the possibility of an airborne dust problem.

5. Geology and Mineral Resources

Radium Evaporation Pond would have no effects on the existing geology of the area. Slumping would not occur because of the shallow slopes in the basin. Underlying formations would not be affected, since the basin is watertight and the dam and dike foundations would be sealed by cutoff trenches, blanketing, and grouting. The filling of the pond would not cause any induced seismicity, and such factors as the seismic history, geology, and the dam's material composition would be fully analyzed in final designs to ensure that the dam and dike could withstand a maximum credible earthquake.[1/]

Although no substantial uranium ore bodies have been identified by Union Carbide Corporation in the ore-bearing zone 900 to 1,500 feet beneath the proposed Radium Evaporation Pond, the corporation has been sufficiently encouraged to continue exploration. If extensive deposits are located beneath the pond, neither Reclamation nor Union Carbide geologists are concerned that the pond would create technical mining problems, since the overburden is thick and the pond would be watertight. They are concerned, however, that mining costs could be substantially increased, since the pond could dictate the location of surface facilities, which in this type of mining must be quite extensive, and thus necessitate longer underground haulage distances. Both could be serious economic detriments (Union Carbide Corp., October 5, 1977). The Bureau of Mines also voiced concern because of the potential conflict of interest and recommended an alternative pond site be sought (Ward, 1977). Through subsequent conversations, however, the Bureau of Reclamation assured the Bureau of Mines that at the maximum pumping rate of 5 cfs not only is the Radium Pond site the only impermeable pond site in the unit area, but that the use of the evaporation pond is far superior, both economically and practically to all other methods that were examined for brine disposal at the reconnaissance level. Reclamation also explained that Union Carbide expects to complete its exploration program at the Radium Pond site in 1978 and that the final decision on whether or not to build Radium Evaporation Pond would not be made until the well field testing program is completed in 1980 and the results completely analyzed. Thus, when the final decisions were made on the construction of the pond, it would be with the full knowledge of the results of Union Carbide's exploration program.

6. Water Resources

The maximum depletion of the Dolores and Colorado Rivers is estimated to average 3,950 acre-feet annually, based on a pumping rate of 5 cfs. The depletion, however, would be less if a lower pumping rate were feasible. Approximately 3,600 acre-feet of the depletion would result

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1/ A hypothetical earthquake from a given source that could produce the most severe vibratory ground motion at the site.

from removing and evaporating brine now entering the Dolores River, and 350 acre-feet would be attributable to the evaporation of natural runoff in Radium Evaporation Pond.

The Bureau estimates that the maximum unit depletion of 3,950 acre-feet annually would consist of about 3,550 acre-feet of surplus streamflows not appropriated under existing rights and about 400 acre-feet now diverted during low streamflows by holders of senior rights downstream of Paradox Valley. The 3,550-acre-foot depletion would be charged to Colorado's allocated share of Colorado River water and would thus reduce the amount of water available for future development within the State.

If, through augmentation, the Bureau of Reclamation in coordinated effort with the State of Colorado is able to replace for its present use the 400 acre-feet that would be required for project operation during late summer low flow periods, the effects on present downstream users would actually be beneficial since the quality of the replacement water would be considerably higher than that which they presently use because of the contribution from Paradox Valley. However, if augmentation were not possible, 400 acre-feet would have to be acquired for project use from present users downstream. While the present users would be compensated for the water rights to the estimated 400 acre-feet, there would be a slight reduction in agricultural production in the area, since this water is presently used for such crops as alfalfa, small grains, and irrigated pasture.

The unit depletion would be about 1 percent of the average annual streamflow of the Dolores River immediately above its confluence with the San Miguel River. The depletion would be particularly noticeable during late summer and fall when the riverflow below the valley is frequently less than 5 cfs and consists mostly of surfacing brine ground water and irrigation return flows. In these circumstances, the unit would deplete essentially all of the flow between the valley and the mouth of the San Miguel River. The relative magnitude of depletion would be reduced, however, as a result of large flows that would reach the valley in the summer and fall from the Dolores Project (see Section B-6). During the spring, when the flows would be much larger with or without the Dolores Project, the depletion would be negligible.

Radium Evaporation Pond would reduce the natural runoff in Dry Creek Basin by about 2,600 acre-feet annually, but it is estimated that only about 350 acre-feet would otherwise have reached the San Miguel River, with the rest lost through evapotranspiration in the pond area and along the channel of Dry Creek. The depletion of 350 acre-feet would be negligible, amounting to only about 0.1 percent of the average annual runoff of the San Miguel River at Uravan.

The unit would have no significant effects on West Paradox Creek or private wells in the western part of the valley. Because of the distance of these wells from the brine well field, the pumping of brine would cause a maximum drawdown estimated at no more than about 1 to 2 feet in the private wells.

7. Water Quality

a. Stream Systems

By removing an estimated 180,000 tons of salts annually, the unit would decrease the average annual flow-weighted salinity of the Dolores River by about 474 mg/l at the exit from Paradox Valley, or about 65 percent below existing conditions (Bureau of Reclamation, 1978b). The largest reductions would occur in the concentrations of sodium and chloride, with relatively small reductions in sulfate, potassium, magnesium, calcium, and various heavy metals (particularly iron and lead). Overall, the water quality of the river would be only slightly lower just below the valley than it is just above, because the unit would not remove all of the salts entering the river in the valley.

Although the unit would reduce the salt influx in the valley by about 88 percent, the resulting reduction in the concentrations of total dissolved solids would vary considerably on a seasonal basis because of the large fluctuations in streamflow. During the spring, when the salinity is normally low because of the dilution effect of high snowmelt runoff, the unit would improve the quality only slightly. Since the salinity can increase by as little as 30 mg/l (from 120 to 150 mg/l) under present conditions as the river crosses the valley, the unit reduction could be as low as 20 percent. During the low flows of summer and fall, however, when the river consists predominantly of highly saline brine, the unit would cause a dramatic improvement. Under present conditions, the maximum concentrations have been 3,700 mg/l on the upstream side of the valley and 166,000 mg/l on the downstream side. In situations similar to this, the unit reduction would be in the neighborhood of 90 percent.

The salt removal of the unit would be reflected downstream in the Dolores River and in the Colorado River below their confluence but would be progressively buffered by increased flow. As Table C-3 shows, the amount of the average annual reduction would gradually decrease to about 18.2 mg/l in the Colorado River at Imperial Dam. Seasonal variations would also be buffered downstream, since regulatory reservoirs on the Colorado River have reduced the seasonal fluctuations in flow.

Table C-3
Average annual unit effects on water quality
(flow-weighted mg/l)

Location	Present level	With unit	Reduction
Dolores River			
Below Paradox Valley	1/ 729	255	474
Below confluence with San Miguel River	2/ 659	355	304
Colorado River			
Below confluence with Dolores River	3/ 695	665	30
At Imperial Dam	3/ 1,102	1,084	18.2

1/ Historical average, 1971-76 (available record).
2/ Historical average, 1974-76 (available record).
3/ The 1976 modified salinity level, as explained earlier, is a hypothetical situation which takes under consideration all projects constructed or under construction as of 1976. For further explanation, see Cumulative Impacts, section C-11-f.

The unit would have no effect on the water quality of the San Miguel River. Radium Evaporation Pond would retain and evaporate all of the brine, with no leakage to influence either Dry Creek or the San Miguel. As stated in Chapter A, evaporation would increase the salinity of the brine from 260,000 mg/l at first to saturation at about 350,000 mg/l after the sixth year. This concentration would be maintained during the remainder of the unit operations, except for minor short-term changes resulting from high storm runoff diluting the salts.

b. Radium Evaporation Pond

It is unlikely that the production of significant amounts of hydrogen sulfide would occur at the evaporation pond (Bureau of Reclamation, March 8, 1976). Although elemental sulfur would be piped to the pond, sulfur bacteria, of themselves, do not reduce this element to form the potentially toxic compound. It is also unlikely that such bacteria would produce a significant amount of hydrogen sulfide from the decomposition of organic matter, since the high salinity of the pond would prevent significant populations of biological organisms. Although blue-green algae, one of the most highly salt-tolerant aquatic organisms, are known to exist in high salinities, having recorded tolerances of 137,000 to 159,000 mg/l, their growth would probably be severely restricted by the brine which in this case would range from 260,000 mg/l initially to 350,000 mg/l at saturation.

8. Fish and Wildlife

a. Fish and Aquatic Invertebrates

The unit would have essentially no benefical or adverse effects on fish and aquatic invertebrates during construction but would have significant beneficial effects in the long term as a result of reduced salinity. The improvement would be particularly noticeable in the Dolores River from Paradox Valley to the confluence with the San Miguel River and less dramatic from this point to the confluence with the Colorado River. The unit would have a small beneficial effect on the Colorado River.

During construction work the installation of the collection pipeline from the well field to the hydrogen sulfide stripping plant would temporarily increase the turbidity of the Dolores River and the lower 1,000 feet of West Paradox Creek. The fishes in this area are well adapted to high turbidity, however, and would consequently not be adversely affected. In addition, the work would probably be done during periods of low flow, when the lack of water and the high salinity would normally prohibit fishes from occupying these reaches.

Unit operations would have a major beneficial impact on the 7 miles of the Dolores River from the brine well field to the mouth of the San Miguel River by reducing the salinity levels that have previously limited or prohibited fish and aquatic invertebrates during much of each year. Consequently, fishes such as the speckled dace, flannelmouth sucker, bluehead sucker, roundtail chub, red shiner, fathead minnow, and black bullhead could occupy this reach whenever sufficient flows were available. In addition, invertebrates such as black flies, caddisflies, and midges would become established. Fish would still be forced out of this reach during the extremely low flows of late summer and early fall, and the duration of such occurrences could be increased by the maximum unit depletion of 5 cfs. Even with this circumstance, however, the stream would be inhabitable for a longer time each year than it now is. With the Dolores Project (INT FES 77-12; May 9, 1977), sufficient flows would be available for a year-round fishery in about 3 out of every 4 years. The improved water quality of the Dolores River would also encourage the development of fish cover in the form of submerged and riparian vegetation along the 7-mile reach from the well field to the mouth of the San Miguel River.

The unit would also enhance fish and aquatic invertebrates in the Dolores River between the mouth of the San Miguel River and the confluence with the Colorado River, a distance of about 63 miles. Although the San Miguel River contributes enough flow to dilute the salinity and provide a year-round fishery, the improved water quality resulting from the unit would be sufficient to cause a minor increase in existing populations.

Because of the relatively large flow and salt load in the Colorado River, the reduced salinity and flow resulting from the unit would not cause a noticeable change in fish habitat. Existing populations and distributions would not be altered.

b. Threatened or Endangered Fishes

The Fish and Wildlife Service analyzed the possible impacts of the unit in compliance with Section 7 of the Endangered Species Act. The effect of the flow depletion (3,950 acre-feet in the Colorado River) on proposed critical habitat for the Colorado River squawfish and humpback chub is so minute as to be immeasurable in terms of potential habitat alteration. The Fish and Wildlife Service analyzed the potential impacts of the unit on these species and stated that the improved water quality attributable to the unit could enhance their environment, although additional studies would be necessary to verify this conclusion (See Attachment 2, Memorandum of February 15, 1977).

c. Wildlife

(1) Introduction

The unit would affect wildlife because of temporary and permanent losses of habitat and the limited degree of human activity required for the operation of the facilities. Of the 7,891 acres of land acquired for the unit, wildlife habitat would be altered on about 7,536 acres. The remaining 355 acres, which would be located at the well field and construction material sites, would not be changed from existing habitat. Of 7,536 acres of habitat modified, 218 acres would be temporary losses along pipeline alignments, 3,658 acres would be permanent losses at other unit facilities, and 3,660 acres would be improved habitat at the wildlife mitigation area. It is estimated that about 60 acres of riparian habitat along about 7 miles of the Dolores River downstream from the well field would be slowly improved because of the reduction of salts in the river water. Table C-4 shows the types of wildlife habitat changes by feature within the unit rights-of-way. Radium Evaporation Pond would cause the only major long-term loss, amounting to 3,630 acres after 100 years of unit operations, and the other surface structures would result in only minor permanent losses totaling less than 30 acres.

During the 6-year construction period, wildlife would be disturbed within and near the rights-of-way as a result of noise, dust, blasting, men and equipment, and temporary losses of vegetation. The more mobile and adaptable species could avoid the construction areas by moving to adjacent land, although in many cases this land would already be at its carrying capacity and would not be capable of supporting additional animals. Consequently, some individuals would be lost, and the habitat would be deteriorated. Other species which are less mobile, primarily reptiles and other small animals, would suffer losses at the construction sites. Generally, the population losses that would result from temporary disturbances and losses of habitat would gradually be offset as the habitat recovered and was reoccupied by various species.

Long-term impacts would vary according to species. Among big game populations the pronghorn and mule deer would not be significantly affected because of the mitigation provided by the proposed

Table C-4
Terrestrial habitat changes of the Paradox Valley Unit

Feature and present habitat	Acres required	No habitat change	Habitat losses: Temporary	Habitat losses: Permanent 1/	Habitat gains (per-manent)	Habitat with the unit
Brine well field						
Cropland or irrigated pasture	52	46	5	1		11 acres of operation and maintenance roads and well sites (no habitat); 19 acres of pipeline right-of-way which would be revegetated after construction; remaining 335 acres required for right-of-way but unchanged.
Grassland	2	2				
Tamarisk	81	69	9	3		
Seablite	108	102	4	2		
Sagebrush	24	20		4		
Greasewood	36	34	1	1		
River channel	62	62				
Pinyon-juniper	0	0				
Winterfat and snakeweed	0	0				
Subtotal	365	335	19	11		
Hydrogen sulfide stripping plant						
Sagebrush	6		0	6		No habitat
Housing for operation and maintenance						
Sagebrush	4		0	4		No habitat
Pipeline and pumping plants						
Sagebrush	165		158	7		7 acres of pumping plant sites; 199 acres of initial loss through construction that would later be revegetated with shrubs and grasses.
Pinyon-juniper	36		36			
Winterfat and snakeweed	5		5			
Subtotal	206		199	7		
Radium Evaporation Pond						
Sagebrush	472		0	472		Habitat permanently lost through construction and inundation.
Greasewood	944			944		
Winterfat and snakeweed	2,214			2,214		
Borrow area	20	20				Existing source area that could be slightly expanded.
Subtotal	3,650	20	0	3,630		
Radium wildlife area						
Sagebrush	2,011		0		2,011	Developed and managed for improved habitat.
Greasewood	259				259	
Pinyon-juniper	182				182	
Winterfat and snakeweed	1,208				1,208	
Subtotal	3,660		0		3,660	
Total	7,891	355	218	3,658	2/3,660	

1/ Total permanent loss figures do not reflect 20 acres of existing borrow area not currently used as wildlife habitat. The borrow site would be used as a source of project riprap and gravels.

2/ The estimated 60 acres of riparian habitat along the Dolores River that would slowly improve as habitat because of the reduced salinity have not been included in the total.

wildlife area. Others, including the elk, black bear, and mountain lion would also not be significantly affected, since they are generally not found in the area of unit impacts. Small game and nongame mammals, furbearers, and varmints would also be affected very little.

Some species of raptors, gamebirds, nongame birds, and reptiles would benefit from the unit, while others would undergo small losses. The unit effects on waterfowl cannot be entirely predicted at this time, but field investigations are underway to evaluate the impacts. Reptiles would decline, and amphibians would increase their range and density.

(2) Big Game

(a) Mule Deer and Elk

The construction of the unit would result in short-term losses of mule deer, primarily as a result of temporary losses of habitat along the alignments of the buried pipelines. Amounting to about 199 acres, this habitat loss would consist of a small part of the range now used by about 100 wintering deer and less than 200 year-round residents. The loss is considered to be an insignificant portion of the available range, and the affected area would gradually be restored by reseeding with more desirable types of vegetation.

The only significant long-term impact on mule deer would be the inundation of a maximum of 3,630 acres of winter range by the evaporation pond (based on the assumption that the part of the pond area allocated for flood storage and evaporation would also be lost for wildlife use). This loss would occur gradually, with about 50 percent of the area flooded after 25 years, 70 percent flooded after 50 years, and 100 percent flooded after 100 years. Although the area is now used by an estimated 80 to 100 deer there should be no overall impact on the population, since the development and management of 3,660 acres around the pond as a wildlife area would increase the carrying capacity of this land and potentially compensate for the wildlife displaced from inundated habitat. Because of the unpalatability of brine, animals would not ingest a sufficient quantity to cause detrimental effects.

The brine well field would have a minimal long-term effect on deer. This area, which supports a small year-round herd, would be adversely affected by the loss of 11 acres of habitat and the small increase in human activity at the site. Although some animals would be displaced, the overall impact on the valley's population would be relatively minor.

The unit would have no significant impacts on elk, either short term or long term. This animal normally uses the area only in years of abnormally heavy snowfall.

(b) Pronghorn

Because of the wildlife mitigation area the unit would overall have little effect on the pronghorn population. Radium Evaporation Pond would inundate 3,630 acres of habitat now used by less than 20 animals, but the population is limited by predation and livestock competition rather than by a lack of available range. By improving the habitat in the wildlife area and fencing the area to exclude livestock but not pronghorns, the unit would provide a habitat of better quality than now exists for the present population or for animals considered for planting from other parts of the State by the Division of Wildlife.

(c) Black Bear and Mountain Lion

The unit would have no significant impacts on the black bear or mountain lion. Both of these species use the area only minimally.

(3) Small Game Mammals

Populations of the desert cottontail, which is the only small game mammal identified in the unit area, are expected to be temporarily reduced by the loss of habitat along the brine pipeline, but the revegetation of this area would more than compensate for the losses. The restored habitat would probably contain a diversity of shrubs and grasses that would be more desirable than the sagebrush that now predominates. In the long term the evaporation pond would displace a substantial number of animals, and the well field would displace an insignificant number. The wildlife area would provide additional habitat of a good quality, however, and as a result the overall impact of the unit would be slightly beneficial.

(4) Furbearers

Impacts on furbearers would vary according to species. The construction of unit facilities would lead to temporary reductions in populations of the long-tailed weasel, gray fox, striped skunk, and badger by reducing habitat and the number of prey species available. In the long term, however, the development of the wildlife area and the revegetation of the pipeline alignment would provide a more desirable diversity of vegetation, increased cover, and increased abundance of prey. As a result, these furbearers would benefit from the unit. In addition, the reduced salinity of the Dolores River would have a beneficial impact on the beaver and muskrat by providing increased habitat in the form of streamside and submerged aquatic vegetation. The unit would have no effect on other furbearers--including the ringtail, marten, and spotted skunk--since the area lacks desirable habitat for these species.

(5) Varmints

Unit construction would have temporary adverse effects on the varmints inhabiting the area, but no significant impacts would remain following the development of the wildlife area and the revegetation of the pipeline alignment. One species, the raccoon, would benefit in the long term from increased riparian vegetation along the Dolores River below the well field.

(6) Small Nongame Mammals

Populations of small nongame mammals would temporarily decline during construction but would return to approximately their present levels after the development of the wildlife area and the revegetation of the pipeline alignment. Overall, the population density would not be significantly changed, but the modifications in the habitat would change the species composition by favoring some species, such as the deer mouse and western harvest mouse, more than others, such as the pinon mouse, white-tailed antelope ground squirrel, and Ord's kangaroo rat.

(7) Raptors

The unit's effects on raptors, beneficial for some species and adverse for others, would overall result in a slight decrease in raptor use of the area. Many raptors would benefit from an increased density of prey species in the wildlife area. The removal of 36 acres of pinyon-juniper woodland along the brine pipeline would reduce by a minor amount the available nesting habitat of the Cooper's hawk, goshawk, and great horned owl; but the revegetation of this area with shrubs and grass would provide suitable hunting habitat for species such as the red-tailed hawk, rough-legged hawk, and American kestrel. Increased human activity and loss of habitat during the long-term operation of the brine well field would cause a minor decrease in hunting areas for red-tailed hawks and prairie falcons nesting along the nearby cliffs, but this impact would be more than compensated for by the establishment of improved riparian habitat along the Dolores River. Consequently, the overall effect on these two species would be beneficial.

(8) Gamebirds

The unit would have minor effects on gamebirds in the area, with the possible exception of the sage grouse. Populations of the ring-necked pheasant and mourning dove would decline slightly as a result of the small loss of habitat at the well field. The mourning dove could take advantage of the vegetation changes along the pipeline alignment as an additional feeding area, but the impact would be minor. A sage grouse population of about 40 birds would be displaced by the inundation of 472 acres of sagebrush habitat at the evaporation pond. This area is in poor condition as a result of livestock grazing, however, and the grouse population could be increased by fertilizing and seeding to improve the 2,011 acres of similar habitat in the 3,660-acre wildlife area.

(9) Waterfowl and Shore Birds

The improved water quality in the Dolores River, by increasing submerged and streamside vegetation, fish, and aquatic invertebrates, would enhance the habitat for waterfowl and shore birds downstream from Paradox Valley. Studies being conducted on the possible impacts of Radium Evaporation Pond, although not completed, suggest that prolonged exposure to the brine would be dangerous for waterfowl, but that the birds would be unlikely to remain on the pond long enough to experience serious consequences.

These studies were undertaken in response to concern expressed by the Fish and Wildlife Service over the possibility of waterfowl mortality caused by exposure to evaporation ponds with very high levels of dissolved solids. A laboratory investigation was conducted by Colorado State University under a contract with the Bureau, using mallard ducks which were exposed to brine similar to that expected to occur at Radium Evaporation Pond, under variable climatic conditions. Results of the study (Colorado State University, 1977) clearly indicated that the brine could be lethal because of severe dehydration and hypothermia if the birds were confined to the water at low temperatures for 12 hours or more. Shorter exposures may not be fatal, and the birds used in the tests showed discomfort and a preference to leave the brine after about 2 hours, suggesting that wild birds landing on the pond would soon leave for surrounding land or preferably a source of fresh water. Although the birds used in the experiment could not fly because their wings were clipped, the small effect that salts had on their feathers suggests that wild birds could probably lift off in flight, even after several hours of exposure.

Although this study has contributed significantly in determining the potential effects of Paradox Valley brine on waterfowl, additional laboratory investigations have been initiated, and a field study was begun in February 1978. The study is being conducted at a temporary 5-acre evaporation pond located immediately northwest of the brine well field and adjacent to the Dolores River. The Colorado State University Department of Physiology and Biophysics is conducting experiments designed to determine the impacts of the brine on captured wild birds of both diving and dabbling types under natural conditions. The results of both lab and field studies will be subject to review by the Fish and Wildlife Service and the Colorado Division of Wildlife and will also be available for review by any other interested parties. If the results of the field study indicate significant losses of waterfowl would occur because of Radium Evaporation Pond, the Bureau, in coordination with the appropriate State and Federal Agencies would undertake a mitigation program to help offset those losses.

(10) Nongame Birds

Increased human activity and vegetation clearing during construction would temporarily displace nongame birds and cause relatively small declines in population. In the long term, however, most of the unit facilities would cause little overall change. Revegetation along the pipeline would cause a significant change in species diversity along the alignment but not in species density. Increased riparian habitat along the river and improved habitat at the wildlife area would largely mitigate the population losses caused by unit construction and operation.

(11) Reptiles and Amphibians

The unit would decrease the populations of most reptiles in the area, since revegetation along the pipeline and the development of the wildlife area are not expected to compensate for habitat losses. One species, the side-blotched lizard, would benefit from the additional open habitat along the pipeline, but others would be adversely affected. The evaporation pond would also have an adverse effect that could not be mitigated. There would be little effect in the well field area.

Amphibians would benefit from the habitat modifications of the unit. Existing brine pools and salt deposits along the river would be replaced by more desirable freshwater pools filled during spring floods, and water retention structures in the wildlife area would also provide additional habitat. Overall, populations of amphibians would increase.

d. Threatened or Endangered Wildlife

Possible effects on the active peregrine falcon aerie in the unit area have been investigated by the Fish and Wildlife Service, in accordance with the requirements of Section 7 of the Endangered Species Act. The Service reports that the improved riparian vegetation resulting from the unit could enhance hunting areas for the falcon. The unit in all likelihood would not jeopardize the falcon or adversely affect its critical habitat (see Attachment 2, Memorandum of October 18, 1977). The Bureau of Land Management will initiate a monitoring program and close the nesting area seasonally (March 1 to August 1) to public use and development. Based on the Fish and Wildlife Service's recommendation, the Bureau of Reclamation, Bureau of Land Management, Fish and Wildlife Service, and Colorado Division of Wildlife would cooperate to ensure adequate protection, determine the extent of breeding areas, and identify the exact aerie location.

Although the northern bald eagle is a winter visitor to the unit area, the construction and operation of the unit are not expected to have a significant impact on the species for several reasons. Heavy construction activity would not occur during the winter months when the eagles most frequently inhabit the area. The permanent four-member work force, based at the stripping plant, would not unduly increase present human activity in the area. The evaporation pond and surrounding wildlife area would remove a total of 7,290 acres from what presently serves primarily as livestock range that provides carrion (primarily from dead sheep) for wintering northern bald eagles. On the other hand, the wildlife area, once established, would support more wildlife, providing either carrion or prey for the eagle. The riparian habitat along the Dolores River would improve once the salinity influx was reduced, and would provide better habitat for such eagle prey species as rabbits.

The presently known Paradox Valley habitat of the Great Basin silverspot butterfly (Speyeria nokomis nokomis) as given in the Federal Register of July 3, 1978, is about 5 miles northwest of the nearest area to be affected by construction of any unit features. In August 1978, a survey for the butterfly and the violet plants essential to the larval stage was conducted by Bureau biologists on all land that would be affected by project activities. No evidence was found of either the butterfly or the violet.

9. Prehistorical and Historical Sites

Two sites--one the remains of a ranch and the other an area of lithic scatter--lie within the basin of Radium Evaporation Pond and would be flooded. Neither site has been formally evaluated for eligibility for the National Register of Historic Places. In the opinion of the State Historic Preservation Officer, however, the historical homestead site does not appear to be eligible for listing in the Register (Hartmann, March 11, 1977. See Attachment 3.). The small lithic site would be evaluated for eligibility before initiating construction on the pond. The collection and possible excavation program planned for the site has been reviewed and approved by the Colorado State Archaeologist (Rippeteau, March 18, 1977. See Atachment 3.). The brine pipeline would cross part of the route through Dry Creek Basin taken in 1776 by the Dominguez-Escalante expedition.

10. Land Ownership and Use

As shown in Table A-2, the proposed rights-of-way for unit features would total approximately 7,891 acres. About 5,381 acres of private land would be acquired and used for such unit features as the brine well field, hydrogen sulfide plant, brine pipeline, brine pumping plants, evaporation pond, and operation and maintenance housing. This land consists of about 5,072 acres in San Miguel County and 309 acres in Montrose County. The county revenue of San Miguel County would be reduced by about $1,186 as a result, but the decrease is negligible compared to the total annual revenues of $161,000. The reduction in Montrose County would be imperceptible. For the loss of these tax revenues, the counties would receive payment under provisions of Public Law 94-565 (Local Government Units. Public Lands, Payments.).

An additional 2,510 acres of land already in public ownership would be used for unit purposes. Since the pipeline would be covered and the soil reseeded, livestock would be able to use the right-of-way for grazing. Wildlife would be able to use the well field, pipeline right-of-way, and the area around the evapoartion pond for habitat.

Two ranching operations would be affected by the acquisition of about 4,990 acres of private land at Radium Evaporation Pond and the withdrawal of another 2,300 acres of public land administered by Bureau of Land Management on which they now hold grazing permits. Neither rancher's farmstead would be affected by the necessary land acquistions and withdrawals, since their headquarters are not in the pond area. Yet, one rancher would lose 3,110 acres of private grazing land which he now uses as winter range for his sheep operation in conjunction with Bureau of Land Management grazing permits on public land which supports the sheep operation during the summer months. Because this rancher's holdings are quite extensive (estimated at over 50,000 acres within the county) the impact of the land acquisitions at Radium would probably not be severe; but if replacement lands with adequate public grazing rights attached to them could not be found, his ranch income would be reduced.

The impacts on the second rancher are potentially more severe. Although he would lose less acreage, estimated at about 1,880 acres, his is a much smaller operation. Thus, the necessary acquisition would reduce his private holding by almost half and his privately owned winter pasture by about two-thirds, and also cause a reduction of 500 acres in his public grazing permits. This reduction, in the opinion of Reclamation analysts, may make continued ranching operations uneconomic and, in that case, the Bureau would offer to purchase his remaining land. At the very least, the reduction could cause changes in the type of operations, if replacement lands with adequate grazing permits could not be found. The San Miguel County Agent reports that some grazing land is available in the area. The Bureau of Reclamation has contacted the two ranchers involved concerning the potential impacts if the unit, as proposed, is funded for construction. They have also been advised of assistance and possible compensation available under the Uniform Relocation and Assistance Act, P.L. 91-646.

The projected land use changes, particularly at the evaporation pond, could also have an impact on livestock production in the project area. Present production on the 7,290 acres that would be needed for the pond and surrounding wildlife area is estimated at 12 or 13 acres per animal-unit-month (AUM).[1/] This represents winter grazing for roughly 100 cows with their calves or 500 ewes with their lambs. If the present operators elected not to go to some kind of feeder operation to compensate for the loss of winter grazing land or could not find replacement land that is presently grazed well below its capacity, a significant reduction in this present production would be necessary.

1/ The amount of feed necessary to support one cow and unweaned calf or five sheep for 1 month.

11. Cumulative Impacts

a. Introduction

The Bureau of Reclamation has proposed preparation of a comprehensive environmental statement covering Reclamation activities along the entire Colorado River. In order for this undertaking to proceed, Congressional funding will be required. If funded, the statement will assess the environmental impacts resulting from operation and maintenance activities on existing projects and proposed further actions on existing projects. In addition, it will assess the significant cumulative impacts expected in about the next 25 years whether they come from operation of existing projects, projects under construction, projects proposed for construction, or projects under study in the Colorado River area. The comprehensive statement also will be responsive to issues raised by several environmental groups, including the Environmental Defense Fund, Colorado Open Space Council, Trout Unlimited, the Island Foundation, the Sierra Club, and the Wilderness Society.

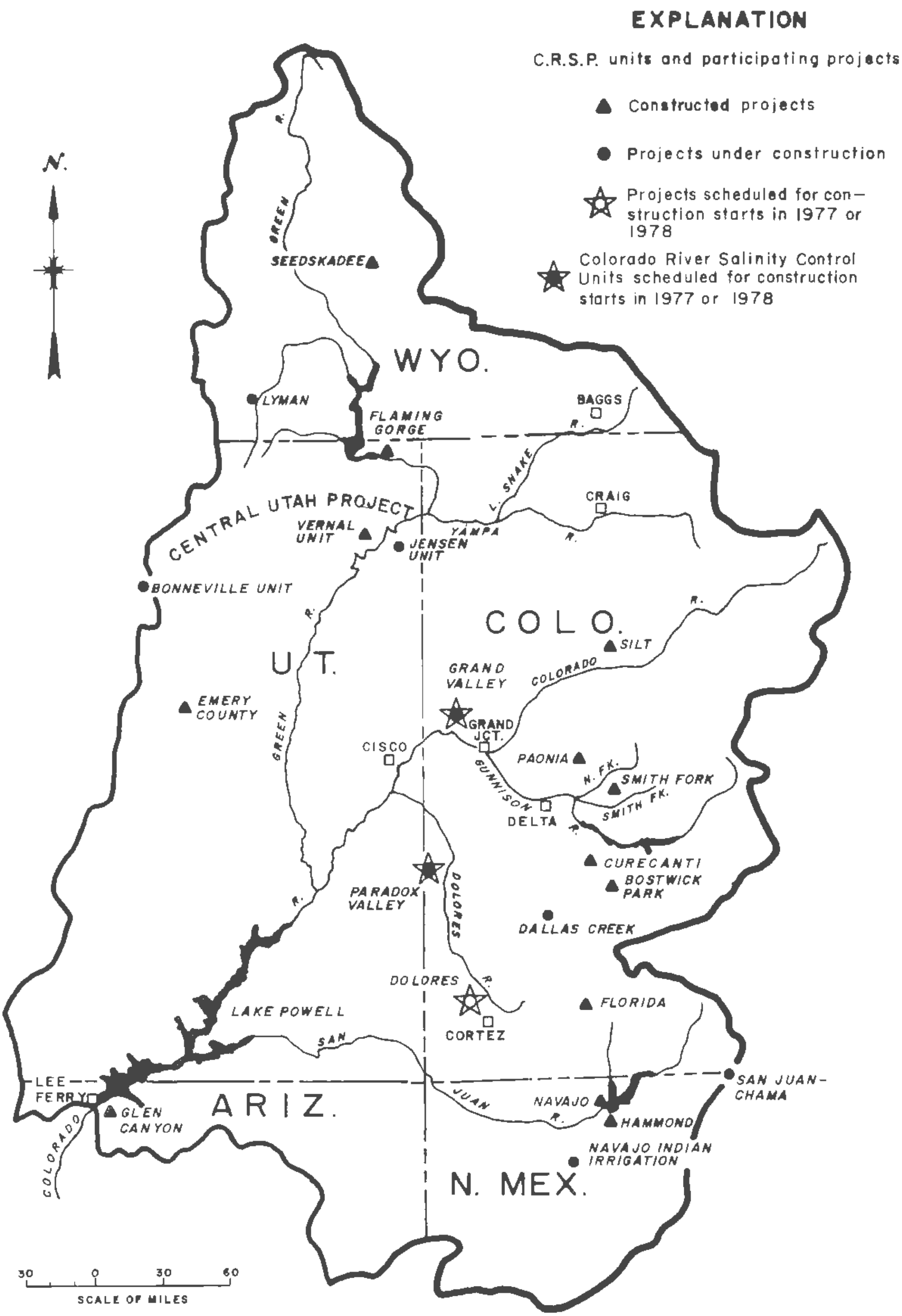
The statement will require some time to prepare if it is indeed to be comprehensive in scope and depth. In order to give as much information as is now available, however, the following discussions are prepared as an appraisal of the cumulative impacts in the Upper Colorado River Basin of 19 units and participating projects of the Colorado River Storage Project (hereinafter designated CRSP) which are constructed or under construction and three developments which are scheduled for the start of construction in 1977 and 1978 pending compliance with the National Environmental Policy Act, including one of CRSP and two of the Colorado River Basin Salinity Control Project. Except for salinity, the analysis does not extend to any authorized developments planned for construction starts beyond 1978 since firm information for such projects is not available.

The base for the discussions, termed the 1976 modified base, is a hypothetical condition which includes actual conditions in 1976 with modifications for effects of developments which are under construction. The base includes many Federal and private developments, but the effects of CRSP are analyzed separately. In turn, the cumulative effects of the three developments scheduled for construction starts in 1977 and 1978 are analyzed as an increment to the 1976 modified base condition. The comparisons of project conditions with the assumed base conditions are admittedly imprecise. They are based on the best information currently available, however, and give some perspective to impacts of Reclamation developments in the Upper Colorado River Basin.

The individual developments included in the appraisal are listed in Table C-5 and shown on the map in Figure C-1. The dates of authorization and actual or anticipated dates of completion are listed with the projects. Although some of the developments are not scheduled for completion for several years, they are considered as in place since their construction has been started and in some cases is well along.

Table C-5
Developments included in cumulative impact analysis

	Actual or estimated completion date
CRSP developments constructed or under construction	
Storage Units--Act of April 11, 1956	
Curecanti, Colo.	
Blue Mesa Dam, Reservoir, and Powerplant	1966
Morrow Point Dam, Reservoir, and Powerplant	1970
Crystal Dam, Reservoir, and Powerplant	1977
Flaming Gorge, Wyo.	1963
Glen Canyon, Utah and Ariz.	1965
Navajo, N. Mex.	1963
Participating projects	
Act of April 11, 1956	
Florida, Colo.	1963
Paonia, Colo.	1962
Silt, Colo.	1966
Smith Fork, Colo.	1963
Hammond, N. Mex.	1975
Central Utah, Utah	
Bonneville Unit	1996
Jensen Unit	1986
Vernal Unit	1961
Emery County, Utah	1965
Lyman, Wyo.	1980
Seedskadee, Wyo. (Fontenelle Dam and Powerplant)	1964
Act of June 13, 1962	
Navajo Indian, N. Mex.	1987
San Juan-Chama, Colo. and N. Mex.	1983
Act of September 2, 1964	
Bostwick Park, Colo.	1971
Act of September 30, 1968	
Dallas Creek, Colo.	1981
Developments scheduled for construction starts in 1977 and 1978	
Act of September 30, 1968	
Dolores, Colo.(CRSP)	1988
Act of June 24, 1974	
Grand Valley Unit, Colo. (Colorado River Basin Salinity Control Project)	1987
Paradox Valley Unit, Colo. (Colorado River Basin Salinity Control Project)	1984



UPPER COLORADO RIVER STREAM SYSTEM

Figure C-1

Two of the developments listed, the Bonneville Unit of the Central Utah Project and the San Juan-Chama Project, would involve diversions of water out of the Colorado River Basin. Essentially all of the water of the San Juan-Chama Project would be delivered to the Rio Grande River Basin in New Mexico. Water of the Bonneville Unit would be used both in the Uinta Basin of Utah, which is part of the Colorado River Basin, and in the Bonneville Basin of Utah, which is a part of the Great Basin.

The Fruitland Mesa Project in Colorado and the Savery-Pot Hook Project in Colorado and Wyoming, both participating projects of the CRSP had been scheduled for early construction starts. They were not funded in the Public Works Appropriation Bill of August 7, 1977, however, and the President's Water Review of 1977 resulted in the administration's proposal they be deauthorized; therefore they are not included in the appraisal of future developments.

The discussions of cumulative impacts are based on numerous reports of the Bureau of Reclamation and Federal, State, and local agencies. The references are so numerous that they could not all be identified in this section, but they are included in the Bibliography in Section I.

b. Socio-Economic Conditions

(1) Crop Production

(a) CRSP Developments Constructed or Under Construction

The contribution to crop production of CRSP developments constructed or under construction is large, amounting to a value of nearly $26 million annually, or about 25 percent of the total crop production in the basin with assumed ultimate development of the CRSP projects considered (1976 modified base). Additional crop production from water exported from the Colorado River Basin under the Bonneville Unit and San Juan-Chama Project would have a value of nearly $15 million annually. A project-by-project comparison of crop production in the basin is shown in Table C-6 along with data used for comparisons. Crop production from CRSP developments constructed or under construction both within and outside of the basin is shown in Table C-7. The value of water for irrigated pasture and the value of livestock and livestock products have not been included in either the base or the CRSP project evaluations because comparable data are not available. As a general rule in the Upper Basin, however, it can be stated that the value of crop production is only about a third of the gross agricultural production and the value of livestock and livestock products accounts for the remaining two-thirds. Thus the total value of agricultural production in the Upper Basin from CRSP developments constructed or under construction is roughly estimated at about $80 million annually, with an additional value of about $45 million outside of the basin.

Table C-6
Summary of annual gross crop values
from CRSP projects constructed or under construction

	Irrigable acreage (acres)			
	Full service land	Supple-mental service land	Irrigation supply (acre-feet)	Gross value of crop production 1/
Production in basin shown in 1969 Agricultural Census indexed to 1975				$84,957,000
Crop production from CRSP Projects within basin based on 1975 Bureau of Reclamation crop reports				
Curecanti Unit			No irrigation	
Flaming Gorge Unit			No irrigation	
Glen Canyon Unit			No irrigation	
Navajo Unit			No irrigation	
Florida Project	5,730	13,720	26,000	1,057,000
Paonia Project	2,230	13,070	20,000	1,352,000
Silt Project	2,120	4,480	13,000	548,000
Smith Fork Project	1,420	8,060	10,000	251,000
Hammond Project	3,900		19,000	733,000
Bonneville Unit 2/		26,450	22,700	802,000
Jensen Unit 2/	440	3,640	5,000	167,000
Vernal Unit		14,781	18,000	602,000
Emery County Project	770	17,210	22,000	473,000
Lyman Project		46,670	49,000	486,000
Navajo Indian Irrigation Project 2/	100,000		330,000	19,256,000
Bostwick Park Project	1,320	4,290	11,000	305,000
Dallas Creek Project 2/		20,850	11,200	622,000
Seedskadee Project			No irrigation	
Subtotal	117,930	173,221	556,900	26,654,000
Less crop production in both 1969 census and 1975 crop reports				5,016,000
Total crop production in basin (1976 modified base)				106,595,000
Percent of crop production in basin from CRSP developments				25

1/ Exclusive of irrigated pasture and livestock production.
2/ Based on 1975 per acre values for nearby existing projects.

Table C-7
Summary of annual gross crop values within and outside of Colorado River Basin from CRSP projects constructed or under construction

	Irrigable area (acres)			
	Full service land	Supplemental service land	Irrigation supply (acre-feet)	Gross value of crop production 1/
Crop production from CRSP projects within basin	117,930	173,221	556,900	$26,654,000
Crop production from CRSP projects out of basin				
Bonneville Unit				
Bonneville Basin	29,370	186,720	184,300	11,303,000
San Juan-Chama Project				
Rio Grande Basin		84,380	61,300	3,577,000
Subtotal	29,370	271,100	245,600	14,880,000
Total CRSP in and outside of basin	147,300	444,321	802,500	41,534,000

1/ Exclusive of irrigated pasture and livestock production.

(b) Developments Scheduled for 1977 and 1978 Construction Start

The three developments scheduled for construction starts in 1977 and 1978 would contribute more than $5.7 million in additional agricultural crop production or about 5 percent of the basin's crop production in the 1976 modified base. A comparison of crop production that would result from the three projects is shown in Table C-8. Based on the assumption that crop production represents only about a third of the total agricultural production, the value of gross agricultural production from the three projects is estimated at about $17 million.

(2) Power

The capability for power production from CRSP projects constructed or under construction is estimated at slightly more than 6 million megawatt-hours. This is equivalent to nearly 10 percent of the 1975 power consumption in the CRSP power marketing area which includes the entire States of Arizona, Colorado, New Mexico, Wyoming, and Utah, as well as three southwestern counties of Nevada and a small portion of California. The comparison of project capability and consumption in the market area is shown in Table C-9. On the basis of an average annual use of 2,600 kilowatt-hours per capita, the CRSP power generation from projects constructed or under construction would be sufficient to meet residential needs of more than 2.3 million people or, from another perspective, could supply the entire estimated residential needs in the State of Arizona. No power would be generated by the developments scheduled for construction starts in 1977 and 1978.

Table C-8
Summary of annual gross crop values from developments scheduled for 1977 and 1978 construction starts

Time frame	Irrigable area (acres) Full service land	Supple-mental service land	Irrigation supply (acre-feet)	Gross value of crop production 1/
1976 modified base				$106,595,000
Projects scheduled for 1977 and 1978 construction starts				
Dolores Project	35,360	26,300	90,900	5,595,000
Grand Valley Unit				2/ 154,000
Paradox Valley Unit				no irrigation
Subtotal				5,749,000
Total				112,344,000
Percent of 1976 modified base				5

1/ Exclusive of irrigated pastures and livestock production.
2/ Represents increased production on existing Grand Valley Project that would result from decreased salinity levels.

Table C-9
Power capability of CRSP projects constructed or under construction compared with 1975 consumption in market area

	Capacity (MW)	Generation[1/] (MWh)
Project capability		
Curecanti Unit		
Blue Mesa	60	268,984
Morrow Point	120	365,664
Crystal	28	173,000
Flaming Gorge Unit	108	604,903
Glen Canyon Unit	950	4,233,668
Bonneville Unit	133	300,670
Seedskadee Project	10	63,912
Navajo Indian Irrigation Project	23	118,000
Total	1,432	6,128,801

State	1975 consumption[2/] (MWh)
Power market area	
Arizona	20,468,000
California	N/A
Colorado	15,792,000
Nevada	7,672,000
New Mexico	6,748,000
Utah	7,644,000
Wyoming	4,452,000
Total	62,776,000

1/ Based on 19th Annual Report, Colorado River Storage Project and Participating Projects for Fiscal Year 1975 for projects completed.

2/ Based on the 1975 Energy Production System in the States of the Rocky Mountain Region by Charles D. Kolstad, Los Alamos Scientific Laboratory of the University of California.

(3) Municipal and Industrial Water

(a) CRSP Developments Constructed or Under Construction

The municipal and industrial water supply for CRSP developments constructed or under construction amounts to a total of 541,500 acre-feet annually, including about 216,500 acre-feet for municipal uses and 325,000 acre-feet for industrial use. Based on an estimated annual per capita use of 0.25 acre-foot, the water for municipal use could supply the domestic water for a population of about 860,000 or a city about the size of Denver, Colo. The largest single use of industrial water is for steam-electric power generation. The supply available from individual projects is shown in Table C-10.

Table C-10
Municipal and industrial water supply--
CRSP developments constructed or under construction
(Unit--acre-feet)

For use within Upper Colorado River Basin	
Glen Canyon Unit	142,000
Navajo Unit	64,000
Central Utah Project	
Jensen Unit	18,000
Vernal Unit	2,000
Emery County Project	6,000
Lyman Project	1,500
Seedskadee Project	120,000
Dallas Creek Project	28,000
Subtotal	381,500
For use outside Upper Colorado River Basin	
Bonneville Unit	99,000
San Juan-Chama Project	61,000
Subtotal	160,000
Total use	541,500

(b) Developments Scheduled for Construction Starts in 1977 and 1978

Of the three developments scheduled for construction starts in 1977 and 1978, only the Dolores Project would provide water for municipal and industrial use. It would develop 8,700 acre-feet for residential use in local communities.

(4) Recreation

(a) CRSP Developments Constructed or Under Construction

It is estimated CRSP developments constructed or under construction will provide more than 5 million man-days of recreation use annually within the Upper Colorado River Basin, as shown in Table C-11. This constitutes an estimated 12 percent of the overall recreation use within the basin, assuming all CRSP developments are in place (1976 modified base). The greatest contribution from CRSP comes in the area of water-related recreation which is limited in the largely semiarid to arid Upper Colorado River Basin. This is borne out in Table C-11 which shows 29 percent of the fishing, 25 percent of the boating, and 14 percent of the camping in the basin is at CRSP developments. From an economic standpoint these contributions are significant, since recreation and tourism are major industries in the basin. In addition to recreation development in the basin, CRSP developments provide another 500,900 man days of recreation use outside the basin.

Table C-11
Recreation use--CRSP developments constructed or under construction
(Unit--annual man days)

Project	Sightseeing	Picnicking	Camping	Boating	Fishing 1/	Hunting 2/	Other 3/	Total
Upper Colorado River Basin								
Recreation use without CRSP (1976) 4/	8,720,430	5,625,610	8,807,030	1,815,320	3,221,400	1,403,640	9,311,940	38,905,370
CRSP recreation use								
Curecanti	480,730	16,400	102,800	51,800	82,700	110	5,070	739,610
Flaming Gorge	98,000	24,000	132,300	133,600	143,700	7,900	119,300	658,800
Glen Canyon	84,140	18,900	798,300	166,700	210,800	530	91,980	1,371,350
Navajo	60,020	40,400	38,600	56,200	64,100	3,910	87,660	350,890
Florida	31,500	11,500	4,100	2,500	25,000		3,000	77,600
Paonia	4,700	3,500	4,100	1,200	2,600	10	650	16,760
Silt	17,000	3,000	16,500	6,600	28,700	150	4,070	76,020
Smith Fork	23,180	10,000	16,600	11,100	36,700		1,520	99,100
Hammond								
Central Utah								
Bonneville Unit	76,250	24,400	91,500	79,300	551,800	9,150	24,400	856,800
Jensen Unit	10,000	3,200	12,000	10,400	9,500	1,200	3,200	49,500
Vernal Unit	10,600	9,200	8,100	17,600	7,400	50	7,910	60,860
Emery County	13,800	14,200	57,800	19,700	49,600	3,900	16,400	175,400
Lyman	3,670	12,840	11,000	1,830	47,000	1,830	5,500	83,670
Seedskadee	9,500	1,000	12,000	7,500	55,000	600	1,650	87,250
Bostwick Park	26,000	500			7,900	100	200	34,700
Dallas Creek	147,620	26,050	130,250	43,420	6,000	No estimate	No estimate	353,340
Total	1,096,710	219,090	1,435,950	609,450	1,328,500	29,440	372,510	5,091,650
Recreation use in basin with CRSP (1976 modified base)	9,817,140	5,844,700	10,242,980	2,424,770	4,549,900	1,433,080	9,684,450	43,999,020
Percent attributable to CRSP	11	4	14	25	29	2	4	12
CRSP use outside of basin								
Bonneville Unit	57,530	18,410	69,030	59,830	225,200	6,900	18,410	455,310
San Juan-Chama Project	1,920	2,940	23,040	5,380	8,300	No estimate	4,050	45,630
Total	59,450	21,350	92,070	65,210	233,500	6,900	22,460	500,940
Total CRSP use in and outside of basin	1,156,160	240,440	1,528,020	674,660	1,562,000	36,340	394,970	5.592,590

1/ Includes use for reservoirs and improved streams.
2/ Does not include hunting use on project agricultural lands.
3/ Includes swimming, hiking, and water skiing.
4/ Hypothetical value--derived from State Comprehensive Outdoor Recreation Plans for the portion of five basin States involved, updated to estimated 1976 conditions, less 1976 recreation use of CRSP developments constructed.

One of the tradeoffs for the new recreational opportunities has been the elimination of white-water boating opportunities in the canyon sections of Lake Powell (Glen Canyon) and Flaming Gorge Reservoir. Some reservoirs, particularly Lake Powell, have adversely altered the natural splendor of the landscape by inundation, but, on the other hand, these areas now receive increased recreation use because of the improved access and facilities. For instance, it has been estimated that Rainbow Bridge at Lake Powell had been seen by no more than 20,000 people prior to CRSP.[1/] The National Park Service now estimates that, with Lake Powell, as many as 80,000 people a year visit the bridge.

(b) Developments Scheduled for 1977 and 1978 Construction Starts

Of the three projects scheduled for construction starts in 1977 and 1978, only the Dolores Project would increase the recreation use base. As shown in Table C-12, the Dolores Project would result in an additional 473,900 man-days annually, or about 1 percent. The greatest increases would come in fishing, boating, and picnicking. Perhaps the most significant recreational tradeoff associated with the project would be the loss of some white-water boating opportunities below McPhee Reservoir on the Dolores River for the establishment of a perennial stream for fishing, other recreational uses, and improvement of aesthetic values.

(5) Employment Opportunities

(a) CRSP Developments Constructed or Under Construction

CRSP developments constructed or under construction account for about 4,500 permanent jobs annually, including about 4,000 jobs in agriculture and 500 associated with operation and maintenance of CRSP developments, as shown in Table C-13. Of the 4,500 jobs, about 2,800 are associated with employment in the basin and 1,700 outside of the basin. Total employment in the basin in the 1976 modified base, including CRSP developments constructed or under construction, is about 168,800, with the CRSP developments accounting for about 2 percent of the total. The impact of CRSP on agricultural employment is more significant, however, amounting to about 14 percent of the total in the 1976 modified base. Additional employment opportunities are created outside of the basin by the Bonneville Unit of the Central Utah Project and the San Juan-Chama Project.

(b) Developments Scheduled for 1977 and 1978 Construction Starts

Developments scheduled for construction in 1977 and 1978 would result in an increase of more than 380 permanent jobs,

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1/ Sypulski, John S., The Colorado River, Reprint from New York State Range School Alumni News.

Table C-12

Recreation use--developments scheduled for 1977 and 1978 construction starts

(Unit--annual man days)

Project	Sightseeing	Picnicking	Camping	Boating	Fishing 1/	Hunting 2/	Other 3/	Total
Recreation use in basin with CRSP (1976 modified base)	9,817,140	5,844,700	10,242,980	2,424,770	4,579,900	1,433,080	9,684,450	44,027,020
Recreation use for projects scheduled for 1977 and 1978 construction starts								
Dolores	26,550	96,560	48,600	60,350	152,100	31,800	57,940	473,900
Grand Valley Unit								
Paradox Valley Unit								
Subtotal	26,550	96,560	48,600	60,350	152,100		57,940	473,900
Total	9,843,690	5,941,260	10,291,580	2,485,120	4,732,000		9,742,390	44,500,920
Percent increase	0.3	1.7	0.5	2.5	3.3		0.6	1

1/ Includes use for reservoirs and improved streams.
2/ Does not include hunting use on project agricultural lands.
3/ Includes swimming, hiking, and water skiing.

Table C-13
Average annual employment opportunities
CRSP developments constructed or under construction

	Agriculture			CRSP operation and maintenance	Other	Total
	Direct	Indirect	Total			
Upper Colorado River Basin without CRSP1/	12,000	3,000	15,000		151,000	166,000
Upper Colorado River Basin						
Storage units and Seedskadee Project1/				230		230
Florida Project	120	30	150	6		156
Paonia Project	300	70	370	6		376
Silt Project	70	20	90	6		96
Smith Fork Project	70	20	90	2		92
Hammond Project	50	10	60	5		65
Bonneville Unit	80	20	100	10		110
Jensen Unit	20	10	30	5		35
Vernal Unit	140	30	170	7		177
Emery County Project	150	40	190	3		193
Lyman Project	140	30	170	3		173
Navajo Indian Irrigation Project	750	180	930	102		1,032
Bostwick Park Project	30	10	40	2		42
Dallas Creek Project	30	10	40	2		42
Subtotal (rounded)	1,900	500	2,400	400		2,800
Outside of Upper Colorado River Basin						
Bonneville Unit	1,100	280	1,380	91		1,471
San Juan-Chama Project	170	40	210	37		247
Subtotal (rounded)	1,300	300	1,600	100		1,700
Total (rounded)	3,200	800	4,000	500		4,500
Total basin employment including CRSP 1976 modified base	13,900	3,500	17,400	400	151,000	168,800
Percent of basin employment resulting from CRSP developments	14	14	14	100	0	2

1/ For interrelated power operations.

including about 340 jobs in agriculture and more than 40 jobs associated with project operation and maintenance. Temporary employment would amount to a total of more than 11,000 additional jobs over the various construction periods for the three projects. Estimated employment opportunities from the three projects are listed in Table C-14.

Table C-14
Employment opportunities--
developments scheduled for 1977 and 1978 construction starts

	Average annual permanent employment opportunities (number of jobs)					Total temporary employment opportunities over project construction periods (man-years)
	Agriculture			Operation and maintenance	Total	
	Direct	Indirect	Total			
1976 modified base 1/	13,900	3,500	17,400	400	17,800	
Employment increases						
Dolores Project	270	70	340	30	370	6,270
Grand Valley Unit				10	10	4,840
Paradox Valley Unit				4	4	700
Total	270	70	340	44	384	11,810
Percent of 1976 modified base	2	2	2	11	2	

1/ Based on U.S. Water Resources Council, 1975 Water Assessment Specific Problem Analysis, Upper Colorado Region, Technical Memorandum No. 2, August 1976.

c. Aquatic Wildlife

(1) Habitat Changes

(a) CRSP Developments Constructed or Under Construction

As shown in Table C-15, CRSP has resulted in a slight increase (an estimated 1 percent) in the miles of cold water fishery (primarily supporting trout) in the Upper Colorado River Basin and a significant decrease (an estimated 34 percent) in the miles of warm water fishery (primarily supporting catfish and nongame species). In total, these changes constitute an estimated 6 percent reduction in the sport stream fishery in the Upper Colorado River Basin. Additional impacts not shown in the table include the degradation of 183 miles of existing cold water fishery, the improvement of 285 miles of existing cold water fishery, and the improvement of 190 miles of existing warm water fishery.

Table C-15
Increases and decreases in stream fisheries
in Upper Colorado River Basin
from projects constructed or under construction

Type of fishery	Stream miles: Without CRSP[1/]	Stream miles: Inundated	Stream miles: Changed from warm to cold water[2/]	1976 modified base	Changes (percent)
Cold water	7,715	133	+212	7,793	+1
Warm Water	1,811	405	-212	1,194	-34

1/ Based on Upper Colorado Region Comprehensive Framework Study, Appendix XIII, Fish and Wildlife, June 1971.

2/ Changed as a result of storage regulation.

A project-by-project description of the streams impacted and the reservoirs created is presented in Table C-16. The table points to some of the more significant tradeoffs which have resulted. For instance, in place of the estimated 538 miles of stream fishery inundated, CRSP impoundments create approximately 263,880 surface acres of flat water fisheries. Moreover, some of the better trout stream fishing in the Upper Basin States has been created downstream of a number of the CRSP reservoirs. Fifteen miles of the Colorado River below Glen Canyon, 73 miles of the Green River below Fontenelle, 26 miles of the Green River below Flaming Gorge, and 18 miles of the San Juan River below Navajo are rated as good to excellent trout stream fisheries whereas before CRSP they were rated primarily as poor to fair warm water fisheries. In contrast to the creation of the cold water stream fishery areas, important adverse impacts pertaining to the cold water stream fishery of the Upper Colorado River Basin are the inundation of 40 miles of the Gunnison River by the Curecanti Unit, the inundation of 27 miles of several streams by the Bonneville Unit of the Central Utah Project, and the degradation of about 109 miles of stream by the Bonneville Unit. All of these stream sections were rated good to excellent prior to inundation, with the Gunnison River section regarded as one of the better cold water stream fisheries in the entire basin.

Table C-16 shows that with the increase in the available fishing water created by the CRSP activities there has been an accompanying and significant annual increase of fishing use in the Upper Basin. From the standpoint of aesthetics or quality experience, it could be argued that the existing conditions after CRSP are artificial or man made and therefore no longer constitute a natural, quality fishery experience. However, it should also be recognized that although the fishing experience may be artificial, CRSP has generally improved fisherman access and provided fishing opportunities to a much greater segment of the Nation's fishing public.

Various specific fishery programs have been completed or are being planned under CRSP that are not reflected in the table. For example, two National fish hatcheries have been developed

	shery improved		Flat water fishery created	
Project (re	r change	Use (fisherman days)	Acres and type of fishery3/	Estimated use in 1976 (fisherman days)
Upper Colorado Ri\				
Curecanti				
(Blue Mesa)	r quality,	No estimate		
(Morrow Poi	ratures,	available	9,180 CW	82,700
(Crystal)	rbidity			
Flaming Gorge				
(Flaming Go		16,900	42,000 CW	126,800
Glen Canyon				
(Glen Canyor		3,800	163,000 CW and WW	207,000
		Not available		
		Not available		
Navajo				
(Navajo)	plus im-	40,000	15,600 CW and WW	48,500
	s	Not available		
Florida (Lemon	s	5,000	600 CW	20,000
Paonia (Paonia)		None	300 CW	2,600
Silt (Rifle Ga		None	350 CW	28,700
Smith Fork (Cr		None	400 CW and WW	36,700
Hammond (no re				
Central Utah				
Bonneville U		2,000	19,900 CW	5/ 549,800
Jensen Unit		None	500 CW	9,500
Vernal Unit		None	800 CW	7,400
Emery County (		None	1,200 CW	40,000
(Huntington)		None	200 CW	8,200
Lyman (Meeks C	s, access,	1,000	500 CW	30,000
(Stateline)	mprove-	1,000	300 CW	17,000
	ires			
Seedskadee (Fo	n, tempera-	33,000	8,750 CW and WW	22,000
	turbidity			
Bostwick Park	num flows	4,300	300 CW	3,600
	l water			
Dallas Creek (I		6,000	No fishery planned6/	
Total witl				
No fisl				
Warm wa				
Cold wa				
T		113,000	263,880	1,240,500
Outside of basin				
Bonneville Unit		27,300	8,400 CW and WW	7/ 197,900
San Juan-Chama	um flows	1,000	5,900 CW	7,300
Total out		28,300	14,300	205,200
Total char				
outside		141,300	278,180	1,445,700

1/ Table sh ithin Upper Colorado River Basin since the base data necessary to make an impact

2/ Quality

3/ Quality

4/ Consists Stillwater, Hayes, Mona, Jordanelle, Diamond Fork, and Lampton Reservoirs.

5/ Combinati

6/ A reserv shery. If public pressure forced stocking, however, an estimated 24,400 man-

7/ Fishing

with CRSP funds. Jones Hole Hatchery in Utah produced 2.6 million trout in 1975, and Hotchkiss Hatchery in Colorado produced 3.3 million. These hatcheries are used to help stock CRSP reservoirs and segments of improved streams. Specific fishery lakes have been constructed or stabilized in association with the Curecanti, Bonneville, and Emery County Projects, and post-impoundment studies have been funded to provide management data for project streams and reservoirs.

(b) Developments Scheduled for 1977 and 1978 Construction Starts

The three projects scheduled for construction starts in 1977 and 1978 would cause an estimated 0.1 percent increase in the cold water stream fishery and an estimated 2.3 percent decrease in the warm water stream fishery (see Table C-17). These changes would amount to a net decrease in the stream fishery in the Upper Colorado River Basin by only about 18 miles (0.2 percent). In addition the projects would improve about 44 miles of existing cold water fisheries and 52 miles of existing warm water fisheries. No existing fisheries would be degraded.

Table C-17
Increases and decreases in stream fisheries in Upper Colorado River Basin of developments scheduled for 1977 and 1978 construction starts

	Stream miles				
Type of fishery	1976 modified base	Inundated	Changed warm to cold water 1/	Remaining conditions	Changes (percent)
Cold water	7,793	2	+11	7,802	0.1
Warm water	1,194	16	-11	1,167	-2.3

1/ Changed as a result of storage regulation.

Table C-18 gives a project-by-project description of the streams to be affected and shows the 18 miles of streams to be inundated can be classified as generally poor cold or warm water fisheries.

The tradeoffs for the streams lost and degraded are the creation and improvement of reservoir fisheries with a total surface area of about 5,200 acres and the improvement of 44 miles of cold water stream fishery and 52 miles of warm water stream fishery. Although the Grand Valley and Paradox Valley Units would improve the downstream water quality, no significant change in the related warm water fisheries is expected. It is estimated the three projects would result in a net increase of approximately 106,100 man-days of fishing annually for warm and cold water species of fish.

(2) Endangered Fish Species

(a) CRSP Developments Constructed or Under Construction

Four endemic species of fish unique to the Colorado River and its larger tributaries (generally the downstream portions of the Green, Yampa, Gunnison, and San Juan Rivers) are of particular concern in evaluating impacts of the CRSP. These four species are the Colorado River squawfish, the humpback and bonytail chub, and the humpback sucker. Because of a decline in habitat range and population numbers, the Fish and Wildlife Service has classified the Colorado River squawfish and humpback chub as endangered species, and a number of Colorado Basin States have classified the humpback sucker and the bonytail chub as endangered and/or threatened.

The four species are all large river fishes. They evolved in the natural river and its larger tributaries when the environment of these streams was extremely harsh and characterized by warm water, radical flow fluctuations, heavy silt load, areas of extreme turbulence, and high dissolved solid concentrations. The populations have declined drastically, however, with the changes in aquatic habitat caused by man's activities. The decline is attributable to such activities as construction of large river impoundments, dumping of wastes and pollution in the river systems, introduction of exotic species of game and nongame fish, and other physical and chemical alterations in the system.

The Fish and Wildlife Service under the Endangered Species Act of December 28, 1973 (P.L. 93-205), is in the process of proposing that approximately 620 miles of the Colorado River and tributaries be designated as critical habitat for the Colorado River squawfish. The stream sections to be affected by this proposal are the Colorado River from Lake Powell to Grand Junction, Colo., the Green River from the confluence to the junction with the Yampa, the Yampa River upstream for about 90 miles, and a short section of the Gunnison River upstream from the junction of the Colorado River.

Within the lower Colorado River Basin, the area downstream of Glen Canyon Dam, the species are now either rare or nonexistent.[1/] The basic reason most often cited for their decline is the construction and operation of approximately 15 impoundments which control the lower river and have significantly altered the river habitat. In the Upper Basin it can be estimated that prior to the CRSP there were approximately 1,350 miles of habitat occupied by the Colorado River squawfish and the humpback chub. The CRSP has inundated 364 miles and changed the river conditions in another 170 miles of stream habitat below mainstream impoundments to eliminate a total of 534 miles of habitat as shown in Table C-19.

1/ Holden, Paul B. and Clair B. Stalnaker. Distribution and Abundance of Mainstream Fishes of the Middle and Upper Colorado River Basins, 1967-73, Transactions of the American Fisheries Society, April 1975.

Table C-18

Fishery data for CRSP developments scheduled for construction in 1977 and 1978

Project	Streams inundated: Length (miles), quality, and type of fishery1/: Main stem	Streams inundated: Tributaries	Streams inundated: Loss of use (fisher-man days)	Stream sport fishery improved: Length (miles), quality, and type of fishery1/	Stream sport fishery improved: Reason for improvement	Stream sport fishery improved: Increase in use (fisher-man days)	Flat water fishery created or improved: Acres and type of fishery1/	Flat water fishery created or improved: Estimated use (fisher-man days)
Dolores								
McPhee Reservoir	10 (P) WW	6 (P) WW	Insignificant	11 (G) CW 45 (G-F) WW	Improved flows and access	10,000 CW 28,000 CW	4,470 CW	52,000
Monument Creek Reservoir			None				84 WW	1,500
Dawson Draw Reservoir	2 (P) CW		Insignificant				294 CW	35,000
Groundhog Reservoir2/				33 (G) CW	Improved flows	8,000 CW	400 CW	17,600
Grand Valley			None				None	None
Paradox3/			None	7 (F) WW	Water quality	No estimate available	None	None
Summary								
Warm water fishery	10	6		52		28,000	84	
Cold water fishery	2			44		18,000	5,164	
Total	12	6		96		46,000	5,248	106,100

1/ Quality factors given as E-excellent, G-good, F-fair, P-poor, and O-no sport fishery; CW denotes a cold water fishery and WW denotes a warm water fishery.

2/ An existing reservoir to be improved through stabilization.

3/ Includes an offstream, 3,600-acre evaporation pond that would have no value for aquatic life.

Table C-19
Loss of river habitat for endangered fish species in Upper Colorado River system--CRSP developments constructed or under construction
(Unit--miles)

	Eliminated by inundation	Loss due to water quality change	Total
Glen Canyon			
Colorado River	186	1/ 15	201
San Juan River	71		71
Flaming Gorge (Green River)	72	65	137
Navajo (San Juan River)	35	40	75
Curecanti (Gunnison River)		50	50
Total	364	170	534

1/ Also altered habitat in Lower Basin.

Glen Canyon Dam in addition to altering 15 miles of habitat downstream in the Upper Basin also altered flow and water quality downstream in the Lower Basin for many more miles, including the Marble and Grand Canyon areas which were once considered significant habitat for the native fish species. Prior to closing Flaming Gorge Dam the Fish and Wildlife Service conducted a fish eradication program in the reservoir basin and in the tributary area downstream to Dinosaur National Monument, which eliminated many of the native fishes in this section of the Green River. However, this operation did not kill all of the fish or permanently alter the river habitat. The Curecanti Unit dams have not directly affected any of the original habitat of the four large river species. However, the associated changes in flow regime and temperature in the 50-mile stretch of the Gunnison River between Delta and Grand Junction, Colo., have probably contributed to the decline of some species and the elimination of others.[1/]

Unlike the large storage units discussed above, the smaller participating projects constructed or under construction have not eliminated habitat of the Colorado River endangered fish species. The projects in total, however, reduce the flows in the main stem, change water quality and, therefore, may indirectly have an adverse effect on the endangered fish species. The degree to which the projects may adversely affect the endangered species is very difficult to estimate because of the lack of information concerning life, history, and habitat requirements.

1/ Kidd, George, An Investigation of Endangered and Threatened Fish Species in the Upper Colorado River as related to Bureau of Reclamation Projects, Unpublished Consultant's Report for Bureau of Reclamation, January 1977.

(b) <u>Projects Scheduled for Construction Starts in 1977 and 1978</u>

Development of the three projects planned for 1977 and 1978 in the Upper Colorado River Basin would not directly affect any known populations of the four endangered species by inundation of habitat or by discharge of tailwaters into inhabited areas. The fish stocked in project reservoirs and streams would not be expected to travel the substantial distances necessary for them to compete with the endangered fish populations. As Table C-20 shows, the Grand Valley Salinity Control Unit is the only development located near endangered fish habitat. That unit, however, does not entail storage or any major features which would alter fish habitat in the Colorado River, nor is a fish stocking program planned in association with this project.

Table C-20
Major project features in relation to endangered fish species habitat

Project	Feature	Known endangered fish population: Location	Known endangered fish population: Distance from project (miles)
Dolores	McPhee Reservoir	Colorado River at the mouth of Dolores	180
Grand Valley	Irrigation system improvements		0
Paradox Valley	Brine well field	Colorado River at mouth of Dolores	75

Although tolerances of the endangered fishes for temperature, turbidity, salinity, and flow changes have not been determined, the Bureau of Reclamation does not believe the species would be significantly affected by the small changes which may have been predicted for these environmental factors for the following reasons.

The Dolores Project, which is the only project with an on-stream storage reservoir, would change temperatures in flows immediately below the reservoir. By the time these flows reached the Colorado River, which is known to be inhabited by endangered fish species, however, they would have equilibrated with the average air and soil temperatures. Thus, water temperatures of endangered fish habitat would not be influenced.

It is anticipated that turbidity levels in the Dolores River immediately downstream of the Dolores Project would be slightly decreased during spring runoff as a result of sediment deposition in the reservoir. The change would be indiscernible by the time flows from the project reached known endangered fish habitat because of natural interchanges of sediment pickup and deposition in the Dolores River. Project return flows from agricultural lands would enter the San Juan River where they would slightly increase turbidity levels during the summer. The Paradox Valley and Grand Valley Units are not expected to affect stream turbidity.

The salinity changes that would result from the three projects are not expected to affect any of the endangered species since all have been recorded as living in areas with extensive variations in salinity levels. Salinity levels as far downstream as Lees Ferry are projected to average less than 800 mg/l after construction of the three projects. At the Colorado-Utah border in 1974, salinity levels in the Colorado River ranged from 339 mg/l to 1,300 mg/l with no apparent adverse effects on the endangered species in that area. The Colorado squawfish and humpback sucker have also been successfully reared from egg stage to lengths of 10 to 12 inches at Willow Beach National Fish Hatchery in water with salinity levels greater than 800 mg/l.[1/]

The Dolores Project would reduce historic peak flows and slightly increase historic low flows in known habitat areas of endangered fish species. Because postproject flows would be within the range of historic flow fluctuations in these areas, however, it is not thought that the flow changes would have adverse effects. Changes in streamflows resulting from the Paradox Valley and Grand Valley Units would not be significant. Exact numerical values for the flow changes caused by the three projects are not given because the probability of error in measurement is substantially greater than the changes themselves would be.

d. Terrestrial Wildlife

(1) Developments Constructed or Under Construction

Because of the many variables involved and the limited data available on wildlife populations, no attempt has been made to estimate changes in terrestrial wildlife populations caused by CRSP developments constructed or under construction. Indications of the effects on the wildlife, however, can be gained from study of changes in habitat. In this analysis, five broad types of habitat--(1) riparian, (2) aspen-conifer, (3) shrub, brush, pinyon-juniper, (4) grassland, and (5) cropland-pasture--have been considered as key habitat, or habitat essential to the preservation of a species, with the emphasized species being game species such as mule deer, elk, moose, bighorn sheep, antelope, sage grouse, turkey, and waterfowl. Of the area in the Upper Basin in these types, a total of about 42 million acres is considered key habitat.[2/] CRSP reservoir and irrigation developments constructed or

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1/ Willow Beach National Fish Hatchery, Quality of Supply Water for Raceway at Willow Beach Hatchery. 1976.

2/ Key habitat description and estimated acreage have been developed for Upper Colorado River Basin Frame Work Study, Appendix XIII: Fish and Wildlife Resources, 1971.

under construction reduce this habitat by about 367,800 acres or about 1 percent. In addition to changes in the Upper Basin, changes occur on about 70,000 acres of land in the Bonneville Basin and Rio Grande Basin as a result of CRSP developments. All of the habitat changes are not a total loss to wildlife since most key habitat has been converted to reservoirs and irrigated cropland which have value to a variety of waterfowl, small game, and nongame species. Although the changes in the basin appear small in relation to the total habitat, they have significant impacts in local areas of individual projects and are one of the many man-caused factors placing pressure on wildlife in the basin. A summary of the habitat changes is given in Table C-21.

In addition to the habitat changes tabulated, adverse impacts on wildlife result from construction of such facilities as canals, powerlines, recreation areas, and access roads. Then, too, some reservoirs, such as Flaming Gorge, have indirectly affected key habitat by interfering with historic big game migration routes. Irrigation projects have also probably adversely affected wildlife by necessitating localized control measures because of crop depredation problems on newly irrigated cropland. On the other hand, livestock grazing has been controlled within rights-of-way for some reservoirs to the benefit of wildlife.

Losses of riparian shrub habitat, amounting to about 8,700 acres, are especially significant to local project areas because of the relative scarcity of such vegetation and its importance to a diversity of species. Mule deer and, to a lesser extent, elk use these areas for food and cover. Other wildlife groups which are more dependent on this vegetative type and which have been adversely affected by its loss are furbearers, nongame birds, small mammals, and birds of prey. At Glen Canyon, for example, the narrow band of riparian habitat inundated probably represented the most critical habitat in this desert environment and should be recognized as a locally significant loss.

The losses of approximately 2,000 acres of subalpine-montane forest habitat have probably not been significant because of the small acreages involved with individual projects. Such lands, however, are important to deer and elk for food, cover, and fawning and calving areas.

Some of the most significant impacts would be related to the loss of approximately 199,000 acres of brushlands and pinyon-juniper woodlands in the basin. In much of the basin these areas are winter range for deer and elk. Some of these areas also provide key habitat for antelope and sage grouse. Cottontail rabbits and numerous nongame species also utilize this habitat. In terms of key habitat available, this acreage loss does not appear significant basinwide, but this habitat type often includes crucial areas for individual herds or groups of animals.

Table C-21
Major terrestrial wildlife habitat changes--
CRSP developments constructed or under construction
(Unit--acres)

	Riparian[2]	Aspen-conifer	Shrub, brush, pinyon-juniper[3]	Grassland	Cropland-pasture		Flat water	Specific wildlife developments
Key habitat in Upper Colorado River Basin without CRSP[1]	200,000	6,648,900	29,987,300	1,064,700	3,720,700		80,700	Not determined
	Reductions				Reductions	Gains	Gains	Gains
Changes in Upper Basin[4]								
Curecanti Unit	430	1,010	6,000	270	2,070		9,180	
Flaming Gorge Unit	1,730	800	34,970		940		42,000	5,520
Glen Canyon Unit	90		2,930	[5]153,290			163,000	
Navajo Unit	150		12,190		4,000		15,600	3,060
Florida Project	10	100	5,930	300		5,730	600	
Paonia Project	5		2,430	100		2,230	300	
Silt Project	10	15	2,320		200	2,120	350	
Smith Fork Project	10		1,590		130	1,420	400	
Hammond Project			3,030			3,900		
Bonneville Unit	3,000		17,500	3,000	200		19,900	10,200
Jensen Unit	40		680	230	60	440	500	500
Vernal Unit			580		300		800	600
Emery County Project	10		2,160			770	1,400	2,030
Lyman Project	260		1,190	260			800	1,270
Seedskadee Project	2,860		3,660		2,310		8,750	22,000
Navajo Indian Irrigation Project			100,000			100,000		
San Juan-Chama Project	5							
Bostwick Park Project		20	1,400	190		1,320	300	
Dallas Creek Project	100		920		600		1,000	1,000
Total	8,710	1,945	199,480	157,640	10,810	117,930	264,880	46,180
Total remaining habitat in basin--1976 modified base (rounded)	191,300	6,647,000	29,788,900	907,100	3,827,800		345,580	
Percent change	4	0.03	0.7	17	3		328	
Changes outside of basin								
Bonneville Unit								
Bonneville Basin	25,000		12,000			29,370	8,400	14,500
San Juan-Chama Project								
Rio Grande Basin	5		31,810			5,730	5,905	8,000
Total	25,005		43,810			35,100	14,305	22,500
Total changes in and outside of basin	33,715	1,945	243,290	157,640		153,030	279,185	68,680

1/ Derived from the 1971 Upper Colorado Region Comprehensive Framework Study (1965 data) adjusted to reflect habitat changes due to CRSP units constructed prior to 1965.

2/ Data on quantity of riparian habitat are scarce. Habitat losses due to CRSP projects were estimated on the basis of miles of stream inundated, with the exception of Flaming Gorge, Curecanti, and Glen Canyon where habitat figures were available from pre-impoundment studies.

3/ Includes pinyon-juniper woodland, mountain brush, salt desert shrub, and northern and southern desert shrub types.

4/ Figures shown are estimates for land either inundated or placed under full service irrigation.

5/ Generally not considered key habitat.

Most of the grassland lost, approximately 153,000 acres, was in Glen Canyon. Much of this land would be considered desert and would not represent key wildlife habitat. It had a low density of vegetation including Indian rice grass and galleta and desert shrubs which provided little food and cover for wildlife.

CRSP has increased irrigated croplands and pasture by about 107,000 acres. These lands and small patches of weeds, fence rows, and "waste" areas associated with them provide important feeding area during certain times of the year for game species such as rabbits, pheasants, doves, quail, and waterfowl. Small mammals, nongame birds, and raptors also use such habitat extensively.

CRSP developments constructed or under construction increase the surface areas of flat water in the Upper Basin by more than 300 percent. This habitat is of value to wildlife, particularly waterfowl and shore birds.

Some losses of habitat, for instance riparian habitat, are difficult, if not impossible, to mitigate. Wildlife mitigation and enhancement programs, however, are being undertaken to offset other wildlife habitat losses incurred by the projects. For example, one wildlife refuge and four waterfowl areas are being developed to replace losses or enhance waterfowl habitat. These include the Seedskadee National Wildlife Refuge in Wyoming and the Brown's Park Waterfowl Management Area in Utah, both along the Green River; Miller Mesa Waterfowl Area on the west shore of Navajo Reservoir in New Mexico; and the Desert Lake Waterfowl Management Area in eastern Utah. Stewart Lake Waterfowl Management Area in eastern Utah is being improved in connection with the Vernal and Jensen Units, and planning is underway to mitigate waterfowl losses on the Uintah-Ouray Indian Reservation by construction of waterfowl habitat areas along the Duchesne River in eastern Utah.

Big game range improvements designed to increase the carrying capacity of existing range to replace habitat losses incurred by CRSP developments are being made in association with the Flaming Gorge Unit, Emery County and San Juan-Chama Projects, and the Jensen and Bonneville Units of the Central Utah Project. Additional purchases are being planned in the Bonneville Unit and Lyman and Dallas Creek Projects to mitigate big game range losses. Adequate measures to mitigate habitat losses associated with the Curecanti Unit have not been accomplished to date. However, updated recommendations have recently been received from the Colorado Division of Wildlife, and the Bureau plans to actively respond to the recommendations.

(2) <u>Developments Scheduled for Construction Starts in 1977 and 1978</u>

The three projects scheduled for construction starts in 1977 and 1978 result in an estimated direct reduction of about 16,400 acres of wildlife habitat as shown in Table C-22. Most of this habitat would be considered key habitat. This loss represents a small portion of the total key habitat available in the basin but is significant to some local areas. Because of the importance of these lands to game species, approximately 7,900 acres of the same types of lands are planned for acquisition and initial development to mitigate potential wildlife losses. The acquired lands should substantially offset potential wildlife losses.

e. Availability of Water

(1) CRSP Developments Constructed or Under Construction

The amount of water in the Colorado River available for consumptive use in the Upper Basin has been conservatively estimated by the Secretary of the Interior at an average of 5,800,000 acre-feet annually. This estimate is based on provisions of the Colorado River Compact of 1922 and the Upper Colorado Basin Compact of 1948 and is based on the assumption that the Upper Basin would be obligated to meet one-half (750,000 acre-feet annually) of the commitment of the Mexican Water Treaty of 1944. The estimate also takes into consideration, among other factors, the capability of existing regulatory storage in the Upper Colorado River system to meet compact commitments to the Lower Basin.

Of the average of 5,800,000 acre-feet annually estimated to be available to the Upper Basin, approximately 4,591,000 acre-feet is committed to developments constructed or under construction. Of these commitments, 1,214,000 acre-feet, or 26 percent, is committed to units and participating projects of the CRSP. Depletions by States are shown in Table C-23. Depletions from individual projects are shown in Table C-24.

(2) Developments Scheduled for 1977 and 1978 Construction Starts

Estimated depletions for the three projects scheduled for construction starts in 1977 and 1978 amount to a total of 80,190 acre-feet annually, all for the State of Colorado. These depletions are shown in Table C-24 in comparison with the estimated entitlements and estimated 1976 depletions for Colorado and the Upper Basin as a whole.

f. Salinity

(1) CRSP Developments Constructed or Under Construction

The salinity level of the Colorado River at Imperial Dam under 1976 modified base conditions, including effects of CRSP developments constructed or under construction, is estimated at 1,102 mg/l. This reflects the effects of many variable factors. It includes the natural salt in the river before man's activities as well as salt resulting from man's activities, including storage regulation, diversions for use within and outside of the basin, evaporation, and return

Table C-22
Major terrestrial wildlife habitat changes--
1977 and 1978 construction starts
(Unit--acres)

Time frame	Riparian	Aspen-conifer	Shrub, brush, and pinyon-juniper	Grassland		Cropland-pasture		Flat water	Specific wildlife devel-opments
Total habitat in 1976 modified base conditions	191,300	6,647,000	29,788,900	907,100		3,827,800		345,600	46,180
	Habitat reductions			Reductions	Gains	Reductions	Gains	Habitat gains	
Habitat changes with projects scheduled for 1977 and 1978 construction starts									
Dolores Project	500		2,500	8,800		2,600	7,500	5,200	4,200
Grand Valley Unit	1,000								1/
Paradox Valley Unit	2/		3,800		200				3,700
Total	1,500		6,300	8,600		4,900		5,200	7,900
Remaining habitat	189,800	6,647,000	29,782,600	898,500		3,832,700		350,800	54,080
Percent change	-0.8	0	-0.02	-0.9		+0.1		+1.5	+17.1

1/ A fish and wildlife plan has not been completed at this time.
2/ Approximately 50 acres of riparian would be improved because of salt reduction in 7 miles of the Dolores River.

Table C-23
Stream depletions of CRSP developments
constructed or under construction compared with
estimated entitlements and 1976 modified conditions
(Unit--1,000 acre-feet)

	Colorado	Wyoming	Utah	New Mexico	Arizona	Total
Estimated entitlement	2,976	805	1,322	647	50	5,800
Actual depletions as of 1976[1/]	2,097	409	835	332	25	3,698
Additional depletions from projects under construction	295	120	165	291	22	893
Total depletions to 1976 modified base	2,392	529	1,000	623	47	4,591
CRSP depletions	339	109	336	430		1,214
Percent of CRSP depletion to total depletion	14	21	34	69		26

1/ Includes evaporation from storage reservoirs.

Table C-24
Stream depletions of developments scheduled for
1977 and 1978 construction starts compared with estimated
entitlement and 1976 modified conditions
(Unit--acre-feet)

	Colorado	Total Upper Basin
Estimated entitlement	2,976,000	5,800,000
Total depletions in 1976 modified base	2,392,000	4,591,000
Depletions from projects scheduled for 1977 and 1978 starts		
Dolores Project	80,900	80,900
Grand Valley Unit	-4,000	-4,000
Paradox Valley Unit	4,000	4,000
Subtotal	80,900	80,900
Remainder of estimated entitlement	503,100	1,128,100

flows. Because of the many variable factors involved, it is extremely difficult to determine the effects on salinity from any particular development. Nevertheless it has been estimated that of the 1,102 mg/l salinity level in the modified base, approximately 147 mg/l or 13 percent could be attributable to the units and participating projects of the CRSP included in the base. Of the total 147 mg/l contribution, 128 mg/l would be attributable to concentrating effects of stream depletions and 19 mg/l to the salt loads contributed. Except in cases where special studies have been made to determine specific loading from a project, it has been assumed that irrigation would increase the salt load from new lands by 2 tons an acre but would result in no additional salt load from supplemental service lands. The depletions and salt loads from each development are shown in Table C-25.

(2) Developments Scheduled for 1977 and 1978 Construction Starts

Estimates have been made of salinity impacts on the 1976 modified base that could be expected with the three developments in the Upper Colorado River Basin scheduled for construction starts in 1977 and 1978 pending compliance with the National Environmental Policy Act. Table C-26 shows the estimated salinity impacts of the developments at Imperial Dam, while Table C-27 shows the developments' effects on the Colorado River system at points above Imperial Dam. Table C-26 also shows estimates of economic externalities of the salinity effects. These externalities have been based on a rate of $230,000 for each mg/l of salinity increase at Imperial Dam. This rate has been estimated by the Bureau of Reclamation and takes into account reduced productivity and increased agricultural production costs that downstream water users might experience from the salinity impacts. It also takes into account increased costs that might be necessary for treatment of municipal and industrial water as a result of salinity increases and the reduced life of water pipes and other facilities that would result from the increases in concentration.

(3) Overview of Colorado River

Estimates of future salinity levels in the Colorado River are highly speculative. Various entities have made projections in the past and have arrived at differing estimates because of different base conditions assumed with respect to quantity of runoff, rate of development, and implementation of salinity control measures. In order to provide some early perspective of projected salinity levels in the river, however, this section includes a discussion of Bureau of Reclamation estimates and the results of one of several analyses made by the Colorado River Basin Salinity Control Forum.

In its study the Bureau of Reclamation analyzed effects of 43 water resource developments and 17 salinity control measures. Except for the Fruitland Mesa and Savery-Pot Hook Projects which were excluded from the study since they were not funded in the 1977 Public

Table C-25
Estimated depletions and salt loads
CRSP developments constructed or under construction

Projects	Depletions (1,000 acre-feet)	Salt loads 1/ (1,000 tons)	Total
Storage units			
Curecanti	10		
Flaming Gorge	50		
Glen Canyon	460		
Navajo	26		
Participating projects			
Florida	14	11	
Paonia	10		
Silt	6	4	
Smith Fork	6	3	
Hammond	5	8	
Central Utah			
Bonneville	166	1/ -27	
Jensen	15	1	
Vernal	12		
Emery County	17	2	
Lyman	10		
Seedskadee	22		
Navajo Indian	254	220	
San Juan-Chama	110	1/ -16	
Bostwick Park	4	3	
Dallas Creek	17	9	
Total	1,214	218	
Increase in concentration at Imperial Dam (mg/l)	128	19	147

1/ Negative amount due to transbasin diversion of salts.

Works Appropriation Bill, the developments are the same as those discussed in the _Final Environmental Statement, Colorado River Water Quality Improvement Program_ of May 1977 (FES 77-15) prepared by the Bureau of Reclamation and Soil Conservation Service. Also, except for the exclusion of the Fruitland Mesa and Savery-Pot Hook Projects, the water resource developments are the same as those listed in the Department of the Interior's _Progress Report No. 8, Quality of Water, Colorado River Basin_. The water resource developments include authorized Federal developments as well as State, local, and private developments. Thirty-three of these are in the Upper Basin and 10 in the Lower Basin. The salinity control measures are planned to provide control of point, diffuse, and irrigation sources of salinity. Under the Colorado River Salinity Control Act of June 24, 1974, four salinity control projects were authorized for construction and 12 authorized for further study. The 17th unit, the Meeker Dome Unit in Colorado, is now also under investigation. Of the 17 salinity control measures, 12 would be in the Upper Basin and 5 in the Lower Basin.

The Bureau of Reclamation estimates were made to the year 2000. They were based on hydrologic records for the period 1941-74, since this is the only period having extensive concurrent runoff and quality data, and on the assumption that all projects constructed or under construction as of 1976 had been under full scale operations for the entire period of record. During this period the mean annual virgin runoff at Lees Ferry was approximately 13.9 million acre-feet. The corresponding depletion levels at Imperial Dam for the years 1990 and 2000 were projected to be 13.5 million acre-feet and 13.9 million acre-feet, respectively, part of which is supplied by inflows below Lees Ferry.

Estimates of future salinity in the Colorado River were compared against a standard salinity level of 879 mg/l at Imperial Dam (average historical concentration of 1972). This standard was proposed by the Colorado River Basin Salinity Control Forum and approved by the Environmental Protection Agency. Establishment of this standard was part of the salinity program in the Colorado River Basin which is being undertaken with the general objective of keeping salinity in the Lower Basin at or below present levels while the Basin States continue to develop their compact apportioned water.

Salinity projections of the Bureau of Reclamation are shown in Table C-28 and Figure C-2. As shown in the table, salinity control measures authorized and under study would provide a reduction of about 1.9 million tons of salt annually. This level represents a concentration reduction of about 204 mg/l at Imperial Dam in the year 2000, which only partially offsets the expected maximum total concentration of 1,205 mg/l. In order to attain the adopted salinity standard, additional control, augmentation, or management steps will be necessary. Thus weather modification, vegetation management, watershed improvement, additional desalting, and various nonstructural measures remain to be considered and studied in detail.

Table C-26
Salinity impacts at Imperial Dam
of projects scheduled for 1977 and 1978 construction starts

Project	Effects of concentration: Stream depletion (1,000 acre-feet)	Effects of concentration: Effect on salinity (mg/l)	Effects of concentration: Economic exter-nalities ($1,000)	Effects of salt loading: Change in salt load (1,000 tons)	Effects of salt loading: Effect on salinity (mg/l)	Effects of salt loading: Economic exter-nalities ($1,000)	Total effects on salinity (mg/l)	Total economic exter-nalities ($1,000)
	Participating projects of Colorado River Storage Project							
Dolores	80.9	10.1	-2,323	10.0	1.0	-230	11.1	-2,553
	Units of Colorado River Basin Salinity Control Project							
Grand Valley	-4.0	-.5	115	-410.0	-42.5	9,775	-43.0	9,890
Paradox	3.9	.4	-92	-180.0	-18.6	4,278	-18.2	4,186

Table C-27
Salinity effects of projects scheduled for 1977
and 1978 construction starts as related to base
conditions on Colorado River system
(Unit--mg/l)1/

Stream and reference point	1976 modified base	Effects of three projects	Base with three projects
Colorado River at Lees Ferry, Ariz.	677	-40	637
Colorado River at Imperial Dam	1,102	-50	1,052

1/ Rounded to nearest unit.

Table C-28
Summary of cumulative salinity impacts at year 2000
projected by Bureau of Reclamation
(average annual conditions)

	Total depletions (1,000 acre-feet)	Salt added (1,000 tons)	Salinity at Imperial Dam (mg/l)	Salt removal necessary to maintain 879 mg/l at Imperial Dam (1,000 tons)
	Development level			
Present modified (1974) 1/	11,500		861	
Development projects	2,350	67	344	2,830
Projected total year 2000	13,850	67	1,205	2,830

Salinity control measures	Salinity reduction at Imperial Dam (mg/l)	Salt to be removed (1,000 tons)
Authorized (4 units)	73	634
Under investigation (13 units)	131	1,250
Total	204	1,884

1/ Present modified refers to historic conditions (1941-74) modified to reflect all upstream existing projects for the full period.

Curve A on Figure C-2 shows the shape and magnitude of salinity effects of anticipated Colorado River Basin development from the 43 identified water resource development projects without any salinity control. Curve B shows salinity effects shown by Curve A accompanied by the timely construction of four authorized salinity control units. Curve C shows the cumulative effects of incorporating the 17 salinity control units authorized and under study. Curve D shows the additional measures needed to obtain the 1976 salinity standard.

The Colorado River Basin Salinity Control Forum analyzed an array of runoff and depletion levels in developing the salinity standards. The results of one of its analyses are plotted in Figure C-3. Curve A represents the salinity effects of the anticipated basin development without salinity control measures. Curve B represents the effect of adding the four authorized salinity control projects, 12 of the salinity control projects under investigation (Meeker Dome not included), and the adoption of a "no salt return" policy to industrial development. The Forum has concluded that the salinity standard can be maintained through 1990 under certain sets of conditions. Recognizing the inherent difficulty in projecting cumulative future impacts in the basin, a key provision allows for reassessment and review of salinity criteria every 3 years.

Figure C-2

SALINITY AT IMPERIAL DAM
PROJECTED BY BUREAU OF RECLAMATION

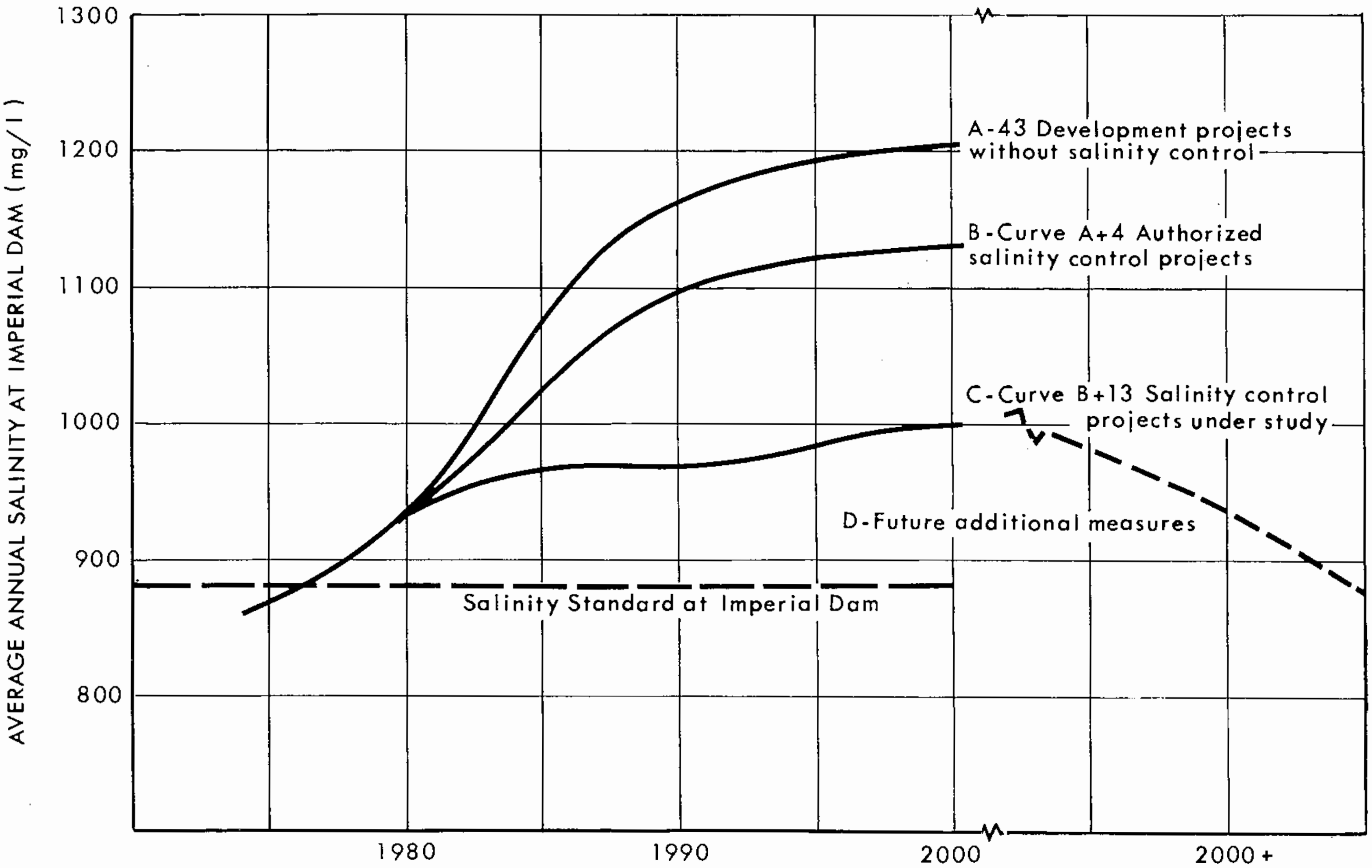
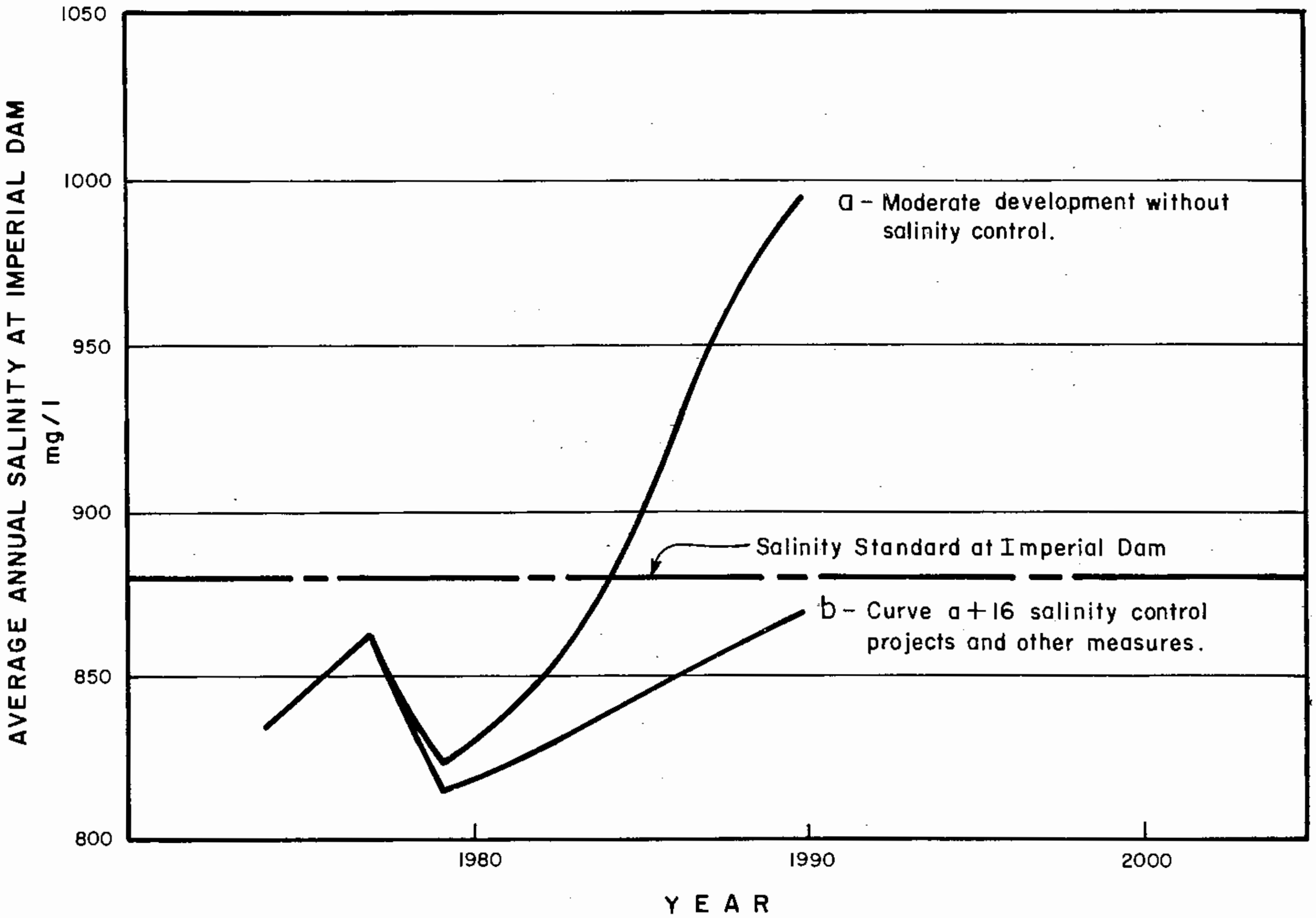


Figure C-3

SALINITY AT IMPERIAL DAM
PROJECTED BY THE COLORADO RIVER BASIN
SALINITY CONTROL FORUM



The methods of analysis used by the Forum and the Bureau of Reclamation are similar. The input assumptions were different, however, and the resulting projected 1990 salinity levels are different. The following is a comparison of one set of assumptions used by the Forum with those used by the Bureau in its study.

Using other sets of conditions the Forum also found that with full implementation of all identified salinity control measures, 1990 salinities can be maintained at or below the 1972 standard of 879 mg/l at Imperial Dam if there is a low depletion rate with a virgin flow at Lees Ferry of 14,000,000 acre-feet annually or if there is a moderate depletion rate with a virgin flow of 15,000,000 acre-feet annually.

	Bureau of Reclamation	Forum
Virgin runoff (Lees Ferry)	13,900,000 acre-feet	15,000,000 acre-feet
Depletion level	13,500,000 acre-feet	12,600,000 acre-feet
Salinity control	Completion of 4 authorized and 13 investigated projects. Grand Valley 410,000 tons salt load depleton. Adoption of a "no salt return" policy to large industrial development.	Completion of 4 authorized and 12 investigated projects (Meeker Dome not included). Grand Valley 200,000 tons salt load depletion. Adoption of a "no salt return" policy to industrial development.

As shown in Figure C-3, the Forum projected a decrease in salinity for the period 1977-79 because of projected releases of excess flows from storage passing Imperial Dam. These releases would be required because an average inflow of 15 million acre-feet would occupy all available storage in the basin before the projected depletions equalled the total inflow. The Forum depletion projections include most of the same projects and developments as those of the Bureau of Reclamation. The anticipated date of completion for some of the projects is later in the Forum's projections and its projected total depletion by 1990 is less. The long-term runoff at Lees Ferry (1906-74) is 14.9 million acre-feet and the Forum adopted a future water yield closer to that number in its assessment.

CHAPTER D

MITIGATING MEASURES AND AIR AND WATER QUALITY ASPECTS

D. MITIGATING MEASURES AND AIR AND WATER QUALITY ASPECTS

1. General

This section presents the measures that would be employed to protect the environment and mitigate the adverse effects of the unit.

2. Safety of Dams

In accordance with Reclamation policy the final design of Radium Dam and Dike would be based on extensive geologic investigations. In addition, the design data would be reviewed by independent engineering firms with appropriate expertise to ensure that no data were overlooked or incorrectly analyzed. During construction piezometers and settlement instruments would be installed to monitor any changes that might occur as the pond filled.

3. Measures to be Employed During Construction

Construction specifications would be written and construction activities monitored to protect the environment. Contractors would have to comply with pertinent Federal, State, and local laws, orders, and regulations concerning the prevention and control of air and water pollution and noise. Specifications would also require the preservation of the landscape.

a. Air Quality and Noise Control

During construction, measures would be carried out to reduce dust and excessive exhaust pollution. Noise levels would be kept below 75 decibels at night (8 p.m. to 7 a.m.) and 80 decibels during the day, as measured outdoors at residences or other noise-sensitive areas.

b. Water Quality

Construction of the Paradox Valley Unit would be performed by methods that would not increase the turbidity of Dry Creek above natural levels. However, since Dry Creek is an intermittent stream, a 404 permit would not be sought. The San Miguel River below the confluence with Dry Creek would be monitored and State of Colorado water quality standards would not be violated.

Minimal erosion control practices would be utilized to prevent excessive sedimentation to the San Miguel River. Construction activities would be performed by methods that would prevent solid matter, debris, and other contaminants from entering streams, ground water, and other water courses. Such pollutants include refuse, garbage, grout or cement, sanitary wastes, and petroleum products. Turbidity would be controlled by the use of suitable sedimentation or settling ponds and flocculating agents where necessary. The Bureau would obtain permits under the National Pollutant Discharge Elimination System. The contractor would be required to comply with stipulations governing the issuing of these permits to control the quality of waste water discharges. Small stilling basins may be constructed in the stream below the construction site to reduce the stream energy and settle out suspended sediment if necessary. These stilling basins would be cleaned out during nonflow periods to insure their reuse.

c. Landscape Preservation

The construction camp, shops, offices, and yards would be located and arranged so as to preserve soil and vegetation as much as practicable. At the evaporation pond site, these areas would be located within the basin of the pond. On abandonment all materials and debris would be removed from the site, and the construction area outside the basin would be reshaped and revegetated with native grasses and trees. The movements of crews and equipment would be limited to established routes, and if temporary roads were necessary the alignments would be restored. Borrow and riprap areas would be excavated so as not to pond water, and, before being abandoned, the sides would be brought to stable slopes and shaped to give a natural appearance.

d. Other Considerations

Should the use of pesticides be necessary, only those registered with the Environmental Protection Agency in compliance with the Environmental Pesticide Control Act of 1972 would be used. Drilling and blasting would be carried out in compliance with applicable Federal, State, and local safety regulations.

4. Measures Incorporated in Unit Design and Operation

a. Wildlife Measures

To compensate for potential losses in wildlife populations caused by the filling of Radium Evaporation Pond, 3,660 acres of private and public land surrounding the pond would be acquired, developed, and maintained specifically for wildlife with Congressional approval, as discussed in Section A-3b(7). About 15 miles of fence would be built around the area to exclude unmanaged livestock, and water retention structures would be constructed to collect natural runoff. Seeding of selected browse plant species and fertilizing would be done to improve the habitat for wildlife.

All powerlines constructed to serve the brine pumping plants would be designed to eliminate electrocution hazards to raptors. Areas along the brine pipeline right-of-way that would be disturbed during construction would be reseeded with species of browse, forbs, and grasses that would benefit wildlife by providing food and cover and by increasing the diversity of vegetation.

b. Archaeological and Historical Sites

The Bureau would comply with specific regulations contained in the Reservoir Salvage Act of 1960, Presidential Executive Order 11593, the National Environmental Policy Act of 1969, the Historic Preservation Act of 1966, the Historic Sites Act of 1935, and the Antiquities Act of 1906, which are intended to protect, preserve, restore, and maintain prehistorical, historical, and anthropological resources on public land. According to its specific policy to mitigate adverse impacts on historical and archaeological sites, the Bureau adheres to the following program.

1. Contracting with professional archaeologists to examine the project area and to provide inventories of the resources

2. Evaluating the resources for significance and for eligibility for nomination to the National Register of Historic Places

3. Nominating to the register any properties deemed eligible

4. Seeking the advice of the President's Advisory Council on Historic Preservation whenever properties eligible for or already on the Register would be affected

5. Developing and carrying out specific mitigation programs in coordination with the State Historic Preservation Officer and the Advisory Council on Historic Preservation

The loss of the prehistorical site located within the evaporation pond would be mitigated by collecting surface materials and testing for the depth of the prehistorical lithic scatter to obtain information about the site. Should the recovered materials reveal that significant amounts of data might be recovered, although this possibility is unanticipated, the site would be completely excavated. To mitigate the loss of the historical site at the pond, research would be conducted to establish its history. Information would also be recovered by mapping and photographing the site.

Other mitigating measures would include monitoring construction activities and having a professional archaeologist evaluate any sites uncovered during construction. Standard clauses in the construction specifications would also serve to protect all cultural resources by keeping men and equipment away from any sites.

c. Preservation of Scenery

Whenever practicable, roads, borrow and riprap sources, and other facilities would be located so as to minimize their visual effects. Design criteria, color, and textures would also be considered in helping blend features into the surrounding landscape. The hydrogen sulfide stripping plant and the pumping plants, for example, would be painted in an earth tone and would have a low profile.

d. Protection from Hazards

Project features have been designed to minimize hazards. Safety devices at the well field, hydrogen sulfide stripping plant, and pumping plants would include fences and warning signs.

e. Land Acquisition

All land acquisitions would be accomplished under provisions of the Uniform Relocation Assistance and Real Property Acquisition Act of 1970 and other pertinent Federal legislation and regulations. These acts and regulations compel the Government to pay an amount determined to be the fair market value based on an approved procedure of appraisal. In partial takings, the fair market value includes any loss in value to the remainder of the property (severance damage). All landowners would be advised of acquisition procedures, assisted in the preparation of applications for reimbursement, and provided with other services that the Act requires.

CHAPTER E

UNAVOIDABLE ADVERSE EFFECTS

E. UNAVOIDABLE ADVERSE EFFECTS

The predicted beneficial and adverse environmental impacts connected with the Paradox Valley Unit have been discussed in Chapter C. Measures designed to mitigate adverse effects and protect the environment are outlined in Chapter D. This chapter lists the most significant adverse impacts that could not be avoided or fully compensated for.

1. General Setting

The unit's structures would be visually unattractive to some people. The most significant impact would be the brine pond and eventual salt flat created with the gradual filling of Radium Evaporation Pond.

2. Water Resources

The unit would deplete the average annual flows of the lower Dolores and Colorado Rivers by a maximum of about 3,950 acre-feet. This reduction would be about 1 percent of the Dolores River's flow below Paradox Valley and would be about 0.1 percent of the Colorado River's flows immediately below the confluence with the Dolores River.

CHAPTER F

SHORT- AND LONG-TERM ENVIRONMENTAL USES

F. SHORT- AND LONG-TERM ENVIRONMENTAL USES

This chapter briefly discusses the extent to which the unit would involve exchanges between short-term environmental gains at the expense of long-term losses, and vice-versa, and the extent to which the proposed action precludes future choices.

1. Short-Term Gains Compared to Long-Term Losses

For the short term, Federal funds for construction would provide job opportunities and stimulate the local economy during the 6-year construction period. The excavation of the prehistorical site would contribute to the knowledge of the area's prehistory.

Over the long term, certain environmental losses would occur. The unit would deplete the flows of the Dolores and Colorado Rivers by an annual average of about 3,950 acre-feet. Two ranchers would be adversely affected, one of them markedly, because of necessary land acquisitions at Radium Evaporation Pond. A total of 3,658 acres of wildlife habitat and grazing land would be permanently lost, consisting of 3,630 acres at Radium Evaporation Pond and about 28 acres removed by other surface facilities. Minimal losses of deer would result at the brine well field because of increased human activity. The removing of 36 acres of pinyon-juniper woodland along the brine pipeline and the increased human activity at the well field would reduce the available nesting habitat or decrease the hunting area for some species of raptors. Long-term losses would also be expected for some of the various species of small nongame mammals, gamebirds, nongame birds, and reptiles. Although studies have not been completed, waterfowl losses could occur at the evaporation pond. The unit structures would disrupt the scenery of the area.

Inundation of the pond could restrict the development of potential uranium deposits beneath the site. Two archaeological sites would be permanently lost by inundation of the pond.

2. Short-Term Losses Compared to Long-Term Gains

Short-term losses would include the strain placed on local utilities, educational and medical facilities, police and fire protection, recreational facilities, and other community services. Temporary losses for wildlife, such as mule deer, small game and nongame mammals, furbearers, varmints, and nongame birds, would occur during the clearing of 218 acres of habitat for the proposed pipeline.

The most significant long-term gains would be from the benefits derived in the Lower Colorado Basin resulting from reduced salinity, totaling $4,186,000 annually, and from contributions toward the maintenance of established salinity standards along the river. The habitat of fish and aquatic invertebrates would be enhanced in about 70 miles of the lower Dolores River. Habitat improvement at Radium Evaporation Pond, along the Dolores River, and along the brine pipeline would benefit pronghorns, small game and nongame mammals, furbearers, varmints, some raptors, and gamebirds, waterfowl and shore birds, and one species of reptile and represents a long-term commitment to the habitat requirements of these species.

3. Relationship Between Unit Development and Future Options for Resource Development

The fuels, power, manpower, and construction materials required for unit construction and operation would not be available for other uses. Federal funds committed to the unit could not be put to other uses. The water depleted from the river, although extremely small, would also not be available for alternative uses.

CHAPTER G

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

G. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

A total of 7,891 acres of land now in use for livestock grazing and wildlife habitat would be acquired for unit purposes. Of this total, 4,211 acres would be irreversibly and irretrievably committed to long-term unit purposes for the evaporation pond, well field, hydrogen sulfide plant, housing, and brine pumping plants. The 3,660 acres in the wildlife area, although committed to its proposed use for a long period, could be restored to approximate present conditions, if desired. The 20 acres required for construction materials would not be irreversibly committed to the unit.

The construction materials irretrievably committed to use would include an estimated 7,684,000 cubic yards of soil, sand, gravel, cobble, and riprap required for the dam, dike, and pond, as well as an undetermined amount of materials for roads and other features. Concrete aggregate of an undetermined quantity would come from the area for construction of the dam, dike, part of the brine pipeline, hydrogen sulfide plant, and pumping plants. Cement and manufactured materials brought in from outside the area would be irretrievably committed to unit purposes. Construction would also involve the consumption of energy such as fuels, explosives, and electrical power. After construction, an average of 15,200,000 kilowatt-hours annually of electrical energy would be consumed at the brine well field, hydrogen sulfide plant operation and maintenance housing, and pumping plants.

With a maximum pumping rate of 5 cfs and proposed flood storage capacity in Radium Evaporation Pond, 3,950 acre-feet would be irretrievably depleted each year in the lower Dolores River and the Colorado River. The evaporated water would be unavailable for other uses in the Colorado River Basin.

Two archaeological sites would be irretrievably disturbed because of an investigation program and unit construction. The sites, which would be inundated by Radium Evaporation Pond, consist of an abondoned ranch homestead and an area of lithic scatter.

The unit would irreversibly change the scenery for the life of the unit wherever manmade structures would be built as unit features. After 100 years, Radium Evaporation Pond would be irreversibly committed as a salt flat.

CHAPTER H

ALTERNATIVES TO PROPOSED ACTION

H. ALTERNATIVES TO PROPOSED ACTION

1. Introduction

This chapter discusses three alternatives to the proposal. The first is the alternative of no Federal development. In the second alternative, Radium Evaporation Pond would be replaced by a pond in Sinbad Valley to the north of Paradox Valley, which is the only other site in the unit area that would be suitable for disposing of brine at a rate of 5 cfs. The other plan is based upon diverting the Dolores River into a lined bypass channel to be constructed across Paradox Valley. The brine ground water would continue to surface in the natural flood plain to form an evaporation pond in the middle of the valley.

The Bureau also considered three alternative concepts which were discarded because of doubtful practicality and which are not included in this chapter. One of these would involve desalting the moderate and low flows of the Dolores River immediately downstream from the brine area and piping the effluent to Radium Evaporation Pond for disposal. The product water would be returned to the river channel. The surfacing brine itself could not be treated, since it is too saline for present desalting processes. In fact, it is already saltier than the effluent from a desalting plant. This alternative would remove much less salt than the proposal, would have excessively high construction and operation costs, and would require large amounts of electric power.

The second method would be to establish a freshwater lake over the zone of brine inflow to develop a positive head over the aquifer and thus reduce or prevent brine inflow into the river. This method would require the construction of a dam with outlet works and would inundate a large acreage of bottom and agricultural land and a number of farm homes in the Bedrock town area. Consequently, due to the high cost to investigate, the large adverse environmental impact to the area, and most of all the inability to determine the overall effectiveness for a number of years, the method was rejected.

The third method would be to identify the source or sources of ground water recharge, then drill wells and pump the frest water before it comes in contact with the salt dome beneath Paradox Valley. The potential recharge area is very large, however, including West and East Paradox Valley, the valley walls, and the nearby La Sal Mountains; and the amount of recharge that must be specifically identified is quite small at about 1 cfs. Recharge may also be diffused over the entire area rather than restricted to within smaller localities. As a consequence, identifying and controlling the recharge would be very costly with only limited results.

In addition to studying alternatives to the proposed plan, the Bureau has considered several measures that would be feasible if a well field pumping rate of about 2 cfs rather than the proposed rate of 5 cfs would effectively remove most of the salt now entering the river. A long-term rate in the range of 2 cfs is a possibility, given the rate of brine inflow, which is estimated at an average of 0.8 cfs and a maximum of 2.1 cfs. Consequently, in one alternative, the Bureau has modified the proposed plan by reducing the design capacities of the unit facilities and has also formulated four alternatives for brine disposal that may be possible at a reduced pumping rate. Three of these alternatives would replace Radium Evaporation Pond with alternative ponds, and another would involve the injection of brine into deep wells. In each case the brine well field, hydrogen sulfide stripping plant, and modified brine pipelines would still be required. The alternative plan previously introduced for constructing the Dolores River bypass channel would also be considered at 2 cfs, since its capacity, costs, and effectiveness are based upon the flow of the Dolores River rather than the rate of brine inflow.

If ongoing testing shows that a pumping rate at or near 2 cfs would indeed be effective in removing the salts, the Bureau would reanalyze the unit to determine whether one of the 2 cfs plans discussed in this section would be more desirable than the proposed plan.

2. Alternatives to the Proposed Plan

a. Nondevelopment

The discussion of this alternative is based on the assumption that the unit would not be developed as a Federal project. Although other organizations could conceivably undertake its development, the interstate and international aspects of salinity control would present serious problems for such an action. These problems would arise because the unit, although located in Colorado, would offer the most tangible benefits to water users in the Lower Basin States of California and Arizona as well as in the Republic of Mexico. In addition, the unit is part of a comprehensive program involving all seven States in the Colorado River Basin.

Without the unit's salinity reductions of 180,000 tons of salt annually, the water users in the Lower Basin States would not realize the annual economic benefits of about $4,186,000. Salinity would cause increasing economic damages in the future, and other methods to help meet the salinity standards would have to be looked at and used if water resource development continues in the basin.

Economic and social conditions in the unit area would remain essentially as they are now, with no short-term impacts from the influx of construction workers and no long-term impacts from the acquisition of private grazing land, with associated losses of grazing permits on public land. In addition, the potential exploitation of uranium deposits would not be restricted by Radium Evaporation Pond.

Wildlife habitat would not be reduced by unit structures, nor would riparian habitat along the Dolores River be enhanced by the reduction of salinity. Consequently, wildlife populations would remain at or near their present levels. The stream fishery in the river would continue to be very poor, and frequently nonexistent, in the 7-mile reach from Paradox Valley to the confluence with the San Miguel River. Fisheries would also be unchanged in the lower Dolores River and in the Colorado River.

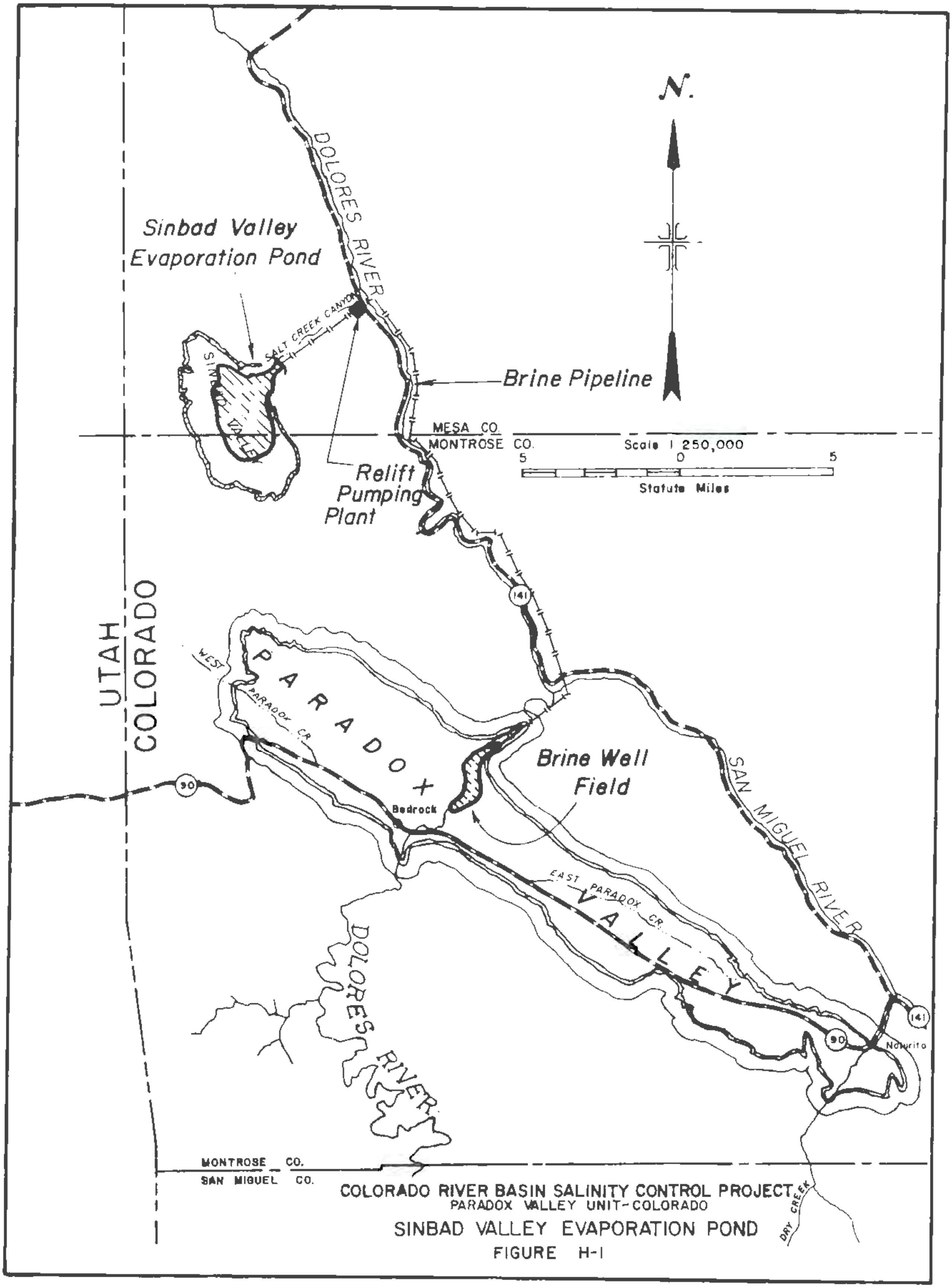
Archaeological sites in the area would remain undisturbed and perhaps unstudied. The landscape of the area would not be altered.

b. Sinbad Valley Evaporation Pond

(1) Development Plan

This alternative would involve pumping 5 cfs of brine from the existing well field to an evaporation pond in Sinbad Valley, a collapsed salt anticline located about 13 miles northwest of the well field (see Figure H-1). After being pumped from the wells, the brine would be collected and conveyed to an adjacent hydrogen sulfide stripping plant on the west side of the Dolores River for treatment. Because of very rugged terrain between the plant and the pond site, the brine would then be conveyed in a buried pipeline for about 26 miles downstream along the river and about 3.7 miles up Salt Creek, an intermittent stream which drains Sinbad Valley and is tributary to the Dolores River. A high-lift pumping plant would be required near the confluence of the two streams to lift the brine through a total vertical difference of about 1,060 feet into the pond, with power obtained from an existing transmission line along the river about 1 mile to the east.

The evaporation pond would be formed by the construction of a large earthfill dam across Salt Creek on the downstream side of the valley. About 413 feet high and 1,440 feet long at the crest, the dam would contain an estimated 9,800,000 cubic yards of material (about four times as much as Radium Dam and Dike combined). The pond, which would have a useful life of 100 years at the maximum brine inflow of 5 cfs, would have a total capacity of about 245,000 acre-feet, over twice as large as the proposed Radium Evaporation Pond, but a surface area of only 2,280 acres, or about one-third smaller. The additional capacity would be required for two reasons. First, the pond would have to store and evaporate a larger volume of average annual precipitation and surface runoff than occurs in Dry Creek Basin. Second, because of the valley's steep topography a large capacity would be necessary to create an adequate surface area for evaporation. Even as now designed, the pond's water surface would not be large enough for annual evaporation to equal the average annual inflow of brine, precipitation, and surface runoff during the 100-year period of operations. Consequently, the pond



COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT-COLORADO
SINBAD VALLEY EVAPORATION POND
FIGURE H-1

would consist primarily of brine at the end of the unit life, with some deposited salt, and only after a long period of time would all of the water evaporate and leave an exposed salt flat.

The construction cost and cost per ton of salt removed would be about three times as high as the proposed plan. In addition, the construction of an evaporation pond in the valley would pose serious technical engineering problems because of the geology. The dam would require a large amount of material, and there is no known quantity of suitable material in the area. Large-scale seepage could also be a severe hazard, necessitating expensive lining of the reservoir basin. The valley floor is the residual cap of a salt dome, composed of gypsum and other soluble materials like those found beneath Paradox Valley, and would consequently be questionable for a pond basin. The valley walls would also cause seepage problems since the strata dip away from the pond site, are highly fractured, and are characterized by collapsed fault blocks.

(2) Environmental Impacts

This alternative would have essentially the same impacts as the proposed plan on lower basin water users, water quality, and fish and aquatic invertebrates in the Dolores River. Construction would require a larger work force over a longer time span, however, and would thus bring more money into the area in the form of salaries and retail trade, but as a result would also place a greater strain on local municipal facilities. Stream depletions of the Colorado River would be slightly greater. The acquisition of private land for the pond would not seriously affect the one rancher in the valley since the operation is quite extensive. Since Salt Creek is intermittent and highly saline, the evaporation pond would not have any impacts on fish and aquatic invertebrates below it. The acquisition of wildlife mitigation lands could, depending on their ultimate location, seriously jeopardize ranching operations, since these acquisitions would have to be quite large in order to adequately compensate for the wildlife habitat inundated by the pond and degraded by the pipeline. The pond would inundate up to 2,280 acres of wildlife habitat characterized by mountain mahogany, Gambel's oak, and serviceberry on the valley slopes and mixtures of pinyon-juniper woodland with sagebrush on the valley floor. Although this is about 1,350 acres less than would be lost at the proposed Radium Evaporation Pond, it is a critical winter range for mule deer and also a good range for mountain lion. The brine pipeline along the river would also cause a significant loss in wildlife populations by the removal of about 100 acres of valuable riparian habitat. Because of these impacts, this plan could require a much more extensive mitigation program than the proposed plan. The Fish and Wildlife Service, under Section 7 of the Endangered Species Act, would have to review this alternative for potential adverse impacts on the peregrine falcon, since additional riparian habitat would he lost.

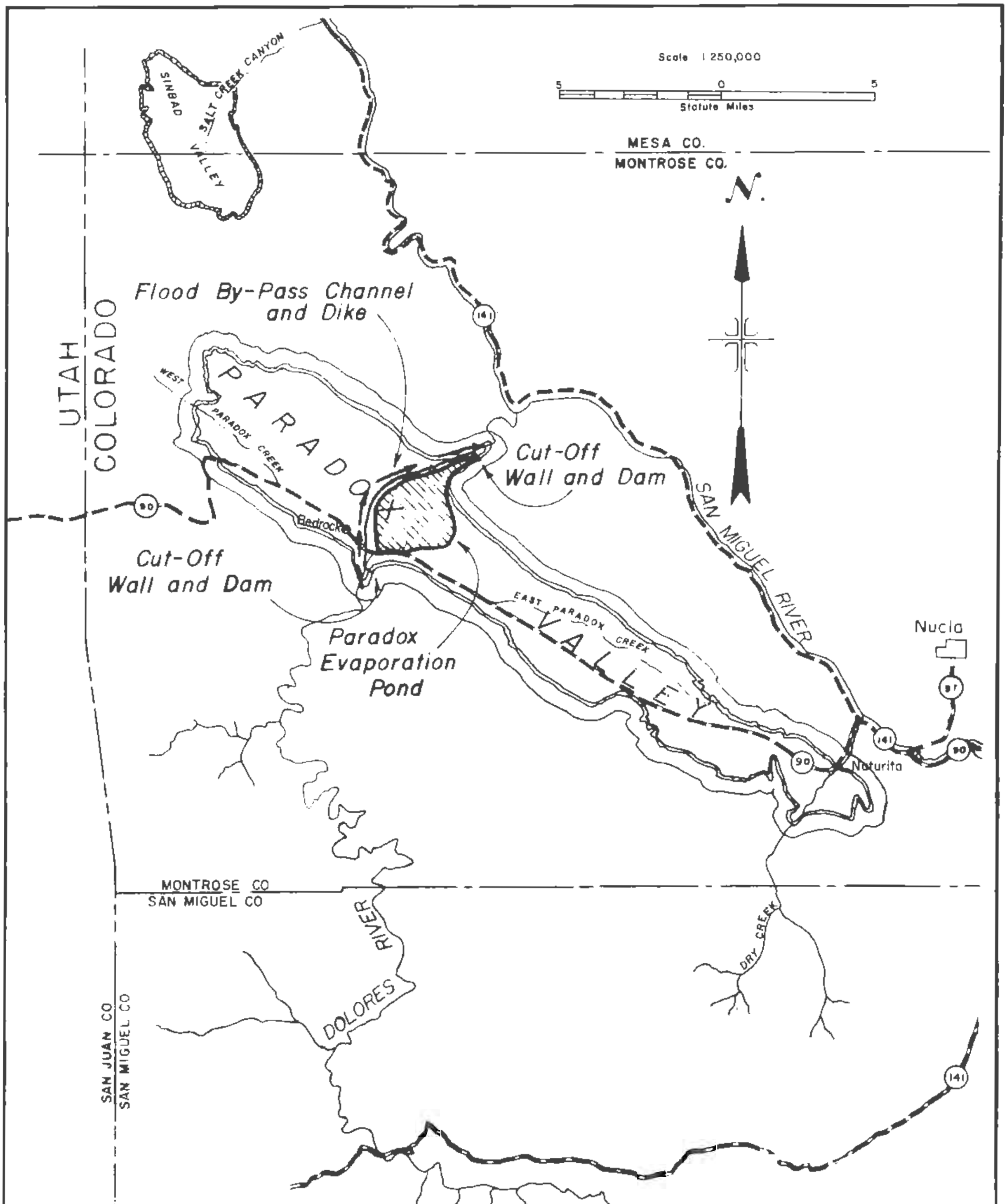
c. Dolores River Bypass Channel

(1) Development Plan

This alternative would involve diverting the Dolores River out of its natural channel and routing it across Paradox Valley in a channel constructed of impervious material, allowing the brine and fresher ground water to evaporate in the natural flood plain where they now surface (see Figure H-2). Intermittent flows of East Paradox Creek would also be evaporated, but the flows of West Paradox Creek would be diverted into the bypass channel, which would be located to the west of the present riverbed.

At the upstream side of the valley an earthfill diversion dam 80 feet high and 1,000 feet long at the crest, combined with a cutoff wall, would force all of the surface and subsurface flows of the river into the bypass channel, which would have a total length of about 5 miles. The eastern bank of the channel, with a height of about 52 feet above the natural riverbed, would prevent the maximum probable riverflow of 74,200 cfs from spilling into the brine evaporation area. The western bank would be lower, about 22 feet high, and would contain the estimated 25-year flood of 11,600 cfs. Although larger flows would spill over the western bank away from the natural river channel and temporarily inundate up to 900 acres, the water would drain out as the flood receded. An impervious lining of compacted earth placed on the bottom and lower sides would handle flows of 3,000 cfs or less, which occur about 95 percent of the time. With larger flows the water level would rise into the unlined portion of the banks, where some seepage would occur, but the infrequency and short duration of such occurrences would keep the losses to a minimum. At the downstream side of the valley, the channel would end with a concrete drop structure that would discharge the flows into the natural riverbed. A second dam and cutoff wall would be constructed across the riverbed just upstream from the drop structure. This dam would also be earthfill, with a height of 80 feet and a crest length of 850 feet. The purpose of this structure would be to prevent the surfacing brine from leaving the valley and entering the river downstream from the bypass channel. Impounded behind the dam, the brine would form an evaporation pond in the natural flood plain of the river. The pond would be enclosed by the lower dam on the north, by the bank of the bypass channel on the west, and by natural terrain on the south and east. With a maximum size of 58,200 acre-feet in volume and 2,630 acres in surface area, it would be large enough for a 100-year operational life. At its maximum size, it would extend across the entire width of the valley. The total construction cost and the cost per ton of salt removed would be about the same as the proposed plan.

The long-term effectiveness of this plan is uncertain, since the formation of a large pond on top of the seeps and springs could alter the behavior of the ground water. As the pond grew larger, the increasing static head created by the water and the precipitated



COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT COLORADO

DOLORES RIVER BYPASS CHANNEL
FIGURE H-2

salts might gradually overcome the ground water pressure that now forces the brine to surface along the river. Consequently, part or all of the brine might begin to surface at one or more locations outside the control area and again enter the river.

The plan could be modified by increasing the size of the upper dam to provide temporary storage space for floodflows of the Dolores River. The stored flows would then be gradually released at a controlled rate into the bypass channel, thus allowing the capacity of the channel to be decreased. Such a modification does not offer any economic advantage, however, since the increased cost of the dam would outweigh the decreased cost of the channel.

(2) Environmental Impacts

This alternative would have larger adverse impacts on local economic and social conditions than the proposed plan as a result of relocating up to ten residences, a cemetary, part of Colorado State Highway 90, and about 5 miles of county road. In addition, up to 2,630 acres of pasture, irrigated cropland, and range would be removed from agricultural production. Although the total acreage affected would be less than the 3,630 acres inundated by the proposed Radium Evaporation Pond, most of it is of a much better quality for agriculture. An additional 900 acres of agricultural land would be temporarily taken out of production when the Dolores River flows were high enough to flood over the western bank of the bypass channel. The residents of the valley would probably be offended by the presence of such a large and unaesthetic structure across the middle of the valley.

The stream depletion is estimated to be nearly the same as the proposed plan at a maximum of about 3,750 acre-feet annually, consisting of 2,900 acre-feet of brine and fresher ground water and 850 acre-feet of intermittent flows from East Paradox Creek. If the brine did not surface in new areas, the impacts on water quality in the lower Dolores and Colorado Rivers would be the same as the proposed plan, with a salt reduction of 180,000 tons annually.

Like the proposed plan, this alternative would enhance stream habitat for fish and aquatic invertebrates downstream from Paradox Valley by the improvement in water quality. The bypass channel, however, would eliminate about 5 miles of river channel in Paradox Valley above the brine area that now supports fish whenever the flows are sufficient.

The evaporation pond would reduce the available wildlife habitat in the valley by inundating 2,630 acres of cropland and pasture, native grassland, sagebrush, greasewood, seablite, pinyon-juniper woodland, and nearly all of the valuable riparian growth in the valley. This vegetation, particularly the riparian growth, is considered to be more valuable for most wildlife species than the vegetation found at the proposed Radium Evaporation Pond site. Big game mammals would be minimally affected because of their limited use of the area, but small game and nongame populations would be reduced significantly. The alternative would also have a greater potential for adverse impacts on the critical habitat of the endangered peregrine falcon by reducing hunting areas.

3. Smaller Scales of Development

a. Modified Radium Evaporation Pond

(1) Development Plan

If pumping brine from the well field at 2 cfs would reduce the salt inflow by about 180,000 tons annually, all of the proposed unit facilities would be reduced in operating capacity. None of them could be eliminated, however. The hydrogen sulfide stripping plant, brine pipeline, pumping plants, and evaporation pond would all have the same locations as they would at 5 cfs. The most significant change would involve Radium Evaporation Pond, which would be reduced from 86,800 to 36,000 acre-feet in capacity and from 3,630 to 1,780 acres in surface area, located entirely in the drainage of the West Fork of Dry Creek. Radium Dam would be reduced in size to a height of 89 feet and a crest length of 6,000 feet but would have the same location. The dike, also considerably smaller with a height of 22 feet and a crest length of 5,500 feet, would be located on the saddle between the East and West Forks. Because of the smaller pond, the size of the wildlife area would also be reduced. The total construction costs and cost per ton of salt removed would be slightly more than half the costs of the proposed plan.

(2) Environmental Impacts

This alternative would have fewer short-term impacts during construction than the proposed plan, since a smaller work force and shorter construction period would be required. The plan would have essentially the same long-term impacts with respect to economic and social conditions, water quality, fish and aquatic invertebrates, and historical and archaeological sites. Of the two ranchers with grazing land at the pond, the impacts on the one who would be severely affected in the proposed plan would remain substantially the same since his lands would still be in the pond basin. The other rancher would be less affected since his land is in right-of-way required primarily for wildlife mitigation land, which would be considerably less in this alternative. Although the stream depletion would be less, about 1,770 acre-feet annually compared to 3,950 acre-feet, the resulting impacts on fish and wildlife habitat downstream would not be significantly different. The only marked difference would be at the smaller evaporation pond, which would inundate less than half as much wildlife habitat and result in smaller population losses. Because of the uniformity of habitat throughout Dry Creek Basin the species affected would be similar, including mule deer, pronghorn, sage grouse, small game, nongame, and raptors. Range acquisition and improvement would compensate for most of the potential losses.

b. Modified Sinbad Valley Evaporation Pond

(1) Development Plan

This plan would involve pumping the brine to Sinbad Valley for disposal, as discussed earlier, but the H_2S stripping plant, 29.7-mile brine pipeline, pumping plants, and evaporation pond would be reduced in capacity to handle only 2 cfs of brine. The evaporation pond would have a maximum capacity of 146,000 acre-feet and a corresponding surface area of 1,600 acres. The dam required to form the pond would be about 360 feet high and 1,400 feet long at the crest. Because of the valley's steep topography, the pond's water surface would not be large enough for annual evaporation to equal the average annual inflow of brine, precipitation, and surface runoff during the 100-year period of operations. Only after a long period of time would all of the water evaporate and expose a salt flat.

Like the larger evaporation pond in Sinbad Valley this pond would also have serious geologic problems. The problems would include the lack of a known quantity of suitable material for construction and the potential for large-scale seepage through the valley floor and walls. This plan would be about three times as costly as the modified Radium Evaporation Pond and nearly twice as costly as the proposed plan described in Chapter A.

(2) Environmental Impacts

During construction, this plan would have more serious adverse impacts on local economic and social conditions than the plan just described for the reduced Radium Evaporation Pond, since the work force would be larger and the construction period would be longer. The plan would have essentially the same long-term impacts, however, with respect to economic and social conditions, stream depletions, water quality, and fish and aquatic invertebrates. Impacts on wildlife would be more severe because of the inundation of about 1,600 acres of critical winter range for the mule deer and the loss of about 100 acres of valuable riparian habitat along the brine pipeline. The pond would also remove good range for the mountain lion. Because of the overall impacts, a significant mitigation program would be necessary.

c. East Paradox Valley Evaporation Pond

(1) Development Plan

With a well field pumping rate of about 2 cfs, the brine could be evaporated at an alternative site about 11 miles southeast of the proposed hydrogen sulfide stripping plant. A buried pipeline with three pumping plants would convey the brine to the evaporation pond, which would be located on a low and relatively flat saddle separating Paradox Valley from the northern tip of the Dry Creek drainage. A dike and a dam would be constructed to form the pond. On the west side a dike with a height of 88 feet and a crest length of 7,970 feet would extend across East Paradox Creek. On the east side a dam with a height of 180 feet and a crest length of 2,140 feet would be located on an intermittent tributary of Dry Creek. The resulting pond would have a total capacity of 65,000 acre-feet and a maximum surface area of 1,030 acres. The large capacity would be required to produce an adequate area for evaporating the brine. Even with the 1,030 acres, evaporation would occur more slowly than inflow, and few salts would be deposited during the 100-year period of operations. Eventually, however, an exposed salt flat would replace the brine. This plan would be about twice as costly as the scaled down Radium Evaporation Pond and about equally as costly as the proposed plan.

The location of the dam in this plan presents geologic problems, since the foundation would be situated in a number of fault blocks. The site is an area of peripheral collapse dividing the main Paradox salt cell from a lesser salt cell which underlies this reach of the Dry Creek drainage. Consequently, an expensive lining would be required for the pond.

(2) Environmental Impacts

This alternative would have the same impacts as the small-scale Radium Evaporation plan on economic and social conditions, (both short- and long-term), stream depletions, water quality, and fish and aquatic invertebrates. The impacts on wildlife would generally be smaller however. The brine pipeline and evaporation pond would affect fewer acres, and the habitat involved would be less valuable for wildlife. The 11-mile-long pipeline would remove about 110 acres of sagebrush and semidesert shrublands, compared to a total loss of about 206 acres for the proposed pipeline. In addition, the proposed line would affect some pinyon-juniper woodland, which is more valuable for many species of wildlife. The evaporation pond would inundate about 570 acres less than the 2-cfs Radium Evaporation Pond and would be located in an area that is generally less valuable for wildlife. This alternative would have a minimal impact on local agriculture, since most land utilized would be Federal land presently managed by the Bureau of Land Management, although there would be a slight reduction in grazing permits.

d. West Paradox Valley Evaporation Ponds

(1) Development Plan

At a pumping rate of 2 cfs or less, the brine could also be evaporated by a series of eight small ponds beginning adjacent to the well field and extending to the northwest for about 2 miles. The hydrogen sulfide stripping plant would also be located on the northwestern side of the well field, and a buried pipeline would extend from the plant along the length of the ponds, with a separate turnout and valve for each pond. A pumping plant would be installed at the beginning of the pipeline. The ponds would be formed by excavating eight small basins and using the material to construct surrounding dikes that would range in height from 25 to 80 feet. The resulting ponds would vary in size--the smallest with a capacity of 1,670 acre-feet and a surface area of 130 acres, the largest with a capacity of 8,900 acre-feet and a surface area of 500 acres. The total capacity would be about 29,600 acre-feet. To prevent any seepage, the ponds would be lined with impervious material, such as butyl rubber, vinyl, or treated clay derived from local shale formations such as the Mancos Shale or Morrison Formation. The ponds would be constructed one at a time as needed during the 100-year operational life of the unit, and the last one would not be completed until about the 70th year. As each one was filled with salt deposits, it would be covered with earth and seeded. The costs for this plan would be about the same as the costs of the alternative plan using the 2-cfs Radium Evaporation Pond.

(2) Environmental Impacts

Since the ponds would be built as needed over a 70-year period, this alternative would have fewer beneficial and adverse impacts on economic and social conditions from construction work than the 2-cfs Radium Evaporation plan. The alternative would have the same long-term impacts as the small Radium evaporation plan with respect to economic and social conditions, stream depletions, water quality, and fish and aquatic invertebrates downstream. The eight ponds would remove about the same total amount of wildlife habitat, consisting of 1,700 acres of sagebrush, pinyon-juniper woodland, and semidesert shrubs, but the resulting impacts on wildlife would be different. Big game species use the area only minimally and would consequently not be affected significantly, while small game and nongame species would experience significant declines in population. The plan would also have a much greater potential for adversely affecting critical habitat of the endangered peregrine falcon by the inundation of hunting areas and long-term human activity at the ponds.

e. Deep Well Injection

(1) Development Plan

This plan would involve pumping the brine at a rate of 2 cfs or less from the existing well field, removing the hydrogen sulfide gas, then injecting the brine into one or more deep wells as a means of disposal. The injection deep wells, located in Paradox Valley near the river, would eliminate the need for the brine pipeline and evaporation pond. A stripping plant would still be needed, however, to insure that the H2S gas did not impede underground injection of the brine. If necessary, additional surface facilities would be constructed to pretreat the brine by filtration or the addition of chemicals in order to prevent clogging of the formation.

A study by a consulting geologist under contract with the Bureau has recommended that an abandoned oil exploration well, located about 0.75 mile southwest of the brine well field, be rehabilitated and tested to determine the feasibility of brine injection (Turner, 1975). The well extends over 15,000 feet into sediments of Mississippian age underlying the salt core of Paradox Valley. Because of their extensive size, thickness, and noted porosity, these sediments could possibly provide a suitable subsurface reservoir for the brine. The depth to the sediments is also a favorable factor, since they are deep enough to be unaffected by faults and other structures that could cause leakage to the surface and is also well below any freshwater circulation and confined by the thick layer of salt immediately above it. Because of the depth and homogeneity of the formation, injection would not be likely to cause tremors, as have occurred elsewhere, but other environmental impacts--as yet undetermined but associated with the increased pressures and fluids within the formation--could occur.

To investigate this means of disposal, the oil well would be rehabilitated, tested, and drilled to a greater depth if the tests showed that this would open up additional porous zones. A buried pipeline would convey the brine from the hydrogen sulfide stripping plant, and a pumping plant would be installed to compress the existing formation water and thus force the brine into the sediments. Although deep well injection for oil production is an established practice, its use for waste disposal into Mississippian-aged formation at depths of 15,000 feet is still considered experimental. Since brine would be injected into a formation which already has an existing fluid, compression of the fluids and perhaps the formation rock itself would be necessary.

Several potential problems of a more definable nature would occur with this alternative, however, particularly in the area of deep well effectiveness. Even if the formation would receive brine without significant problems, a large number of new wells would probably be required to provide an operational life of 100 years for the unit. Some wells would probably encounter impervious areas of the formation and would have to be discarded, and the successful wells would probably exhibit a great deal of variation in the rate of brine they could receive and the storage area available for brine.

The total construction cost of this plan would depend upon the number of wells ultimately required to inject brine for an operational period of 100 years. The number of wells would in turn be dependent upon the injection rate per well, which in comparable, operational deep wells varies from .25 to 1.0 cfs and upon the life of each well, which would probably be less than 10 years. The injection pressure would probably be in the range of 1,000 to 2,500 pounds per square inch. The Bureau of Reclamation estimates that the cost of rehabilitating the existing well and installing surface pretreatment facilities would be about $1,000,000, and that the cost of installing each new injection well would be about $3.5 million. Because of the many variable and unknown factors involved in deep well injection, the total construction costs could vary considerably. If conditions were extremely favorable, with each well receiving 1 cfs of brine over a useful life of 10 years, this plan would be the most economical of all of the 2-cfs plans for a 100-year project life, amounting to perhaps half of the cost of the modified Radium Evaporation Pond plan. If conditions were unfavorable, however, with each well receiving only about 0.25 cfs over a life of only 3 years, this plan could cost perhaps four or five times as much as the modified Radium Evaporation Pond plan. Based on optimum efficiency of deep wells to handle 2 cfs of brine, annual operation, maintenance, and replacement costs, including the power requirements, would be similar to those in the recommended plan.

(2) Environmental Impacts

Construction work on this plan would occur over a long period of time with new injection wells drilled as necessary. Consequently, while the resulting construction impacts on local conditions at any one time would be of much smaller magnitude than the 2-cfs Radium Evaporation plan, they would essentially endure over the life of the project since construction would be continual. The alternative would have the same long-term impacts as the 2-cfs Radium plan on stream depletions, water quality, and fish and aquatic invertebrates downstream from the well field. It would have smaller effects on most species of wildlife, and agriculture, however, since it would have no evaporation pond to replace existing habitat. In addition, the short pipelines to the disposal wells would remove only a small amount of habitat. The well field would have impacts similar to those in the proposed plan, and the surface pretreatment facilities would probably have effects quite similar to those of the hydrogen sulfide stripping plant. By requiring fewer surface structures, the alternative would have lesser impacts on the scenery of the area. Continual construction activity at the well field, however, has the potential to adversely affect the endangered peregrine falcon.

CHAPTER I

CONSULTATION AND COORDINATION

I. CONSULTATION AND COORDINATION

1. Development of the Proposal

In formulating the proposed plan, the Bureau of Reclamation obtained planning aid and evaluation of unit purposes from several Federal and State agencies, including the Fish and Wildlife Service, the Bureau of Land Management, the Colorado Division of Wildlife, the Colorado State Archaeologist, and the Colorado State Historical Society.

2. Preparation and Review of Draft Environmental Statement

a. Preparation of Statement

In preparing the Draft Environmental Statement, the Bureau of Reclamation received information from various Federal, State, and other agencies and organizations concerning the present environment, anticipated impacts of the unit, and recommendations for the wildlife area and the archaeological preservation plan. The Fish and Wildlife Service provided a planning aid memorandum concerning possible impacts of the unit and recommended a mitigation plan, which the Bureau incorporated into its plan. The Service also furnished information, which is attached to this statement, on the impacts of the unit on endangered species. The Colorado State Division of Wildlife, under a contract with the Bureau, conducted an inventory of fish and wildlife in the area and the expected impacts from the unit. Also under a contract with the Bureau, Colorado State University is studying the effects of brine on waterfowl. A fauna inventory was conducted by Fort Lewis College under a contract with the Bureau, and, under a contract with the National Park Service, the college reported on the archaeological and historical resources in the area. Information on the geology and mineral resources of the unit area and water quality data came from such agencies and organizations as the Environmental Protection Agency, the U.S. Geological Survey, the Bureau of Mines, and Utah State University. The Colorado State Archaeologist and the Colorado State Historical Society assessed the impacts of the proposed action on archaeological sites in the unit area.

b. Distribution of Statement

When the Draft Environmental Statement (DES 78-18) was released in May 1978, approximately 250 copies were distributed for review to Federal, State, and local agencies and to water users' organizations, conservation groups, educational institutions, news media, and individuals. Copies were also made available for public inspection at public, college, and university libraries. Agencies and organizations receiving the draft statement and those commenting thereon are indicated in the distribution list near the front of this statement.

The review period for the Draft Environmental Statement began with the notice of availability published in the Federal Register of May 17, 1978. The review period officially ended June 26, 1978; however, written comments received after that date have been accepted and considered in preparation of this final statement.

c. Public Hearing

A formal public hearing was held June 17, 1978, to receive comments on the Draft Environmental Statement. Notice of the hearing was made in the Federal Register of May 17, 1978. The hearing was held at the Nucla, Colo., high school. It was convened at 10 a.m. and was adjourned at about 10:45 after all who wished had testified. The hearing was conducted by James Limb, Regional Solicitor's Office, Department of the Interior, Salt Lake City, Utah. John W. Keys, Chief of the Colorado River Quality Office of the Bureau of Reclamation, Denver, Colo., and Wayne E. Cook, Senior Staff Officer, Western Colorado Projects Office, Durango, Colo., were present to represent the Bureau of Reclamation and to receive the testimony.

Forty-three people signed the attendance registration for the hearing. Ten persons presented oral testimony. The following is a list of those testifying in the order in which they appeared.

Name	Representing
Neil Reams	Montrose County Commission
Dan Crane	Naturita Town Council
Kent Dahlquist	Union Carbide Corporation and self
Bill Raley	San Miguel Water Conservancy District
Mike and Vivian Young, Netherton family and, Bill and Carol Koon	Local residents: Donna Netherton presented statement for all
Jack De Koevend	Town of Nucla
Wes Wilson	EPA-Denver Regional Office
Marshall Hughes	Self
Victor Roushar	Attorney representing Marshall and Charles Hughes of Norwood
Earl Wilcox	Self-holder of mineral rights

A verbatim transcript of the hearing was recorded by an official reporter. This transcript has been bound and is available for public inspection at the locations listed on the following page. Copies can be purchased from the reporter, Holman W. Mills, 6123 Queen Court, Arvada, Colo. 80004.

Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street
Salt Lake City, Utah 84147

Bureau of Reclamation
Western Colorado Projects Office
835 2nd Avenue
Durango, Colorado 81301

Major concerns expressed at the hearing centered on the impact on the local communities whose education, medical, law enforcement, and water and sewage systems are already taxed by energy resource development; potential mineral resources that would be covered by the evaporation pond and existing mineral rights in the area; possible salt contamination of fresh water supplies; possible damage and health problems from windblown salt; loss of possible use of evaporation pond area for waterfowl habitat and a recreation area in the future; and consideration of alternative brine disposal methods. Bureau of Reclamation responses to comments read by Mr. Roushar (representing Messrs. Marshall and Charles Hughes), Mrs. Donna Netherton (speaking for Ed and Donna Netherton, Mike and Vivian Young, and Bill and Carol Koon), and Mr. Wes Wilson (representing the Environmental Protection Agency) are included in the written comments section and, therefore, are not summarized here. A summary of the major concerns presented at the hearing and responses to them follows.

Concern:

The local people and the impact the unit would have upon communities and county government is not being considered. Impacts from the unit would come on top of energy-related impacts. It would be beneficial to everyone, including the companies and corporations causing impacts, to do advance planning so that services such as education, medical care, water and sewage, and law enforcement are not inundated.

Response:

We agree that there is a need for advance planning. Among our purposes in circulating the Draft Environmental Statement was to inform people in the area of proposed development of the potential impacts and the planning that has been undertaken to keep any adverse impacts at their miniumum.

Impacts of the unit on the local, social, and economic conditions have been described in Section C-3. The unit area's economy and the part energy development has played in that economy are described in Section B-3b. According to the recently released Western Montrose County Comprehensive Development Plan (October 1978), prepared by the District 10 Regional Planning Commission, no new large-scale developments are forecast for the unit area in the immediate future. A uranium mill is planned at Slickrock, Colo., about 40 miles south of the unit area, but should not impact the unit area because of the distance involved. According to the District 10 Regional Planning Commission's report there is also the possibility of the construction of a coal-fired generating plant in the general area. But because plans for this development are extremely tentative, an impact analysis cannot be accomplished at this time.

Concern:

In the long term, wouldn't it be cheaper and more environmentally desirable to remove the 18.2 milligrams per liter of salt by enlarging the desalting plant now being constructed in the lower basin.

Response:

Given the present state of the art, the cost of salinity control is more a function of the volume of water handled and treated than of the total dissolved solids concentration. This means that it invariably is more cost effective to handle and treat water of low volume and high TDS concentrations at or near the source of pollution than it is to treat diluted concentrations at some central point far removed from the pollution source. Because the Paradox Valley water is highly concentrated brine and low in volume, the unit is very cost effective, but if the Paradox Valley water were to be treated at some point downstream on the main stream of the Colorado, the cost effectiveness would be greatly diminished since the volume of water that would have to be treated would be vastly greater and the concentration diluted by other sources.

The desalting plant being constructed in the lower basin is not on the main stream of the Colorado River but on the tributary Gila River where the TDS concentrations are higher and the volume of flow much smaller. Moreover, this desalting plant does not benefit United States water users since it is below all major diversion points within the United States and could not therefore fulfill the purposes of the Paradox Valley Unit.

Concern:

A reservoir for recreation and waterfowl habitat could be built in the future. The salt flat would preclude the use for other purposes.

Response:

The Bureau of Reclamation, in a 1966 Feasibility Report on the San Miguel Project, proposed that Radium Reservoir be built for irrigation, recreation, and fish and wildlife purposes. The water supply for the reservoir would have been imported from the San Miguel River through a project-constructed conveyance system. Although the project was authorized for construction in 1968 and is now under advance planning studies, the Bureau has modified the plan and no longer proposes a reservoir at the site. Any reservoir at this site would be shallow and would have a large surface area, thereby resulting in considerable evaporation. Without the importation of water from the San Miguel River, the amount and timing of water in Dry Creek would be inadequate to establish and maintain a reservoir. Advance planning studies have not shown that the recreation and waterfowl potential benefits of Radium Reservoir could offset the costs of importing water.

Concern:

There was agreement on the advisability of taking salt out of the river. However, the method of disposal was a concern. Other alternatives such as deep well injection and Dolores River bypass channel were given as preferable disposal methods. It was mentioned that it is essential the Bureau of Reclamation keep its options open regarding alternative methods.

Response:

Section A-3 has been rewritten to make clearer the fact that the well field testing program and determination of the design pumping rate based on those tests is only a first step in project development. As shown and explained in Section A-5, Construction Program, the construction of other major project features would commence only after the results of this testing program have been compiled, fully analyzed, and reviewed. Only then would the final determination on the disposal method be made. The emphasis in the statement on the 5-cfs pumping rate and the sizing of Radium Evaporation Pond to accommodate that pumping rate was made so that maximum impacts could be assessed as called for under NEPA. This course of action should not be construed as an attempt to prematurely eliminate options. The alternatives presented in Chapter H, particularly the 2-cfs alternatives, will continue to be given serious consideration during the testing program.

Concern:

The town of Nucla proposed that, with some assistance, the temporary mobile home camp and necessary water storage for construction workers could be developed on town land.

Response:

The Bureau of Reclamation appreciates this suggestion from the town of Nucla, but it is probable that the camp would be constructed closer to the work site. The primary construction contractor would have the option of building the camp at Nucla, however, and the environmental statement will serve as a public record showing that the town does have some interest in having the camp there. If the camp were constructed at Nucla, the short-term social impacts would remain in the magnitude forecast in the statement except that they would be more focused on the town itself. Sewage and water treatment facilities would have to be expanded and school enrollments in the Nucla school would increase substantially over those estimated in the statement, but enrollment would still remain substantially below the generally accepted optimum student-to-teacher ratio of 25 to 1. (The impacts on Norwood school would not occur as reported in the statement if the contractor took this option.) The contractor could enter into an agreement with the town to help defray the cost of expanding water and treatment facilities since those expenses would accrue to him if the camp were built nearer Radium Evaporation Pond.

Concern:

The salt removal would benefit primarily the lower Colorado River Basin. Benefits to the local area are very minimal at best and very short term.

Response:

The purpose of the Colorado River Basin Salinity Control Project, of which the Paradox Valley is one unit, is to help maintain salinity standards in the Colorado River while the Basin States, including the State of Colorado, continue to use and develop their apportioned share of that water. As discussed in some detail in Section C-11, Cumulative Impacts, the development and use of Colorado River water has been of major economic and social benefit to the people in the Upper Basin States. However, this development has not been without some significant tradeoffs. One of these has been an increase in salinity in the water available to Lower Basin users, causing decreased crop production on irrigated farmland and increased maintenance costs to municipal and industrial users. Therefore, a sensible salinity control program benefits the interests of all the States in the Basin, for it minimizes the threat of decreased production and increased operating costs in the Lower Basin while it helps to insure the continued use and development of apportioned water in the upper States.

Concern:

The pipeline and pumping equipment could fail, which would cause brine to permanently damage existing plants and animals and fresh-water supplies.

Response:

Corrosive damage from the brine solution would be most severe at the valves and meter couplings on the brine pipe network. The estimated service life of the pipeline is 50 years, the fittings 10 years, and the pumping units 10 years. Supervisory control of the stripping plant and brine pumping would provide a nearly constant monitoring of the operations. Part of the duties of the permanent operating force would be to inspect the operation of the valves and meters periodically. Provisions would be made in design of the system to make repairs without jeopardizing plants and animals or fresh-water supplies. A more detailed discussion of safeguards can be found in Section A-3b(3).

Concern:

The pumping plan has not been proven. The Bureau should not now incur costs associated with the building of an evaporation pond.

Response:

It has never been the Bureau's intention to build Radium Evaporation Pond prior to extensive test pumping at the well field. Only after the data gathered through the testing program at the field have been analyzed and reviewed both within and outside the Bureau would the final determination on the most efficient and environmentally acceptable method of brine disposal be made. Sections A-3a and A-5 have been expanded to clarify this matter.

Concern:

Who furnishes the 3,950 acre-feet of water that will be depleted by the unit?

Response:

The depletion would come from the State of Colorado's apportioned share of Colorado River water. It should be recognized, however, that 3,950 acre-feet is only a preliminary estimate and that the final design pumping rate could actually be substantially less since the brine inflow into the river is only in the magnitude of 500 to 900 acre-feet annually.

Concern:

The evaporation pond would cover a uranium deposit that has the potential of development as a mineral resource.

Response:

The Bureau of Reclamation has dealt with this concern in Sections B-5c and C-5. It feels it can carry the analysis no further at this time because of the inconclusiveness of the information available from Union Carbide Corporation. Also see response to the letter from the Bureau of Mines.

Concern:

Mineral rights are privately owned in Paradox Valley at the site of the well field, and the construction of the Paradox Valley Unit may have an effect on these rights.

Response:

The question of whether, in this case, the brine is a compensable mineral is being considered by the Department of Interior's legal division. If the determination is made that it is and that the unit would disturb that mineral, the owners of the affected mineral estates in Paradox Valley would be compensated by the Federal Government in accordance with existing law and procedures.

d. Written Comments

Numerous written comments on the Draft Environmental Statement have been received by the Bureau of Reclamation. Some of the views expressed in these comments parallel those given at the public meeting, but in total they cover a wider range of concern. Copies of the written comments are included at the end of this chapter. The letters are grouped alphabetically in the following four categories: (a) Federal agencies, (b) State and local governments, (c) private organizations, and (d) individuals. The originals of these written comments are on file in the Upper Colorado Regional Office of the Bureau of Reclamation in Salt Lake City, Utah.

3. Disposition of Comments Received on Draft Statement

The review comments received by the Bureau of Reclamation, both written and oral, have been considered in the preparation of this Final Environmental Statement. The statement has been expanded and modified where appropriate to accommodate the input received in these comments.

Where response is appropriate, each letter reproduced in this chapter is followed by a memorandum which responds to the viewpoints raised. Some of the letters require no response, but their receipt is acknowledged.

a. <u>Comments from Federal Agencies</u>

Department of the Interior
- Bureau of Land Management
- Bureau of Mines
- Fish and Wildlife Service
- Geological Survey
- Heritage Conservation and Recreation Service

Advisory Council on Historic Preservation

Department of Agriculture
- Forest Service
- Soil Conservation Service

Department of the Army, Corps of Engineers

Department of Health, Education, and Welfare
- Public Health Service

Environmental Protection Agency

IN REPLY REFER TO
CO-922
1793

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

COLORADO STATE OFFICE
ROOM 700, COLORADO STATE BANK BUILDING
1600 BROADWAY
DENVER, COLORADO 80202

JUN 26 1978

Memorandum

To: Regional Director, Bureau of Reclamation, Upper Colorado Regional Office, P. O. Box 11568, Salt Lake City, Utah 84147

From: State Director, BLM, Colorado

Subject: DES-78/19 - Paradox Valley Unit, Colorado River Basin Salinity Control Project, Bureau of Reclamation

We have reviewed the draft environmental statement and offer the following comments. Specific comments are keyed to page numbers.

General Comments

The Paradox Valley Unit draft statement has not considered in depth the visual resource in the description of the environment in Section B and in the impacts chapter, Section C. The short paragraph on "Preservation of Scenery" in mitigating measures, Section D, has no continuity with previous chapters and offers nothing specific. Impacts on visual resources should have been systematic and specific.

The description of the proposed action is not detailed enough to adequately assess visual impacts such as location of facilities, cuts and fills, clearings, etc.

Greater emphasis should be given to the soils resource in the ES. Information on the erodability, engineering properties and ability to sustain rehabilitation measures seems appropriate.

There is no reference to other projects in the region, such as uranium exploration and mining expansion, Shell, Mobil and other CO_2 well field and pipeline developments, coal development, and other water projects, etc., which will have cumulative impacts on the economic and social integrity of the population of the region. A project of this size would have impacts in conjunction with others, and it should be analyzed in light of the other impacting activities, not apart from it.

The ES also needs a description of the existing roads, their condition, their present traffic load, and the resulting increase in use due to the proposal. The assumption has been made in the analysis that most of the workers would commute from distant areas by private vehicle to work. The impacts to the roads and safety due to the increase in use should be assessed.

Benefits to recreation have been analyzed in terms of increased numbers of man days of certain activities. A similar list of man days lost to the other recreation values, such as wilderness, solitude and aesthetics, should have been examined. Quality of experience is as important as quantity of use.

Drawings in transverse and cross-section of the two dams on the Radium Evaporation pond would be helpful in interpreting the size of the structures. Volume capacities in millions of cubic yards are difficult to envision.

In assessing economic and social impacts, it would be helpful to provide a more detailed description of the stages of implementation. Figure A-7, page A-20, appears to be the only such description.

Specific Comments

Page A-5: The oblique photo on page A-5 does not sufficiently identify the 68 monitoring wells, 19 brine wells, and stream monitoring stations on the map.

Page A-6, paragraph 3, Hydrogen Sulfide Stripping Plant: The amount of nickel sulfate which would be used as a catalyst, and the concentration in the brine should be discussed.

Page A-12, paragraph 1, Radium Dam: More detail in the dam descriptions is needed.

Page A-13, paragraph 4, Transmission Facilities: A description of the construction and design details of the proposed transmission facilities would be helpful. It should show how they are designed to eliminate hazards to raptors. The map should give the route of the power line.

Page A-19, paragraph 3, Construction: More detail is needed on stages of implementation.

Page B-6, Recreation: The ES needs to discuss dispersed recreation capabilities in the Paradox Valley, as well as the relatively intensive river running potential along the Dolores. In terms of regional recreation interest, Bedrock is the downstream egress point for a significant (approximately 5,000 visits annually) number of river running trips on the Dolores River. This point also marks the lower-most extension of a 105-mile segment of the Dolores River that has been recommended in the final Wild and Scenic Rivers study report for inclusion in the national W & SR system. The relative significance of the area for sightseeing/pleasure driving is indicated in the most recent Colorado Department of Highways traffic volume studies.

Page B-6, paragraph 4, Transportation: An influx of a large number of construction workers would likely cause an increase in recreational driving, especially off-road and back-road use. Present use data would be helpful here.

Page B-6, Item 4 - Air Quality: No discussion of climate appears in the description of the environment. The observation is made that existing climatic conditions, such air flow patterns, wind velocities, etc., have not been considered in the Nucla and Dry Creek Basin areas. In view of the fact that radium is to be extracted from a Dry Creek Basin evaporating pond, these climatic conditions may need to be described to ascertain potential health hazards to the Nucla, Naturita and Norwood communities.

Page C-4, paragraph 1-3: This is an example of where visual impacts have been ignored. Temporary mobile home parks can cause considerable visual blight.

Page C-5, Facilities and Services: No discussion of the effects of increased traffic has been given in this section.

Page C-6, paragraph 1, Recreation: An influx of construction workers away from their families would result in increased use of back country roads and two-track trails. Vandalism of archeological sites and some violation of game laws might occur.

C-15, paragraph 2, Raptors: Consideration should be given to the effect the powerline will have on raptors in the vicinity, and shown in the ES.

Pages C-27, 28 - paragraphs 1 and 2, Recreation: This section describes numerous effects of other Colorado River Storage Projects, but no specific impacts of the Paradox Valley project are discussed.

The loss of one recreation resource is not compensated by the increase in another. Accessibility to a recreation event or location may detract from its value to some people. This discussion does not consider the impacts to wilderness, solitude, or visual recreation values separate from increased fishing, boating and camping.

Page C-52, Table C-28: It is apparent from the table that even if the authorized and investigated projects were implemented, the salinity of the Colorado River at Imperial Dam would still increase.

Considering that many of our comments deal with the adequacy of treatment of impacts to several resource values, we would appreciate an opportunity to comment on the final ES and on other ES's concerning CRSP projects.

Overall, the attempt in this DES to discuss cumulative impacts in terms of CRSP projects appears grossly misleading. There is probably a need to discuss those impacts in an ES as indicated in earlier correspondence; however, the cumulative effect on southwest Colorado of this and other actions can and should be the focus of this ES.

cc: Director (260)
Montrose District Office

Memorandum

To: Files

Subject: Response to Letter from Bureau of Land Management, Colorado State Office, Denver, Colo., Dated June 26, 1978.

1. Comment:

The Paradox Valley Unit draft statement has not considered in depth the visual resource in the description of the environment in Section B and in the impacts chapter, Section C. The short paragraph on "Preservation of Scenery" in mitigating measures, Section D, has no continuity with previous chapters and offers nothing specific. Impacts on visual resources should have been systematic and specific.

The description of the proposed action is not detailed enough to adequately assess visual impacts such as location of facilities, cuts and fills, clearings, etc.

Response:

The visual quality of the project area has been briefly and generally discussed in Sections B-2 and C-2, General Setting.

A comparison of the existing visual resource and the basic elements with which to evaluate scenic quality was made by our landscape architect using the Bureau of Land Management's Visual Resource Management guide. The scenic quality rating procedure is based upon the premise that all landscapes have scenic value, but those with the most variety and contrast have the greatest potential for high value. Classifications utilized in the evaluation process are land forms, vegetation types, water, colors, and scarcity or uniqueness of features. Applying this process gave a low rating to the area around the unit features, and a more extensive and detailed inventory was not considered necessary. This process is in keeping with the general directives set forth in the Council on Environmental Quality guidelines, which specifically advise that presentation and analysis should be exhaustive only in those areas of major environmental impact and concern.

Section D-3c, Landscape Preservation, specifically states what would be done to preserve or restore the natural landscape. Figures in Chapter A are aerial photographs or maps showing locations of the unit features. There would be no cuts and fills. Material sources for the dam and dike would come from within the reservoir basin or from an already disturbed area, as discussed in Section A-3b(9).

2. Comment:

Greater emphasis should be given to the soils resource in the ES. Information on the erodability, engineering properties and ability to sustain rehabilitation measures seems appropriate.

Response:

A detailed land classification soil survey was not conducted because this project, unlike many Reclamation projects, is not an irrigation development. Information on the soil characteristics at project construction sites, however, is presented in Section B-5, Geology. Information on the soil resource can also be gained from the description of existing vegetation, Section B-8. Information on the construction measures that would be used to restrict erosion is contained in Section D-3b. Information on landscape preservation is contained in Section D-3c.

3. Comment:

There is no reference to other projects in the region, such as uranium exploration and mining expansion, Shell, Mobil and other CO_2 well field and pipeline developments, coal development, and other water projects, etc., which will have cumulative impacts on the economic and social integrity of the population of the region. A project of this size would have impacts in conjunction with others, and it should be analyzed in light of the other impacting activities, not apart from it.

Response:

Reference is made in Section B to present and future developments in the area. However, information on the future developments lacks detail and certainty in many key areas; therefore to avoid any misleading speculation we have had to limit our detailed description of impacts presented in Section C to available data. As new information is released, it will be used in the planning process.

4. Comment:

The ES also needs a description of the existing roads, their condition, their present traffic load, and the resulting increase in use due to the proposal. The assumption has been made in the analysis that most of the workers would commute from distant areas by private vehicle to work. The impacts to the roads and safety due to the increase in use should be assessed.

Response:

The assumption was not made that most workers would commute from distant areas by private vehicle. On the contrary, Section C-3c of the Draft Environmental Statement described in detail the housing that would be expected and showed that almost all workers would probably live in camps near the construction sites. All roads in the area are in good condition and have low to moderate use, so the minor increase in traffic should have no significant impact on roads and safety. Increased road use would occur during the time for obtaining riprap and pervious materials. The source is located about 13 miles southeast of the evaporation pond site, and hauling would be over adequate county roads through Dry Creek Basin and on Highway 141. An estimated 8,200 trips would be made for pervious material and 6,000 trips for riprap over the 4 years of primary construction activity. Safety measures would be incorporated into contractor's specifications.

5. Comment:

Benefits to recreation have been analyzed in terms of the increased numbers of man days of certain activities. A similar list of man days lost to the other recreation values, such as wilderness, solitude and aesthetics, should have been examined. Quality of experience is as important as quantity of use.

Response:

The Bureau assumes that this comment is intended as a remark about recreation use as it is assessed in the Cumulative Impacts, Section C-11b(4), since recreation features are not a part of the plan for the Paradox Valley Unit itself and no long-term change in recreation use has been predicted as a result of the unit. Reclamation did not attempt to give a man-day value to such recreation values as wilderness, solitude, and aesthetics that may have been lost because of the recreation developments that have accompanied many Reclamation projects since it knows of no reasonable way to make such a computation. However, the Bureau recognizes that there have been significant tradeoffs as a result of these developments. Specifically identified in Section C-11b(4) are the adverse effects on white-water boating and the inundation of the natural landscape by reservoirs. Included within the latter are the loss of recreation values such as wilderness, solitude, and perhaps aesthetics. Also see response to comment 21.

6. Comment:

Drawings in transverse and cross-section of the two dams on the Radium Evaporation pond would be helpful in interpreting the size of the structures. Volume capacities in millions of cubic yards are difficult to envision.

Response:

The Bureau of Reclamation recognizes the need to help the reader come to some spatial understanding about the physical dimensions of the dam and dike. That, in part, is why information on these structures' crest length, height, width, and material volume has been presented in Section

A-3b(4). It is also why Figure A-5, which is an aerial photo of the pond site with an artist's concept of the proposed pond sketched over it, has been included. Reclamation does not agree that detailed design drawings in transverse and cross-section would aid appreciably in interpreting the size of these structures and has therefore not included them. This information is available from design drawings and planning documents at Reclamation offices in Durango and Salt Lake City.

7. Comment:

In assessing economic and social impacts, it would be helpful to provide a more detailed description of the stages of implementation. Figure A-7, page A-20, appears to be the only such description.

Response:

The discussion in Sections A-3a and A-5 has been expanded to show the relationship of the testing program to the construction of major project features. The first 2 years would be a period of testing and evaluation at the well field. Construction of major features would begin following data collection, analysis, and determination of the disposal method. Impacts presented in Chapter C are based upon this testing and construction schedule.

8. Comment:

Page A-5: The oblique photo on page A-5 does not sufficiently identify the 68 monitoring wells, 19 brine wells, and stream monitoring stations on the map.

Response:

A map has been included as Figure A-2 that shows the location of 31 of the monitoring wells and 3 of the stream salinity monitoring stations, as well as the pipeline and test wells. The rest of the monitoring wells so closely surround the test wells they are impossible to portray on a map of this scale. The other two stream monitoring stations are about 1.5 miles north and south of the outside stations shown on the map.

9. Comment:

The amount of nickel sulfate which would be used as a catalyst, and the concentration in the brine should be discussed.

Response:

For a 5-cfs hydrogen sulfide stripping plant, approximately 60 pounds, or 1 cubic foot per day, of nickel sulfate would be used, which would result in a concentration in the brine of about 2 parts per million.

10. Comment:

Page A-12, paragraph 1, Radium Dam: More detail in the dam descriptions is needed.

Response:

The information presented in the statement, Section A-3b(4), on the location and physical dimensions of the dam and dike has been condensed from detailed technical design data. Reclamation feels that this information in combination with the information on dam safety, Section D-2, and Geology, Section B-5, is adequate to come to an informed, nontechnical understanding of the dam and dike. Reclamation also feels that this approach is consistent with CEQ Guidelines which specifically advise against the inclusion of "highly technical and specialized analyses and data." The technical design information is available for public inspection at the following locations.

Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street
Salt Lake City, Utah 84147

Bureau of Reclamation
Western Colorado Projects Office
835 2nd Avenue
Durango, Colo. 81301

11. Comment:

Page A-13, paragraph 4, Transmission Facilities: A description of the construction and design details of the proposed transmission facilities would be helpful. It should show how they are designed to eliminate hazards to raptors. The map should give the route of the power line.

Response:

A description of the transmission facilities is presented in Section A-3b(6). Since, as explained there, all project facilities are in proximity to existing transmission lines, preliminary design estimates indicate that the longest tapline to be constructed would be about 1,000 feet. Reclamation analysis indicates that aesthetic impacts associated with this construction would be minor, and we believe that the information presented is adequate to reach that conclusion. It is stated in Section D-4a that the taplines would be designed to prevent hazards to raptors. This information has been added to Section A-3b(6) so that there is no misunderstanding. Design consideration for the taplines would be based primarily on information presented in Suggested Practices for Raptor Protection on Powerlines, June 1975, and distributed by Raptor Research Foundation, Inc., for Edison Electric Institute. Section A-3b(6) has also been expanded to show that the construction of the taplines at the well field has begun and that a negative determination (February 17, 1977) has been written consistent with the requirements of NEPA. More detailed design information on the taplines is available from Reclamation offices in Durango and Salt Lake City.

12. Comment:

Page A-19, paragraph 3, Construction: More detail is needed on stages of implementation.

Response:

The discussion has been expanded to give added detail to the significance of the construction time table, as explained earlier in the response to comment #7.

13. Comment:

Page B-6, Recreation: The ES needs to discuss dispersed recreation capabilities in the Paradox Valley, as well as the relatively intensive river running potential along the Dolores. In terms of regional recreation interest, Bedrock is the downstream egress point for a significant (approximately 5,000 visits annually) number of river running trips on the Dolores River. This point also marks the lower-most extension of a 105-mile segment of the Dolores River that has been recommended in the final Wild and Scenic Rivers study report for inclusion in the national W & SR system. The relative significance of the area for sightseeing/pleasure driving is indicated in the most recent Colorado Department of Highways traffic volume studies.

Response:

As reported in Section C-3d(6), the unit would have only a minimal impact on hunting and fishing. Paradox was specifically excluded from the Dolores River Wild and Scenic River study, as discussed in Section B-6a. Since the town of Bedrock is the downstream exit point for the river running and marks the lowermost extension of the segment of the river recommended for wild and scenic status, the unit features would be north and east of the area and would not have an effect on those recreational aspects. The General Map shows the location of the unit's features relative to Bedrock. In Paradox Valley, unit features would have some visual impact, but measures would be taken, such as the low profile of buildings at the hydrogen sulfide stripping plant and painting the buildings in earth tones, to minimize adverse impacts. Sections D-3c and D-4c discuss these measures. The most recent traffic volume figures for Paradox Valley available from the Colorado State Highway Department show an average of 540 vehicular trips per day west of Naturita and 950 east of Naturita. The increase in part reflects multiple trips by residents in the vicinity of the more urbanized area. This volume is considered light usage according to the Colorado State Highway Department. This is not indicative of significant sightseeing/pleasure driving in the vicinity of unit features.

14. Comment:

An influx of a large number of construction workers would likely cause an increase in recreational driving, especially off-road and back-road use. Present use data would be helpful here.

Response:

No information on this subject is available for the Paradox area, according to the Bureau of Land Management, which has jurisdiction there. However, it is probable with the temporary increase in personnel that an increase in back-road/off-road driving would also occur. The demand upon county roads and public lands would be low initially, increasing to moderately high during the fifth year of the project and dropping back to low in the sixth year.

15. Comment:

Page B-6, Item 4, Air Quality: No discussion of climate appears in the description of the environment. The observation is made that existing climatic conditions, such as air flow patterns, wind velocities, etc., have not been considered in the Nucla and Dry Creek Basin areas. In view of the fact that radium is to be extracted from a Dry Creek Basin evaporating pond, these climatic conditions may need to be described to ascertain potential health hazards to the Nucla, Naturita, and Norwood communities.

Response:

The last paragraph of Section B-2 of the Environmental Statement describes the existing climatic conditions of the area. The name, Radium Evaporation Pond, should not be taken as being descriptive of any chemical process to be employed. The pond is named for Radium Mountain, a landmark in the area. The purpose of the pond, as stated throughout the statement, is to evaporate brine which presently pollutes the Dolores River. Elemental radium would not be present in the pond nor would it be extracted.

16. Comment:

Page C-4, paragraph 1-3: This is an example of where visual impacts have been ignored. Temporary mobile home parks can cause considerable visual blight.

Response:

Mobile home parks can cause considerable negative visual impact; however, it does not have to be so and the impact can be minimized. As stated at the end of Section C-3c, the contractors and Federal Government would have to comply with county regulations on mobile home spacing and with Colorado Senate Bill 35 on subdivisions and the Colorado State

Standards and Regulations for Mobile Home Parks concerning sanitation, water, sewage, electricity, access roads, maintenance, and street lighting, as explained in Section C-3c. All county regulations covering mobile home owners would have to be followed. Mobile homes are already common in the area and many of the local people live in this type of housing.

17. Comment:

Page C-5, Facilities and Services: No discussion of the effects of increased traffic has been given in this section.

Response:

The existing highways and county roads are in good condition. The present population is low and, therefore, present traffic is light. The construction camp, where the majority of new people probably would be housed, is about 5 miles from the work area; transportation to and from work would be over an existing county road that has low usage now. This increased traffic may be an inconvenience to some residents. The increased use would be only during construction and would not have a long-term effect. The Draft Environmental Statement has been reviewed by the State, and possibilities for increased traffic problems were not identified.

18. Comment:

Page C-6, paragraph 1, Recreation: An influx of construction workers away from their families would result in increased use of back country roads and two-track trails. Vandalism of archaeological sites and some violation of game laws might occur.

Response:

The Bureau of Reclamation has no substantiation for the assumption that the presence of construction workers, with or without their families, would mean vandalism of archaeological sites or violations of game laws. Some increased use of roads and trails might occur, but in an area so vast with so much potential for such activity the impact should be minimal. The Bureau of Reclamation hopes that the environmental statement has been helpful in allowing the Bureau of Land Management to anticipate any increased public use that may occur during the construction phase on public land under its administration.

19. Comment:

C-15, paragraph 2, Raptors: Consideration should be given to the effect the powerline will have on raptors in the vicinity, as shown in the ES.

Response:

This potential hazard was considered using Suggested Practices for Raptor Protection on Powerlines, June 1975, distributed by Raptor Research Foundation, Inc., for Edison Electric Institute. As stated in Sections A-3b(6) and D-4a, transmission lines will be designed to eliminate this hazard to raptors.

20. Comment:

Pages C-27, 28 - paragraphs 1 and 2, Recreation: This section describes numerous effects of other Colorado River Storage Projects, but no specific impacts of the Paradox Valley project are discussed.

Response:

Each subject in the cumulative impacts section, C-11, is discussed in two parts: (a) CRSP Developments Constructed or Under Construction and (b) Developments Scheduled for Construction Starts in 1977 and 1978. The impacts or significance of the Paradox Valley Unit as it relates to each of the subjects discussed can be found in the latter. As Table C-12 shows, the Paradox Valley Unit is expected to have no significant impacts on recreation.

21. Comment:

The loss of one recreation resource is not compensated by the increase in another. Accessibility to a recreation event or location may detract from its value to some people. This discussion does not consider the impacts to wilderness, solitude, or visual recreation values separate from increased fishing, boating, and camping.

Response:

The opinion has not been expressed in the Cumulative Impact Section, C-11, that a decrease in one recreation resource is compensated for by the increase in another. It is simply reported that projections indicate Colorado River Storage Projects will provide well over 5,000,000 man-days of recreation use annually and that this use has a significant impact on the region's recreation and tourism industries. But, on the other hand, it is also reported in Section C-11b(4) that there have been significant tradeoffs as a result of these opportunities. Specifically identified are the adverse effects on white-water boating opportunities and the inundation of the natural landscape by reservoirs. It is also noted that even inundation is in some instances not without some complexity, for, as reported, sightseeing trips to Rainbow Bridge at Lake Powell have increased markedly because of the easier accessibility provided by the reservoir. The Bureau of Reclamation recognizes that accessibility detracts from the value for some people and adds to the value for others. Because of the absence of public consensus, the statement is intended to be merely a presentation of these tradeoffs and not an attempt to be judgmental about them.

22. Comment:

Page C-52, Table C-28: It is apparent from the table that even if the authorized and investigated projects were implemented, the salinity of the Colorado River at Imperial Dam would still increase.

Response:

Accompanying the table cited above is a discussion explaining that the salinity control measures authorized and under study would only partially offset the expected concentration at Imperial Dam. A list of additional measures that can be utilized is also given.

23. Comment:

Overall, the attempt in this DES to discuss cumulative impacts in terms of CRSP projects appears grossly misleading. There is probably a need to discuss those impacts in an ES as indicated in earlier correspondence; however, the cumulative effect on southwest Colorado of this and other actions can and should be the focus of this ES.

Response:

The Cumulative Impacts Section, Section C-11, has been included because the Bureau believes it affords the interested reader an opportunity to better grasp the significance of Reclamation projects in the Upper Colorado River Basin and put in perspective the relationship between the Paradox Valley Unit and other developments already constructed or under construction. While the section does add breadth to the statement, the introduction to the section explains its purpose, and it should not, therefore, pose an obstacle to the reader who is only interested in the Paradox Valley Unit itself.

OFFICE OF THE DIRECTOR

United States Department of the Interior

BUREAU OF MINES
2401 E STREET, NW.
WASHINGTON, D.C. 20241

July 3, 1978

DES-78/19

Memorandum

To: Commissioner, Bureau of Reclamation

Acting
Through: Assistant Secretary--Energy and Minerals 7 1978

From: Director, Bureau of Mines

Subject: Draft environmental statement, Paradox Valley Unit

On page C-7 reference is made to Union Carbide's ongoing exploration and evaluation of the deep-seated uranium mineralization underlying the proposed Radium reservoir site. It is evident that after several years of exploration at what must be a substantial cost this uranium mineralization is at least marginally attractive. Whether or not Union Carbide can convert the deposit to an orebody--considering the current state of the art of uranium recovery and near-term expectations of uranium's market value--seems immaterial at this time. Technologic innovation is difficult to foresee; however, the 7-fold increase in uranium's market price thus far in the 1970's is the kind of inducement that makes innovation attractive. And because it is the consensus that the long-term cost of energy fuels will continue to increase appreciably in real terms, the marginal mineral deposits (noneconomic resources) of today appear certain to become the orebodies (economic reserves) of tomorrow. Apparently, at worst, the uranium mineralization of Radium reservoir site fits the marginal-deposit definition at this time.

Radium reservoir would be a 3,630-acre brine disposal pond, surrounded by 3,660 acres developed and managed so as to enhance the few species of wildlife that would be adversely affected by the pond. Clearly, cost of future underground mining of uranium beneath the pond would be substantially increased. Moreover, recovery of the uranium by solution mining, if it becomes feasible in this area (as it is elsewhere) during the 100-year life of the disposal pond, would also be subject to increased costs if not precluded altogether.

In essence, the uranium resource underlying proposed Radium reservoir may be locked up for a century. This mineral-related conflict at the Radium

AMERICAN REVOLUTION BICENTENNIAL 1776-1976 site was pointed out in the March 1977 Bureau of Mines report on mineral resources at the proposed Paradox Valley Unit. We continue to believe that an alternative to Radium reservoir would be in the best interest of long-term uranium conservation.

Thank you for the opportunity to review this well-prepared draft environmental statement.

J Morgan

Acting Director

Memorandum

To: Files

Subject: Response to Letter from the Bureau of Mines, Dated July 3, 1978.

After receiving the above referenced letter, the Bureau of Reclamation, in renewed conversations with the Bureau of Mines, has had the opportunity to emphasize that at least 33 alternative methods and/or sites for brine disposal were examined at the reconnaissance level, and that the proposed plan plus the seven alternatives presented in Chapter H are the most feasible from the standpoint of the environment, economics, geology, and engineering technology. Reclamation has also informed the Bureau of Mines that Union Carbide's mineral exploration program at Radium Pond site will be completed prior to the completion of the well field testing program, and that the final decision on the method of brine disposal will only be made once the results of that testing program have been analyzed. At that time, Union Carbide will have complete information to present, whereas now it does not, and that information will be considered in coming to the decision on the best site and method of brine disposal.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

AREA OFFICE COLORADO—UTAH
1426 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138

In Reply Refer To (ES)

June 1, 1978

MEMORANDUM

TO: Regional Director, Bureau of Reclamation
Salt Lake City, Utah

FROM: Acting Area Manager, Fish and Wildlife Service
Salt Lake City, Utah

SUBJECT: Paradox Valley Unit, Draft Environmental Statement
(EC 78/17)

In response to the transmittal dated May 16, 1978, we have reviewed the subject statement and believe the document adequately describes existing fish and wildlife resources and adequately discusses the project impacts on those resources.

Regarding mitigation however, Page D-2 should stipulate that range improvement (fertilizing and seeding) will be an incorporated wildlife measure. It should also be stipulated that the Bureau of Reclamation will construct required mitigating features if the continuing studies determine significant losses of waterfowl will result with construction of Radium Reservoir.

William C. White

Memorandum

To: Files

Subject: Response to Letter from Fish and Wildlife Service, Colorado-Utah Area Office, Dated June 1, 1978.

1. Comment:

Regarding mitigation, however, Page D-2 should stipulate that range improvement (fertilizing and seeding) will be an incorporated wildlife measure.

Response:

It is explained in the wildlife program, Section A-3c(7), that among the specific measures to improve the land to be managed for wildlife at Radium Evaporation Pond are fertilizing and seeding. Section D-4a summarizes the information relative to the wildlife program; however, so there can be no misunderstanding, the fact that seeding and fertilizing would be part of the plan has been added.

2. Comment:

It should also be stipulated that the Bureau of Reclamation will construct required mitigating features if the continuing studies determine significant losses of waterfowl will result with construction of Radium Reservoir.

Response:

The Bureau of Reclamation recognizes this responsibility and has added language to Section C-8c(9) acknowledging it.

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

In Reply Refer To:
EGS-DES-78/19
Mail Stop 760

JUN 1 6 1978

Memorandum

To: Director, Office of Environmental Affairs
Bureau of Reclamation

Through: Assistant Secretary--Energy and Minerals Henry J Keller

JUN 19 1978

From: Director, Geological Survey

Subject: Review of draft environmental statement for Paradox Valley Unit, Salinity Control Project, Colorado

We have reviewed the subject draft environmental statement as requested in your memorandum of May 12.

The loss of access to potential uranium deposits beneath the evaporation pond has been referred to only briefly (p. c-7, par. 3) and has not been mentioned in the summary of environmental impacts.

On the basis of the hydrologic design for the evaporation pond (p. A-7, par. 4), there is no probability of a spill until after the 100-year period of operation. Thereafter, as continued sediment inflow would reduce the flood-storage capacity, the probability of a spill would eventually become significant. The long-term consequences should be discussed in the statement.

Locations of surrounding wells that are in use and of production and observation wells with respect to the river should be shown on a map drawn to scale. Such a map should also show the distribution of the alluvium and any other pertinent geologic features. To permit impact appraisal,

AMERICAN REVOLUTION BICENTENNIAL 1776-1976 the typical hydraulic characteristics of the aquifer should be included in the statement. The current water-table configuration and the topography of the alluvial valley should be discussed to permit evaluation of the significance of underflow parallel to the stream axis. The draft statement asserts that nearly all of the Radium Evaporation Pond is underlain by Mancos Shale, the low permeability of which is expected to protect ground water. We suggest that at least representative permeabilities of the shale and other underlying materials as well as a surficial geologic map of the pond area should be included in the impact analysis.

Acting Director

Memorandum

To: Files

Subject: Response to Letter from the U.S. Geological Survey, Reston, Va., Dated June 19, 1978.

1. Comment:

The loss of access to potential uranium deposits beneath the evaporation pond has been referred to only briefly (p. C-7, par. 3) and has not been mentioned in the summary of environmental impacts.

Response:

The possible uranium deposit was also mentioned in Section F-1 (Short- and Long-Term Environmental Uses) of the Draft Environmental Statement. These sections remain in the Final Environmental Statement. Access to the possible uranium deposit would not be lost but would be made more expensive.

2. Comment:

On the basis of the hydrologic design for the evaporation pond (p. A-7, par. 4), there is no probability of a spill until after the 100-year period of operation. Thereafter, as continued sediment inflow would reduce the flood-storage capacity, the probability of a spill would eventually become significant. The long-term consequences should be discussed in the statement.

Response:

The estimated average annual sediment inflow to the pond is 24 acre-feet; during the 100-year life of the pond, 2,400 acre-feet of sediment would be accumulated. After 100 years the sediment would continue to accumulate and slowly reduce the flood-storage capacity. After about 800 years the flood-storage capacity would be used up, and inflows would begin to spill. Since much of the sediment from the surrounding drainage would be Mancos Shale and other clays with low permeability, which would cover the salt, and since natural inflows would be in the form of thunderstorms that would quickly dissipate, it is not anticipated that there would be much interaction between the runoff and the underlying salt. At that time the sediment would be about 5 feet thick.

3. Comment:

Locations of surrounding wells that are in use and of production and observation wells with respect to the river should be shown on a map drawn to scale. Such a map should also show the distribution of the alluvium and any other pertinent geologic features.

Response:

Figure A-2 has been added to the statement showing the location of the production and observation wells. Because of the scale of the map, irrigation wells, which are to the west in the valley, could not be shown. The area's surficial geology with the proposed project features overlain is shown in Figure B-3, General Geology Map.

4. Comment:

To permit impact appraisal, the typical hydraulic characteristics of the aquifer should be included in the statement. The current water-table configuration and the topography of the alluvial valley should be discussed to permit evaluation of the significance of underflow parallel to the stream axis.

Response:

In nontechincal terms, the typical hydraulic characteristics of the aquifer and water table configuration have been explained in Chapter A as they relate to the design and operation of the well field. Additional pertinent information is contained in Sections B-6, Water Resources, and B-7, Water Quality. Although no contour maps have been included, a schematic drawing, Figure B-2, and the accompanying narrative, Section B-5a, have been included to help the general reader come to an understanding about how the valley's topography was formed. This information has been extracted from detailed technical planning documents which are available for public inspection at Reclamation offices in Durango and Salt Lake City. The approach Reclamation has taken is in keeping with CEQ Guidelines which advise against including "highly technical and specialized analyses and data" in the statement. The information presented is a helpful approach in allowing the general reader to come to an understanding of the ground water aquifer and the design principles used in planning the well field to arrest the brine inflow into the Dolores River.

5. Comment:

The draft statement asserts that nearly all of the Radium Evaporation Pond is underlain by Mancos Shale, the low permeability of which is expected to protect ground water. We suggest that at least representative permeabilities of the shale and other underlying materials as well as a surficial geologic map of the pond area should be included in the impact analysis.

Response:

In the draft statement, Section B-5b, it was explained that inflow permeability tests conducted by the Bureau of Reclamation in the pond basin indicated the underlying formation to be entirely impervious. Reclamation lab tests have shown the compacted Mancos Shale to have a permeability in the range of 0.005 foot per year. The artesian effect in nearby stock wells adds supporting evidence, since the basin's drainage is extremely limited and in a semiarid area with a low amount of recharge. A surficial geologic map, Figure B-3, is also a part of Section B-5b. Reclamation feels that this information belongs in Chapter B since it is, properly, a description of existing conditions and not impacts. However, the information presented does allow the Bureau to assert, as it has in Chapter C, that the unit would not affect the area's geology and that the pond would be water tight. Details of the permeability tests are available for public inspection at Reclamation offices in Durango, Colo., and Salt Lake City, Utah.

United States Department of the Interior
HERITAGE CONSERVATION AND RECREATION SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

DES 78-19
D6427-UCO

Memorandum

To: Director, Office of Environmental Affairs, Bureau of Reclamation

From: Director, Heritage Conservation and Recreation Service

Subject: Review of Draft Environmental Statement for Paradox Valley Unit, Montrose and San Miguel Counties, Colorado

This memorandum responds to your May 13, 1978, request that we review the document noted above. The proposed cultural resource program provides adequate mitigation for the loss of the two cultural resource sites. In addition, the discussion of the Dominguez-Escalante Trail is satisfactory. Therefore, we find that the document adequately addresses the environmental and programmatic concerns of this agency.

Meg Maguire
for Chris Therral Delaporte

Memorandum

To: Files

Subject: Response to Undated Letter from Heritage Conservation and Recreation Service, Washington, D.C.

The Bureau of Reclamation acknowledges the letter and appreciates the review of the Draft Environmental Statement.

Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

May 22, 1978

Mr. Harl M. Noble
Acting Regional Director
Upper Colorado Regional Office
Bureau of Reclamation
P. O. Box 11568
125 South State Street
Salt Lake City, Utah 84147

Dear Mr. Noble:

This is in response to your request of May 11, 1978, for comments on the draft environmental statement (DES) for the Paradox Valley Unit, Colorado River Basin Salinity Control Project, Montrose and San Miguel Counties, Colorado.

The Council has reviewed the DES and notes that the Bureau of Reclamation has identified one archeological site at the location of the Radium Evaporation Pond which will be affected by the proposed project. We also note that this site has not been evaluated for eligibility for inclusion in the National Register of Historic Places. We suggest that the final environmental statement demonstrate compliance with Section 106 of the National Historic Preservation Act of 1966 (16 USC 470f, as amended, 90 Stat. 1320) in accordance with the "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800). If this archeological site is determined eligible for inclusion in the National Register and there will be an effect on the property the final environmental statement should contain the comments of the Council in accordance with the Procedures.

We look forward to working with the BR if this property is determined to be eligible for inclusion in the National Register after consultation with the Colorado State Historic Preservation Officer. Should you have any questions or require additional information regarding this matter, please contact Brit Allan Storey of the Council staff at P. O. Box 25085, Denver, Colorado 80225, or at (303) 234-4946, an FTS number.

Sincerely yours,

Louis S. Wall
Assistant Director, Office of
Review and Compliance, Denver

The Council is an independent unit of the Executive Branch of the Federal Government charged by the Act of October 15, 1966 to advise the President and Congress in the field of Historic Preservation.

Memorandum

To: Files

Subject: Response to Letter from the Advisory Council on Historic Preservation, Dated May 22, 1978.

Comment:

We note that one archaeological site at the location of Radium Evaporation Pond has not been evaluated for eligibility for inclusion in the National Register of Historic Places. We suggest that the final environmental statement demonstrate compliance with Section 106.

Response:

Preliminary evaluation indicated that the site is probably not eligible for the National Register. Further evaluation is necessary for a final determination; however, since further evaluation is itself destructive to the site it was decided to delay this work until the final decision is made on the brine disposal method. The site would not be affected if the evaporation pond were not constructed. The State Historic Preservation Officer concurred with this decision. Should the site be determined eligible for the National Register and the decision made to construct the pond, the Bureau of Reclamation would follow all necessary procedures in consultation with the State Historic Preservation Officer and Advisory Council.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
11177 West 8th Avenue
P.O. Box 25127
Lakewood, Colorado 80225

1950

June 30, 1978

Office of Regional Director
Bureau of Reclamation
P. O. Box 11568
125 South State Street
Salt Lake City, Utah 84147

Gentlemen:

Thank you for the opportunity to review the Draft Environmental Statement for the Colorado River Basin, Salinity Control Project, Paradox Valley Unit. We have no comments.

Sincerely,

for
CRAIG W. RUPP
Regional Forester

6200-11 (1/69)

Memorandum

To: Files

Subject: Response to Letter from Forest Service, Regional Forester, Lakewood, Colo., Dated June 30, 1978.

The Bureau of Reclamation acknowledges the letter and appreciates the review of the Draft Environmental Statement.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 17107, Denver, CO 80217

July 21, 1978

Mr. Harl M. Noble
Acting Regional Director
Bureau of Reclamation
Upper Colorado Regional Office
P. O. Box 11568
Salt Lake City, UT

Re: Paradox Valley Unit Draft EIS - Comments

Dear Mr. Noble:

The Soil Conservation Service has the following specific comments on the Draft Environmental Impact Statement on the Paradox Valley Unit:

1. Section B (Description of the Environment)

   a. Page B-10 - Soils information is limited. No reference made to soil characteristics (i.e., shrink-swell potential, etc.) that may determine construction site suitability. Nothing included about production potential of soils in the Paradox Valley area.

   b. Page B-18 - Winterfat (Ceratoides lanata) is a valuable forage plant that usually would decrease under heavy grazing pressure, whereas snakeweed would tend to increase.

2. Section C (Environmental Impacts)

   a. Pages C-1 to C-54 - This section of the draft environmental statement does not adequately address the rangeland production that will be irreversibly lost (4,211 acres). The environmental statement should show the long-term loss of range production expressed in terms of expected potential range condition class for each range site. In addition, the statement could show the acreage production of the present rangeland to be changed (4,211 acres) in acres per animal unit month.

b. Page C-6, paragraph 4 - A statement is made that "salt blowing from the evaporation pond would be minimal because the precipitated brine would form a hard crust". This conclusion could be further supported by observations from existing evaporation ponds. Areas of the pond will not be dry and wind could move the brine solution. As a result, there could be air movement of the salt and deposition of the salt on adjacent areas downwind from the evaporation pond.

c. Pages C-9 to C-10 - Fish and Wildlife - This section should specifically address wetlands that will be impacted. In the Description of the Environment, the document mentions "rushes and marshy areas" (see page B-18, line 10); a "marshy meadows" (see page B-18, line 19); and "wetland habitats" (see page B-31, last paragraph). However, the impact section makes no reference to wetland habitat changes.

Sincerely,

R G Halstead

Robert G. Halstead
State Conservationist

Memorandum

To: Files

Subject: Response to Comments from the Soil Conservation Service

1. Comment:

Page B-10: Soils information is limited. No reference made to soil characteristics (i.e., shrink-swell potential, etc.) that may determine construction site suitability. Nothing included about production potential of soils in the Paradox Valley area.

Response:

Information on the soils at the proposed project construction sites is contained in Section B-5, Geology. With the exception of the acreage at Radium Evaporation Pond that would be inundated, the unit would not influence soil production potential. At Radium, the Bureau of Land Management has estimated that grazing capacity is from 12 to 13 acres for each animal-unit-month (AUM) and could probably be upgraded to 5 acres per AUM through a range improvement program, giving some idea of the soil's production potential.

2. Comment:

Page B-18: Winterfat (*Ceratoides lanata*) is a valuable forage plant that usually would decrease under heavy grazing pressure, whereas snakeweed would tend to increase.

Response:

Winterfat has been deleted as an indicator of overgrazing.

3. Comment:

Section C (Environmental Impacts), pages C-1 to C-54: This section of the draft environmental statement does not adequately address the rangeland production that will be irreversibly lost (4,211 acres). The environmental statement should show the long-term loss of range production expressed in terms of expected potential range condition class for each range site. In addition, the statement could show the acreage production of the present rangeland to be changed (4,211 acres) in acres per animal unit month.

Response:

It is estimated in Section C-8c(1) that 3,610 acres of public and private range would be irreversibly lost for grazing. Present production from this acreage is 1 animal unit month (AUM) for 12 or 13 acres and would amount to about 300 AUM's of grazing annually. This represents winter grazing for about 50 cows with their calves or 250 ewes with their lambs.

Production from this area could be increased significantly through range improvement, according to the Bureau of Land Management (BLM). Although BLM has no immediate plans for range improvement in the project area, they anticipate that eventually land in this area would undergo brush eradication and reseeding. Based on similar range improvement programs in southwestern Colorado, it is estimated by the BLM that production could be increased to 5 acres per AUM. At this level of production grazing losses would amount to about 700 AUM's annually representing winter grazing for 120 cows and their calves or 600 ewes with their lambs.

4. Comment:

Page C-6, paragraph 4: A statement is made that "salt blowing from the evaporation pond would be minimal because the precipitated brine would form a hard crust." This conclusion could be further supported by observations from existing evaporation ponds. Areas of the pond will not be dry and wind could move the brine solution. As a result, there could be air movement of the salt and deposition of the salt on adjacent areas downwind from the evaporation pond.

Response:

Through observations and consultations with others who have and are operating large brine evaporation ponds, it has been determined that when the salt precipitates out, it crystallizes and becomes a rock-hard mass. Two examples of this were observed, one on the Malaga Bend Experimental Salinity Alleviation Project in New Mexico and the other at Texas Gulf Sulfur at Moab, Utah. Both have a large pond with large amounts of precipitated salts around the edges. Vegetation around the two areas showed no sign that any salt had blown from the pond. In addition, the Union Carbide effluent ponds at Uravan, Colo., used for precipitating salt brine-uranium liquors, produce only large crystalline particles and are free of dust problems. The prevailing winds in the area, as measured at Bureau of Reclamation stations at Bedrock and Dry Creek Basin, are from the southwest and are strongest in spring. Therefore, the winds off the pond would be blowing to the northeast away from the populated farm area in Dry Creek Basin and in the direction of the alkaline/saline-tolerant sagebrush and greasewood vegetation (see Figure B-7, Vegetation Map).

5. Comment:

Pages C-9 to C-10, Fish and Wildlife: This section should specifically address wetlands that will be impacted. In the Description of the Environment, the document mentions "rushes and marshy areas" (see page B-18, line 10); a "marshy meadows" (see page B-18, line 19); and "wetland habitats" (see page B-31, last paragraph). However, the impact section makes no reference to wetland habitat changes.

Response:

In Section C-8, Table C-4, subscript No. 2, refers to the anticipated increase in value of some 60 acres of riparian habitat along the Dolores River. However, because the estimate is a highly subjective judgment, we did not include it as an actual habitat change. The Fish and Wildlife Service Coordination Act report (January 21, 1977) refers to temporary turbidity as the only measurable project impact on the aquatic environment. On October 18, 1977, and in response to a Bureau Section 7 Compliance request, the Fish and Wildlife Service concluded that the project "could improve riparian vegetation, and as a consequence, benefit the prey-base for falcons." Although no quantification of these changes has been made, we believe the overall riparian and wetland habitat should improve because of decreased salinity in the Dolores River.

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

SPKED-W

15 June 1978

Office of Regional Director
Bureau of Reclamation
PO Box 11568
Salt Lake City, Utah 84147

Gentlemen:

Your recent letter inclosing your draft environmental statement for the Paradox Valley Unit, Colorado River Basin Salinity Control Project (INT DES 78-19) was referred by the Office of the Chief of Engineers to the Sacramento District for reply.

We have reviewed the statement, and the proposed work will not conflict with flood control projects or investigations within our jurisdiction. However, a Department of the Army permit may be required under the Clean Water Act (33 USC 1344), as amended.

We appreciate the opportunity to review the draft environmental statement.

Sincerely yours,

for Joseph D. Countryman
GEORGE C. WEDDELL
Chief, Engineering Division

Memorandum

To: Files

Subject: Response to Letter from Army Corps of Engineers, Sacramento District, Dated June 15, 1978.

Comment:

We have reviewed the statement, and the proposed work will not conflict with flood control projects or investigations within our jurisdiction. However, a Department of the Army permit may be required under the Clean Water Act (33 USC 1344), as amended.

Response:

Because the tributaries have a combined average annual flow of less than 5 cubic feet per second, they are considered headwaters and therefore, exempt from individual 404 permit requirements (Part 323 of the July 19, 1977, Federal Register, Vol. 42).

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333
TELEPHONE: (404) 633-3311

June 16, 1978

Office of Regional Director
Bureau of Reclamation
P.O. Box 11568
Salt Lake City, Utah 84147

Gentlemen:

We have reviewed the draft environmental statement on the Paradox Valley Unit, Colorado River Basin, Salinity Control Project. We are responding on behalf of the Public Health Service.

It is noted that the Radium Evaporation Pond will have a surface area of 3,630 acres and will be designed to retain the evaporated brine that will be collected in a 100-year period. This facility will be located in Dry Creek Basin, which is a tributary to the San Miguel River. The river does not currently have a salinity problem. The wisdom of storing this amount of salt high in the San Miguel Basin in perpetuity should be re-examined. Geological events, design errors, and human failure do occur, thus the proposed pond could pose a potential disaster to the San Miguel River. Therefore, the most current technology available for spill prevention and erosion should be employed in the proposal. The pond is designed for a 100-year life. For a plan of this duration, we feel some type of perpetual maintenance commitment should be addressed.

With respect to the alternatives to the Radium Evaporation Pond, 3. e. would be the least favorable option.

On page C-6, the document states no gases would be emitted to the air from the hydrogen sulfide plant. This is not consistent with the process description on page A-6. This part states: "High pressure air would be released through an outside vent to dissipate harmlessly in the atmosphere." In conclusion, it is unrealistic to expect that no unoxidized hydrogen sulfide would be stripped from the brine and vented to the atmosphere. This would pose an odor problem in the vicinity of the plant.

The vector potential associated with the evaporation pond and seepages was addressed by letter of December 5, 1977, from Dr. Sam Breeland, Bureau of Tropical Diseases, Center for Disease Control, to Mr. Wayne E. Cook in Durango, Colorado.

Thank you for the opportunity of reviewing this document. We would appreciate receiving two copies of the final statement when it is issued.

Sincerely yours,

for William H. Foege, M.D.
Assistant Surgeon General
Director

Memorandum

To: Files

Subject: Response to Letter from Public Health Service, Center for Disease Control, Atlanta, Ga., Dated June 16, 1978.

1. Comment:

It is noted that the Radium Evaporation Pond will have a surface area of 3,630 acres and will be designed to retain the evaporated brine that will be collected in a 100-year period. This facility will be located in Dry Creek Basin, which is a tributary to the San Miguel River. The river does not currently have a salinity problem. The wisdom of storing this amount of salt high in the San Miguel Basin in perpetuity should be re-examined. Geological events, design errors, and human failure do occur, thus the proposed pond could pose a potential disaster to the San Miguel River. Therefore, the most current technology available for spill prevention and erosion should be employed in the proposal. The pond is designed for a 100-year life. For a plan of this duration, we feel some type of perpetual maintenance commitment should be addressed.

Response:

Radium Evaporation Pond would actually be fairly low in the San Miguel River Basin, rather than high. It would be located on tributaries to Dry Creek, which enters the San Miguel River about 20 miles upstream from the river's confluence with the Dolores River, which already has a salinity problem from Paradox Valley. Although the unit is designed for an operational life of 100 years, the Bureau would retain continuing maintenance responsibility for the unit. As explained in Section A-3b(4), extreme care would be taken in the design and maintenance of the pond to insure that no leakage would occur. Also see response to the U.S. Geological Survey Comment 2.

2. Comment:

With respect to the alternatives to the Radium Evaporation Pond, 3.e. would be the least favorable option.

Response:

The Bureau of Reclamation acknowledges the comment but, as explained in the statement, intends to investigate the well injection alternative (3e) further if the well field testing program indicates a pumping rate at or near 2 cfs would control the brine inflow to the Dolores River.

3. Comment:

On page C-6, the document states no gases would be emitted to the air from the hydrogen sulfide plant. This is not consistent with the process description on page A-6. This part states: "High pressure air would be released through an outside vent to dissipate harmlessly in the atmosphere." In conclusion, it is unrealistic to expect that no unoxidized hydrogen sulfide would be stripped from the brine and vented to the atmosphere. This would pose an odor problem in the vicinity of the plant.

Response:

Section C-4 has been revised to explain that high pressure air would be released to dissipate harmlessly in the atmosphere. During the period January 27 to February 10, 1976, a small pilot hydrogen sulfide stripping plant was field tested at Paradox Valley using the aeration process. During this test no odors were associated with the discharged air or water, indicating total stripping of the hydrogen sulfide. During the fall and winter of 1978 tests will be run to obtain additional design data and verify the effects of the stripping process. The designs of the permanent stripping plant would include specifications stating that the plant must meet Federal and State air quality regulations concerning gases and odors around the plant.

4. Comment:

The vector potential associated with the evaporation pond and seepages was addressed by letter of December 5, 1977, from Dr. Sam Breeland, Bureau of Tropical Diseases, Center for Disease Control, to Mr. Wayne E. Cook in Durango, Colorado.

Response:

The letter from the Public Health Service, December 5, 1977, stated, "Certain vector mosquitoes prefer saline water habitats, and the evaporation pond and seepages could provide this type of breeding site. It is suspected, however, that the salinity will probably be too great for prolific mosquito production." Therefore, it is believed that no vector problem would occur.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80203

JUL 17 1978
Ref: 8W-EE

Mr. Joe D. Hall
Regional Director
U.S. Bureau of Reclamation
Upper Colorado Regional Office
P.O. Box 11568
125 S. State Street
Salt Lake City, Utah 84147

Dear Mr. Hall:

The Region VIII Office of the Environmental Protection Agency has reviewed the draft environmental impact statement for Paradox Valley Unit, part of the Colorado River Basin Salinity Control Program. EPA strongly supports your agency's efforts to reduce the salt load in the Colorado River Basin in order that State adopted and EPA approved salinity standards might be maintained. Such efforts are supported particularly where there are few conflicts with aesthetic, recreational or environmental values as is the situation with the Paradox Valley saline seeps. However, EPA does have severe environmental problems regarding the proposed method of brine disposal.

Surface disposal of brine at the Radium Evaporation Site has the following potential environmental problems:

1. possible contamination of underlying aquifers,
2. possible fugitive dust problems regarding salt dispersion to surrounding areas,
3. erosion of the proposed salt flat over geologic time,
4. conflicts with the existing land uses of ranching, wildlife habitat, and uranium exploration,
5. possible hazard to waterfowl.

EPA believes that disposal by deep well injection is the environmentally preferred solution and therefore should be seriously investigated for brine disposal. Deep well injection will not require large tracts of land for surface disposal with its attendant environmental problems. To be environmentally acceptable, brine injection must be below possible interference with potable or potentially potable aquifers and the risk of seismic changes should be minimal.

The economic suitability of deep well injection is highly dependent upon the rate of pumping necessary to achieve efficient salt removal. Therefore, the eighteen month study proposed by the Bureau to ascertain well pumping rate is an ideal time to simultaneously study the feasibility and costs of deep well injection.

EPA requests that the Bureau define in the final EIS specific criteria to determine "satisfactory" salt removal. EPA understands that the Bureau feels committed to removing 180,000 tons per year of salt regardless of the pumping rate, or cost associated impacts, needed to achieve this reduction. While EPA supports this goal, it is our opinion that the Bureau should consider both an "optimization" of cost per unit salt reduction as well as "total" salt removal. This is particularly important in light of OMB's concerns about cost effectiveness due to the limited resources available for program implementation. The Paradox Valley Project is suitable for a program staging approach with the initial phase based on an "optimum" level of salt removal while maintaining the opportunity for "total" removal at a later stage (assuming that the "optimum" level is determined to be less than "total" removal). EPA recommends that the staging approach be fully explored in the final EIS.

EPA also notes that brine disposal by deep well injection offers the advantage of reducing the secondary impacts to surrounding communities. Rather than constructing the Radium Evaporation Pond initially which requires a large construction crew, a deep well injection system would require fewer construction employees. New wells need only be constructed as needed, therefore the "boom-to-bust" effect would be reduced.

To meet the goal of using the environmentally preferred solution by deep well injection, the Bureau should not incur sunk costs related to surface disposal. The initial study period should be used to determine if deep well injection is feasible possibly by converting an existing deep well, such as the Continental Oil well, for the purpose of disposing brine.

According to the procedures EPA has adopted to rate the adequacy of draft environmental impact statements, the draft EIS for the Paradox Valley Unit will be listed in the Federal Register in Category ER-2. This means we have environmental reservations with the proposed action and request additional information as outlined in this letter and the attached detailed comments. My staff is available to meet with your staff to discuss resolution to these problems.

Sincerely yours,

Alan Merson
Regional Administrator

Enclosure

Detailed Comments
by the
U.S. Environmental Protection Agency
on the
Paradox Valley Unit Draft EIS

Deep Well Injection Alternatives

1. It is not true that deep well injection for disposal is only an experimental technique. The oil industry used deep well injection to dispose of more than 3.4 billion barrels of brine in 1976 plus an additional 16 billion barrels that were injected for secondary recovery. It is probably true that few if any disposal wells inject into formations which are as deep as the one that the Continental Oil well taps, but there is no reason not to test this alternative if the amount of brine being pumped is not large. There are wells which inject at depths greater than 10,000 feet for purposes of secondary recovery.

2. The Turner report (Feasibility Study of Brine Disposal by Deep Injection on the Paradox Valley Unit, 1975) indicates that the Continental Oil well bottoms below the salt formation in two hundred feet of sediment of Mississippian age. This location separated from any potable aquifer by the impervious salt dome and distant from the faulted edges of the anticline is suitable from an environmental standpoint for permanent disposal of brine.

Because this is potentially an environmentally suitable location for deep well injection, EPA strongly recommends the Bureau invest in retrofitting this well to determine the costs and feasibility(rate of acceptance, useable life, environmental acceptability, etc.), of brine disposal by this method. It may be possible to develop this well soon enough to dispose of brine developed during the test program.

Radium Evaporation Pond

1. There needs to be a better description of the ground water conditions at this evaporation and pond site. This should include the depth to water in both the artesian and non-artesian aquifers which apparently underlie the site. There should also be some estimates (based on site infiltration data) on the worst case infiltration rates that might be expected. If the Radium Evaporation Site is the selected alternative, the Bureau should install monitoring devices directly under the site in the unsaturated zone both in the portion underlain by the Dakota Sandstone and in the portion underlain by the Mancos Shale. This could be done by installing vacuum lysimeters buried prior to installation of the clay liner that will be used in portions of the pond. Monitoring the unsaturated zone will allow an early warning if brine is moving out of the site at rates larger than are deemed allowable. Have any infiltration estimates been made for the Radium site using the drill hole data and data on the site geology? Are there any open fracture systems due to the faulting and folding in this area which might transmit salt water into Dry Creek and thus to the San Miguel River?

2. The draft EIS states that all drill holes in the pond site will be sealed by grouting. What is the estimate of the total number of wells which will need to be sealed? Uranium exploration has apparently taken place in this area for 20-25 years? How will old wells be located?

3. The Bureau of Mines opposes the use of this site due to potential conflict with uranium extraction. What is the estimated cost for mineral right purchase? By what methods would any subsequent mineral recovery use to prevent brine flow into such a mine? The San Miguel Water Conservancy District has raised the question of water rights ownership at this site. What is the status of water rights that might be effected in the Dry Creek Basin? What is the cost of securing these rights? The estimated annual cost due to reduced livestock production should be specified.

4. There are two possible mechanisms for the drift of salts and fugitive dust from this evaporation pond that should be investigated. First when the pond has received a large amount of surface runoff, the depth of brine and runoff combined with the long reach may create significant wave action. The resultant evaporation could cause a salt drift downwind. Second, incoming sediment from surface runoff will dry and may move along the crusted salt (especially since there would be little or no vegetation) creating a dust storm of particulates and salt. The significance of these two potential problems plus any problems with noxious odors should be reviewed in the final EIS.

5. Over geologic time the salt deposited at the Radium Site will erode downstream to the San Miguel River. What efforts can be made to stabilize the dikes to minimize the rate of erosion?

6. What can be done if the brine pond does lead to waterfowl mortality? Are any additional studies planned to define the extent of this problem?

Well Field

1. EPA understands that the proposed 18-month study to determine rates of pumping at the well field should solve many of the unresolved problems associated with brine pumping. Therefore the following questions need not be answered in the final EIS but rather in the detailed study the Bureau proposes. EPA does request that the Bureau specify in the final EIS what constitutes efficient salt removal criteria. As suggested in our cover letter, EPA prefers to see consideration of optimizing along with maximizing pumping. Of course, the well field study may show almost 100% salt reduction at low pumping rates which is ideal. What we are concerned with is that low pumping rate may achieve significant salt reduction but not 100% but the Bureau will attempt to get 100% salt removal regardless of pumping rate. High pumping rates near 5 cfs demand much greater costs for any disposal alternative and may bias the analysis against the deep well injection alternative.

2. There is little discussion as to what the magnitude of the lowering of salt water, fresh water interface is expected to be and whether the pumping of wells, which are obtaining their brine from zones that are close to the interface, may create a mixing effect between the fresh water and the salt water. There should be some discussion as to the amount of fresh water which may be mixed with the brine and the magnitude of the change in quality that is acceptable. Have the existing and projected Piezometric surfaces been mapped? What will be the frequency of ground water monitoring? Will the "temporary disposal pond" interfere with monitoring during the test period? How does the width of exposure of the Dolores to the salt anticline compare to the well field design? A more detailed cross-section through the valley could clarify. If the Dolores River is "occasionally dry" does this indicate that the brine is evaporating or leaving by subsurface flow? Flow figures are at McPhee Dam. What would they be at the Bedrock gage? What impact will the flow modification have on the ground water/surface water interface in Paradox Valley? More detailed discussion of the seasonal variation in the surface water/groundwater relationship is needed. The basic hydrology should receive more attention, specifically:

(a) ground water/surface water relationship as it now exists

(b) ground water/surface water relationship with project

(c) ground water/surface water relationship with McPhee Dam.

3. There is no discussion as to whether corrosion problems with associated cost increases are anticipated and whether this could effect the project. The H_2S that is in the brine could cause problems with the pumping units themselves which could require the use of special corrosion resistant pumps or a high maintenance cost. The various management alternatives and their costs should be discussed.

4. What is the status of the necessary well permit and acquisition of water rights?

5. Many of the proposed well field facilities are in the flood plain. This includes the temporary disposal pond for brine disposal during the pumping tests. How will this structure be flood-proofed? What will be done to protect wells and the stripping plant from flood damage? What is the effect of the project being shut down during extensive flooding?

General Comments

1. Because costs are used by the Bureau to justify alternative selection, EPA believes the final EIS should have a cost analyses of pumping rates and disposal alternatives. This is particularly important to determine if the environmentally preferred solution of deep well injection is of similar cost to the proposed action.

2. What is the status of the Wild and Scenic River Study?

3. The possible use of solar energy should be considered.

4. When will the results of the cultural survey be available?

Memorandum

To: Files

Subject: Response to Letter from the Environmental Protection Agency, Denver, Colo., Dated July 17, 1978.

1. Comment:

EPA believes that disposal by deep well injection is the environmentally preferred solution and therefore should be seriously investigated for brine disposal. Deep well injection will not require large tracts of land for surface disposal with its attendant environmental problems. To be environmentally acceptable, brine injection must be below possible interference with potable or potentially potable aquifers and the risk of seismic changes should be minimal.

The economic suitability of deep well injection is highly dependent upon the rate of pumping necessary to achieve efficient salt removal. Therefore, the eighteen month study proposed by the Bureau to ascertain well pumping rate is an ideal time to simultaneously study the feasibility and costs of deep well injection.

Response:

The Bureau agrees that deep well injection could potentially have the fewest adverse environmental impacts of all the alternatives and, consequently, has not rejected this method of possible brine disposal. This method is limited to low pumping rates and is highly dependent upon the characteristics of the receiving formation, which may or may not be uniform beneath Paradox Valley. Because of the large expense associated with an investigation of deep well injection, it is not reasonable to evaluate this alternative more fully until the effective pumping rate at the brine well field is determined. Sections A-3a and H-1 state that if the testing program indicates that a pumping rate at or near 2 cfs would be effective the unit plan would be reanalyzed to determine whether another disposal method or site would be more desirable than the proposed plan.

2. Comment:

EPA requests that the Bureau define in the final EIS specific criteria to determine "satisfactory" salt removal. EPA understands that the Bureau feels committed to removing 180,000 tons per year of salt regardless of the pumping rate, or cost associated impacts, needed to achieve this reduction. While EPA supports this goal, it is our opinion that the Bureau should consider both an "optimization" of cost per unit salt reduction as well as "total" salt removal. This is particularly important in light of OMB's concerns about cost effectiveness due to the limited resources available for program implementation. The Paradox Valley Project is suitable for a program staging approach with the initial phase based on an "optimum" level of salt removal while maintaining the opportunity for "total" removal at a later stage (assuming that the "optimum" level is determined to be less than "total" removal). EPA recommends that the staging approach be fully explored in the Final EIS.

Response:

The Bureau of Reclamation believes that theoretically, net benefits would be maximized at 100 percent salt removal, although this level of salt removal may not be practically attainable.

The major costs associated with the unit would be for the hydrogen sulfide stripping plant, the 20.5-mile pipeline, the pumping plants, and the evaporation pond. Costs associated with the well field would be minor by comparison, and the efficiency of the salt removal would be more dependent on modifications and improvements in the well field than on the overall pumping rate. The purpose of the well field testing program is to determine the efficiency of the well field as well as the overall pumping rate. If the ratio of total costs to salt removal does, at a given level, begin to increase with each succeeding increment of salt removal, optimization of cost effectiveness vs. salt removal would be considered.

The Bureau is, in essence, in a staged development, since the design data collection program will permit the analysis of various methods of operation and various pumping rates before proceeding with the construction of any major structures for brine treatment, transportation, and disposal. This approach is particularly valuable because at almost any pumping rate, these structures will be much more costly to build and operate than the well field itself.

3. Comment:

EPA also notes that brine disposal by deep well injection offers the advantage of reducing the secondary impacts to surrounding communities. Rather than constructing the Radium Evaporation Pond initially which requires a large construction crew, a deep well injection system would require fewer construction employees. New wells need only be constructed as needed, therefore the "boom-to-bust" effect would be reduced.

Response:

The Bureau of Reclamation recognizes that during the construction phase the impacts on the area's social environment with deep well injection disposal would be of less magnitude than under the proposed plan. The tradeoff, however, would be that some construction activity would be necessary at least intermittently over the 100-year life of the project and has so stated in Section H-3e(2).

4. Comment:

To meet the goal of using the environmentally preferred solution by deep well injection, the Bureau should not incur sunk costs related to surface disposal. The initial study period should be used to determine if deep well injection is feasible possibly by converting an existing deep well, such as the Continental Oil well, for the purpose of disposing brine.

Response:

The Bureau would not incur sunk costs related to surface treatment, conveyance, and disposal until the design pumping rate is determined. Neither does it feel it should incur sunk costs for deep well injection until it is determined that the pumping rate would be substantially less than 5 cfs, since deep well injection would be impractical at the high rate of disposal.

5. Comment:

It is not true that deep well injection for disposal is only an experimental technique. The oil industry used deep well injection to dispose of more than 3.4 billion barrels of brine in 1976 plus an additional 16 billion barrels that were injected for secondary recovery. It is probably true that few if any disposal wells inject into formations which are as deep as the one that the Continental Oil well taps, but there is no reason not to test this alternative if the amount of brine being pumped is not large. There are wells which inject at depths greater than 10,000 feet for purposes of secondary recovery.

Response:

The Bureau did not mean to imply that deep well injection is experimental in all parts of the United States. Injection into Mississippian-aged formations in the Western States at depths of 15,000 feet is considered experimental, however. Another important factor is that the Bureau would not be injecting into formations from which oil is being or has been removed, as is the usual case with the oil industry.

The Bureau agrees that deep well injection should be given serious consideration if the pumping rate is considerably less than 5 cfs and has so stated in Section H-3e.

6. Comment:

The Turner report (Feasibility Study of Brine Disposal by Deep Injection on the Paradox Valley Unit, 1975) indicates that the Continental Oil well bottoms below the salt formation in two hundred feet of sediment of Mississippian age. This location separated from any potable aquifer by the impervious salt dome and distant from the faulted edges of the anticline is suitable from an environmental standpoint for permanent disposal of brine.

Response:

As stated in the discussion of the deep well injection plan, Section H-3e, the Bureau recognizes that the rehabilitation of Continental Scorrup #1 well would be the most practical method to investigate deep well injection, since the well has been drilled and is only 3/4 of a mile from the well field. Although the well may be ideally suitable from an environmental standpoint, the economics of injection may be formidable in view of pretreatment requirements, limited well or receiving formation capacities, and high pumping pressures, possibly in excess of 2,000 psi.

7. Comment:

Because this is potentially an environmentally suitable location for deep well injection, EPA strongly recommends the Bureau invest in retrofitting this well to determine the costs and feasibility (rate of acceptance, useable life, environmental acceptability, etc.), of brine disposal by this method. It may be possible to develop this well soon enough to dispose of brine developed during the test program.

Response:

If, as the testing program proceeds, the pumping rate appears to be significantly less than 5 cfs, the Bureau is prepared to consider retrofitting this well as part of the testing program.

8. Comment:

There needs to be a better description of the ground water conditions at this evaporation and pond site. This should include the depth to water in both the artesian and non-artesian aquifers which apparently underlie the site. There should also be some estimates (based on site infiltration data) on the worst case infiltration rates that might be expected. If the Radium Evaporation Site is the selected alternative, the Bureau should install monitoring devices directly under the site in the unsaturated zone both in the portion underlain by the Dakota Sandstone and in the portion underlain by the Mancos Shale. This could be done by installing vacuum lysimeters buried prior to installation of the clay liner that will be used in portions of the pond. Monitoring the unsaturated zone will allow an early warning if brine is moving out of the site at rates larger than are deemed allowable. Have any infiltration estimates been made for the Radium site using the drill hole data and data on the site geology? Are there any open fracture systems due to the faulting and folding in this area which might transmit salt water into Dry Creek and thus to the San Miguel River?

Response:

As mentioned on page B-7 infiltration tests conducted in the Mancos Shale have indicated it to be entirely impervious. Investigations are continuing to locate possible fractures or well holes that would allow the brine to escape from the pond. If all these wells have not already been plugged as required by State law they would be plugged with grout and/or covered by an impervious blanket.

Drilling, studying the logs of existing drill holes, and geological investigations have verified that nearly all of the pond area is underlain by Mancos Shale. At some locations, the thickness of the shale was greater than 600 feet. As pointed out in the environmental statement, a blanket composed of Mancos Shale would be put over areas where the shales are thin or sandstone outcrops are exposed. Lab tests by the Bureau of Reclamation have shown the compacted Mancos Shale to have a permeability in the range of 0.005 foot per year.

At the pond, the exchange of sodium in the brine with the calcium in the shale would cause some structural change in the shale that would aid in the sealing of the pond. Because of the high concentration of salts in the brine, generally no salts would be leached out of the shale.

The Bureau has devised a monitoring program using eight peizometers which would be clustered around the evaporation pond to monitor any leakage as discussed in Section A-3b(4). The use of vacuum lysimeters will also be considered if it is determined that they would provide a more adequate monitoring system.

9. Comment:

The draft EIS states that all drill holes in the pond site will be sealed by grouting. What is the estimate of the total number of wells which will need to be sealed? Uranium exploration has apparently taken place in this area for 20-25 years? How will old wells be located?

Response:

An estimate of the number of drill holes that would need to be sealed is not available. However, to insure location of all drill holes at the time of final design data collection for Radium Evaporation Pond, the Bureau would obtain drilling logs from the companies that have conducted exploratory drilling in the basin--these include Union Carbide Corporation, Atlas Corporation, and AMAX, Inc. It would also consult the drill records of BLM and the Bureau of Mines. Because the Bureau is aware that there may be unrecorded drill sites, it would be prepared to conduct a field search survey to insure that all wells had been located.

10. Comment:

The Bureau of Mines opposes the use of this site due to potential conflict with uranium extraction. What is the estimated cost for mineral right purchase? By what methods would any subsequent mineral recovery use (sic) to prevent brine flow into such a mine?

Response:

Because it has not yet been determined whether sufficient quantities exist to make it economically feasible to extract the uranium at depths of 1,000 feet or more, no economic impacts have been identified. Moreover, the Bureau of Reclamation does not believe nor did the Bureau of Mines report conclude that the existence of a brine evaporation pond would physically preclude the development of uranium deposits. An evaporation pond would restrict the location of surface facilities and make the ventilation of the mine more difficult, thus creating the potential for increased costs. Also see response to Bureau of Mines letter.

11. Comment:

The San Miguel Water Conservancy District has raised the question of water rights ownership at this site. What is the status of water rights that might be effected (sic) in the Dry Creek Basin? What is the cost of securing these rights? The estimated annual cost due to reduced livestock production should be specified.

Response:

The San Miguel Water Conservancy District holds a conditional storage right at the proposed pond site. That storage right expires in 1980. The right will probably not be renewed since the pond site is not now being considered by the Bureau of Reclamation in its advance planning studies on the San Miguel Project. The site has been judged unsuitable for storage because any development there would be subject to a high evaporation rate, making it questionable whether the San Miguel Project water users could afford the water depletion from evaporation that would occur. In these determinations, the fact that the flow, timing, and quality of water in Dry Creek Basin are inadequate to establish and maintain a reservoir at this site without substantial importation from another source was also a consideration.

12. Comment:

There are two possible mechanisms for the drift of salts and fugitive dust from this evaporation pond that should be investigated. First, when the pond has received a large amount of surface runoff, the depth of brine and runoff combined with the long reach may create significant wave action. The resultant evaporation could cause a salt drift downwind. Second, incoming sediment from surface runoff will dry and may move along the crusted salt (especially since there would be little or no vegetation) creating a dust storm of particulates and salt. The significance of these two potential problems plus any problems with noxious odors should be reviewed in the final EIS.

Response:

Through observations and consultations with others who have been and are operating large brine evaporation ponds, it has been observed that when the salt precipitates out, it crystallizes and becomes a rock-hard mass. Two examples of this were observed, one on the Malaga Bend Experimental Salinity Alleviation Project in New Mexico and the other at Texas Gulf Sulfur at Moab, Utah. Both have a large pond with large amounts of precipitated salts around the edges. Vegetation around the two areas showed no sign that any salt had blown from the pond. In addition, the Union Carbide effluent ponds at Uravan, Colo., used for precipitating salt brine-uranium liquors, produce only large crystalline particles and are free of dust problems. The prevailing winds in the area, as measured at Bureau of Reclamation stations at Bedrock and Dry Creek Basin, are from the southwest. Any minor quantities of windblown salt would be carried to the north of the populated farm area in Dry Creek Basin and in the direction of the alkaline/saline-tolerant sagebrush and greasewood vegetation (see Figure B-7, Vegetation Map). Records show the winds are at their most forceful in spring when the ground is dampest, further reducing the possibility of an airborne dust problem.

The only noxious odors associated with the brine stem from hydrogen sulfide gas, which would be stripped from the brine before it reaches the evaporation pond. There would be no odors from bacteriological factors at the evaporation pond itself; because of severe osmotic pressure associated with brine, the pond would be essentially lifeless.

13. Comment:

Over geologic time the salt deposited at the Radium Site will erode downstream to the San Miguel River. What efforts can be made to stabilize the dikes to minimize the rate of erosion?

Response:

The Bureau of Reclamation does not believe that the dikes or salt would erode, since the upstream face of the dikes would be riprapped and eventually armored with salt and sediment and the downstream face would be protected by sand and gravel. Moreover, by the time the flood storage pool is filled with sediment (after about 800 years, assuming an operational life of 100 years) and floods begin to spill over the spillway a 5-foot-thick layer of fine, relatively impervious sediment would separate the salt from natural runoff.

The Bureau of Reclamation has annual maintenance review and rehabilitation and betterment programs on all of its dams to insure their stability. Also see response Geological Survey, comment #2.

14. Comment:

What can be done if the brine pond does lead to waterfowl mortality? Are any additional studies planned to define the extent of this problem?

Response:

As noted in the statement, Section C-8c(9), preliminary results of the CSU study suggest that waterfowl would not be harmed by the brine under natural conditions. But the results of the completed study will be reviewed by State and Federal natural resource agencies. Should the completed studies indicate that losses of waterfowl are likely to occur, the Bureau would coordinate with the Fish and Wildlife Service to mitigate such impacts. Possible mitigative measures could include development of waterfowl habitat to increase waterfowl production elsewhere and thereby net out overall losses, although any specific recommendation would depend on the degree of impact. Based on our preliminary findings, we do not anticipate any losses at the brine pond.

15. Comment:

EPA does request that the Bureau specify in the final EIS what constitutes efficient salt removal criteria.

Response:

Please see response to your comment #2, preceding.

16. Comment:

Because costs are used by the Bureau to justify alternative selection, EPA believes the final EIS should have a cost analyses of pumping rates and disposal alternatives. This is particularly important to determine if the environmentally preferred solution of deep well injection is of similar cost to the proposed action.

Response:

It is the policy of the Department of the Interior that elaborate financial analyses are not part of an environmental statement. This information is developed in technical planning documents which are available for public inspection at the following locations.

Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street
Salt Lake City, Utah 84147

Bureau of Reclamation
Western Colorado Projects Office
835 2nd Avenue
Durango, Colo. 81301

The following tables show comparative costs of the different alternatives at 5 cfs and 2 cfs. Detailed cost information for the deep well injection alternative is not available, since, to determine costs, information would be needed as to the injection rate, injection pressure, and life of the well. As explained in Section H-3e, this information could only be gathered through actual operation.

Cost summary of alternatives

	Construction costs (January 1977 prices)	Annual equivalent cost 1/	Cost per mg/l of salinity reduction
Proposed plan	$50,390,000	$3,498,000	$192,200
Alternative plans			
Sinbad Valley Evaporation Pond	162,500,000	10,484,000	576,000
Dolores River bypass channel	56,000,000	3,700,000	203,300

1/ Includes the capital investment and interest during construction amortized over a 100-year period at 5 5/8 percent interest and annual operation, maintenance, and replacement costs.

Cost summary of small-scale plans
(well field pumping rate of 2 cfs)

	Construction costs (January 1977 prices)	Annual equivalent cost 1/	Cost per mg/l of salinity reduction
Modified Radium Evaporation Pond	$34,800,000	$2,379,000	$130,700
Modified Sinbad Valley Evaporation Pond	108,400,000	6,754,000	371,100
East Paradox Valley Evaporation Pond	58,700,000	3,910,000	214,800
West Paradox Valley Evaporation Ponds	35,400,000	2,330,000	128,000
Deep well injection	Unknown 2/	Unknown 2/	Unknown 2/
Dolores River bypass channel	56,000,000	3,700,000	203,300

1/ Includes the capital investment and interest during construction amortized over a 100-year period at 5 5/8 percent interest and annual operation, maintenance, and replacement costs.

2/ The Bureau estimates that each injection well would cost about $3.5 million but cannot determine the total number of wells required or the total cost of the plan.

17. Comment:

What is the status of the Wild and Scenic River Study?

Response:

As explained in Section B-6a, the Final Environmental Statement on the Dolores River Wild and Scenic River Study was filed with CEQ in 1976 (INT FES 76-56). It was recommended in the statement that a 105-mile reach above Paradox Valley be included in the Wild and Scenic River System and that the reach from just below the valley to the Utah State line not be included until further studies were completed. Paradox Valley itself was specifically excluded from the study. To date, Congress has not acted upon these recommendations.

18. Comment:

The possible use of solar energy should be considered.

Response:

At the present time, solar energy as a source of electrical power for the unit is not economically competitive with other means. If, however, it becomes competitive in the future, the conversion to solar energy would be investigated.

19. Comment:

When will the results of the cultural survey be available?

Response:

The cultural survey conducted by archaeologists from Fort Lewis College is available for public inspection at the following location.

Bureau of Reclamation
Western Colorado Projects Office
825 2nd Avenue
Durango, Colo. 81301

b. <u>Comments from State and Local Governments</u>

State of Colorado
- Colorado Geological Survey
- Colorado Historical Society
  - Office of the State Archaeologist
  - Office of Historic Preservation
- Department of Health
- Division of Commerce and Development
- Division of Employment and Training
- Division of Highways
- Division of Water Resources
- Division of Wildlife

State of California
- Colorado River Board of California

State of Utah
- Division of Health

STATE OF COLORADO

RICHARD D. LAMM
GOVERNOR

JOHN W. ROLD
Director

COLORADO GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES
715 STATE CENTENNIAL BUILDING — 1313 SHERMAN STREET
DENVER, COLORADO 80203 PHONE (303) 839-2611

June 8, 1978

Mr. Stephen O. Ellis, Principal Planner
Colorado A-95 Clearinghouse
Department of Local Affairs
Division of Planning
520, 1313 Sherman Street
Denver, CO 80203

JUN 09 1978

DIV. OF PLANNING

Dear Mr. Ellis:

RE: DRAFT ENVIRONMENTAL STATEMENT, PARADOX VALLEY UNIT

This office has reviewed the above draft environmental statement and find that it has adequately evaluated the proposed development.

Sincerely,

Richard H. Pearl, Chief
Ground Water Investigations
Section

RHP/vt

Memorandum

To: Files

Subject: Response to Letter from State of Colorado, Geological Survey, Denver, Colo., Dated June 8, 1978.

The Bureau of Reclamation acknowledges the letter and appreciates the review of the Draft Environmental Statement.

Office of the
State Archaeologist
839-3391

COLORADO
HISTORICAL
SOCIETY

JUN 12 1978
DIV. OF PLANNING

The Colorado Heritage Center 1300 Broadway Denver, Colorado 80203

Mr. Stephen Ellis
Colorado A-95 Clearinghouse
Department of Local Affairs
Division of Planning
520 Centennial Building
Denver, CO 80203

RE: Draft Environmental Statement for the Paradox Valley Unit, Colorado River Basin Salinity Control Project, Bureau of Reclamation, Department of the Interior: Archaeological Resources

Dear Mr. Ellis:

The Office of the State Archaeologist has received and reviewed the Draft Environmental Statement for the Paradox Valley Unit, Colorado River Basin Salinity Control Project, Bureau of Reclamation, Department of the Interior. (The Colorado Historical Society's Department of Historic Preservation will independently comment upon architectural/historical resources.)

If the stipulations described on page A-14-15 for Archaeological Resources are adhered to, we find that the Archaeological Resources have been adequately considered and meet the goals and objectives of the National Historic Preservation Act *et alia* and those of this Office.

Thank you for the opportunity to comment on the proposed project. We appreciate the Bureau of Reclamation's consideration of Colorado's Heritage and our non-renewable Archaeological Resources.

If this Office can be of further assistance, please do not hesitate to call upon ES Reviewer Betty LeFree (839-3391).

For the State Historic
Preservation Officer

Bruce E. Rippeteau, Ph.D.
State Archaeologist Colorado

BER(BJL):ng
cc: Townsend, SHPO
Noble, Regional Director
Weakly, BRec
Madden, BRec

Memorandum

To: Files

Subject: Response to Undated Letter from State of Colorado, Colorado Historical Society, Office of the State Archaeologist, Denver, Colo.

The Bureau of Reclamation acknowledges the letter and appreciates the review of the Draft Environmental Statement.

COLORADO HISTORICAL SOCIETY

The Colorado Heritage Center 1300 Broadway Denver, Colorado 80203

JUN 22 1978
DIV. OF PLANNING

June 20, 1978

S. O. Ellis
State Clearinghouse
520 State Centennial Building
1313 Sherman Street
Denver, Colorado 80203

RE: Bureau of Reclamation; Colorado River Basin Salinity Control -- Paradox Valley Unit

Dear Mr. Ellis:

We shall comment pertaining to architectural and historical properties that may be located within the impact area of this project; the office of the State Archaeologist will comment separately concerning archaeological properties.

The Bureau of Reclamation has consulted with our office previously concerning architectural and historical properties. Based on the information supplied, we concurred with the Bureau that it had fulfilled its responsibilities to identify and consider historical properties as required by the National Historic Preservation Act of 1966, as amended (copy enclosed). We have no addition or changes to our previous comment.

Sincerely,

ARTHUR C. TOWNSEND
State Historic Preservation Officer

James E. Hartmann
Coordinator, Historic Preservation

JEH(MCQ)/rb

Memorandum

To: Files

Subject: Response to Letter from State of Colorado, Colorado Historical Society Coordinator, Historic Preservation, Denver, Colo., Dated June 20, 1978.

The Bureau of Reclamation acknowledges the letter and appreciates the review of the Draft Environmental Statement.

COLORADO DEPARTMENT OF HEALTH

4210 E. 11TH AVENUE DENVER 80220 PHONE 388-6111 EXT. 329

ANTHONY ROBBINS, M.D., M.P.A. EXECUTIVE DIRECTOR

DATE: June 15, 1978

SUBJECT: NON-STATE ASSISTANCE

REVIEW AND COMMENTS

JUN 16 1978

DIV. OF PLANNING

TO: Stephen Ellis
Division of Planning

PROJECT TITLE: Colorado River Basin Salinity Control Project - Paradox Valley Unit

STATE IDENTIFIER: #78-112

COMMENTS DUE BY: 6/15

Yes [X] No [ ] Is this project consistent with the goals and objectives of this agency?

Yes [ ] No [X] Is there evidence of overlapping of duplication with other agencies?

Yes [ ] No [X] Is meeting desired with applicant?

Yes [ ] No [X] A 15-day extension is requested.

Comments:

Micki Barnes

Name, Title & Phone

MICKI BARNES, PROGRAM ADMINISTRATOR

SOC-3, Feb 77

ATTACHMENT B

COLORADO DEPARTMENT OF HEALTH

4210 E. 11TH AVENUE   DENVER 80220   PHONE 388-6111 EXT. 329

ANTHONY ROBBINS, M.D., M.P.A. EXECUTIVE DIRECTOR

DATE:

SUBJECT: NON-STATE ASSISTANCE

REVIEW AND COMMENTS

TO: Steve Ellis
Colo. A-95 Clearinghouse
Div. of Planning

JUN 26 1978
DIV. OF PLANNING

PROJECT TITLE: Paradox Valley Unit

STATE IDENTIFIER: 78-112

COMMENTS DUE BY:

Yes [✓] No [ ] Is this project consistent with the goals and objectives of this agency?

Yes [ ] No [✓] Is there evidence of overlapping of duplication with other agencies?

Yes [ ] No [✓] Is meeting desired with applicant?

Yes [ ] No [✓] A 15-day extension is requested.

Comments:

Ron Samuels
Name, Title & Phone

SOC-3, Feb 77

ATTACHMENT B

Memorandum

To: Files

Subject: Response to Letters from State of Colorado, Department of Health, Denver, Colo., Dated June 15, 1978, and June 26, 1978.

The Bureau of Reclamation acknowledges the letters and appreciates the review of the Draft Environmental Statement.

JUN 22 1978

DIV. OF PLANNING

TO Stephen O. Ellis, Principal Planner
Colorado A-95 Clearinghouse

FROM Russ Caldwell, Commerce & Development RC

SUBJECT Colorado River Basin Salinity Control Project
Paradox Valley Unit

DATE June 21, 1978

I am sorry for the six day delay in giving you our comments on the Bureau of Reclamation EIS for Paradox Valley. The 89 COBG reviews have back logged us to a considerable extent.

The Division has circulated the EIS to offices in the Division. A number of major concerns have been raised that necessitate a lack of support for the project from Commerce and Development. Although our comments try to stand within the bounds of economic considerations, comment number four may be outside our particular expertise.

In general, this Division recognizes the need to remove salt from the rivers to improve water quality for downstream users. Unfortunately the proposed activity with all alternatives considered lacks sufficient benefits to Colorado and causes sufficient problems to warrant no support from this Division. Specific concerns include:

(1) The irreversable loss of graying lands (7,891 acres) now in use for livestock grazing further hinders the state's ability to promote and continue economic diversity on the western slope. The grazing land affects are currently being used for sheep grazing. This sector of our agriculture economy has been suppressed. In fact, Colorado's sheep population has declined in recent years due to other federal action such as reduction in federal land available for grazing. Through other federal programs Colorado has begun an effort to stabilize the sheep production. The proposed project will adversely affect these efforts.

(2) The Division of Commerce and Development is concerned about the cumulative effect of this activity with other Bureau projects and with energy and

mineral development on the Western Slope. Loss of agricultural capacity in grazing for this activity needs to be compared with other federally induced development (energy). It appears than the continued decline of agriculture from this federal project and others may eliminate the state's ability to create a diversified and stable west slope economy.

(3) The project proposes a loss of 3,950 acre feet of water in the annual flow of water downstreams. Will downstream beneficiaries of the project be willing to credit this loss to Colorado?

(4) Although the communities affected by the project will gain some temporary employment and growth in retail sales, will the strain on local services be worth the benefits? It appears this project with the cumulative effect of energy development will further strain local service capabilities. The upward limits of the total pressures being placed on these communities should be identified and the communities should be compensated for the services required.

(5) During the transaction of developing new habitat areas for wildlife, will there be an economic loss due to removal of existing habitat? The sporting/hunting activities in the area contribute significantly to the local economies.

Memorandum

To: Files

Subject: Response to Letter from Division of Commerce and Development, State of Colorado, Dated June 21, 1978.

1. Comment:

In general, this Division recognizes the need to remove salt from the rivers to improve water quality for downstream users. Unfortunately the proposed activity with all alternatives considered lacks sufficient benefits to Colorado and causes sufficient problems to warrant no support from this Division. Specific concerns include:

(1) The irreversible loss of grazing lands (7,891 acres) now in use for livestock grazing further hinders the state's ability to promote and continue economic diversity on the western slope. The grazing land affects (sic) are currently being used for sheep grazing. This sector of our agriculture economy has been suppressed. In fact, Colorado's sheep population has declined in recent years due to other federal action such as reduction in federal land available for grazing. Through other federal programs Colorado has begun an effort to stabilize the sheep production. The proposed project will adversely affect these efforts.

(2) The Division of Commerce and Development is concerned about the cumulative effect of this activity with other Bureau projects and with energy and mineral development on the Western Slope. Loss of agricultural capacity in grazing for this activity needs to be compared with other federally induced development (energy). It appears that the continued decline of agriculture from this federal project and others may eliminate the state's ability to create a diversified and stable west slope economy.

Response:

Only about 3,610 acres, mostly in the evaporation pond basin, would be irreversibly lost to grazing. Much of the remaining acreage requirement for project use would be committed on a long-term basis for wildlife to the exclusion of livestock, but this commitment should not be considered irreversible.

As described in the statement, the project's purpose is to help protect the water quality in the Colorado River Basin while the Basin States, including the State of Colorado, continue to use and develop their apportioned share of that water. Among the chief beneficiaries of the water development, as shown in Section C-11, have been the agricultural interests of Colorado's western slope. It can therefore be seen that a sensible salinity control program is of considerable importance to the economy of western Colorado with respect to the continued use and development of Colorado water for agriculture as well as for a variety of other uses.

2. Comment:

The project proposes a loss of 3,950 acre-feet of water in the annual flow of water downstreams. Will downstream beneficiaries of the project be willing to credit this loss to Colorado?

Response:

The depletion would come from the State of Colorado's apportioned share of Colorado River water. It should be recognized, however, that 3,950 acre-feet is only a preliminary estimate and that the final design pumping rate could actually be substantially less, since the brine inflow into the river is only in the magnitude of 500 to 900 acre-feet annually.

3. Comment:

Although the communities affected by the project will gain some temporary employment and growth in retail sales, will the strain on local services be worth the benefits? It appears this project with the cumulative effect of energy development will further strain local service capabilities. The upward limits of the total pressures being placed on these communities should be identified and the communities should be compensated for the services required.

Response:

Because the nearby communities are small, retail sales and services are very limited and the local people themselves must go to larger population centers. Businesses and services tend to grow because of demand, and local facilities would grow to meet whatever is practical for the temporary demand. Part of the purpose of the environmental statement is to help local people and businessmen to understand the short-term nature of impacts on local services. Section C-3 recognizes areas in which construction would place temporary strains on local services and facilities. For the goods and services not available locally the construction people would resort to the many larger communities in the general area where there should be no strain from the additional trade.

4. Comment:

During the transaction of developing new habitat areas for wildlife, will there be an economic loss due to removal of existing habitat? The sporting/hunting activities in the area contribute significantly to the local economics.

Response:

The development of the proposed wildlife area would compensate for the loss of habitat caused by project construction and operation. The increase in wildlife on the developed lands and the improved access provided by the Colorado Division of Wildlife, which would manage the wildlife area, would guard against any decrease in hunting opportunities because of the project.

OF COLORADO

DIVISION OF EMPLOYMENT AND TRAINING

251 EAST 12th AVENUE / DENVER, COLORADO 80203
AREA CODE 303, TELEPHONE 893-2451

...ARD D. LAMM
Governor

BURTON L. CARLSON
Director

MAY 23 1978
DIV. OF PLANNING

Date : May 22, 1978

Subject: Non-State Assistance

To : State Clearinghouse
Division of Planning

REVIEW AND COMMENTS

Applicant Agency: U.S. Bureau of Reclamation

Project Title : Colorado River Basin Salinity Control Project - Paradox Valley Unit

State Identifier: None

Comments due by: June 15, 1978

Yes X No ___ This project is consistent with the goals and objectives of this agency.

Yes ___ No X There is evidence of overlapping or duplication with other agencies.

Yes ___ No X A meeting is desired with applicant.

Yes ___ No X A 15-day extension is requested.

Comments: ___

Richard L. Reed
Richard L. Reed
Chief, Branch of Planning and Evaluation
Telephone 839-5833, Ext. 346

SCC-3, Apr. 76

Jobs for People • People for Jobs

Memorandum

To: Files

Subject: Response to Letter from State of Colorado, Division of Employment and Training, Denver, Colo., Dated May 22, 1978.

The Bureau of Reclamation acknowledges the letter and appreciates the review of the Draft Environmental Statement.

STATE DEPARTMENT OF HIGHWAYS

JACK KINSTLINGER
EXECUTIVE DIRECTOR

DIVISION OF HIGHWAYS
E. N. HAASE
CHIEF ENGINEER

NIL SINE NUMINE
STATE OF COLORADO

COLORADO STATE PATROL
COL. C. WAYNE KEITH,
CHIEF

4201 EAST ARKANSAS AVENUE • DENVER, COLORADO 80222 • (303) 757-9011

June 26, 1978

JUN 27 1978
DIV. OF PLANNING

Mr. Philip H. Schmuck
Director
Colorado Division of Planning
520 State Centennial Building
1313 Sherman Street
Denver, Colorado 80203

Dear Mr. Schmuck:

The Colorado Department of Highways has completed its review of the Draft Environmental Impact Statement for the Colorado River Basin Salinity Control Project - Paradox Valley Unit and offers the following comments.

The project as proposed will not have an impact on any current highway water quality monitoring programs. It does not appear that the project will interfere with any proposed highway system in the area. The Bureau of Reclamation is requested to contact the District Engineer, C.A. Morain, Highway Building, Durango, 259-1241, to obtain the proper utility permits when crossing S.H. 90.

Thank you for the opportunity to review this document.

Very truly yours,

Harvey R. Atchison
Director
Division of Transportation Planning

By Patsy D. Goodman
Patsy D. Goodman
Acting Manager
Impact Evaluation Branch

REG/rg

Memorandum

To: Files

Subject: Response to Letter from State of Colorado, Department of Highways, Dated June 26, 1978.

<u>Comment</u>:

The project as proposed will not have an impact on any current highway water quality monitoring programs. It does not appear that the project will interfere with any proposed highway system in the area. The Bureau of Reclamation is requested to contact the District Engineer, C.A. Morain, Highway Building, Durango, 259-1241, to obtain the proper utility permits when crossing S.H. 90.

<u>Response</u>:

Prior to any construction involving crossing State Highway 90 the Bureau of Reclamation would obtain the proper utility permits.

RICHARD D. LAMM
Governor

C.J. KUIPER
State Engineer

DIVISION OF WATER RESOURCES

Department of Natural Resources
1313 Sherman Street - Room 818
Denver, Colorado 80203
Administration (303) 892-3581
Ground Water (303) 892-3587

June 16, 1978

JUN 19 1978

DIV. OF PLANNING

MEMORANDUM

TO: CHARLIE JORDON, DIVISION OF PLANNING

FROM: DR. JERIS A. DANIELSON, DEPUTY STATE ENGINEER

SUBJECT: PARADOX VALLEY UNIT, DRAFT ENVIRONMENTAL STATEMENT

In accordance with your request, we have reviewed the above referenced statement. We have primarily one basic concern with the proposed project which involves the effect of the stream depletion of the project upon downstream senior water rights.

The statement indicates that the annual depletion to the Dolores River could be 3950 acre-feet per year. A portion of this depletion will occur in the irrigation season when streamflow is not sufficient to satisfy the decreed water rights downstream. The statement does not mention these detrimental effects nor does it offer to remedy the injury through a plan for augmentation or plan of exchange.

In light of this potential for injury to downstream water rights, this office has not issued permanent well permits for the 19 well permit applications on file. We have issued temporary permits to allow testing of the well field so that a final design can be developed. A condition on the permit states that at the end of the testing period the wells must be plugged and abandoned unless a plan for augmentation is approved by the Division Water Court.

We would strongly recommend that the Final Environment Statement contain a section on the mitigation measures that will be taken to protect the rights of downstream water users.

Jeris A. Danielson

Jeris A. Danielson

JAD/HDS:mvf

Memorandum

To: Files

Subject: Response to Letter from Division of Water Resources, Department of Natural Resources, State of Colorado, Dated June 16, 1978.

<u>Comment</u>:

The statement indicates that the annual depletion to the Dolores River could be 3950 acre-feet per year. A portion of this depletion will occur in the irrigation season when streamflow is not sufficient to satisfy the decreed water rights downstream. The statement does not mention these detrimental effects nor does it offer to remedy the injury through a plan for augmentation or plan of exchange.

We would strongly recommend that the Final Environmental Statement contain a section on the mitigation measures that will be taken to protect the rights of downstream water users.

<u>Response</u>:

The Bureau recognizes that the maximum depletion of 3,950 acre-feet annually would interfere with the ability of downstream irrigators to make diversions in fulfillment of their water rights. Before construction could be undertaken, provisions would be required to compensate the users for reductions in their diversions, to obtain senior water rights for project operations, or to augment the streamflow by exchange or some other means. The method would be selected in coordination with the State of Colorado and would depend to some degree on the brine pumping rate determined as a result of the current design data collection program. A section has been added to Chapters A and C to discuss the project water rights.

STATE OF COLORADO
Richard D. Lamm, Governor
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WILDLIFE

Jack R. Grieb, Director
6060 Broadway
Denver, Colorado 80216 (825-1192)

June 28, 1978

Mr. Stephen O. Ellis, Principal Planner
Centennial Building
Colorado A-95 Clearinghouse
Denver, CO 80203

JUL 3 1978
DIV. OF PLANNING

Re: Colorado River Basin Salinity Control Project
Paradox Valley Unit

Dear Steve:

The DOW has reviewed the Draft Environmental Statement for the Paradox Valley Unit of the Colorado River Basin Salinity Control Project. This report is well written and, except for a few minor comments, adequately assesses the impacts on the fish and wildlife resources. These comments are:

B-28 (2) Small Game Mammals

Sentence 1. Insert "project" before area. It is possible that the chickaree or red squirrel inhabits forested areas adjacent to the project area.

B-30 (6) Raptors and C-15 (7) Raptors

The loggerhead shrike is not a raptor since it is not in the order falconiformes or strigiformes. It should be classified as a nongame bird since it is of the order passeriformes.

D-2 (4) Measures incorporated in Unit Design and Operation

First sentence - add "developed" to ". . . pond would be acquired and maintained with Congressional approval . . ."

I-1 (2) Preparation of Draft Environmental Statement

No mention is made of Preston Somers contribution.

Chapter H - Alternatives to Proposed Action

We do not believe that adequate study has been given to the alternative methods of brine disposal particularly as to the location of the evaporation ponds. Since the project is still experimental and the amount of brine disposal is unknown, we suggest that an interagency study be conducted to choose a method of brine disposal which would have the least amount of environmental impact.

Sincerely yours,

Jack R. Grieb

Jack R. Grieb
Director

JRG/kk

cc: Harris Sherman
Bob Evans
Bob Rosette

Memorandum

To: Files

Subject: Response to Letter from State of Colorado, Division of Wildlife, Dated June 28, 1978.

1. Comment:

B-28 (2), Small Game Mammals: Sentence 1. Insert "project" before area. It is possible that the chickaree or red squirrel inhabits forested areas adjacent to the project area.

Response:

This has been corrected in Section B-9c(2) of the Final Environmental Statement.

2. Comment:

B-30 (6), Raptors and C-15 (7), Raptors: The loggerhead shrike is not a raptor since it is not in the order falconiformes or strigiformes. It should be classified as a nongame bird since it is of the order passeriformes.

Response:

This has been changed in Sections B-9c(6) and B-9c(9).

3. Comment:

D-2 (4) Measures incorporated in Unit Design and Operation: First sentence - add "developed" to ". . . pond would be acquired and maintained with Congressional approval . . ."

Response:

This has been added to Section D-4a of the Final Environmental Statement.

4. Comment:

I-1 (2) Preparation of Draft Environmental Statement: No mention is made of Preston Somers' contribution.

Response:

Section I-2 has been changed to include the fauna inventory conducted by Dr. Somers under a contract between the Bureau of Reclamation and Fort Lewis College.

5. Comment:

Chapter H, Alternatives to Proposed Action: We do not believe that adequate study has been given to the alternative methods of brine disposal particularly as to the location of the evaporation ponds. Since the project is still experimental and the amount of brine disposal is unknown, we suggest that an interagency study be conducted to choose a method of brine disposal which would have the least amount of environmental impact.

Response:

At the reconnaissance level the Bureau examined at least 33 alternative methods and/or sites for brine disposal. Those presented in the alternative chapter are the most feasible from the standpoint of the environment, economics, geology, and engineering technology.

The extensive coordination that was an integral part of the plan formulation process has been outlined in Chapter I, Consultation and Coordination. Reclamation intends to maintain an open review process, and it will initiate renewed interagency coordination if the well field testing program indicates a pumping rate at or near 2 cfs would curtail the brine inflow into the Dolores River.

STATE OF CALIFORNIA—THE RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

COLORADO RIVER BOARD OF CALIFORNIA
107 SOUTH BROADWAY, ROOM 8103
LOS ANGELES, CALIFORNIA 90012
(213) 620-4480

June 27, 1978

Mr. Harl M. Noble
Regional Director's Office
U. S. Bureau of Reclamation
Post Office Box 11568
125 South State Street
Salt Lake City, Utah 84147

Dear Mr. Noble:

We have reviewed the "Paradox Valley Unit Draft Environmental Statement" dated May 11, 1978. We recognize the difficulties connected with preparing such a statement when the sizes of required facilities are unknown (evaporation pond, delivery lines, etc.). The Colorado River Board of California strongly supports this salinity control project and, considering the limited data available, feels you have made the proper choice from alternatives available.

Other comments on the report are as follows:

1. Nowhere in the report are dollar costs of the project presented. The report made it clear that sufficient data has not been gathered to size the project. Nevertheless, since certain maximum and minimum sizes of the facilities have been assumed, it is possible to present the costs for these upper and lower limits. Since the benefits have been presented in dollar amounts, the costs should also be shown.

2. On page A-3 it states that testing of the well field is expected to be completed in 1979. This is inconsistent with the information presented to the Colorado River Basin Salinity Control Forum at the December, 1977, meeting by the Bureau's Colorado River Water Quality Control Office. At that meeting, Bureau representatives reported that a two-year well field testing program would be undertaken in early 1978. This discrepancy should be corrected.

3. The report does not present methods or data upon which the flood reservation in the various evaporation ponds was determined. Was flow data actually gathered at the reservoir sites, or was a maximum flood flow synthesized? Since salt from the ponds must not escape, adequate flood flow storage must exist. We recommend that the method of determining flood storage requirements be presented.

4. The report points out that a uranium bed underlies USBR's preferred evaporation pond; that USBR and Union Carbide agree the bed can be mined even if a pond is constructed; that the Bureau of

Mines recommends the pond not be built because of the uranium bed; and that the quantity of uranium available is speculative. We support the Bureau of Reclamation's position that the best evaporation pond site lies over the uranium bed and that is where it should be built.

5. Your report discusses the Colorado River Salinity Control Forum's projections of future water quality conditions made for the June, 1975, report. Your discussion of the Forum's conclusions is misleading. You say "The Forum has concluded that the salinity standard can be maintained through 1990" (P C-54). For the one set of Forum conditions presented in your report, that's an accurate statement. But, the Forum studied numerous sets of conditions and found that "with full implementation of all identified salinity control measures, 1990 salinities can be maintained at or below 1972 salinities for the following water supply and depletion rates:

Hoover Dam - Virgin flow at Lee Ferry of 14 million acre-feet/year or more with the moderate depletion rate.

Parker Dam - Virgin flow at Lee Ferry of 14 million acre-feet/year or more with a low depletion rate and 15 million acre-feet/year or more with the moderate depletion rate.

Imperial Dam - Virgin flow at Lee Ferry of 14 million acre-feet/year or more with a low depletion rate and 15 million acre-feet/year or more with the moderate depletion rate."

6. Page C-26 says, "The Fish and Wildlife Service under the Endangered Species Act of December 28, 1973, (P. L. 93-205), is in the process of proposing that approximately 620 miles of the Colorado River and tributaries be designated critical habitat for the Colorado River Squawfish." If such classification would affect construction of a salinity control unit, we oppose such classification and urge the Bureau to do likewise.

We appreciate the opportunity to review this environmental statement.

Sincerely yours,

M. B. Holburt

Myron B. Holburt
Chief Engineer

Memorandum

To: Files

Subject: Response to Letter from Colorado River Board of California, Los Angeles, Calif., Dated June 27, 1978.

1. Comment:

Nowhere in the report are dollar costs of the project presented. The report made it clear that sufficient data has not been gathered to size the project. Nevertheless, since certain maximum and minimum sizes of the facilities have been assumed, it is possible to present the costs for these upper and lower limits. Since the benefits have been presented in dollar amounts, the costs should also be shown.

Response:

Briefly, the reduction in salinity at Imperial Dam would result in direct and indirect benefits annually of about $230,000 per milligram per liter. In addition there are unquantified benefits to recreation, wildlife (particularly aquatic), and aesthetics. The annual equivalent cost for the net salinity decrease at Imperial Dam for the extreme 5 cfs plan would be $192,800 per milligram per liter. If a lower pumping rate were utilized, the cost would be lower. Also see response to EPA comment #16.

It is the policy of the Department of the Interior that detailed technical and economic analyses are not presented in environmental statements. This information is developed in technical planning documents which are available for public inspection at the following locations.

Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street
Salt Lake City, Utah 84147

Bureau of Reclamation
Western Colorado Projects Office
835 2nd Avenue
Durango, Colo. 81301

2. Comment:

On page A-3 it states that testing of the well field is expected to be completed in 1979. This is inconsistent with the information presented to the Colorado River Basin Salinity Control Forum at the December, 1977, meeting by the Bureau's Colorado River Water Quality Control

Office. At that meeting, Bureau representatives reported that a two-year well field testing program would be undertaken in early 1978. This discrepancy should be corrected.

Response:

The 2-year testing program would be completed in 1980. References to this date have been corrected in the Final Environmental Statement.

3. Comment:

The report does not present methods or data upon which the flood reservation in the various evaporation ponds was determined. Was flow data actually gathered at the reservoir sites, or was a maximum flood flow synthesized? Since salt from the ponds must not escape, adequate flood flow storage must exist. We recommend that the method of determining flood storage requirements be presented.

Response:

In reaching floodflow storage requirements for Radium Evaporation Pond, the maximum annual inflow was determined using monthly rainfall records at Norwood correlated with monthly flow volumes in Dry Creek Basin in terms of yield per square mile. In addition, all precipitation data in the general region were studied, and the maximum probable precipitation for each month was determined. Maximum storms in the general region occurring in areas with topography similar to that in the vicinity of the unit were included.

After the 100-year life of the unit, the pond would still have the capability to store and evaporate the maximum annual inflow. After about 800 years the slowly accumulating sediment would have filled the flood storage capacity. Inflows would begin to spill but should not present a hazard, as explained in the response to U.S. Geological Survey comment #2.

4. Comment:

The report points out that a uranium bed underlies USBR's preferred evaporation pond; that USBR and Union Carbide agree the bed can be mined even if a pond is constructed; that the Bureau of Mines recommends the pond not be built because of the uranium bed; and that the quantity of uranium available is speculative. We support the Bureau of Reclamation's position that the best evaporation pond site lies over the uranium bed and that is where it should be built.

Response:

Reclamation analysis indicates that Radium Pond site is easily the best at a pumping rate of 5 cfs; however, as explained in the statement, Reclamation will give full consideration to all of the 2-cfs alternatives if the testing program shows that the smaller pumping rate would effectively reduce the brine inflow to the Dolores River.

5. Comment:

Your report discusses the Colorado River Salinity Control Forum's projections of future water quality conditions made for the June, 1975, report. Your discussion of the Forum's conclusions is misleading. You say "The Forum has concluded that the salinity standard can be maintained through 1990" (P C-54). For the one set of Forum conditions presented in your report, that's an accurate statement. But, the Forum studied numerous sets of conditions and found that "with full implementation of all identified salinity control measures, 1990 salinities can be maintained at or below 1972 salinities for the following water supply and depletion rates:

Hoover Dam - Virgin flow at Lee Ferry of 14 million acre-feet/year or more with the moderate depletion rate.

Parker Dam - Virgin flow at Lee Ferry of 14 million acre-feet/year or more with a low depletion rate and 15 million acre-feet/year or more with the moderate depletion rate.

Imperial Dam - Virgin flow at Lee Ferry of 14 million acre-feet/year or more with a low depletion rate and 15 million acre-feet/year or more with the moderate depletion rate."

Response:

Section C-11(3) has been revised to explain that the Forum studied numerous sets of circumstances in its projections and that the comparison made in the statement with Reclamation projections reflects but one of them.

6. Comment:

Page C-26 says, "The Fish and Wildlife Service under the Endangered Species Act of December 28, 1973, (P.L. 93-205), is in the process of proposing that approximately 620 miles of the Colorado River and tributaries be designated critical habitat for the Colorado River Squawfish." If such classification would affect construction of a salinity control unit, we oppose such classification and urge the Bureau to do likewise.

Response:

A final designation of "critical habitat" for the Colorado River squawfish has not been made. The final designation will rest, in part, upon the life requirements for the species. The Bureau is actively cooperating with the Fish and Wildlife Service to develop adequate information to determine what those requirements are and thereby establish a biological basis for determining "critical habitat." Opposition to the final "critical habitat" designation would have to be made on the basis of the adequacy of the biological information presented in coming to that determination, rather than the potential impact such a designation might have on the salinity control program in the basin.

Social Services

Scott M. Matheson, Governor, State of Utah
Anthony W. Mitchell, Ph.D., Executive Director

June 16, 1978
533-6146

Mr. Harl Noble
Acting Regional Director
Bureau of Reclamation
7402-A Federal Building
125 South State
Salt Lake City, Utah 84138

Re: Paradox Valley Unit
Draft Environmental Statement

Dear Mr. Noble:

We have reviewed the Draft Environmental Statement for the Paradox Valley Unit of the Colorado River Basin Salinity Control Project and in general find it brief, concise and well written. The following comments are offered for your consideration:

1. We failed to find a summation of the project costs to include a cost to benefit ratio.

2. On page A-7 it is stated that a polyvinyl chloride liner will be used to prevent leakage from the forebay of pumping plant No. 1. Based upon our experience with PVC liner, it is recommended that the specifications call for a performance test prior to acceptance.

3. On page A-7 it is stated that the flows from various intermittent tributaries of Dry Creek would be intercepted and contained by Radium Pond. It is felt that the document could be improved by adding a short discussion concerning the feasibility of routing surface runoff around the Radium Pond.

4. On page D-1 paragraph 3.b provides the standard assurance that water quality standards will not be violated and possible construction impacts will be minimized. It is felt

Division of Health
Environmental Health Services Branch
Lynn M. Thatcher
Deputy Director of Health

150 West North Temple, Suite 426
P.O. Box 2500, Salt Lake City, Utah 84110
801-533-6121

that these catchall statements should be re-evaluated in light of the construction related impacts at the Stateline Reservoir site.

We appreciate the opportunity to review the document and hope our comments have been helpful.

Sincerely,

Calvin K. Sudweeks
Director
Bureau of Water Quality

JRC:br

Memorandum

To: Files

Subject: Response to Letter from Bureau of Water Quality, Division of Health, State of Utah, Dated June 16, 1978.

1. Comment:

We failed to find a summation of the project costs to include a cost to benefit ratio.

Response:

Briefly, the reduction in salinity at Imperial Dam would result in direct and indirect benefits annually of about $230,000 per milligram per liter. In addition there are unquantified benefits to recreation, wildlife (particularly aquatic), and aesthetics. The annual equivalent cost of the net salinity decrease at Imperial Dam for the extreme 5-cfs plan would be $192,800 per milligram per liter. If a lower pumping rate were utilized, the cost would be lower.

It is the policy of the Department of the Interior that technical and exhaustive financial considerations are not part of an environmental statement. This information is developed in technical planning documents which are available for public inspection at the following locations.

Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street
Salt Lake City, Utah 84147

Bureau of Reclamation
Western Colorado Projects Office
835 2nd Avenue
Durango, Colo. 81301

2. Comment:

On page A-7 it is stated that a polyvinyl chloride liner will be used to prevent leakage from the forebay of pumping plant No. 1. Based upon our experience with PVC liner, it is recommended that the specifications call for a performance test prior to acceptance.

Response:

The specifications would call for a performance test on the polyvinyl chloride liner prior to acceptance. Specifications would also include handling and placing methods that would prevent damage to the lining.

3. Comment:

On page A-7 it is stated that the flows from various intermittent tributaries of Dry Creek would be intercepted and contained by Radium Pond. It is felt that the document could be improved by adding a short discussion concerning the feasibility of routing surface runoff around the Radium Pond.

Response:

Radium Evaporation Pond would be designed to store and evaporate maximum probable floods in addition to the brine inflow. A bypass large enough to handle a major flood would be extremely costly. There would be no advantage in bypassing natural runoff of flows less than major floods since the pond would need the additional capacity for the major floods anyway. Even if a bypass channel were constructed large enough to bypass major floods, considerable additional pond capacity would be necessary to store and evaporate precipitation falling directly on the pond surface. It is much more economical to have additional capacity in the pond for all inflows than to try to bypass portions of the floodflows.

It should be pointed out that one of the main advantages of the Radium site is the very small amount of area actually draining into the pond area. The topography of the area is such that placement of the dam and dike was made to exclude any large tributaries. The largest amount of natural inflow to the pond would be the precipitation falling directly on the pond surface.

4. Comment:

On page D-1 paragraph 3.b provides the standard assurance that water quality standards will not be violated and possible construction impacts will be minimized. It is felt that these catchall statements should be reevaluated in light of the construction related impacts at the Stateline Reservoir Site.

Response:

It was not intended that the measures described in Chapter D to protect water quality standards should be interpreted as catchall statements. They are a sincere attempt to frame in nontechnical language a summary of the detailed technical language contained in all contract specifications which general contractors working on Reclamation projects are legally required to abide by. The attempt to keep the discussion of these measures in nontechnical language is in keeping with the CEQ guidelines. However, since this attempt has been somewhat misconstrued, the section in question has been expanded.

The Bureau of Reclamation recognizes the problems it has encountered in protecting the surface water quality below Stateline Dam. The problem developed from the fact that the coordination between reservoir clearing and dam construction got out of phase, allowing sediment that should have been settled out behind the dam to escape to the waterway downstream. While the Bureau of Reclamation believes that the language in its contract specifications is adequate to protect the water quality at construction sites, it also recognizes that under exceptional circumstances, like those that transpired at Stateline Damsite, better coordination is needed to properly monitor and enforce contract specifications. Presently, the Bureau in cooperation with EPA is drafting erosion control plans to facilitate better coordination and enforcement.

c. <u>Comments From Organizations</u>

Colorado River Water Conservation District

Environmental Defense Fund

Upper Colorado River Commission

June 27, 1978

Office of Regional Director
Bureau of Reclamation
P.O. Box 11568
125 South State Street
Salt Lake City, Utah 84147

Dear Sir:

We appreciate the opportunity to review the Draft Environmental Statement for the Paradox Valley Unit, Colorado River Basin Salinity Control Project (INT DES 78-19).

The following comments are offered for your consideration:

1. Table A-2 on page A-16 indicates that 1,290 acres of privately owned land will be taken exclusively for wildlife mitigation, in addition to 1,050 acres of BLM land which will be removed from multiple use for the same purpose. Perhaps this compensates for supposed adverse impact on wildlife, but it generates an added adverse impact on the ranching community which is not adequately addressed. The statement on page C-18 that revenue to San Miguel County would be reduced by $1,186 and is therefore negligible is totally misleading. The acutal loss to the economy of the area would be the gross value of the reduced number of livestock sold, since practically all of such receipts pass through local business channels. This project which primarily benefits people in other areas and other states, should not be used by the Fish and Wildlife interests as an excuse to alter established land use practices.

2. The report contains very detailed information on the adverse impacts resulting from the project but verylimited and brief data on the significant long term beneficial effects on fish and aquatic invertebrates (page C-9 and C-10), improvement of riparian habitat along the Dolores River (page C-11) and improving the environment for Colorado Squawfish and Humpback Chub (page C-11).

3. Chapter C includes data on the impact that construction would have on adjacent towns. These effects appear to be minimized in the report. The assumption is made that the construction workers will all be housed at the construction camp and all government workers at the government camp and that the majority of retail purchasing would be done at larger commercial centers. This may not occur. All

facilities and services in this area are now receiving maximum utilization and the influx of construction and government personnel could create major problems in the nearby towns.

4. Page A-19 presents a table on energy requirement for project operation indicating an average of 15,200,000 kw hours annually. This is a substantial energy requirement and could be expanded beyond the brief one-sentence reference in Chapter G -- Commitments of Resources.

5. The inclusion of data and information on CRSP Units and Colorado River Salinity Control Units (pages C-21 to C-54) may be necessary but is confusing to a receiver and his analysis of the effects of one particular project.

6. Pages A-5, A-6, and A-7 provide information on facilities, their operation and location. No information is provided on the corrosive effect of the brine on the pipeline and the pumps -- i.e. what is the estimated life of the facilities? What type of inspections or procedures are planned to prevent or handle brine leakage?

In reviewing this report it is obvious that the benefits occuring from control of salinity of water in the Colorado River Basin far exceed any projected adverse impacts. This fact deserves more positive emphasis.

Very truly yours,

Roland Fischer

ROLAND C. FISCHER
Secretary-Engineer

RCF:dvc

Memorandum

To: Files

Subject: Response to Letter from Colorado River Water Conservation District, Glenwood Springs, Colo., Dated June 27, 1978.

1. Comment:

Table A-2 on page A-16 indicates that 1,290 acres of privately owned land will be taken exclusively for wildlife mitigation, in addition to 1,050 acres of BLM land which will be removed from multiple use for the same purpose. Perhaps this compensates for supposed adverse impact on wildlife, but it generates an added adverse impact on the ranching community which is not adequately addressed. The statement on page C-18 that revenue to San Miguel County would be reduced by $1,186 aud is therefore negligible is totally misleading. The actual loss to the economy of the area would be the gross value of the reduced number of livestock sold, since practically all of such receipts pass through local business channels. This project which primarily benefits people in other areas and other states, should not be used by the Fish and Wildlife interests as an excuse to alter established land use practices.

Response:

The Bureau of Reclamation recognizes from the comment that there are secondary impacts on the area's economy which were not adequately addressed and has, consequently, expanded Section C-3d(6) to cover the adverse impacts the acquisition of private grazing land would have on the area's retail trade. Reclamation feels that the more direct adverse impacts on San Miguel County's tax revenues and the two ranchers who would lose private holdings and public grazing permits at the pond site and the measures available to mitigate those impacts have been accurately addressed in the section in question, C-10.

Reclamation has the responsibility to protect against or minimize adverse impacts that could occur to a given environment as the result of a Federal undertaking under its sponsorship. The proposed wildlife program and Federal assistance available to the two ranchers under the Uniform Relocation and Assistance Act are attempts to be responsive to the interests of both.

The Bureau of Reclamation recognizes that the more tangible benefits of the Paradox Valley Unit would occur for the Lower Basin water users, but indirectly the unit would also act to insure the continued development of the State of Colorado's apportioned share of Colorado River water by helping to maintain the river's quality. The Bureau is aware of the desirability of economic diversity and stability in western Colorado, particularly with respect to agriculture. Two Colorado water resource development projects, the Dallas Creek and Dolores Projects, are under construction and will be of considerable economic benefit to the economy of western Colorado (see Section C-11, Cumulative Impacts). The San Miguel Project, now in the advance planning stages, is in the general Paradox Valley Unit area. This project, if found environmentally acceptable under the NEPA process and funded by Congress, would be of considerable economic benefit to the area.

2. Comment:

The report contains very detailed information on the adverse impacts resulting from the project but very limited and brief data on the significant long-term benefical effects on fish and aquatic invertebrates (page C-9 and C-10), improvement of riparian habitat along the Dolores River (page C-11), and improving the environment for Colorado Squawfish and Humpback Chub (page C-11).

Response:

Both adverse and beneficial project impacts on wildlife have been quantified wherever possible (see Section C-8). If adverse impacts have generally been treated in more detail it is because considerable background information and detail is needed to test and analyze the effectiveness of the plans to mitigate those impacts. This approach is consistent with Reclamation policy and the requirements of the National Environmental Policy Act. For the Paradox Valley Unit, beneficial impacts, generally associated with the improved water quality of the Dolores River, would be of a gradual nature. For this reason, quantification, which would of necessity be extremely subjective under these circumstances, has in most cases been avoided so as not to give the impression of scientific accuracy where, in fact, it does not exist.

3. Comment:

Chapter C includes data on the impact that construction would have on adjacent towns. These effects appear to be minimized in the report. The assumption is made that the construction workers will all be housed at the construction camp and all government workers at the government camp and that the majority of retail purchasing would be done at larger commercial centers. This may not occur. All facilities and services in this area are now receiving maximum utilization and the influx of construction and government personnel could create major problems in the nearby towns.

Response:

The Bureau of Reclamation recognizes the difficulty in assessing social impacts before the fact. But in arriving at the analysis presented in the statement, a trend analysis compiled on similar Reclamation projects (Bureau of Reclamation, 1977) was consulted, and the opinion of a private construction contractor with immediate and recent experience on Federal projects of a similar nature was sought. The information gained in this process plus the knowledge that the only available housing on any scale in the area is over 90 miles away in the cities of Grand Junction, Montrose, and Cortez, Colo., and Moab, Utah, led the Bureau to conclude that construction camps for government and nongovernment workers would be almost imperative. Therefore, the Bureau included the construction of a camp to house government workers as part of the project plan. The Bureau would not force the primary private contractor to build a camp to house his personnel; but the construction specifications would contain background information pointing out the lack of housing in the immediate area. The Bureau feels relatively sure that contract bids which are based on the construction specifications would properly consider that fact. If the contractor chooses not to accommodate his personnel, which seems unlikely, it would be necessary for most of his work force to travel from 4 to 5 hours a day to get to and from work--time he would almost surely have to compensate them for with overtime pay.

In the unlikely event that most of the workers were forced to live in the larger cities outside the immediate area most of the impacts, adverse and beneficial, to the small towns, as portrayed in the statement, would be on a much smaller scale. The exception would be in the area of highway traffic. In the peak construction year, traffic would be increased on the connecting State and Federal highways by an estimated 75 to 100 cars in the early morning and evening hours. These highways presently have from light to moderate use, and in the opinion of the Colorado State Patrol such an increase would not adversely affect public safety since the increased traffic would still be well below the highways' carrying capacity.

It is because of the recognition that the limited facilities and services in the nearby small communities are fully utilized that the assumption was made that construction-related personnel would resort to the larger trade centers for major purchases. The local people themselves go to these larger communities for goods and services.

4. Comment:

The inclusion of data and information on CRSP Units and Colorado River Salinity Control Units (pages C-21 to C-54) may be necessary but is confusing to a receiver and his analysis of the effects of one particular project.

Response:

The Cumulative Impacts Section, Section C-11, has been included because the Bureau believes it affords the interested reader an opportunity to better grasp the significance of Reclamation projects in the upper Colorado River Basin and put in perspective the relationship between the Paradox Valley Unit and other developments already constructed or under construction. While the section does add breadth to the statement, the introduction to the section explains its purpose, and it should, therefore, not pose an obstacle to the reader who is only interested in the Paradox Valley Unit itself.

5. Comment:

Pages A-5, A-6, and A-7 provide information on facilities, their operation and location. No information is provided on the corrosive effect of the brine on the pipeline and the pumps--i.e. what is the estimated life of the facilities? What type of inspections or procedures are planned to prevent or handle brine leakage?

Response:

Corrosive damage from the brine solution would be most severe at the valves and meter couplings on the brine pipe network. The estimated service life of the pipeline is 50 years, the fittings 10 years, and the pumping units 10 years. Supervisory control of the stripping plant and brine line pumping station would provide a nearly constant monitoring of the operations. Part of the duties of the permanent operating force would be to inspect the operation of the valves and meters periodically. Provisions would be made in design of the system to make repairs without jeopardizing plants and animals, fresh water supplies, or the overall operation. A more detailed discussion of safeguards has been added to Section A-3b(3).

6. Comment:

In reviewing this report it is obvious that the benefits occurring from control of salinity of water in the Colorado River Basin far exceed any projected adverse impacts. This fact deserves more positive emphasis.

Response:

The Bureau of Reclamation feels that it has given proper emphasis to both the benefits and the adverse impacts of the project. The primary purpose of the environmental impact statement is to provide clear and objective information on the environmental consequences of a proposed Federal action for the public and its elected representatives. To take an editorial stance favoring one set of consequences over another would be counter to that purpose and in direct conflict with Reclamation instructions and the CEQ Guidelines.

Environmental
Defense
Fund

1657 Pennsylvania St., Denver, Colo. 80203 (303) 831-7559

June 30, 1978

Office of the Regional Director
Bureau of Reclamation
Federal Building
125 South State Street
Salt Lake City, Utah 84147

Gentlemen:

Attached are our comments on the Draft Environmental Statement for the Paradox Valley Salinity Control Unit. Please note that the address for the Environmental Defense Fund listed on p. 3 of the DEIS is incorrect. We also did not receive a copy of the DEIS that was released on May 11, 1978, till June 5 and only after a call to the Bureau's offices in Denver.

Sincerely,

Mohamed T. El-Ashry, Ph.D.
Co-Chairman, Water and
Land Resources Program

MEA:j
Enclosure

Environmental Defense Fund

1657 Pennsylvania St., Denver, Colo. 80203 (303) 831-7559

COMMENTS OF THE ENVIRONMENTAL DEFENSE FUND ON THE DRAFT ENVIRONMENTAL STATEMENT (INT-DES-78-19) FOR THE PARADOX VALLEY UNIT OF THE COLORADO RIVER BASIN SALINITY CONTROL PROJECT

By:

Mohamed T. El-Ashry, Ph.D.
Co-Chairman, Water and
Land Resources Program

June 30, 1978

OFFICES IN: NEW YORK CITY (NATIONAL HEADQUARTERS); WASHINGTON, DC; BERKELEY, CALIF.; DENVER, COL.

General Comments:

In reviewing the Draft Environmental Statement (DEIS) for the Paradox Valley Unit, one immediately recognizes the great similarity with the other Bureau proposed salinity control projects to date. Like the Grand Valley Unit (EAR published in December, 1977), the Paradox Valley Unit as proposed in the DEIS is overdesigned for the benefits that may be realized. While brine inflow is estimated to average only about 0.8 cfs (DEIS at A-18), designs of the unit's components are based on a maximum pumping rate of 5 cfs (DEIS at A-15). We recognize that a high pumping rate would be required initially to lower the level of the brine ground water. However, we seriously question the wisdom of designing an entire project with a lifetime of 100 years solely on the basis of the initial high pumping rate. We believe, based on the estimated average inflow of 0.8 cfs and a report prepared by the U.S. Geological Survey at the request of the Bureau of Reclamation,[1/] that the unit's designs should be based on a sustained withdrawal rate of 1.5-2.0 cfs which can meet the main objective of the project but at less than half the cost of the proposed plan. As a matter of fact, the DEIS presents four alternatives for brine disposal at a well field pumping rate of 2 cfs.

1/ "Evaluation of Hydrogeologic Aspects of Proposed Salinity Control Program in Paradox Valley, Colorado," U.S. G.S. Open-file report 78-27.
-We note that the Bureau of Reclamation chose to completely ignore any reference to this report in the DEIS.

Equally important, this project is advanced for final approval while its basic effectiveness is still greatly in doubt. The 34-day pump test conducted in 1976 failed to provide the needed information for a design pumping rate.[2/] Well No. 3 did not produce, while Well No. 2 had a very poor yield. Also, there was no conclusive evidence of any change in the salinity content of the Dolores River during the pumping test.

Recommendation:

In view of the complex hydrogeologic conditions in Paradox Valley and the many uncertainties involved in the proposed plan we strongly recommend staged construction of the project. Stage One would consist of construction of the brine well field, monitoring wells, stream water quality monitoring stations, and a temporary brine disposal system. Since most of these components have already been constructed, expenditure at this stage will be minimal. Information gained from Stage One operation will then be used to arrive at future planning decisions for the overall unit including alternative brine disposal systems and sizing of the hydrogen sulfide stripping plant, brine pipeline, and pumping plants. This recommendation has been made by the Bureau's own officials in 1976[3/] and was included in the Quarterly Progress Report (footnote 2).

2/ Bureau of Reclamation, "Colorado River Water Quality Improvement Program -- Quarterly Progress Report," July, 1976.

3/ Memorandum to the Files from the Water Resources Branch, Bureau of Reclamation, June 21, 1976, regarding "Design Pumping Rate for Paradox Valley Unit Facilities."

As we mentioned in our comments on the Grand Valley Unit last February, we believe that in the initial phases of implementation of the salinity control program the Bureau of Reclamation should plan for optimal cost-effective controls while it further identifies different levels of treatment in each sub-basin and determines where funds ought to be utilized for the maximum benefit throughout the basin.

<u>Specific Comments</u>:

1. Economic Analysis

In contradiction to the Grand Valley EAR, the DEIS completely lacks any information on the cost of the project or on its construction, operation and maintenance. Yet, benefits from the project have been quantified and assigned a dollar value. Should one assume that the benefits exceed the costs? How does one determine the cost-effectiveness of the proposed plan? How does one compare the cost-effectiveness of the alternatives? On what basis would decisionmakers choose a final plan for implementation? Both decisionmakers and the public must be provided with such information so that independant analyses can be made. Alternatively, one must assume that there is no definite basis at the present time for the proposed plan, nor for the alternatives to it, and that it was premature to issue a DEIS on the project. Certainly the DEIS gives that impression. For example, on page H-2 appears a statement that the entire pumping plan analyzed in the DEIS may be drastically revised ("If ongoing testing shows that a pumping rate at or near 2 cfs would indeed be effective in removing the salts, the Bureau would reanalyze the unit to determine whether one of the 2 cfs plans...would be more desirable than the proposed plan.").

The lack of detailed cost figures is definitely a major deficiency in the DEIS and should be rectified. We recommend that cost figures published in future documents include as well the cost of minerals forgone by unit construction and increased costs of future mining due to the proposed location of the evaporation pond.

2. Radium Evaporation Pond

We question the statement on page A-7 of the DEIS that "nearly all of the pond area is underlain by impervious Mancos Shale, which would prevent seepage of brine into ground or surface waters." Additional data and analyses to support this statement should be supplied particularly in view of the Bureau's own experience in Grand Valley where canals placed in Mancos Shale are leaking with the water leaching considerable amounts of salts from the shale and eventually returning to the river.

The proposed evaporation pond site is also a potential site for the proposed San Miguel Project. Use of the site for brine disposal for the next 100 years would eliminate that option from consideration in developing plans for the San Miguel Project. This should be analyzed in the Paradox Valley EIS.

By letter on October 30, 1975, Union Carbide Corporation requested the Bureau's consideration for their Uravan Mill to participate in the Paradox Valley Project.[4/] Less than a year later a meeting was held at Uravan Plant between Union Carbide and Bureau of Reclamation representatives to discuss the possibility of disposal of the Uravan Mill effluent in Radium Evaporation Pond.[5/] There is no mention in the DEIS of such possibilities. Should it be assumed that no plans whatsoever exist for future disposal of mill effluent from the Uravan Plant into Radium Evaporation Pond?

3. Dolores Project

The Bureau of Reclamation's Dolores Project involves the construction of McPhee Dam on the river approximately 110 miles upstream from Paradox Valley. This will reduce the average annual flow of the river by about 105,200 acre-feet, or 35% of the flow at Bedrock (DEIS at B-11). What will be the impacts of flow reduction on the operation and effectiveness of the Paradox Valley Unit? It is imperative that they be analyzed in the EIS.

In addition, the DEIS states that during late summer and fall the Paradox Valley Unit would deplete essentially all of the flow of the Dolores River between the valley and the mouth of the San Miguel River till the McPhee Dam is completed (DEIS

4/ Letter of Mr. J. F. Emerson, General Manager, Mining and Milling, Union Carbide Corp., Grand Junction, Colorado, to Mr. Edward K. Wiscombe, Bureau of Reclamation, Grand Junction, Colorado.

5/ Memorandum to the Files from the Water Resources Branch, Bureau of Reclamation, April 20, 1976.

at C-7). Releases after completion of the dam, however, will provide increased flows in Paradox Valley in normal and wet years or about three out of every four years (DEIS at B-14). While the information is appreciated, an analysis is needed of the implications of these depletions and increased flows on the hydrology of the fresh and salt water aquifers in the valley and the operation and efficiency of the salinity control unit.

Alternatives

By far, the major deficiency of the DEIS is the alternatives section. This section appears to be an after-the-fact justification of the proposed action. It does not analyze all the reasonable alternatives and does not include all the pertinent data even for the alternatives listed to allow consideration of the optimal, cost effective, and least environmentally objectionable plan. It must be recognized that the National Environmental Policy Act (NEPA) is intended to facilitate policy choices. Yet, there can be no choice if alternatives to the proposed action are lacking or inadequately analyzed.

Outside the "nondevelopment" and "Dolores River Bypass Channel" the alternatives listed in the DEIS are entirely for the brine disposal component of the unit. Viable alternatives which must be considered and analyzed in the DEIS include those which would achieve the same objective (reducing Colorado River salinity) with more efficiency and at less cost both economically and environmentally at other locations in the basin. This certainly is in line with the philosophy of treating salinity as a basin-wide problem adopted by all federal and state agencies. However, it seems that such consideration and analysis, while legally required, will not take place till it is recognized that man-made sources of salinity (i.e. agriculture and other land-use related sources) may be more completely controlled than natural sources and with significant secondary benefits in the respective regions.

Another alternative to the proposed action that should have been considered and analyzed in the DEIS is one that would prevent or intercept recharge to the aquifers, thus minimizing brine discharge. While it is recognized that there are several different sources of ground water recharge that occur over a large area in the valley, which may limit the effectiveness and increase the cost of such approach, the option should still be considered as a supplemental control measure. As indicated in the U.S.G.S. report cited earlier, pumping fresh ground water upgradient from zones of leaching would (1) eventually reduce the rate of brine discharge; (2) provide a source of water to augment the flow of the Dolores River during extreme low-flow periods, and replace the flow to the Dolores River that would be diverted by the well field; and (3) provide a replacement source of irrigation water for farmers in the valley who may experience lower yields from their irrigation wells due to interference from the well field. Potential long-term benefits of this option are

(1) reduced annual pumping requirements in the well field, (2) reduced annual costs for brine disposal through a pipeline; and (3) extended life of the project.

Among the alternative brine disposal plans listed in the DEIS, the "deep well injection" alternative appears to be the most cost-effective and with the least adverse environmental impacts. Yet no adequate analysis is presented to indicate its feasibility and no data were mentioned to support its rejection. We strongly recommend serious investigation of this alternative before any final disposal plan is adopted. If these investigations prove its infeasibility, however, we recommend serious consideration of the "West Paradox Valley Evaporation Ponds" alternative for brine disposal which costs about half the expense of the proposed plan and will involve construction of the eight ponds one at a time as needed.

Memorandum

To: Files

Subject: Response to Letter from Environmental Defense Fund, Denver, Colo., Dated June 30, 1978.

1. Comment:

. . . the Paradox Valley Unit as proposed in the DEIS is overdesigned for the benefits that may be realized. While brine inflow is estimated to average only about 0.8 cfs (DEIS at A-18), designs of the unit's components are based on a maximum pumping rate of 5 cfs (DEIS at A-15) . . . . Equally important, this project is advanced for final approval while its basic effectiveness is still greatly in doubt . . . . In view of the complex hydrogeologic conditions in Paradox Valley and the many uncertainties involved in the proposed plan we strongly recommend staged construction of the project. Stage One would consist of construction of the brine well field, monitoring wells, stream water quality monitoring stations, and a temporary brine disposal system. Since most of these components have already been constructed, expenditure at this stage will be minimal. Information gained from Stage One operation will then be used to arrive at future planning decisions for the overall unit including alternative brine disposal systems and sizing of the hydrogen sulfide stripping plant, brine pipeline, and pumping plants.

Response:

The schedule proposed in the Draft and Final Environmental Statements is essentially the proposal suggested in this comment. The well field would be operational, proven effective, and an operational pumping rate would have been determined before final design and construction of other facilities would be undertaken. To comply with NEPA the maximum environmental impacts associated with the extreme condition, that 5 cfs of concentrated brine would be pumped continuously for the 100-year life of the unit, were evaluated. Through the testing program, it is possible that a significantly lower pumping rate would be determined. Alternative brine disposal methods would also be reevaluated based upon the pumping rate determined from the testing program. Sections A-3a, A-5, and H-1 discuss these steps.

2. Comment:

As we mentioned in our comments on the Grand Valley Unit last February, we believe that in the initial phases of implementation of the salinity control program the Bureau of Reclamation should plan for optimal cost-effective controls while it further identifies different levels of treatment in each sub-basin and determines where funds ought to be utilized for the maximum benefit throughout the basin.

Response:

The Bureau of Reclamation in its planning and investigation of this and other salinity control projects has always taken into account the cost-effectiveness of the projects and tried to optimize the cost-effectiveness. Cost figures for the Paradox Valley Unit show it to be the most cost-effective salinity control unit of the four units authorized for construction. However, it should be pointed out that all identified salinity control projects or their equivalents will be needed to meet the standards in the Colorado River by 1990.

3. Comment:

The lack of detailed cost figures is definitely a major deficiency in the DEIS and should be rectified.

Response:

Briefly, the reduction in salinity at Imperial Dam would result in direct and indirect benefits annually of about $230,000 per milligram per liter. In addition there are unquantified benefits to recreation, wildlife (particularly aquatic), and aesthetics. The annual equivalent cost of the net salinity decrease at Imperial Dam for the extreme 5-cfs plan would be $192,800 per milligram per liter. If a lower pumping rate were utilized, the cost would be lower.

It is the policy of the Department of the Interior that detailed technical and economic analyses are not provided in environmental statements. This information is developed in technical planning documents which are available for public inspection at the following locations.

Bureau of Reclamation
Upper Colorado Regional Office
125 South State Street
Salt Lake City, Utah 84147

Bureau of Reclamation
Western Colorado Projects Office
835 2nd Avenue
Durango, Colo. 81301

4. Comment:

Radium Evaporation Pond - We question the statement on page A-7 of the DEIS that "nearly all of the pond area is underlain by impervious Mancos Shale, which would prevent seepage of brine into ground or surface waters." Additional data and analyses to support this statement should be supplied particularly in view of the Bureau's own experience in Grand Valley where canals placed in Mancos Shale are leaking with the water leaching considerable amounts of salts from the shale and eventually returning to the river.

Response:

Drilling, studying the logs of existing drill holes, and geological investigations have verified that nearly all of the pond area is underlain by Mancos Shale. At some locations, the thickness of the shale was greater than 600 feet. As pointed out in the environmental statement, areas where the shale is thin or where sandstone crops out would be covered with a blanket of compacted Mancos Shale. Lab tests at the E&R Center have shown the compacted Mancos Shale to have a permeability in the range of 0.005 foot per year.

In Grand Valley, the Mancos Formation is impervious at depth, but a weathered zone near the surface can transmit water along joints, fractures, and bedding planes. The water that is leaking through the weathered shale and leaching salts is relatively pure water when compared to the brine that would be put in Radium Evaporation Pond. At the pond, the exchange of sodium in the brine with the calcium in the shale would cause some structural change in the shale that would aid in the sealing of the pond. Because of the high concentration of salts in the brine, generally no salts would be leached out of the shale.

5. Comment:

The proposed evaporation pond site is also a potential site for the proposed San Miguel Project. Use of the site for brine disposal for the next 100 years would eliminate that option from consideration in developing plans for the San Miguel Project. This should be analyzed in the Paradox Valley EIS.

Response:

The Bureau of Reclamation, in a 1966 Feasibility Report on the San Miguel Project, proposed that Radium Reservoir be built for irrigation, recreation, and fish and wildlife purposes. The water supply for the reservoir would have been imported from the San Miguel River through a project-constructed conveyance system. The project was authorized for construction in 1968 and is now under advance planning studies; the Bureau has modified the plan, however, and no longer proposes a reservoir at the site.

The irrigation area the reservoir served has been deleted because of high salinity return flows. The benefits for recreation, fish, and wildlife are not sufficient to cover the high costs of importing a water supply from the San Miguel River to maintain a reservoir. At the present time, there does not appear to be any potential for including Radium Reservoir in the San Miguel Project plan.

6. Comment:

By letter on October 30, 1975, Union Carbide Corporation requested the Bureau's consideration for their Uravan Mill to participate in the Paradox Valley Project. Less than a year later a meeting was held at Uravan

Plant between Union Carbide and Bureau of Reclamation representatives to discuss the possibility of disposal of the Uravan Mill effluent in Radium Evaporation Pond. There is no mention in the DEIS of such possibilities. Should it be assumed that no plans whatsoever exist for future disposal of mill effluent from the Uravan Plant into Radium Evaporation Pond?

Response:

In discussing the possibility of disposal of the Uravan Mill effluent in Radium Evaporation Pond with representatives from Union Carbide, it was determined that the effluent would need pretreatment before being placed in the pipeline to the evaporation pond. It was also determined that at this time the economics of the pretreatment were not feasible. If in the future the technical problems can be worked out, there still exists some possibility for future disposal of the mill effluent from the Uravan plant into Radium Evaporation Pond.

7. Comment:

The Bureau of Reclamation's Dolores Project involves the construction of McPhee Dam on the river approximately 110 miles upstream from Paradox Valley. This will reduce the average annual flow of the river by about 105,200 acre-feet, or 35% of the flow at Bedrock (DEIS at B-11). What will be the impacts of flow reduction on the operation and effectiveness of the Paradox Valley Unit? It is imperative that they be analyzed in the EIS.

Response:

The operation and effectiveness of the unit would not be affected by the average annual 35 percent reduction in flow of the Dolores River. It is not likely that the river is one of the sources of recharge of the brine. Because the halite-rich zone is between 600 and 1,000 feet below the ground surface and the surfacing brine has a greater density than the recharge water, considerable elevation is needed at the recharge source to create sufficient hydrostatic head to force the brine into the river. During low, high, and average flow years the brine continues to emerge in the river, and the flow in the river does not appear to affect the mechanism or the amount of the discharge.

8. Comment:

In addition, the DEIS states that during late summer and fall the Paradox Valley Unit would deplete essentially all of the flow of the Dolores River between the valley and the mouth of the San Miguel River till the McPhee Dam is completed (DEIS at C-7). Releases after completion of the dam, however, will provide increased flows in Paradox Valley in normal and wet years or about three out of every four years (DEIS at B-14). While the information is appreciated, an analysis is needed of the implications of these depletions and increased flows on the hydrology of the fresh and salt water aquifers in the valley and the operation and efficiency of the salinity control unit.

Response:

The years when the Paradox Valley Unit would essentially deplete all of the flow of the Dolores River between the valley and the mouth of the San Miguel River would be extremely dry years. Historically, flows leaving the valley at these times have contained salt concentration in excess of 20,000 mg/l and have been as high as 160,000 mg/l. The fact that the flows would be possibly eliminated would have very little effect on the hydrology of the fresh and salt water aquifers in the valley. The water level in the river has a very limited effect on the hydrology of the fresh and salt water aquifers in the valley. Even during flood stage approximately only 1/4 mile on each side of the river is affected. The pumping in the well field would affect the ground water in the aquifers to a very limited extent. For instance, it is estimated that ground water levels approximately 1/2 to 1 mile west of the river would only be lowered in the range of a few tenths of a foot.

9. Comment:

By far, the major deficiency of the DEIS is the alternatives section. This section appears to be an after-the-fact justification of the proposed action. It does not analyze all the reasonable alternatives and does not include all the pertinent data even for the alternatives listed to allow consideration of the optimal, cost effective, and least environmentally objectionable plan. It must be recognized that the National Environmental Policy Act (NEPA) is intended to facilitate policy choices. Yet, there can be no choice if alternatives to the proposed action are lacking or inadequately analyzed.

Outside the "nondevelopment" and "Dolores River Bypass Channel" the alternatives listed in the DEIS are entirely for the brine disposal component of the unit. Viable alternatives which must be considered and analyzed in the DEIS include those which would achieve the same objective (reducing Colorado River salinity) with more efficiency and at less cost.

Response:

The alternative section is a presentation of sufficient data on reasonable alternatives and their expected impacts to allow readers to evaluate each plan on its own merits and to compare it with the proposed plan. Based upon the information presented, it is possible to make reasonable judgments about the cost effectiveness and the environmental aspects of each of the plans. As a consequence, this section does facilitate policy choices, as well as explaining the rationale for the selection of the proposed plan. To place even more emphasis on the fact that options have not been foreclosed, Sections A-3a and H-3 point out that various alternatives may still be reanalyzed after the completion of the 2-year testing program at the well field.

The Bureau is aware that most of the plans deal with various means of brine disposal, and this fact is a reflection of where most of the possibilities for variation lie. The Bureau has, however, introduced other methods of preventing the brine from affecting the Dolores River and pointed out the important advantages or disadvantages of each. These methods include (1) attempting to reduce or eliminate the ground water recharge, (2) attempting to prevent the brine from rising to the surface by pumping fresh water into shallow wells and forcing it downward, (3) separating the river from brine ground water by placing it in a lined channel across Paradox Valley, and (4) desalting riverflows to remove salt.

Since the purpose of the Paradox Valley Unit is to remove the brine now surfacing in the valley, all of these alternatives have been directed toward that end. A consideration of other plans elsewhere in the Colorado River Basin that would reduce the salinity of the river at Imperial Dam have been discussed in the basinwide, comprehensive Final Environmntal Statement on the Colorado River Water Quality Improvement Program (FES 77-15, May 19, 1977) prepared by the Bureau of Reclamation and the Soil Conservation Service.

10. Comment:

Another alternative to the proposed action that should have been considered and analyzed in the DEIS is one that would prevent or intercept recharge to the aquifers, thus minimizing brine discharge. While it is recognized that there are several different sources of ground water recharge that occur over a large area in the valley, which may limit the effectiveness and increase the cost of such approach, the option should still be considered as a supplemental control measure. As indicated in the U.S.G.S. report cited earlier, pumping fresh ground water upgradient from zones of leaching would (1) eventually reduce the rate of brine discharge; (2) provide a source of water to augment the flow of the Dolores River during extreme low-flow periods, and replace the flow to the Dolores River that would be diverted by the well field; and (3) provide a replacement source of irrigation water for farmers in the valley who may experience lower yields from their irrigation wells due to interference from the well field. Potential long-term benefits of this option are (1) reduced annual pumping requirements in the well field, (2) reduced annual costs for brine disposal through a pipeline, and (3) extended life of the project.

Response:

For fresh water to become as concentrated as the brine found at the well field, it must circulate through almost pure halite, which is found at depths of 600 to 1,000 feet in test drill holes in Paradox Valley. The Bureau recognizes that there are probably several different recharge sources, and a ground water flow net with the stream lines necessary to show circulation through the halite indicates that the recharge area is very large, including East and West Paradox Valley and the nearby La Sal

Mountains. While it is recognized that some salinity control could be achieved if the recharge could be reduced or eliminated, identifying the particular source or sources of only 1 cfs or less over such a large area could take a very long time with only limited results.

The possibility of using ground water to augment low riverflows and thereby replace the water depleted by the brine well field is being considered, although the Bureau does not believe that there would be any appreciable effect on the brine recharge. If water were made available to augment the river it could not at the same time be used for irrigation in Paradox Valley, nor would the irrigators need additional water, since the brine well field would have no significant effect on their existing wells. In fact, pumping fresh water in western Paradox Valley to try to reduce the brine recharge could as easily reduce the recharge of the fresh-water irrigation wells.

11. Comment:

Among the alternative brine disposal plans listed in the DEIS, the "deep well injection" alternative appears to be the most cost-effective and with the least adverse environmental impacts. Yet no adequate analysis is presented to indicate its feasibility and no data were mentioned to support its rejection. We strongly recommend serious investigation of this alternative before any final disposal plan is adopted. If these investigations prove its infeasibility, however, we recommend serious consideration of the "West Paradox Valley Evaporation Ponds" alternative for brine disposal which costs about half the expense of the proposed plan and will involve construction of the eight ponds, one at a time as needed.

Response:

The alternatives section points out that deep well injection could be the most cost effective of the 2-cfs plans in the event that all conditions are favorable. If, however, the conditions are not uniformly ideal, it may well be the most expensive plan. The total costs could thus vary considerably and could only be determined after drilling and operating the wells.

Deep well injection has not been rejected as a possible brine disposal method. This method is limited to low pumping rates and, because of the large expense associated with an investigation of deep well injection, it is not reasonable to evaluate this alternative or its potential impacts more fully until the effective pumping rate is determined. Sections A-3a and H-1 state that if the testing program indicates that a pumping rate at or near 2 cfs would be effective, the unit plan would be reanalyzed to determine whether another disposal method or site would be more desirable than the proposed plan.

UPPER COLORADO RIVER COMMISSION

355 South Fourth East Street

Salt Lake City, Utah 84111

June 14, 1978

Mr. Harl M. Noble
Acting Regional Director
Upper Colorado Region
U. S. Bureau of Reclamation
P. O. Box 11568
Salt Lake City, Utah 84147

Dear Harl:

We have reviewed the Draft Environmental Statement for the Paradox Valley Unit, Colorado River Basin Salinity Control Project and have the following minor comments for your consideration:

1. Page A-1, second paragraph, second sentence: There are no international salinity standards for the Colorado River. The agreement with Mexico provides only for a differential between Imperial Dam and the Northerly International Boundary. The program is not intended to maintain standards while the Republic of Mexico continues to develop. Mexico is fully utilizing the water available to it from the Colorado River and no new development is intended. We suggest this sentence read as follows:

   "This program would help to maintain salinity standards in the Colorado River while the Colorado River Basin States continue to develop."

2. Page C49, Table C27: We are somewhat confused by the column heading "1976 modified base." A condition resulting in 1102 mg/l at Imperial Dam would appear to be about a 1990 level of salinity. We would appreciate an explanation of the term "1976 modified base."

We appreciate the opportunity to review the Paradox Valley Draft Environmental Statement.

Sincerely yours,

Ival V Goslin

Ival V. Goslin
Executive Director

IVG:hiw

Memorandum

To: Files

Subject: Response to Letter from the Upper Colorado River Commission, Salt Lake City, Utah, Dated June 14, 1978.

1. Comment:

Page A-1, second paragraph, second sentence: There are no international salinity standards for the Colorado River. The agreement with Mexico provides only for a differential between Imperial Dam and the northerly International Boundary. The program is not intended to maintain standards while the Republic of Mexico continues to develop. Mexico is fully utilizing the water available to it from the Colorado River and no new development is intended. We suggest this sentence read as follows:

> "This program would help to maintain salinity standards in the Colorado River while the Colorado River Basin States continue to develop."

Response:

This change was made in Section A-1.

2. Comment:

Page C-49, Table C-27: We are somewhat confused by the column heading "1976 modified base." A condition resulting in 1,102 mg/l at Imperial Dam would appear to be about a 1990 level of salinity. We would appreciate an explanation of the term "1976 modified base."

Response:

A footnote to Section A-2 explains the 1976 modified base, and Section C-11f has a detailed discussion of this base. The effects of many factors are reflected in this base. It includes the natural salt in the river before man's activities as well as the salt resulting from man's activities including storage regulation, diversions for use within and outside of the basin, evaporation, and return flows. The base takes into consideration all Bureau of Reclamation projects constructed or under construction as of 1976.

d. <u>Comments From Individuals</u>

Victor T. Roushar, Attorney, representing Charles Hughes and Marshall Hughes

Donna Netherton for Bill and Carol Koon,
Donna and Ed Netherton, and
Mike and Vivian Young

CHARLES A. PETRIE
(1907-1975)

FRANK J. WOODROW
VICTOR T. ROUSHAR
GERALD D. WEAVER
CHARLES E. WITHERS

WOODROW, ROUSHAR, WEAVER & WITHERS,
ATTORNEYS AT LAW
P. O. BOX 327
MONTROSE, COLORADO 81401

144 SO. UNCOMPAHGRE
PHONE
(303) 249-4531

June 16, 1978

United States Department of Interior
Bureau of Reclamation
Upper Colorado Regional Office
P.O. Box 11568
Salt Lake City, Utah 84147

Re: Colorado River Basin Salinity Control Project, Paradox Valley Unit, Colorado

Gentlemen:

We represent Mr. Marshall Hughes and Mr. Charles Hughes of Norwood, Colorado.

On behalf of our clients we wish to express a very strong protest to the proposed development.

We have just recently reviewed the Draft Environmental Statement and in ouropinion insufficient emphasis is given to the fact that there will be irreversible and irretrievable loss of valuable resources.

The Draft Environmental Statement touches very briefly on the fact that 4,211 acres will be irreversibly and irretrievably committed to uses which are inconsistent with either livestock grazing or wildlife habitat, namely, the evaporation pond, well field, hydrogen sulfide plant, housing, and brine pumping plants.

Our clients will be immeasurably damaged by the loss of 3,110 acres of prime grazing land. The location of the land is such that the grasses and browse are substantially more desirable feed for both livestock and wildlife than much of the surrounding land. In addition, the property belonging to our clients is probably the last well suited natural large reservoir site in the entire state which could be reasonably used for recreational and wildlife purposes in addition to its use for grazing.

In its present use there are taxes collected from the land, almost no services from the tax collecting entities are required, and a valuable commodity is raised, namely, livestock for food and clothing. The proposed use of the property according to the Statement will require the irretrievable commitment of an estimated 7,684,000 cubic yards of soil, sand, gravel, cobble, and rip rap for the dam, dike and pond as well as undetermined amount of materials for roads and other features. The Statement also points out that concrete aggregate of an undetermined quantity would come from the area for construction of the dam, dike, and part of the brine pipeline as well as hydrogen sulfide plant and pumping plants.

The Statement points out that after construction is complete an average of 15,200,000 kilowatt hours of electrical energy will be consumed annually at the brine well field, hydrogen sulfide plant operation, and maintenance housing, and pumping plants. Considering the cost of electricity for the private sector at today's rates for energy it is almost incomprehensible that the Government would be considering such an enormous commitment to this project.

Our clients take exception to the inordinate waste of tax resources for the untried, unproven, and nonsensical project outlined in the Draft Environmental Statement.

The Draft Environmental Statement contains the information that with a maximum pumping rate of 5 c.f.s. and proposed flood storage capacity in Radium Evaporation Pond, 3,950 acre feet would be irretrievably depleted each year from the Lower Dolores River and the Colorado River.

Since the present administration has seen fit to annihilate so many other water projects in the west for the announced purposes of saving the drain on the treasury, we would like to recommend that this particular project be treated in the same manner and that the irreversible destruction which is planned be stopped before the damage becomes greater. The last two parts of the brief statement in the Draft Environmental Statement point out that two archeological sites would be irretrievably disturbed' and that the unit would irreversibly change the scenery for the life of the unit wherever manmade structures are built and that after 100 years Radium Evaporation Pond would be irreversibly committed as a salt flat.

We respectfully submit that such a salt flat is neither needed nor desired by anyone who has any familiarity with the same and particularly not wanted nor desired by our clients whose land will be so horribly destroyed.

Respectfully submitted,

WOODROW, ROUSHAR, WEAVER & WITHERS

By ______________________
Victor T. Roushar

VTR:sg
cc: Mr. Marshall Hughes
Mr. Charles Hughes

Memorandum

To: Files

Subject: Response to Letter from Victor T. Roushar Representing Marshall and Charles Hughes, Dated June 16, 1978.

1. Comment:

We have just recently reviewed the Draft Environmental Statement and in our opinion insufficient emphasis is given to the fact that there will be irreversible and irretrievable loss of valuable resources.

The Draft Environmental Statement touches very briefly on the fact that 4,211 acres will be irreversibly and irretrievably committed to uses which are inconsistent with either livestock grazing or wildlife habitat, namely, the evaporation pond, well field, hydrogen sulfide plant, housing, and the brine pumping plants.

Our clients will be immeasurably damaged by the loss of 3,110 acres of prime grazing land. The location of the land is such that the grasses and browse are substantially more desirable feed for both livestock and wildlife than much of the surrounding land.

Response:

It is emphasized in Chapter G, Irreversible and Irretrievable Commitment of Resources, "that 4,211 acres would be committed to long-term unit purposes." It has also been emphasized throughout the statement that the primary purpose of the Paradox Valley Unit is to help protect the water quality of the Colorado River while Colorado River Basin States, among them the State of Colorado, continue to use and develop their apportioned share of that water. The primary beneficiaries of that development have been, and should continue to be, agricultural and municipal and industrial users, as explained in considerable detail in Section C-11.

The environmental statement attempts to address and measure the potential impacts on the two ranchers who hold land and have grazing permits at the site of the proposed Radium Evaporation Pond. The Bureau of Reclamation has not taken lightly those potential impacts. It has made a number of personal contacts with the people involved advising them of Federal assistance available to them under the Uniform Relocation and Assistance Act (P.L. 91-646). Among the options available to them under the Act is the option of seeking Federal assistance in finding and acquiring replacement property. The Bureau will continue to extend advice and information on the progress and direction of the proposed unit.

One of the indirect beneficiaries in protecting the water quality of the Colorado River is wildlife, particularly aquatic species. It has also been pointed out in the statement (Section C-8) that in the immediate unit area the reduction of brine inflow into the Dolores River would result in upgraded riparian vegetation along the river in and below Paradox Valley, thus indirectly benefiting wildlife.

Through coordination with the Fish and Wildlife Service and the Colorado Division of Wildlife, the Bureau of Reclamation has attempted to compensate for the loss in wildlife habitat that would be caused by the installation or construction of project features. It feels the wildlife program, Section A-3b(7), compensates for those losses. This opinion is shared by the State and Federal agencies with interest and expertise in that area as shown in their letters which have been presented in this section.

2. Comment:

. . . the property belonging to our clients is probably the last well suited natural large reservoir site in the entire state which could be reasonably used for recreational and wildlife purposes in addition to its use for grazing.

Response:

Any reservoir constructed at the Dry Creek Basin site would be shallow with a large surface area and, therefore, subject to considerable evaporation. The amount, timing, and quality of water in Dry Creek would be inadequate to establish and maintain a recreational and wildlife reservoir at this site without substantial imporation of water. Moreover, any type of reservoir, whether for recreation, wildlife, or salinity control, would eliminate grazing at the site.

3. Comment:

In its present use there are taxes collected from the land, almost no services from the tax collecting entities are required, and a valuable commodity is raised, namely, livestock for food and clothing.

Response:

Section C-10 of the Draft and Final Environmental Statements has a discussion of the private land that would be acquired and the reduction in tax revenues. This section also points out that for the loss of these revenues, the counties would receive payment under provisions of Public Law 94-565.

4. Comment:

The proposed use of the property according to the Statement will require the irretrievable commitment of an estimated 7,684,000 cubic yards of soil, sand, gravel, cobble, and riprap for the dam, dike and pond as well as undetermined amount of materials for roads and other features. The statement also points out that concrete aggregate of an undetermined quantity would come from the area for construction of the dam, dike, and part of the brine pipeline as well as hydrogen sulfide plant and pumping plants.

Response:

The materials to be used represent a very small amount of the nonmetallic minerals available in the area. The Bureau of Mines report, Mineral Resources at Paradox Valley Unit, Dolores River, March 1977, states that sand, gravel, and stone are removed from deposits in the region in small quantities and, because these nonmetallic mineral resources are abundant, a mineral-related conflict is not anticipated in the area.

5. Comment:

The statement points out that after construction is complete an average of 15,200,000 kilowatt hours of electrical energy will be consumed annually at the brine well field, hydrogen sulfide plant operation, and maintenance housing, and pumping plants. Considering the cost of electricity for the private sector at today's rates for energy it is almost incomprehensible that the Government would be considering such an enormous commitment to this project.

Response:

It is recognized that the Paradox Valley Unit would use a large amount of electrical energy. The 15,200,000 kilowatt-hours would be sufficient electrical energy to supply the noncommercial need of a town of about 1,500 people. It should be pointed out that the 15,200,000 kilowatt-hours are projected for the 5-cfs rate, which is the estimated maximum rate. Any lower pumping rate would mean lower power consumption. Also, by comparison, energy consumption in a desalinization plant would be 5 times as great to achieve the same effectiveness.

The Paradox Valley Unit, even with the maximum pumping rate of 5 cfs, is still the most cost-effective project of any of the identified salinity control projects. Its operation would not only benefit the 14 million people in the basin but would also help to control the salinity levels in the Colorado River while the Basin States continue to use and develop their apportioned shares of the river's water.

6. Comment:

Our clients take exception to the inordinate waste of tax resources for the untried, unproven, and nonsensical project outlined in the Draft Environmental Statement.

Response:

The major facilities would not be built until the well field has been tested and the method is proven to be effective.

7. Comment:

The Draft Environmental Statement contains the information that with a maximum pumping rate of 5 cfs and proposed flood storage capacity in Radium Evaporation Pond, 3,950 acre feet would be irretrievably depleted each year from the Lower Dolores River and the Colorado River.

Response:

The 5-cfs pumping rate and 3,950 acre-feet stream depletion are preliminary estimates based on a maximum pumping rate. The actual rate and depletion would be established only after the test period, as explained in Sections A-3a and H-1. It is also important to note that the water being depleted from the lower Dolores River and the Colorado River is in the form of a highly saline brine. Although the brine discharge is natural, it is a problem in the Dolores and Colorado Rivers and adversely affects water users downstream and has the potential to stymie continued water resource development in the Basin States. The Paradox Valley Unit's purpose is the elimination of this source of pollution to the benefit of all users in the Basin.

June 21, 1978

Office of Recreational Director
Bureau of Reclamation
P. O. Box 11568
125 South State Street
Salt Lake City, Utah 84147

Gentlemen:

Please find enclosed copy of statement presented June 17, 1978 at the Paradox Valley Salt Removal Project hearing on behalf of the residents of Dry Creek Basin, Colorado.

Very truly,

Ed Netherton

By ______________________
Secretary

EN/dln

Enclosure as stated above

According to Mr. Olsen of the Bureau of Reclamation, there is no population in Dry Creek Basin, but we have a small community of people who live here because they think this is the best place in the world to live. Their whole life's savings and accumulations are in Dry Creek Basin. We are naturally very disturbed at the prospect of a large area of salt flats that we feel would very likely contaminate the air and underground water.

While engineers claim that there would be no fluctuation in the water level other than a constant increase of the area, we have seen cloud bursts during the summer months that cause as much as two or three hundred second feet of water to flow in surrounding arroyos for a period of 30 minutes to one hour. In this particular site, the ridge to the West of the reservoir is a solid sandstone area which is just like a tin roof. When we have cloud bursts, the water would run down these arroyos and into the proposed salt lake, thus making the danger of a fluctuation in the water level very great.

We appreciate the fact that the Bureau of Reclamation had picked Dry Creek Basin on account of the Mancos shale that underlies the proposed evaporation pond, but in the past 30 years we have seen hundreds of seismograph holes and uranium exploration holes drilled through this Mancos shale. We know that underlying the layer of Mancos shale is a strata of good water which is the life blood of many residents in this community. We have been assured by geologists that salt water going through these holes would very likely contaminate any good water that lies under the layer of Mancos shale.

About 90% of the time the direction of the wind in this area is from the West to the East, and as the proposed evaporation pond is on the West side of Dry Creek Basin and the community where we all live is on the East side, we will be down wind and in the direct path of any airborne salt coming off of any salt flats that will most assuredly develop as a result of this evaporation pond. We feel that this blowing salt would completely destroy the vegetation, water fowl and wildlife on our property. We also feel that the odor coming from the salt evaporation process will make living down wind uncomfortable, if not impossible, and may present a hazard to human health. In as much as the evaporation pond will cover more than five and one-half square miles, it is nearly impossible for the wind to blow in any direction without crossing these salt flats.

We know these predictions are contrary to the findings of your engineers, but we do not feel that these objections are without foundation, nor are they improbable.

Our major concern is whether or not the Bureau of Reclamation is prepared to make full restitution in the event that the residents of Dry Creek Basin should suffer damages to their property, homes or livelihood.

Another major concern of the residents in Dry Creek Basin is focused on our school system. We are aware that a possible influx of a number of families for a short period of time would cause an additional amount of duress and strain on our already limited school budget, as we have a small tax base and a large district to support, with a large amount of public domain.

We hope that if the Bureau of Reclamation establishes a camp in this area, that it will be in the area of already existing bus routes so as to prevent prolonged bus runs and additional facilites being put into use.

The aforestated comments are submitted by Bill and Carol Koon, Mike and Vivian Young and Ed and Donna Netherton.

Memorandum

To: Files

Subject: Response to Letter from Donna Netherton dated June 21, 1978.

1. Comment:

According to Mr. Olsen of the Bureau of Reclamation, there is no population in Dry Creek Basin, but we have a small community of people who live here because they think this is the best place in the world to live.

Response:

What Mr. Olsen said was that within the land acquisition boundary of the reservoir there is no population. It is recognized that people would be affected by construction of the unit, and the Bureau of Reclamation is prepared to cooperate with them in any way possible in evaluating the project's effect on them and potential means of mitigation.

2. Comment:

While engineers claim that there would be no fluctuation in the water level other than a constant increase of the area, we have seen cloud bursts during the summer months that cause as much as two or three hundred second feet of water to flow in surrounding arroyos for a period of 30 minutes to one hour. In this particular site, the ridge to the west of the reservoir is a solid sandstone area which is just like a tin roof. When we have cloud bursts, the water would run down these arroyos and into the proposed salt lake, thus making the danger of a fluctuation in the water level very great.

Response:

An inflow of 300 cfs for 1 hour would result in a water level increase of about 0.01 foot in the pond, with its surface area of 3,300 acres. The maximum flood inflow used in the design of the flood storage capacity which was large enough probably never to occur, would have a peak inflow of 39,300 cfs and a total volume of 6,600 acre-feet in 60 hours. This would result in a water level fluctuation of 2 feet in 60 hours when the reservoir surface area was 3,300 acres.

3. Comment:

We appreciate the fact that the Bureau of Reclamation had picked Dry Creek Basin on account of the Mancos Shale that underlies the proposed evaporation pond, but in the past 30 years we have seen hundreds of seismograph holes and uranium exploration holes drilled through this Mancos Shale. We know that underlying the layer of Mancos Shale is a strata of good water which is the life blood of many residents in this community. We have been assured by geologists that salt water going through these holes would very likely contaminate any good water that lies under the layer of Mancos Shale.

Response:

At the time of final design data collection for Radium Evaporation Pond, the Bureau would obtain drilling logs from the companies that have conducted exploratory drilling in the basin--these include Union Carbide Corporation, Atlas Corporation, and AMAX, Inc. It would also consult the drill records of BLM and the Bureau of Mines. Because Reclamation is aware that there may be unrecorded drill sites, it would be prepared to conduct a field search survey to insure that all wells had been located. Methods employed to prevent salt water from escaping through the holes could include plugging and grouting each hole or placing a blanket of compacted Mancos Shale over the hole.

4. Comment:

About 90% of the time the direction of the wind in this area is from the west to the east, and as the proposed evaporation pond is on the west side of Dry Creek Basin and the community where we all live is on the east side, we will be down wind and in the direct path of any airborne salt coming off of any salt flats that will most assuredly develop as a result of this evaporation pond. We feel that this blowing salt would completely destroy the vegetation, water fowl and wildlife on our property.

Response:

Through observations and consultations with others who have been and are operating large brine evaporation ponds, it has been determined that when the salt precipitates out, it crystallizes and becomes a rock-hard mass. Two examples of this were observed, one on the Malaga Bend Experimental Salinity Alleviation Project in New Mexico and the other at Texas Gulf Sulfur at Moab, Utah. Both have a large pond with large amounts of precipitated salts around the edges. Vegetation around the two areas showed no sign that any salt had blown from the pond. In addition, the Union Carbide effluent ponds at Uravan, Colo., used for precipitating salt brine-uranium liquors, produce only large crystalline particles and are free of dust problems. The prevailing winds in the area, as measured at Bureau of Reclamation stations at Bedrock and Dry Creek Basin, are from the southwest. Any minor quantities of windblown salt would be carried to the north of the populated farm area in Dry Creek Basin and in the direction of the alkaline/saline-tolerant sagebrush and greasewood vegetation (see Figure B-7, Vegetation Map). Records show the winds are at their most forceful in spring when the ground is dampest, further reducing the possibility of an airborne dust problem.

5. Comment:

We feel that the odor coming from the salt evaporation process will make living down wind uncomfortable, if not impossible, and may present a hazard to human health. Inasmuch as the evaporation pond will cover more than five and one-half square miles, it is nearly impossible for the wind to blow in any direction without crossing these salt flats.

Response:

The only odor associated with the Paradox brine is due to hydrogen sulfide gas. This gas would be removed from the brine before it is transported to Dry Creek Basin. Because of severe osmotic pressure associated with brine the pond would essentially be lifeless and there would be no odors due to bacteriological factors at the pond site.

6. Comment:

Our major concern is whether or not the Bureau of Reclamation is prepared to make full restitution in the event that the residents of Dry Creek Basin should suffer damage to their property, homes or livelihood.

Response:

It has been the history of the Bureau of Reclamation that it has compensated people for damages to their property, homes, or livelihood if it was responsible for that damage. We assume that this will continue to be standard policy.

7. Comment:

Another major concern of the residents in Dry Creek Basin is focused on our school system. We are aware that a possible influx of a number of families for a short period of time would cause an additional amount of duress and strain our already limited school budget, as we have a small tax base and a large district to support, with a large amount of public domain.

Response:

The statement addresses the probable impacts the influx of construction workers' school children would have on the area's school system in Section C-3d(1). The analysis based on trend data gathered from other Reclamation projects indicates that even at the peak of construction the class rolls should be increased by fewer than 60 students. If the nongovernment construction camp were built near the pond site, as the Bureau of Reclamation feels it would be, most of this increase in enrollment would be felt at the Norwood school. Presently the student-to-teacher ratio there is about 14 to 1. The anticipated influx of students would leave the ratio well below the generally accepted optimum of 25 to 1. Therefore, it should not be necessary to expand the present classroom capacity or teaching capability at the school. However, it might become necessary for the school district to expand its existing school bus program during the peak year of construction to handle the projected increase. The Norwood School District has been notified of these projections and has been advised of the Federal impact aid funds that would be available to them under Public Law 81-874 to help alleviate any increased school operation costs caused by the project.

8. Comment:

We hope that if the Bureau of Reclamation establishes a camp in this area, that it will be in the area of already existing bus routes so as to prevent prolonged bus runs and additional facilities being put into use.

Response:

If, as anticipated, a construction camp would be located near the evaporation pond site, children from the camp would attend school in Norwood. The camp would be on the existing bus route. At present the 62-passenger bus carries 20 children. This capacity would be adequate with the possible exception of the peak construction year. The impact to the school system is discussed in greater detail in Section C-3d(1).

4. Bibliography: Paradox Valley Unit

a. General

Holden, Paul B., and Clair B. Stalnaker. 1975. "Distribution of Fishes in the Dolores and Yampa River Systems of the Upper Colorado Basin," The Southwestern Naturalist. Vol. 19. No. 4.

b. State of Colorado

Burdick, Hal. March 3, 1977. Colorado Division of Wildlife, Personal Communication.

Colorado Division of Wildlife. 1977. Final Report: Fish and Wildlife Inventory, Paradox Valley Unit, Colorado River Basin Salinity Control Project. Denver.

Colorado State University. 1977. Department of Physiology and Biophysics. Final Project Report: Colorado River Desalinization--Wild Duck Study Fort Collins.

District 10 Regional Planning Commission. 1978. Western Montrose County Development Plan. Montrose, Colo.

Hartmann, James E., Curator. 1977. The State Historical Society of Colorado. Letter to the Bureau of Reclamation.

King, G. E. 1976. Aquatic Wildlife of the Paradox Valley Unit, Colorado River Basin Salinity Control Project. Denver: Colorado Division of Wildlife.

Rippeteau, Bruce E. 1977. State Archaeologist. The State Historical Society of Colorado. Letter to the Bureau of Reclamation.

c. State of Utah

Bolton, Herbert E. 1972. Pageant in the Wilderness: The Story of the Escalante Expedition to the Interior Basin. Salt Lake City, Utah, State Historical Society.

Jurinak, J. J. 1977. A Thermodynamic Model of the Paradox Valley Unit Brine. Logan, Utah: Utah State University.

d. U.S. Department of the Interior

Applegarth, Susan. 1975. Archaeological and Cultural Resource Survey of the Paradox Valley Unit. Denver: National Park Service.

________. 1976. Inventory of Archaeological and Historical Resources, Proposed Brine Pipeline 1976, Paradox Valley Unit Project. 2 Vols. Durango: Bureau of Reclamation.

Bennett, Merle O. 1975. Recovery and Rehabilitation of Migratory Water Birds from Trona Mining Evaporation Ponds in Southwestern Wyoming, 1973-1975. Fish and Wildlife Service, Seedskadee National Wildlife Refuge.

Bureau of Outdoor Recreation and Forest Service. 1976. The Dolores River, Colorado: A Potential Addition to the National Wild and Scenic Rivers System, Final Environmental Statement. FES 76-56.

Bureau of Reclamation and Soil Conservation Service. 1977. Colorado River Water Quality Improvement Program. Denver: Bureau of Reclamation.

Bureau of Reclamation. March 8, 1976. Biological Reduction of Elemental Sulphur in Brine to Hydrogen Sulfide--Paradox Valley.

________. May 1976a. Geologic Feasability Report: Radium Dam, Dike, and Evaporation Pond Site.

________. 1977. Construction Worker's Survey. Denver: Engineering and Research Center.

________. May 9, 1977. Dolores Project, Colorado, Final Environmental Statement. INT FES 77-12.

________. February 17, 1977. Negative Determination of Environmental Impact, Design Data Collection Program, Paradox Valley Unit, CRBSCP.

________. 1978. Paradox Valley Definite Plan Report.

________. 1978a. Paradox Valley Definite Plan Report, Appendix A, Designs and Estimates.

________. 1978b. Paradox Valley Definite Plan Report, Appendix B, Hydrosalinity.

Cater, Fred W. 1970. Geology of the Salt Anticline Region in Southwestern Colorado: Geological Survey Professional Paper 637. Washington, D.C., Government Printing Office.

Cressey, Scott, and Richard Gard. 1975. Review of Literature Concerning Animals and Plants in the Paradox Valley Area of Colorado. Durango: Bureau of Reclamation.

Fish and Wildlife Service. 1976. "Endangered and Threatened Wildlife and Plants," Federal Register. Vol. 41, No. 115, Part II; and Vol. 41, No. 117, Part IV.

________. January 21, 1977. Advance Planning Aid Memorandum--Paradox Valley Unit. Memorandum to Bureau of Reclamation.

________. February 15, 1977. Compliance with Section 7 of the Endangered Species Act of 1973. Memorandum to Bureau of Reclamation.

________. October 18, 1977. Endangered Species Consultation--Paradox Valley Unit. Memorandum to Bureau of Reclamation.

Kleinman, Allan, Glade Barney, and Sigard Titmus. 1974. Economic Impacts of Changes in Salinity Levels of the Colorado River. Denver: Bureau of Reclamation.

National Park Service. 1977. "National Register of Historic Places," Federal Register. Vol. 42, No. 21.

Somers, Preston. 1976. Final Report: Fauna Inventory of the Paradox Valley Unit. Durango: Bureau of Reclamation.

Turner, Frank P. 1975. Feasibility Study of Brine Disposal by Deep Well Injection on the Paradox Valley Unit. Salt Lake City, (available at the Bureau of Reclamation in Durango, Colo.).

Ward, Albert E. 1976. Mineral Resources at Paradox Valley Unit, Dolores River, Montrose and San Miguel Counties, Colorado. Denver: Bureau of Mines.

5. Bibliography: Cumulative Impacts

a. General

Ecology Consults, Inc., Flora and Terrestrial Vertebrate Studies in the Grand Valley, Colorado. Fort Collins, Colo. June 1976, 281 pages and 3 appendices.

Erdman, James, and Stanley L. Welsh, Annotated Checklist of the Plants of Mesa Verde, Colo., Biological Series, Vol. IV, No. 2 (Provo, Utah: Brigham Young University, April 1964).

Fenneman, Nevin M., Physiography of Western United States (New York: McGraw-Hill, 1931).

Holden, Paul B., and Clair B. Stalnaker, "Distribution of Fishes in the Dolores and Yampa River Systems of the Upper Colorado Basin," The Southwestern Naturalist, Vol. 19, No. 3 (1974).

Holden, Paul B., and Clair B. Stalnaker, "Distribution and Abundance of Mainstream Fishes of the Middle and Upper Colorado River Basin 1967-1973," Transactions of the American Fisheries Society. 104:2 April 1975 pp 217-231.

Kidd, George, An Investigation of Endangered and Threatened Fish Species in the Upper Colorado River as Related to Bureau of Reclamation Projects. January 1977, 43 pages.

Kolstad, Charles D., 1975 Energy Production System in the States of the Rocky Mountain Region. Los Alamos Scientific Laboratory, University of California. Prepared for the U.S. Energy Research and Development Administration. December 1975.

Rocky Mountain/Southwestern Peregrine Falcon Recovery Team, American Peregrine Falcon Recovery Plan (1976).

Woodbury, Angus M., et al., A Survey of Vegetation in the Flaming Gorge Reservoir Basin. University of Utah, Department of Anthropology, Salt Lake City, Utah, 1960, 128 pages.

________. Ecological Studies of Flora and Fauna in Glen Canyon. University of Utah, Department of Anthropology, Salt Lake City, Utah, 1959, 238 pages.

________. Ecological Studies of the Flora and Fauna of Navajo Reservoir Basin, Colorado and New Mexico. University of Utah, Department of Anthropology, Salt Lake City, Utah, 1961, 203 pages.

________. Ecological Studies of the Flora and Fauna of the Curecanti Reservoir Basin, Western Colorado. University of Utah, Department of Anthropology, Salt Lake City, Utah, 1962, 285 pages.

b. State of Arizona

Arizona Outdoor Recreation Coordinating Commission, Statewide Comprehensive Outdoor Recreation Plan, Phoenix, Ariz.

c. State of Colorado

Department of Agriculture and U.S. Department of Agriculture, Colorado Agricultural Statistics, 1970-1975 (Denver, Colo.).

Division of Game, Fish, and Parks, 1970 Colorado Comprehensive Outdoor Recreation Plan, Denver, Colo., 1970.

Division of Parks and Outdoor Recreation, 1976 Colorado-Comprehensive Outdoor Recreation Plan, Vol. I, Denver, Colo., 1976.

Division of Wildlife Annual Surveys (1975).

Water Conservation Board and United States Department of Agriculture, Water and Related Land Resources: Dolores River Basin, Colorado and Utah (Denver: September 1972).

Water Conservation Board and United States Department of Agriculture, Water and Related Land Resources: San Juan River Basin; Arizona, Colorado, New Mexico, and Utah (Denver: June 1974).

d. State of Utah

Division of Wildlife Resources. Flaming Gorge Reservoir, Post Impoundment Big Game Study. Publication 73-8, 1973, 112 pages.

Institute for the Study of Outdoor Recreation and Tourism--, Outdoor Recreation Participation 1971-1972, Utah State University, Logan, Utah, 1973.

Outdoor Recreation Agency, Utah State Comprehensive Outdoor Recreation Plan, Salt Lake City, Utah, April 1, 1973.

e. State of Wyoming

Game and Fish Commission. Preimpounded Study of the Flaming Gorge Reservoir. Fisheries Technical Report #9, 1960, 81 pages.

Recreation Commission, An Outdoor Recreation Plan for Wyoming, Cheyene, Wyoming, September, 1973.

f. U.S. Department of Agriculture

Forest Service, Multiple Use Impact Survey Report: Dolores Project (Denver: Rocky Mountain Region, 1971).

Soil Conservation Service, An Appraisal of Outdoor Recreation Potentials in Dolores and Montezuma Counties (May 1970).

g. U.S. Department of Commerce

Berry, Joseph W. "The Climate of Colorado," Climate of the States: Volume II--Western States, Including Alaska and Hawaii, ed. National Oceanic and Atmospheric Administration (Port Washington, N.Y.: Water Information Center, Inc., 1974).

Bureau of the Census, General Housing Characteristics, Colorado: Census of Housing, 1970 (Washington, D.C.).

Bureau of the Census, General Social and Economic Characteristics, Colorado, 1970 Census of Population (Washington, D.C.).

Bureau of the Census, Number of Inhabitants, Colorado, 1939-1970, Census of Population (Washington, D.C.).

U.S. Department of Commerce, Bureau of Census. United States Census of Agriculture, 1969, Vol. I, Colorado, Utah, New Mexico, and Wyoming.

Bureau of Economic Analysis, Personal Income by Major Source, 1974 (Washington, D.C.).

Census of Agriculture, Colorado (Washington, D.C., 1949, 1959, 1964, 1969, 1974).

Statistical Abstract of the United States (1972).

h. U.S. Department of the Interior

________. Navajo Indian Irrigation Project, New Mexico, Draft Environmental Statement, 1955.

________. Navajo Project, New Mexico, Feasibility Report, January 1955.

Bureau of Land Management, Habitat Management Series of Endangered Species, No. 1 (1972).

Bureau of Reclamation, 19th Annual Report, Colorado River Storage Project and Participating Projects for Fiscal Year 1975.

________. San Miguel Project, Colorado, Feasability Report, February 1966.

________. Bonneville Unit, Central Utah Project, Final Environmental Statement, INT FES 73-42, August 1973.

________. Dallas Creek Project, Colorado, Final Environmental Statement, INT FES 76-50, September 1976.

________. Dolores Project, Colorado, Draft Environmental Statement, INT DES 76-44, November 1976.

________. Federal Reclamation Projects Water and Land Resources Accomplishments, 1975. Statistical Appendices I and II.

________. Fruitland Mesa Project, Colorado, Final Environmental Statement, 1977.

________. Jensen Unit, Central Utah Project, Final Environmental Statement, INT FES 75-103, December 1975.

________. Lyman Project, Wyoming, Final Environmental Statement, INT FES 75-100, December 1975.

________. Proposed Western Gasification Company Coal Gasification Project and Expansion of Utah International, Inc., San Juan County, New Mexico, Final Environmental Statement, INT FES 76-2, January 1976.

________. Quality of Water, Colorado River Basin, Progress Report No. 8 (January 1977).

________. "Recreation and Wildlife Summary," Salt Lake City, Utah, 1971, 1972, 1973, 1974, 1975, 1976.

________. Savery-Pot Hook Project, Colorado and Wyoming, Draft Environmental Statement, INT DES 76-37, December 1976.

Bureau of Reclamation and Fish and Wildlife Service and Colorado Division of Wildlife. San Juan-Chama Stream Fisheries Monitoring Study, Albuquerque, N. Mex., December 1976, 72 pages and 7 appendices.

Bureau of Reclamation and Soil Conservation Service, Colorado River Water Quality Improvement Program, Final Environmental Statement, 2 vols. (Denver: scheduled for release in 1977).

Harris, Guy W., Jr., The Impacts of Various Metals on the Water Quality in Ridgway Reservoir (Bureau of Reclamation, July 1976).

Kleinman, Allan, Glade Barney, and Sigurd Titmus, Economic Impacts of Changes in Salinity Levels of the Colorado (Denver: Bureau of Reclamation, February 1974).

Owen, H.E., Final Vegetative Inventory Report for the Dolores Project (Durango, Colo.: Bureau of Reclamation, August 1, 1974).

Somers, Preston, Final Field Report: Dolores Project Amphibian and Reptile Inventory, (Durango, Colo.: Bureau of Reclamation, 1975).

Fish and Wildlife Service, A Report on Fish and Wildlife Resources, Curecanti Unit, CRSP, Colorado. Albuquerque, N. Mex., September 1957, 32 pages.

________. A Report on Fish and Wildlife Resources in Relation to Colorado River Storage Project, Colorado River Basin, Colorado, Albuquerque, N. Mex., November 1958, 14 pages.

________. A Report on Fish and Wildlife Resources in Relation to the Glen Canyon Unit, CRSP, Colorado River, Utah and Arizona. Albuquerque, N. Mex., June 1958, 17 pages.

________. A Report on Fish and Wildlife Resources in Relation to Hammond (Participating) Project CRSP, Colorado River Basin, New Mexico Albuquerque, N. Mex., February 1958, 15 pages.

________. A Report on the Fish and Wildlife Resources in Relation to the Plan for the Seedskadee Project, Green River Subbasin, Wyoming, Albuquerque, N. Mex., November 1958, 26 pages.

________. Jensen, Buddy Lee, Dolores Project Investigations: Ute Mountain Ute Indian Reservation, Colorado, and New Mexico, (Gallup, N. Mex.: January 30, 1975).

________. Colorado River Storage Project, Bostwick Park Project, Colorado--Bureau of Sport Fisheries and Wildlife Report. Albuquerque, N. Mex., July 1959, 6 pages.

________. Dolores Project, Colorado. Salt Lake City, Utah, March 1976, 15 pages.

________. "Dolores Project, Colorado," Memorandum to the Bureau of Reclamation, Salt Lake City, Utah, March 19, 1976.

________. Emery County Project, Utah, Albuquerque, N. Mex., July 1969, 9 pages.

________. "Endangered and Threatened Wildlife and Plants," Federal Register, Vol. 41, No. 115, Part II (Monday, June 14, 1976) and Vol. 41, No. 117, Part IV (Wednesday, June 16, 1976).

________. Fish and Wildlife Resources in Relation to the Bonneville Unit Central Utah Project, Initial Phase, Albuquerque, N. Mex., 1965, 62 pages.

________. Florida Project, Colorado--Bureau of Sport Fisheries and Wildlife Report. Albuquerque, N. Mex., June 1959, 11 pages.

________. The Fontenelle and Green River Trout Fisheries--Considerations in its Enhancement and Perpetuation, Including Test Flow Studies of 1973, Salt Lake City, Utah, March 1974, 74 pages.

________. Savery-Pot Hook Project, Colorado and Wyoming--A Report on Fish and Wildlife Resources. Denver, Colo., 1976, 39 pages.

________. Silt Project, Colorado--Bureau of Sport Fisheries and Wildlife Report. Albuquerque, N. Mex., September 1961, 5 pages.

________. State Supervisor, Animal Damage Control, letter to the Bureau of Reclamation, Denver, Colo., August 10, 1976.

________. "Threatened or Endangered Fauna or Flora," Federal Register, Vol. 41, No. 208, Washington, D.C., October 27, 1976.

________. Ute Mountain Wildlife Inventory Report, Dolores Project, Colo. (Albuquerque, N. Mex.: May 28, 1976).

Leavesley, George H., Quantity and Quality of Principal Rivers Entering the Southern Ute and Ute Mountain Ute Indian Reservations, Colo., and N. Mex. (Lakewood, Colo.: Geological Survey, 1975).

National Park Service, "National Register of Historic Places", Federal Register, Vol. 41, No. 28 (February 10, 1976).

Sublette, James E., "A Survey of the Fishes of the San Juan River Basin, With Particular Reference to the Endangered Species," (Portales, N. Mex.: Eastern New Mexico University), a report submitted to the Fish and Wildlife Service.

U.S. Environmental Protection Agency

Report for an Investigation of Pesticides Pollution in the Lower Colorado River Basin, 1973 (December 1973).

Water Resources Council

Comprehensive Framework Study. Appendices I through XVIII, Pacific Southwest Interagency Committee, June 1971.

"Water and Related Land Resources," Federal Register, Vol. 38, No. 174 (Monday, September 10, 1973), pages 24779-24869.

1975 Water Assessment: Specific Problem Analyses, Upper Colorado Region Technical Memorandum No. 2, August 1976.

ATTACHMENTS

Chemical analysis of water samples[1/]

Sheet 1 of 4

Constituents	Units	Number of samples	Sampling period	Concentration Minimum	Average	Maximum	Drinking water standards Public Health Service	Colorado	Number of times exceeded
				Dolores River at Bedrock[2/]					
Flow	cfs		8-71 to 10-76	0	448.5	6,240.0			
Temperature	°F	256	8-71 to 10-76	32.0	52.0	89.0			
Conductivity (25° C)	micromho	256	8-71 to 10-76	201.0	1,094.0	4,470.0			
pH	su	256	8-71 to 10-76	7.2	8.0	8.5			
TDS	mg/l	256	8-71 to 10-76	120.0	697.0	3,670.0	500	500	149
Calcium (total)	mg/l	256	8-71 to 10-76	6.4	80.1	460.0			
Magnesium (total)	mg/l	256	8-71 to 10-76	1.5	24.6	132.0	125	125	1
Sodium (total)	mg/l	256	8-71 to 10-76	5.0	117.0	759.0			
Potassium (total)	mg/l	256	8-71 to 10-76	.8	6.0	28.2			
Chloride (total)	mg/l	256	8-71 to 10-76	3.9	148.2	1,169.0	250	250	47
Sulfate (total)	mg/l	256	8-71 to 10-76	2.7	204.4	2,170.0	250	250	54
Carbonate (total)	mg/l	256	8-71 to 10-76	0	.9	20.0			
Bicarbonate (total)	mg/l	256	8-71 to 10-76	81.0	176.4	332.0			
				Dolores River at Bedrock[3/]					
Flow	cfs	50	10-64 to 6-66	18.0	544.6	4,370.0			
Conductivity (25° C)	micromho	51	9-64 to 6-66	215.0	835.1	1,780.0			
pH	su	51	9-64 to 6-66	7.0	7.9	8.6			
Total hardness	mg/l	51	9-64 to 6-66	95.0	259.8	1,040.0			
Calcium (diss.)	mg/l	51	9-64 to 6-66	30.0	72.1	356.0			
Magnesium (diss.)	mg/l	51	9-64 to 6-66	4.9	19.4	39.0	125	125	0
Sodium (diss.)	mg/l	51	9-64 to 6-66	6.9	73.0	188.0			
Potassium (diss.)	mg/l	51	9-64 to 6-66	1.0	3.8	8.7			
Chloride	mg/l	51	9-64 to 6-66	4.9	90.2	288.0	250	250	2
Sulfate (total)	mg/l	51	9-64 to 6-66	26.0	157.8	916.0	250	250	5
Bicarbonate	mg/l	51	9-64 to 6-66	87.0	164.8	245.0			
Silica (diss.)	mg/l	1	9-64	9.0	9.0	9.0			
Boron (diss.)	µg/l	1	9-64	200.0	200.0	200.0			
Radioactivity									
Alpha (diss.)	pc/l	14	12-69 to 1-71	1.1	5.8	11.0			
Alpha (susp.)	pc/l	14	12-69 to 1-71	.2	1.9	4.7			
Alpha (total)	pc/l	14	12-69 to 1-71	2.7	7.7	14.0			
Beta (diss.)	pc/l	14	12-69 to 1-71	4.8	10.6	20.0			
Beta (susp.)	pc/l	14	12-69 to 1-71	.9	5.0	14.0			
Beta (total)	pc/l	14	12-69 to 1-71	8.3	15.6	25.0	[4/]1,000		0
Radium-226 (diss.)	pc/l	156	10-61 to 6-72	.03	.5	13.8	3		1
Radium-226 (susp.)	pc/l	1	6-69	.8	.8	.8			
Radium-226 (sed.)	pc/l	1	1-69	2.3	2.3	2.3			
Strontium-90 (total)	pc/l	1	10-69	2.2	2.2	2.2	10		0
Strontium-89 (total)	pc/l	1	10-69	0	0	0			
Uranium (diss.)	µg/l	143	10-62 to 6-72	.1	8.5	35.0			
				West Paradox Creek[2/]					
Flow	cfs	255	8-71 to 9-76	.3	6.6	96.0			
Temperature	°F	255	8-71 to 9-76	32.0	49.0	82.0			
Conductivity (25° C)	micromho	255	8-71 to 9-76	395.0	1,303.0	2,540.0			
pH	su	255	8-71 to 9-76	7.5	8.0	8.7			
TDS	mg/l	255	8-71 to 9-76	262.0	1,005.0	1,970.0	500	500	237
Calcium (total)	mg/l	255	8-71 to 9-76	46.0	137.3	245.0			
Magnesium (total)	mg/l	255	8-71 to 9-76	15.0	80.8	188.0	125	125	8
Sodium (total)	mg/l	255	8-71 to 9-76	8.0	44.0	200.0			
Potassium (total)	mg/l	255	8-71 to 9-76	1.2	4.6	63.0			
Chloride (total)	mg/l	255	8-71 to 9-76	6.4	45.1	294.0	250	250	2
Sulfate (total)	mg/l	255	8-71 to 9-76	90.0	476.3	936.0	250	250	237
Carbonate (total)	mg/l	255	8-71 to 9-76	0	1.1	34.0			
Bicarbonate (total)	mg/l	255	8-71 to 9-76	96.0	260.1	379.0			
				Dolores River at exit from Paradox Valley[2/]					
Flow	cfs	276	8-76 to 10-76	.6	460.6	6,270.0			
Temperature	°F	284	6-70 to 10-76	30.0					
Turbidity	NTU	21	6-70 to 11-74	2.0	394.1	5,000.0			
Conductivity (25° C)	micromho	284	6-70 to 10-76	218.0	17,231.0	164,000.0			
pH	su	278	6-70 to 10-76	7.0	7.9	8.8			
TDS	mg/l	280	6-70 to 10-76	150.0	12,282.0	166,000.0	500	500	231
Ammonia (total)	mg/l	22	6-70 to 11-74	0	.5	4.5			
Calcium (total)	mg/l	276	6-70 to 10-76	27.0	165.5	985.0			
Magnesium (total)	mg/l	276	6-70 to 10-76	4.5	108.7	1,152.0	125	125	70
Sodium (total)	mg/l	280	6-70 to 10-76	7.0	4,309.0	57,960.0			
Chloride (total)	mg/l	284	6-70 to 10-76	5.0	6,911.1	92,638.0	250	250	226
Sulfate (total)	mg/l	277	6-70 to 10-76	27.0	618.5	5,856.0	250	250	183
Carbonate (total)	mg/l	257	8-71 to 10-76	0	.6	17.0			
Bicarbonate (total)	mg/l	257	8-71 to 10-76	69.0	189.3	317.8			
Potassium (total)	mg/l	257	8-71 to 10-76	1.6	225.1	2,893.0			
				Dolores River, ¼ mile above confluence with San Miguel River[3/]					
Temperature	°F	47	6-70 to 7-76	32.0	52.8	85.0			
Turbidity	NTU	41	6-70 to 7-76	2.0	266.6	5,000.0			
Conductivity (25° C)	micromho	47	6-70 to 7-76	320.0	11,193.3	100,000.0			
Dissolved oxygen	mg/l	27	5-73 to 7-76	7.7	10.1	14.2			
B.O.D. (5-day)	mg/l	33	6-70 to 7-76	.3	1.7	6.0			
C.O.D.	mg/l	1	8-72	25,578.0	25,578.0	25,578.0			
pH	su	36	6-70 to 7-76	7.5	8.1	8.8			
Ammonia (total)	mg/l	42	6-70 to 7-76	0	.4	4.5			
Nitrite (total)	mg/l	41	6-70 to 7-76	0	.02	.3			
Nitrate (total)	mg/l	39	6-70 to 7-76	0	.4	3.2			
Nitrogen (total KJEL)	mg/l	2	4-76 to 6-76	3.4	4.0	4.6			
Phosphorus (total)	mg/l	24	3-74 to 7-76	0	.1	1.1			
Phosphates (total)	mg/l	16	6-70 to 9-73	0	.1	.4			
Cyanide (total)	mg/l	23	6-70 to 6-76	0	0	0	.20	.01	0
Total hardness	mg/l	41	6-70 to 7-76	110.0	624.0	3,120.0			
Calcium	mg/l	28	6-70 to 6-76	78.0	442.5	2,840.0			
Magnesium (total)	mg/l	28	6-70 to 6-76	7.0	71.8	334.0	125	125	4
Sodium (total)	mg/l	42	6-70 to 7-76	11.0	3,105.3	4,800.0			

1/ All data, with the exception of Bureau of Reclamation information, are STORET data from the Air and Water Surveillance and Analysis Division, Environmental Protection Agency, Denver, Colo.

2/ Samples collected by Bureau of Reclamation.

3/ Samples collected by Colorado State Department of Health.

4/ If radium-226 and strontium-90 are within their respect limits, water having a gross beta concentration of up to 1,000 pc/l is usually acceptable. When radium-226 and strontium-90 exceed the limits, the radioactivity of the water supply should be investigated even if the gross beta concentration is less than 1,000 pc/l.

Chemical analysis of water samples1/ (continued)

Constituents	Units	Number of samples	Sampling period	Concentration Minimum	Concentration Average	Concentration Maximum	Drinking water standards: Public Health Service	Drinking water standards: Colorado	Drinking water standards: Number of times exceeded
Dolores River, ½ mile above confluence with San Miguel River2/ (continued)									
Sodium adsorption ratio		40	6-70 to 7-76	0.4	33.5	220.0			
Chloride	mg/l	46	6-70 to 7-76	9.0	4,495.1	76,000.0	250	250	33
Sulfate (total)	mg/l	29	6-70 to 6-76	46.0	527.5	3,330.0	250	250	21
Fluoride (total)	mg/l	26	6-70 to 6-76	.1	.2	.8		2.4	0
Arsenic (total)	µg/l	24	6-70 to 6-76	0	0	0	50	10	0
Boron (total)	µg/l	26	6-70 to 6-76		297.3	2,600.0			
Cadmium (total)	µg/l	24	6-70 to 6-76		3.1	72.0	10	10	1
Chromium (hexavalent)	µg/l	24	6-70 to 6-76		6.7	160.0	50	50	1
Copper (total)	µg/l	24	6-70 to 6-76		4.0	50.0	1,000	1,000	0
Iron (total)	µg/l	26	6-70 to 6-76		702.7	6,000.0	300	300	8
Lead (total)	µg/l	24	6-70 to 6-76		1.8	29.0	50	50	0
Manganese	µg/l	24	6-70 to 6-76		80.0	500.0	50	50	9
Molybdenum (total)	µg/l	18	2-71 to 6-76		7.8	100.0			
Silver (total)	µg/l	9	11-70 to 6-76		6.7	60.0	50		1
Zinc (total)	µg/l	25	6-70 to 6-76		80.0	790.0	5,000	5,000	0
Selenium (total)	µg/l	24	6-70 to 6-76		.8	5.0	10	10	0
Mercury (total)	µg/l	4	11-70 to 1-72	0	.3	.9			
Radioactivity									
Alpha (diss.)	pc/l	24	7-70 to 6-76	1.7	51.3	231.0			
Beta (diss.)	pc/l	24	7-70 to 2-76	6.0	96.2	446.7	1,000		0
Radium-226 (diss.)	pc/l	9	8-70 to 2-76	.3	.7	1.2	3		0
Total coliform (MPN CONF)	/100 ml	46	7-70 to 7-76	2.0	1,383.6	3,000.0			
Fecal coliform (MPNECMEO)	/100 ml	47	7-70 to 7-76	2.0	731.0	3,000.0			
MBAS	mg/l	39	6-70 to 7-76	0	0	.4			
Dry Creek at confluence with San Miguel River3/									
Flow	cfs	18	3-73 to 3-77	0	26.8	418.0			
Conductivity (25° C)	micromho	30	9-60 to 3-77	610.0	3,554.0	8,860.0			
pH	su	30	9-60 to 3-77	7.1	7.8	8.2			
TDS	mg/l	30	9-60 to 3-77	414.0	3,469.0	9,800.0	500	500	29
Calcium	mg/l	30	9-60 to 3-77	59.0	295.4	470.0			
Magnesium	mg/l	30	9-60 to 3-77	14.0	194.2	732.0	125	125	17
Sodium	mg/l	30	9-60 to 3-77	48.0	387.0	1,162.0			
Potassium	mg/l	30	9-60 to 3-77	4.3	10.0	23.0			
Chloride	mg/l	30	9-60 to 3-77	9.9	85.3	266.0	250	250	1
Sulfate	mg/l	30	9-60 to 3-77	161.0	2,007.7	5,549.0	250	250	28
Carbonate	mg/l	30	9-60 to 3-77	0	1.4	9.3			
Bicarbonate	mg/l	30	9-60 to 3-77	87.0	242.8	629.0			
San Miguel River at confluence with Dolores River4/									
Temperature	°F	47	6-70 to 7-76	32.0	51.1	76.0			
Turbidity	Hach NTU	42	7-70 to 7-76	3.7	88.1	800.0			
Conductivity (25° C)	micromho	47	6-70 to 7-76	310.0	1,039.9	2,400.0			
Dissolved oxygen	mg/l	26	3-73 to 7-76	7.0	10.1	14.8			
B.O.D. (5-day)	mg/l	42	6-70 to 7-76	.9	14.2	384.0			
C.O.D.	mg/l	2	8-72 to 10-72	30.0	1,209.5	2,389.0			
pH	su	36	6-70 to 7-76	7.4	8.1	9.1			
Ammonia (total)	mg/l	45	6-70 to 7-76	0	9.8	41.0			
Nitrite (total)	mg/l	45	6-70 to 7-76	0	.3	2.5			
Nitrate (total)	mg/l	45	6-70 to 7-76	.2	2.0	11.0	45	45	0
Nitrogen (total KJEL)	mg/l	1	6-76	5.2	5.2	5.2			
Phosphate (total)	mg/l	21	6-70 to 9-73	0	.1	.3			
Phosphorus (total)	mg/l	23	3-74 to 7-76	0	.1	.6			
Cyanide (total)	mg/l	26	6-70 to 6-76	0	0	0	.2	.01	0
Total hardness	mg/l	39	6-70 to 7-76	122.0	412.8	894.0			
Calcium	mg/l	28	6-70 to 6-76	114.0	277.8	545.0			
Magnesium (total)	mg/l	28	6-70 to 6-76	7.0	39.6	112.0	125	125	0
Sodium (total)	mg/l	39	6-70 to 7-76	14.0	55.6	140.0			
Sodium adsorption ratio		39	6-70 to 7-76	.4	1.1	2.7			
Chloride	mg/l	40	6-70 to 7-76	7.0	48.7	151.0	250	250	0
Sulfate (total)	mg/l	28	6-70 to 6-76	56.0	393.7	944.0	250	250	19
Fluoride (total)	mg/l	28	6-70 to 6-76	.1	.4	.9		2.4	0
Arsenic (total)	µg/l	26	6-70 to 6-76	0	0	0	50	10	0
Boron (total)	µg/l	28	6-70 to 6-76		64.6	170.0			
Cadmium (total)	µg/l	26	6-70 to 6-76		.5	10.0	10	10	0
Chromium (hexavalent)	µg/l	26	6-70 to 6-76		0	0	50	50	0
Copper (total)	µg/l	26	6-70 to 6-76		30.5	770.0	1,000	1,000	0
Iron (total)	µg/l	26	6-70 to 6-76		306.2	2,200.0	300	300	4
Lead (total)	µg/l	26	6-70 to 6-76		4.5	74.0	50	50	1
Manganese	µg/l	27	6-70 to 6-76		115.2	600.0	50	50	12
Molybdenum (total)	µg/l	19	2-71 to 6-76		1.6	10.0			
Silver (total)	µg/l	9	11-70 to 6-76		0	0	50		0
Zinc (total)	µg/l	26	6-70 to 6-76		32.3	270.0	5,000	5,000	0
Selenium (total)	µg/l	26	6-70 to 6-76		1.1	10.0	10	10	0
Mercury	µg/l	3	11-70 to 1-72	0	0	0			
Radioactivity									
Alpha (diss.)	pc/l	23	6-70 to 2-76	7.0	24.5	135.0			
Beta (diss.)	pc/l	10	11-70 to 9-75	11.9	19.4	36.0	5/1,000		0
Radium-226 (diss.)	pc/l	10	6-70 to 11-75	.2	.6	2.8	3		0
Total coliform (MPN CONF)	/100 ml	47	7-70 to 7-76	4.0	3,045.1	30,000.0			
Fecal coliform (MPNECMEO)	/100 ml	48	7-70 to 7-76	2.2	200.6	2,200.0			
MBAS	mg/l	39	6-70 to 7-76	0	0	0			
Fecal streptococcus (MF M-ENT)	/100 ml	1	7-72	.1	.1	.1			
Dolores River below mouth of San Miguel River3/									
Flow	cfs	63	9-74 to 5-76	38.0	674.0	4,820.0			
Temperature	°F	63	9-74 to 5-76	32.0	49.0	77.0			
Conductivity (25° C)	micromho	63	9-74 to 5-76	268.0	3,750.0	12,600.0			
pH	su	63	9-74 to 5-76	5.6	7.7	8.6			
TDS	mg/l	63	9-74 to 5-76	171.0	2,227.0	7,920.0			
Calcium	mg/l	63	9-74 to 5-76	36.0	106.0	260.0			
Magnesium	mg/l	63	9-74 to 5-76	6.0	51.0	207.0	125	125	1
Sodium	mg/l	63	9-74 to 5-76	9.0	612.0	2,208.0			
Chloride	mg/l	63	9-74 to 5-76	6.0	955.0	3,515.0	250	250	46
Sulfate	mg/l	63	9-74 to 5-76	36.0	379.0	1,513.0	250	250	43
Carbonate	mg/l	63	9-74 to 5-76	0	.5	17.0			
Bicarbonate	mg/l	63	9-74 to 5-76	10.0	147.0	373.0			
Potassium	mg/l	63	9-74 to 5-76	2.0	32.0	113.0			

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2/ Samples collected by Colorado State Department of Health.

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5/ If radium-226 and strontium-90 are within their respective limits, water having a gross beta concentration of up to 1,000 pc/l is usually acceptable. When radium-226 and strontium-90 exceed the limits, the radioactivity of the water supply should be investigated even if the gross beta concentration is less than 1,000 pc/l.

Chemical analysis of water samples1/ (continued)

Constituents	Units	Number of samples	Sampling period	Concentration: Minimum	Concentration: Average	Concentration: Maximum	Drinking water standards: Public Health Service	Drinking water standards: Colorado	Drinking water standards: Number of times exceeded
Dolores River at Gateway2/									
Flow	cfs	186	1-70 to 9-73	10.0	934.4	1,250.0			
Temperature	°F	191	1-70 to 9-73	32.0	50.5	79.7			
Conductivity (25° C)	micromho	190	1-70 to 9-73	300.0	2,356.0	8,000.0			
Dissolved oxygen	mg/l	81	4-70 to 8-73	5.4	9.3	14.0			
Carbon dioxide	mg/l	12	12-71 to 9-73	2.8	7.4	11.0			
pH	su	125	1-70 to 9-73	6.5	7.4	8.5			
TDS	mg/l	44	1-70 to 9-73	212.0	1,418.8	4,680.0	500	500	30
Nitrate (diss.)	mg/l	1	10-70	4.7	4.7	4.7			
Nitrite and nitrate (diss.)	mg/l	36	10-70 to 9-73	.2	1.4	3.5			
Phosphate	mg/l	37	2-70 to 9-73	0	.1	.6			
Phosphorus	mg/l	36	10-70 to 9-73	0	0	.2			
Total hardness	mg/l	44	1-70 to 9-73	130.0	421.7	1,100.0			
Calcium (diss.)	mg/l	44	1-70 to 9-73	37.0	101.4	220.0			
Magnesium (diss.)	mg/l	44	1-70 to 9-73	9.4	41.1	130.0	125	125	1
Sodium (diss.)	mg/l	44	1-70 to 9-73	19.0	333.4	1,200.0			
Sodium adsorption ratio		44	1-70 to 9-73	.7	6.5	20.0			
Chloride	mg/l	44	1-70 to 9-73	18.0	512.4	2,000.0	250	250	29
Sulfate (total)	mg/l	44	1-70 to 9-73	7.2	319.9	940.0	250	250	24
Carbonate	mg/l	44	1-70 to 9-73	0	0	0			
Bicarbonate	mg/l	44	1-70 to 9-73	108.0	162.0	256.0			
Potassium (diss.)	mg/l	44	1-70 to 9-73	2.1	17.6	69.0			
Fluoride (diss.)	mg/l	4	2-70 to 12-72	.3	.4	.5		2.4	0
Silica (diss.)	mg/l	38	2-70 to 9-73	3.7	7.4	9.4			
Boron (diss.)	µg/l	4	2-70 to 11-72	.1	72.5	130.0			
Iron (diss.)	µg/l	1	12-72	40.0	40.0	40.0	300	300	0
Manganese (diss.)	µg/l	1	12-72	100.0	100.0	100.0	50	50	1
Dolores River at Gateway3/									
Flow	cfs	22	9-71 to 2-72	84.0	250.3	700.0			
Temperature	°F	22	9-71 to 2-72	32.0	40.3	67.1			
Dissolved oxygen	mg/l	6	9-71 to 2-72	8.4	10.6	11.8			
pH	su	6	9-71 to 2-72	7.1	7.3	7.5			
Ammonia (total)	mg/l	1	12-71	.6	.6	.6			
Nitrite (total)	mg/l	3	12-71 to 5-72	0	0	0			
Nitrate (total)	mg/l	8	12-71 to 8-73	.2	1.1	2.4	45	45	0
Phosphorus (total)	mg/l	8	12-71 to 8-73	0	.2	1.1			
Phosphorus (diss.)	mg/l	8	12-71 to 8-73	0	.1	.2			
Cadmium (diss.)	µg/l	7	12-71 to 8-73	5.0	5.4	6.0	10	10	0
Chromium (diss.)	µg/l	8	12-71 to 8-73	5.0	13.1	20.0	50	50	0
Copper (diss.)	µg/l	8	12-71 to 8-73	5.0	16.2	37.0	1,000	1,000	0
Iron (diss.)	µg/l	7	12-71 to 8-73	15.0	147.0	540.0	300	300	1
Lead (diss.)	µg/l	8	12-71 to 8-73	5.0	10.5	22.0	50	50	0
Manganese (diss.)	µg/l	8	12-71 to 8-73	10.0	77.1	220.0	50	50	5
Zinc (diss.)	µg/l	8	12-71 to 8-73	5.0	13.2	40.0	5,000	5,000	0
Radioactivity									
Radium-226 (diss.)	pc/l	93	7-71 to 7-73	.1	.6	3.3	3		18
Radium-226 (susp.)	pc/l	76	8-71 to 7-73	0	3.6	79.4	3		18
Uranium (diss.)	µg/l	94	7-71 to 9-73	.5	10.5	37.0			
Uranium (susp.)	µg/l	15	10-72 to 7-73	1.0	10.3	76.1			
Dolores River at Gateway4/									
Temperature	°F	54	1-68 to 4-76	32.0	51.3	75.0			
Turbidity	Hach NTU	47	2-68 to 4-76	3.4	393.6	5,000.0			
Conductivity (25° C)	micromho	55	1-68 to 4-76	315.0	2,795.6	8,000.0			
Dissolved oxygen	mg/l	14	3-73 to 4-76	7.2	9.8	12.2			
B.O.D. (5-day)	mg/l	37	2-68 to 4-76	1.0	5.9	48.0			
C.O.D.	mg/l	1	10-72	45.0	45.0	45.0			
pH	su	47	1-68 to 4-76	7.2	8.1	8.8			
Ammonia (total)	mg/l	45	10-68 to 4-76	0	5.4	20.5			
Nitrite (total)	mg/l	43	11-68 to 4-76	0	.3	3.5			
Nitrate (total)	mg/l	43	10-68 to 4-76	.2	1.9	6.2	45		0
Nitrogen (total KJEL)	mg/l	1	4-76	3.4	3.4	3.4			
Phosphate (total)	mg/l	31	10-68 to 9-73	0	.1	.5			
Phosphorus (total)	mg/l	11	4-74 to 4-76	0	.2	.5			
Cyanide (total)	mg/l	28	2-68 to 4-76	0	0	0	.2	.01	0
Total hardness	mg/l	44	2-68 to 4-76	129.0	474.1	1,510.0			
Calcium	mg/l	43	2-68 to 4-76	98.0	298.3	815.0			
Magnesium (total)	mg/l	43	2-68 to 4-76	5.0	44.7	169.0	125	125	1
Sodium (total)	mg/l	44	2-68 to 4-76	12.0	448.2	1,800.0			
Sodium adsorption ratio		44	2-68 to 4-76	.4	7.7	31.0			
Chloride	mg/l	47	2-68 to 4-76	16.0	691.1	2,700.0	250	250	35
Sulfate (total)	mg/l	39	10-68 to 4-76	56.0	354.5	727.0	250	250	32
Flouride (total)	mg/l	31	1-68 to 4-76	.1	.4	.9		2.4	0
Arsenic (total)	µg/l	29	2-68 to 4-76	0	0	0	50	10	0
Boron (total)	µg/l	41	1-68 to 4-76		91.2	500.0			
Cadmium (total)	µg/l	29	1-68 to 2-76		0	.1	10	10	0
Chromium (hexavalent)	µg/l	28	2-68 to 4-76		0	0	50	50	0
Copper (total)	µg/l	28	2-68 to 4-76		.7	20.0	1.000	1,000	0
Iron (total)	µg/l	42	2-68 to 4-76		706.9	7,800.0	300	300	16
Lead (total)	µg/l	28	2-68 to 4-76		1.9	20.0	50	50	0
Manganese	µg/l	39	2-68 to 4-76		39.7	300.0	50	50	13
Molybdenum (total)	µg/l	13	1-72 to 4-76		6.2	50.0			
Silver (total)	µg/l	15	11-68 to 4-76		0	0	50		
Zinc (total)	µg/l	39	2-68 to 4-76		24.1	300.0	5,000	5,000	0
Selenium (total)	µg/l	43	1-68 to 4-76		.9	7.0	10	10	0
Mercury	µg/l	5	10-70 to 1-72		.2	1.1			
Radioactivity									
Alpha (diss.)	pc/l	41	1-68 to 4-76	0	37.6	271.0			
Beta (diss.)	pc/l	26	10-68 to 11-75	.6	27.2	79.8	5/1,000		0
Radium-226 (diss.)	pc/l	20	10-68 to 4-76	.2	1.0	2.6	3	0	0
Total coliform (MPNCONF)	/100 ml	56	1-68 to 4-76	22.0	2,549.6	34,800.0			
Fecal coliform (MPNECMED)	/100 ml	56	1-68 to 4-76	2.2	318.0	3,300.0			
MBAS	mg/l	29	5-69 to 4-76	0	0	0			

1/ All data, with the exception of Bureau of Reclamation information, are STORET data from the Air and Water Surveillance and Analysis Division, Environmental Protection Agency, Denver, Colo.

2/ Samples collected by U.S. Geological Survey.

3/ Samples collected by U.S. Geological Survey, analyzed by EPA.

4/ Samples collected by Colorado State Department of Health.

5/ If radium-226 and strontium-90 are within their respective limits, water having a gross beta concentration of up to 1,000 pc/l is usually acceptable. When radium-226 and strontium-90 exceed the limits, the radioactivity of the water supply should be investigated even if the gross beta concentration is less than 1,000 pc/l.

Chemical analysis of water samples1/ (continued) — Sheet 4 of 4

Constituents	Units	Number of samples	Sampling period	Concentration Minimum	Average	Maximum	Drinking water standards: Public Health Service	Colorado	Number of times exceeded
			Brine pumped from well near Dolores River, Paradox Valley2/						
Conductivity	micromho	1	3-75	221,000.0	221,000.0	221,000.0			
pH	su	1	3-75	7.9	7.9	7.9			
TDS	mg/l	1	3-75	258,000.0	258,000.0	258,000.0			
Calcium (total)	mg/l	1	3-75	1,340.0	1,340.0	1,340.0			
Magnesium (total)	mg/l	1	3-75	1,720.0	1,720.0	1,720.0	125	125	1
Sodium (total)	mg/l	1	3-75	100,000.0	100,000.0	100,000.0			
Chloride	mg/l	1	3-75	165,000.0	165,000.0	165,000.0	250	250	1
Sulfate (total)	mg/l	1	3-75	5,590.0	5,590.0	5,590.0	250	250	1
Sulfide (total)	mg/l	1	3-75	74.4	74.4	74.4			
Carbonate (total)	mg/l	1	3-75	0	0	0			
Bicarbonate (total)	mg/l	1	3-75	118.0	118.0	118.0			
Potassium (total)	mg/l	1	3-75	5,150.0	5,150.0	5,150.0			
Cadmium (total)	µg/l	1	3-75	470.0	470.0	470.0	10	10	1
Chromium (total)	µg/l	1	3-75	260.0	260.0	260.0	50	50	1
Copper (total)	µg/l	1	3-75	220.0	220.0	220.0	1,000	1,000	0
Iron (total)	µg/l	1	3-75	2,400.0	2,400.0	2,400.0	300	300	1
Lead (total)	µg/l	1	3-75	2,900.0	2,900.0	2,900.0	50	50	1
Manganese (total)	µg/l	1	3-75	370.0	370.0	370.0	50	50	1
Nickel (total)	µg/l	1	3-75	230.0	230.0	230.0			
Lithium (total)	µg/l	1	3-75	130.0	130.0	130.0			
Zinc (total)	µg/l	1	3-75	620.0	620.0	620.0	5,000	5,000	0
Oil (total)	µg/l	1	3-75	100.0	100.0	100.0			
Radioactivity									
Strontium (total)	µg/l	1	3-75	2,300.0	2,300.0	2,300.0			

1/ All data, with the exception of Bureau of Reclamation information, are STORET data from the Air and Water Surveillance and Analysis Division, Environmental Protection Agency, Denver, Colo.

2/ Bureau of Reclamation.

ATTACHMENT 2

United States Department of the Interior

FISH AND WILDLIFE SERVICE

AREA OFFICE COLORADO—UTAH
1426 FEDERAL BUILDING
125 SOUTH STATE STREET
SALT LAKE CITY, UTAH 84138

In Reply Refer To
(ES)

February 15, 1977

Memorandum

To: Regional Director
Upper Colorado Region
Bureau of Reclamation
Salt Lake City, Utah

From: Area Manager
U.S. Fish and Wildlife Service
Salt Lake City, Utah

Subject: Compliance with Section 7 of the Endangered Species Act of 1973, Paradox Valley Salinity Control Unit, Colorado (BR) (Your memorandum of February 7, 1977)

An analysis of the impact of the subject unit on the Colorado squawfish (Ptychocheilus lucius) and the Humpback chub (Gila cypha) was not presented in our Advance Planning Aid Memorandum, because aquatic studies conducted by the Colorado Division of Wildlife and other investigators have not found these two species to be present within the project area. The proposed improved water quality resulting from this project may enhance their chances of survival and improve their critical habitat. This opinion, however, will have to be verified by additional studies on the life cycles and habitat requirements for these endangered fishes. Also, it would be contingent upon not developing other projects that would increase the salinity of the Colorado River by the 16 mg/l that the Paradox Valley Unit is designed to remove from the aquatic environment.

If we can be of further assistance, please advise.

Robert H Shields

ATTACHMENT 2

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
10597 West Sixth Avenue
Lakewood, Colorado
Across From Federal Center

IN REPLY REFER TO:
FA/SE/Falcon, peregrine--
Coop.--BR--Paradox Valley Unit

OCT 18 1977

MEMORANDUM

To: Regional Director, Upper Colorado Region
Bureau of Reclamation, Salt Lake City, Utah

From: Regional Director, Region 6
Fish and Wildlife Service, Denver, Colorado

Subject: Endangered Species Consultation--Paradox Valley Unit, Colorado River Salinity Control Project

In response to your request for formal consultation we have conducted a threshold examination. We conclude the Paradox Valley Unit, as now proposed, will in no likelihood jeopardize the continued existence of the American peregrine falcon or destroy or adversely modify its critical habitat.

By lowering the soil salinity, construction of the Paradox Valley Unit, as now proposed, could improve riparian vegetation and, as a consequence, benefit the prey-base for falcons. However, this is not true of some of the other alternatives developed for the Environmental Impact Statement. If one of these other alternatives is selected to replace the proposal now being considered and the new proposal may result in some adverse impact on riparian vegetation, the prey-base, or directly affect the falcons, then the new proposal should be re-examined under the Section 7 formal consultation process.

As you are aware, the eyrie(s) located in the general area of the project is either new or has not been observed prior to this summer. It is certainly a significant find and offers an opportunity to improve the status of the peregrine in that area by various techiques carried out in conjunction with the Western Breeding Project of the Colorado Division of Wildlife and the Peregrine Fund at Fort Collins, Colorado.

The State Director of the Bureau of Land Management has indicated, since the nesting location is almost entirely on public lands, they will initiate a monitoring program for any adverse action and will take the necessary legal steps to close the area seasonally (March 1--August 1) to public use and development.

We recommend the four agencies (Bureau of Land Management, Colorado Division of Wildlife, Bureau of Reclamation, and Fish and Wildlife Service) cooperate to assure adequate protection, determination of the total feeding area and exact eyrie(s) location. In addition, we recommend including some project features to further improve the riparian vegetation by developing marshy areas in the project area. Finally, we wish to commend you on the conservation actions taken to protect these birds and their habitat. The awareness of this need by your people will add considerably to the recovery effort for American peregrine falcon.

Harvey Willoughby

THE STATE HISTORICAL SOCIETY OF COLORADO

Colorado State Museum, 200 Fourteenth Avenue, Denver 80203

March 11, 1977

Mr. Wayne E. Cook
Senior Staff Officer
United States Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Western Colorado Projects Office
Post Office Box 640
Durango, Colorado 81301

RE: Colorado River Basin Salinity Control Project,
Paradox Valley Unit, Colorado

Dear Mr. Cook:

This office shall comment concerning only architectural and historical properties that may exist in the project impact area; the office of the State Archaeologist has been furnished the enclosures of your letter and will respond separately concerning archaeological properties.

After reviewing the survey information, we feel that the Bureau of Reclamation has thoroughly fulfilled its responsibility to identify properties that possess architectural and historical value in the impact area of the project. We also commend its effort to redesign portions of the project to minimize impacts upon the identified properties. As stated in your letter, we concur that the only architectural property to be affected is site 5-SM-169. However, after examining the information gathered relating to this site, we find that it does not appear to be eligible for listing in the National Register. If the Bureau of Reclamation concurs with our finding, then no mitigatory efforts are required by federal preservation law.

A summary of the Bureau of Reclamation's compliance with the procedures set forth in 36 CFR Part 800, and our comments, should be included in all environmental reviews and assessments of this project.

We look forward to working with the Bureau of Reclamation in the same spirit of cooperation on other projects.

FOR THE STATE HISTORIC PRESERVATION OFFICER

Sincerely,

/s/ James Edward Hartmann
Curator, Historic Preservation

ATTACHMENT 3

THE STATE HISTORICAL SOCIETY OF COLORADO

State Archaeologist (Interim address) Pioneer Hall
University of Denver, Denver 80210

March 18, 1977

Mr. Wayne Cook
Bureau of Reclamation
P.O. Box 640
Durango, CO 81301

RE: Colorado River Basin Salinity Control Project,
Paradox Valley Unit, Colorado

Dear Mr. Cook:

We have received and examined the materials forwarded to us for SHPO comment in regard to this project. I believe you have already received SHPO comment on historical dimensions from the Department of Historic Preservation of the State Historical Society.

Your intention to monitor and evaluate archaeological sites encountered in the project is adequate mitigation in my opinion. This is based in part upon the outstanding recent record of the Bureau in managing archaeological resources and upon the information about the archaeological resources so far developed.

If I remember our discussions, site 5SM164 and 169 are small sites whose eligibility to the Register has not been formally evaluated. I imagine that the collection necessary to evaluate them will mitigate them out of existance, except for a small amount of excavation at 169. Consequently, I expect the fiscal commitment for the proposed work at 164 and 169 will be modest.

For the State Historic
Preservation Officer

/s/ Bruce E. Rippeteau, Ph.D.
State Archaeologist Colorado
Phone: (303) 744-1713