COLORADO RIVER BASIN
SALINITY CONTROL PROJECT

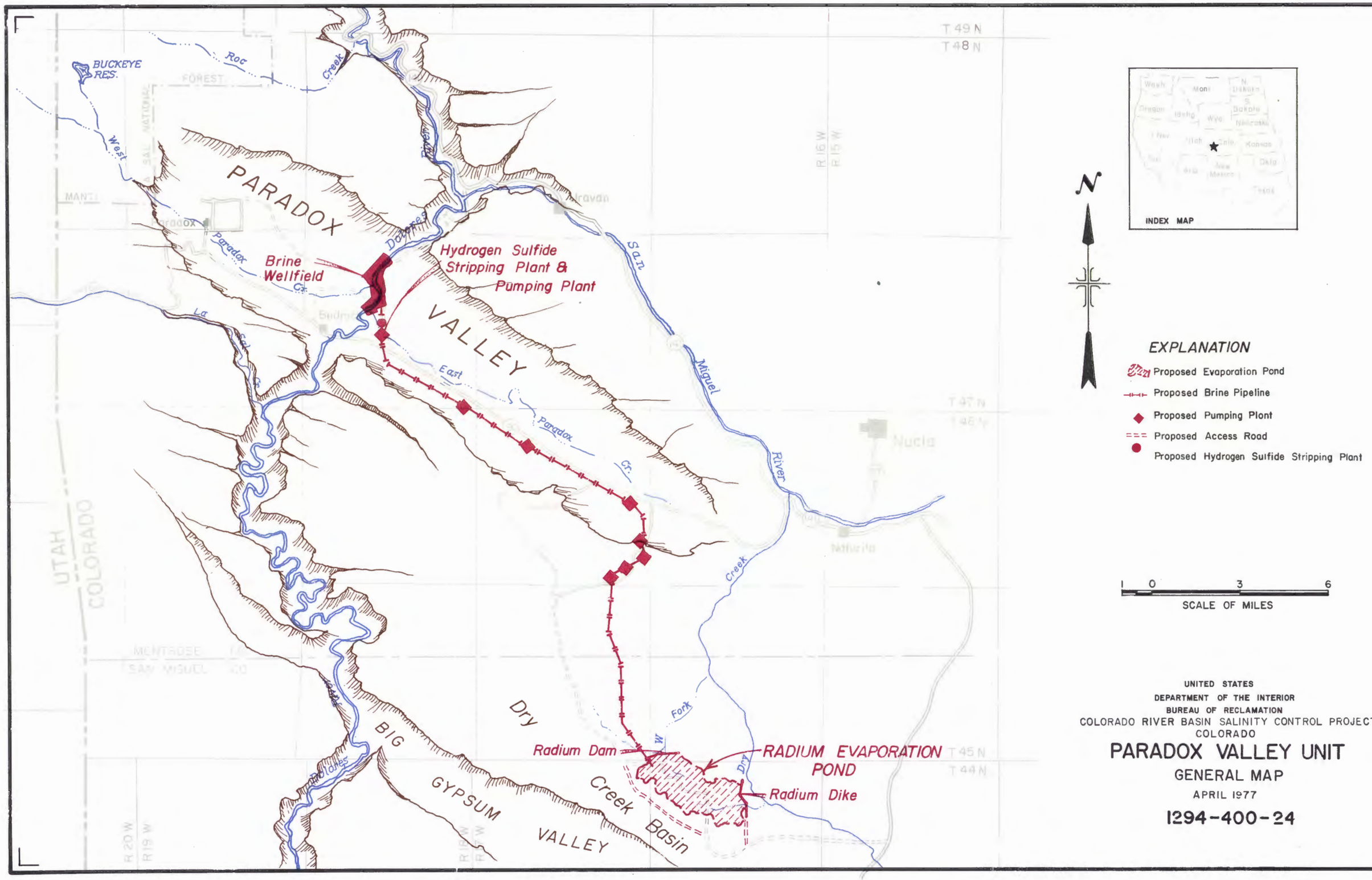
Paradox Valley Unit

DEFINITE PLAN REPORT

September 1978

APPENDIX B
HYDROSALINITY

BUREAU OF RECLAMATION
R.Keith Higginson, Commissioner
UPPER COLORADO REGION
N.W. Plummer, Regional Director



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
COLORADO

PARADOX VALLEY UNIT

GENERAL MAP

APRIL 1977

1294-400-24

SUMMARY SHEETS

Paradox Valley Unit

Colorado River Basin Salinity Control Project

LOCATION

The Paradox Valley Unit would be located in Montrose and San Miguel Counties of southwestern Colorado in the Upper Colorado River Basin.

PLAN

The unit would be designed to reduce the salinity of the Dolores and Colorado Rivers by pumping brine ground water from a well field located along the Dolores River in Paradox Valley and thus preventing it from surfacing in the riverbed. A test well field has already been installed as part of a design data collection program, and other facilities required for brine treatment and disposal would be added during unit construction.

The brine would be piped from the well field to a nearby hydrogen sulfide stripping plant, where potentially toxic and corrosive gas would be converted into sulfur. An operational headquarters would be constructed at the site of the stripping plant. The treated brine and sulfur would be piped from the stripping plant to the proposed Radium Evaporation Pond for disposal. The pond would be located in Dry Creek Basin to the southeast of the well field, and eight pumping plants would be installed on the pipeline to lift the brine over the divide between Paradox Valley and the basin.

To reduce adverse impacts on wildlife, a wildlife area would be developed near the evaporation pond and other areas temporarily disturbed by construction would be seeded with plant species valuable as wildlife habitat. 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. Also included as part of the unit would be a cultural resource program to collect and preserve archaeological information from two sites located within the proposed evaporation pond.

EFFECTS ON COLORADO RIVER (average annual)

Stream depletion (acre-feet)	3,950
Decrease in salt load (tons)	180,000
Effects on salt concentration at Imperial Dam (mg/l)	
Increase from concentrating effect of stream depletion	0.4
Decrease from reduction of salt load	18.6
Net decrease	18.2

ESTIMATED COSTS

Construction costs (January 1977 prices)	
Salinity control	
Brine well field	$1,900,000
Hydrogen sulfide stripping plant	2,300,000
Brine pipeline	5,900,000
Brine pipeline pumping plants	4,800,000
Radium Dam, Dike, and Evaporation Pond	33,000,000
Transmission lines and substations	590,000
Permanent operating facilities	175,000
Operation and maintenance housing	390,000
Capitalized movable equipment	1,010,000
Service facilities	820,000
Depreciation and salvage	-1,570,000
Investigations (Reclamation fund)	456,000
Wildlife mitigation	610,000
Subtotal	50,381,000
Cultural resource program	9,000
Total	50,390,000
Annual equivalent cost of construction	3,175,000
Annual operation, maintenance, and replacement costs (1974-76 prices)	332,300
Total annual costs	3,507,300
Annual equivalent cost per mg/l of net salinity decrease at Imperial Dam	192,700

COST ALLOCATIONS (100-year period at 5 5/8 percent interest)

	Construction costs	Annual operation, maintenance, and replacement costs
Reimbursable costs		
Salinity control facilities	$12,595,000	$84,600
Nonreimbursable costs		
Salinity control facilities	37,786,000	247,700
Cultural resource program	9,000	
Subtotal	37,795,000	247,700
Total	50,390,000	332,300

REPAYMENT OF REIMBURSABLE COSTS (50-year repayment period)

	Construction costs	Annual operation, maintenance, and replacement costs
Lower Colorado River Basin Development Fund	$10,706,000	$70,200
Upper Colorado River Basin Fund	1,889,000	12,400
Colorado Division of Wildlife		2,000
Total	12,595,000	84,600

PROJECT FEATURES

	Number	Depth (feet)	Capacity (cfs)
Wells			
Brine production wells	18	48-155	0.1-1.1
Ground water monitoring wells	68	20-300	
		Length (miles)	
Brine pipeline		20.5	5
Brine pipeline pumping plants	8		5.26
		Radium Dam	Radium Dike
Dams (feet)			
Height above streambed		87	56
Crest length		8,300	7,500
Evaporation Pond			
Capacity (acre-feet)			
Flood control		18,700	
Inactive		62,060	
Dead		6,040	
Total		86,800	
Surcharge		6,540	
Maximum water surface area (acres)		3,750	

Appendixes to the Paradox Valley Unit have been prepared in two volumes with the data grouped as follows.

APPENDIX A
DESIGNS AND ESTIMATES

APPENDIX B
HYDROSALINITY

CONTENTS

CONTENTS (Continued)

TABLES

FIGURES

FIGURES (Continued)

MAPS

CHAPTER I

INTRODUCTION

Unit Purpose and Location

The hydrosalinity appendix presents the results of definite plan studies of the Paradox Valley Unit, Colorado, of the Colorado River Basin Salinity Control Projects. The unit, as shown in Figure 1 on the following page, is one of four salinity control units authorized for construction by Title II of Public Law 93-320 signed by the President on June 24, 1974. The three other units are the Grand Valley Unit, Colorado; the Las Vegas Wash Unit, Nevada; and the Crystal Geyser Unit, Utah. Prior salinity control investigations were authorized by the Colorado River Storage Project Act (Public Law 84-485), the San Juan-Chama Project and Navajo Indian Irrigation Project Act (Public Law 87-483), and the Fryingpan-Arkansas Project Act (Public Law 87-590).

The Paradox Valley Unit would be located in Montrose and San Miguel Counties of southwestern Colorado, just east of the Colorado-Utah State line as shown on the frontispiece map. The unit area would consist of Paradox Valley on the main stem of the Dolores River and the northwestern part of 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.

The Paradox Valley Unit would be designed to reduce the brine inflow to the Dolores River in Paradox Valley. This inflow has been identified as a major natural point source of salt in the Upper Colorado River Basin. As the river crosses the valley it picks up an estimated 205,000 tons of salt annually from surfacing brine ground water and irrigation return flows and carries them to the Colorado River.

Unit Setting

Economic development

The only communities in Paradox 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 is no permanent population in the northwestern part of Dry Creek Basin.

Paradox Valley was first settled in 1877 by farmers and ranchers. Although sporadic mining booms have occurred since that time, agriculture and some small industries have remained as the economic base for the people in the valley.

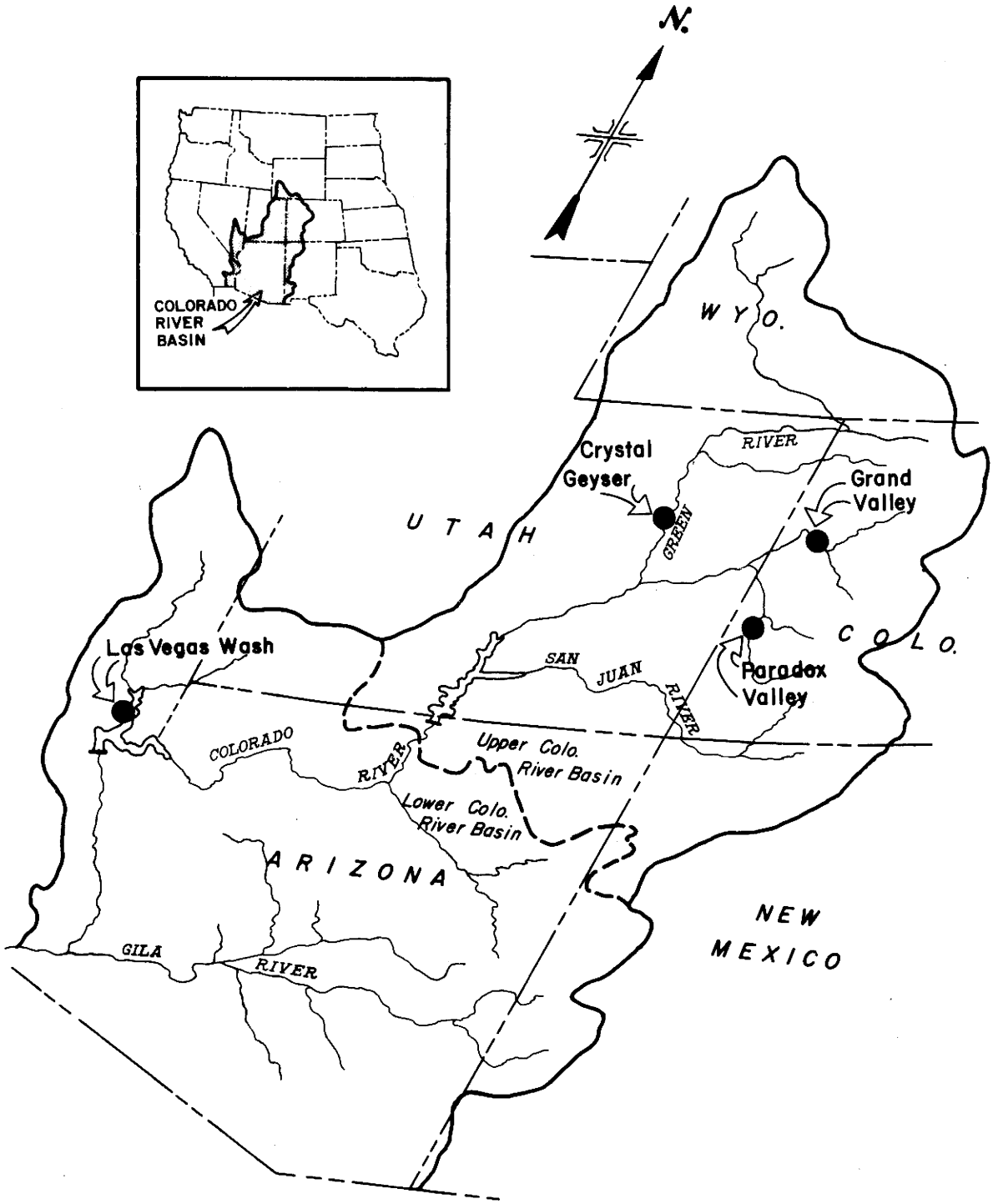


FIGURE 1
LOCATION OF
FOUR AUTHORIZED SALINITY CONTROL UNITS
COLORADO RIVER BASIN

Agriculture in Paradox Valley is confined to the West Paradox Creek watershed which contains about 60,300 acres, with approximately half in private ownership and the remainder under Federal control. The watershed is located in portions of Montrose County, Colorado, and San Juan and Grand Counties, Utah. About 2,500 acres are under irrigation with a water supply from West Paradox Creek, Buckeye Reservoir in the La Sal Mountains to the northwest, and ground water wells. Livestock and livestock feeds provide the principal source of income. The eastern half of the valley provides a limited amount of range, and Dry Creek Basin also provides some sparse grazing.

Two sawmills located near the town of Paradox process timber from the La Sal Mountains to the northwest and the Uncompahgre Plateau to the east, but these operations provide little employment. Mining also contributes to the local economy. Carnotite, a mineral containing the radioactive elements uranium, vanadium, and radium, is mined on the mesas surrounding Paradox Valley. This activity has increased considerably in recent years. A major portion of the ore is shipped to a processing plant in Uravan, which uses brine from a well in Paradox Valley in the milling process. Brine from a second well is sold for use in drilling operations in the area.

Vegetation

Natural vegetation in the project area varies according to elevation, precipitation, soil, and other factors. The Dolores River supports riparian vegetation characterized by cottonwood and forestiera upstream from the brine seeps and tamarisk downstream, with forbs and grasses found in both sections. Rushes are found in marshy areas along the stream. In both Paradox Valley and Dry Creek Basin, extensive semiarid areas with saline soils are characterized by greasewood, seablite, winterfat, snakeweed, and other salt-tolerant plants. Sagebrush is found on higher slopes throughout the area and is associated with a large variety of grasses wherever overgrazing has not occurred. Pinyon-juniper woodlands characterize the mesas and high slopes. No endangered or threatened plants have been identified in the unit area.

Fish and wildlife

In the vicinity of Paradox Valley the Dolores River and West Paradox Creek support primarily nongame fishes, including the speckled dace, flannelmouth sucker, roundtail chub, mottled sculpin, red shiner, bluehead sucker, fathead minnow, black bullhead, and channel catfish. Because of the influx of saline ground water in the valley, fish inhabit the reach in and immediately downstream only when the streamflow is high enough to dilute the salt and move into other reaches or tributaries whenever low flows result in high salinity.

Big game mammals in the unit area include the mule deer, elk, pronghorn, black bear, and mountain lion. Small game mammals, furbearers, varmints, and nongame mammals are found throughout the vicinity of the unit. Over a hundred species of birds, including both resident and migrant populations, have been identified in the area.

The peregrine falcon is the only threatened or endangered species known to inhabit the unit area. A mating couple nested and produced one offspring during the spring of 1977.

Climate

The climate in the project 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 with some winds year round.

The Bureau of Reclamation has maintained weather stations at Bedrock in Paradox Valley and in Dry Creek Basin since February 1975. During that time, the average annual precipitation has averaged about 8 inches at both stations. June is usually the driest month of the year, and July through October are the wettest, primarily because of afternoon showers which occasionally reach thunderstorm intensity. A small to moderate amount of snow falls during the winter. Maximum and minimum temperatures for the years 1975 and 1976 have been 103° F and -22° F for the Bedrock station and 92° F and -26° F for the Dry Creek Basin station.

Topography and geology

The unit area is located in a region topographically characterized by narrow mesas, broad plateaus, long narrow valleys bordered by steep cliffs, and deeply entrenched canyons and gorges. The most prominent geologic features in the vicinity of the unit are the La Sal Mountains, rising to elevations of over 12,000 feet to the northwest, and the Uncompahgre Plateau, a broad uplift of between 8,500 and 10,000 feet in elevation to the northeast. As the Dolores River enters Paradox Valley, it emerges from a 50-mile stretch of narrow and deep canyons which twist through high mesas.

Paradox Valley is one of five major collapsed salt anticlines in southwestern Colorado and southeastern Utah as shown on Figure 2 on the following page. A northwest-southeast trending, elongated valley about 24 miles long and from 3 to 5 miles wide has been formed by the erosion of faulted and uplifted sandstone and shale formations. This process has exposed a residual gypsum cap which covers up to 14,000 feet of relatively pure salt and salt-rich shale. The process is illustrated in Figures 3 and 4 on pages 6 and 7. The emergence of mountainous uplifts on

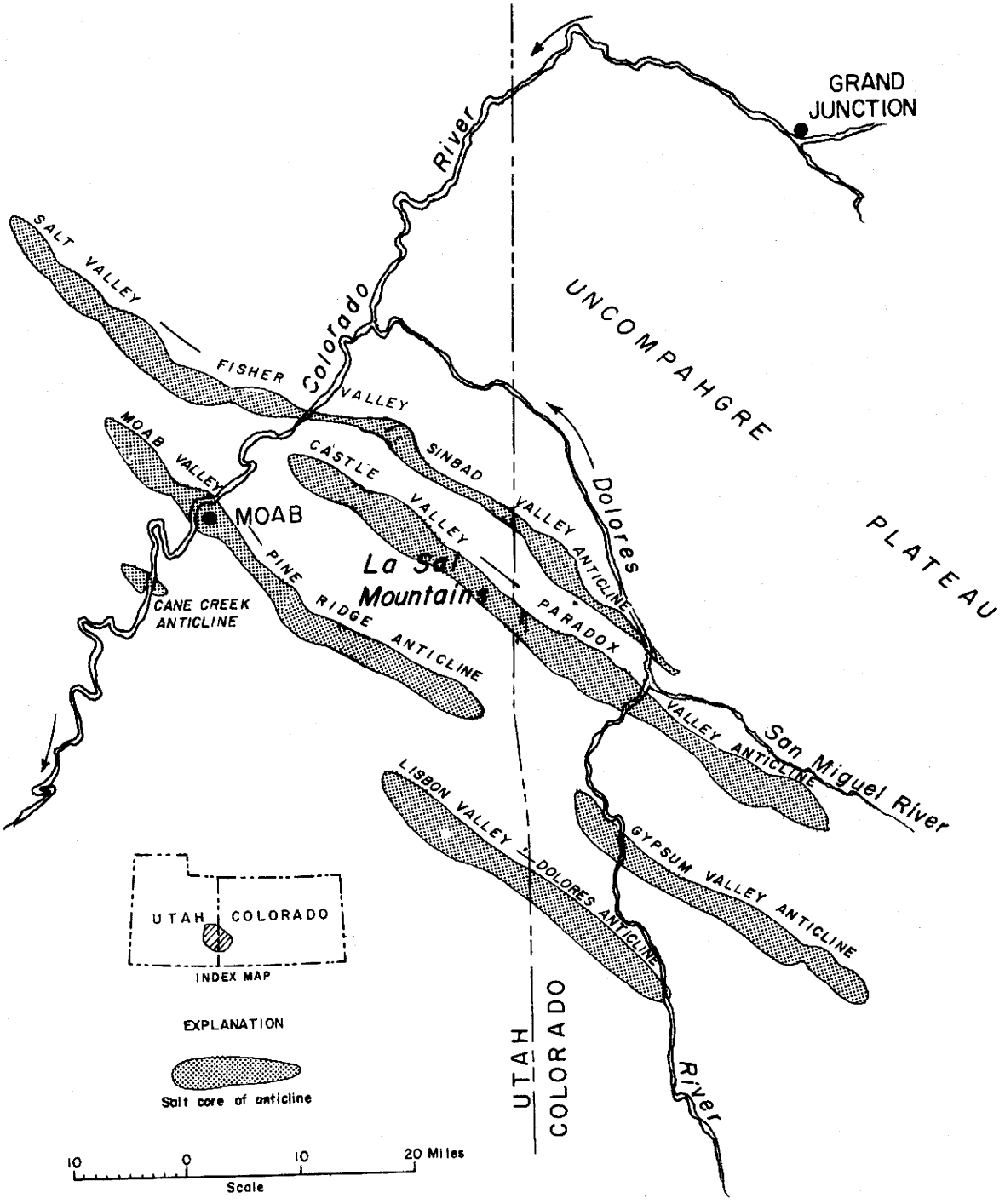


Figure 2

SALT ANTICLINE REGION

Colorado River Basin Salinity Control Project
Paradox Valley Unit, Colorado

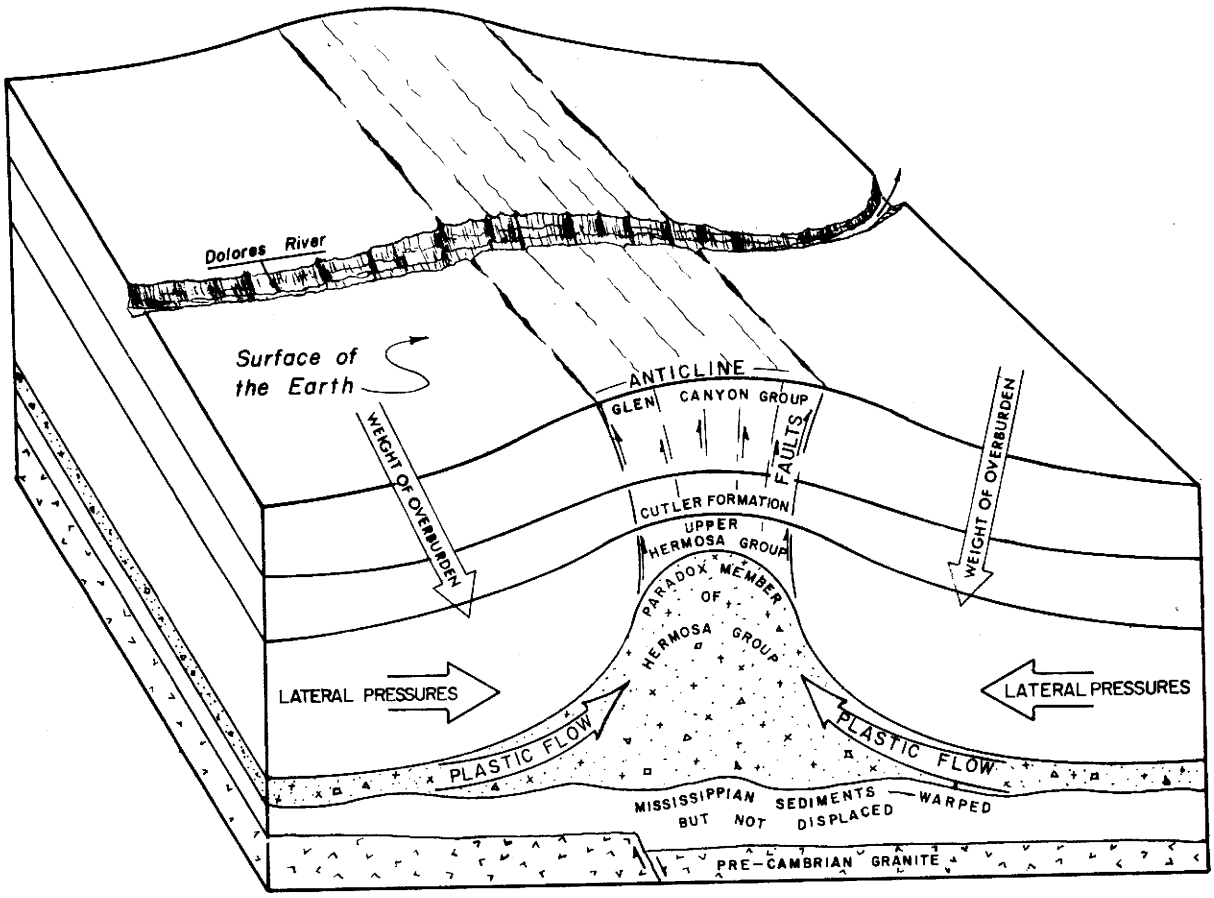


FIGURE 3

PARADOX ANTICLINE
EARLY STAGE OF DEVELOPMENT
Colorado River Basin Salinity Control Project
Paradox Valley Unit, Colorado

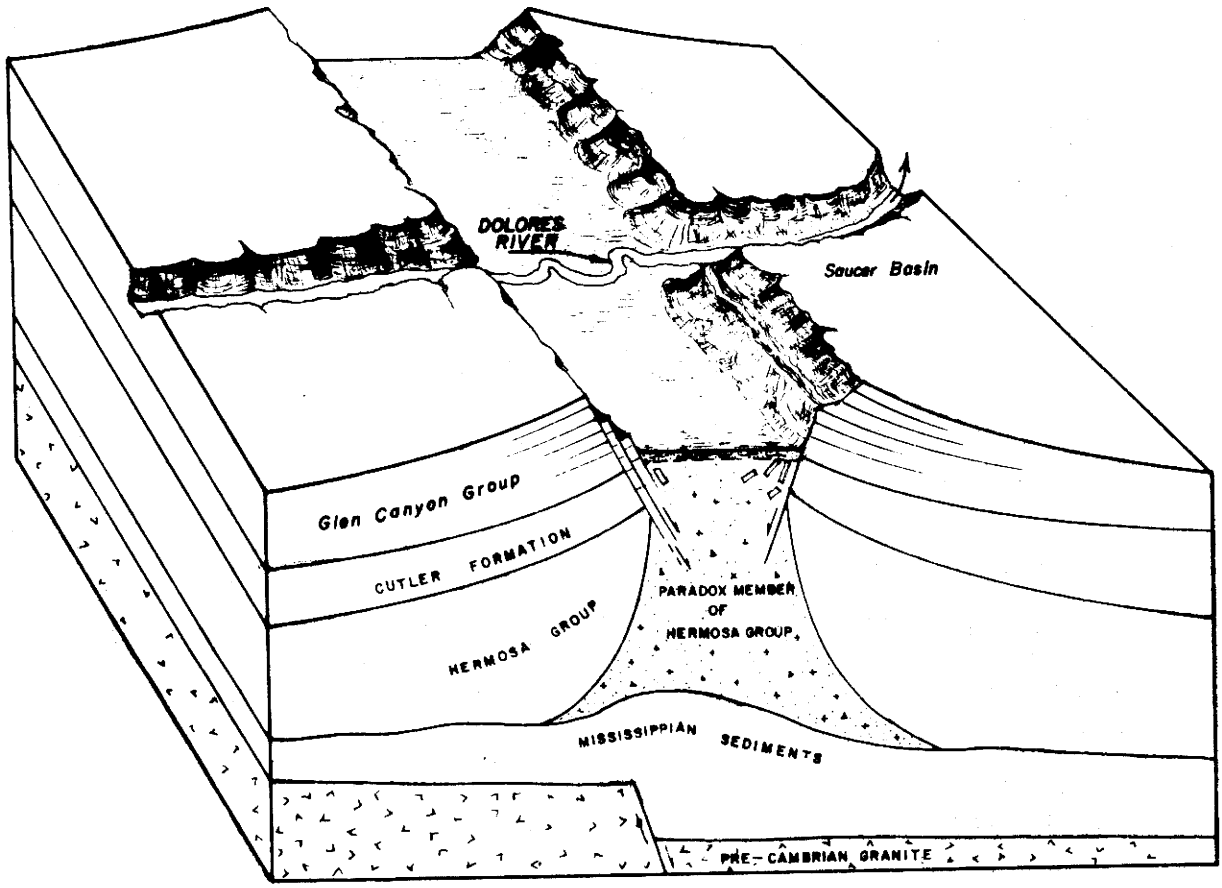


FIGURE 4

PARADOX ANTICLINE
PRESENT STAGE OF DEVELOPMENT
Colorado River Basin Salinity Control Project
Paradox Valley Unit, Colorado

each side of the area has placed intense lateral pressures on the intervening sedimentary formations, resulting in faulting and fracturing along weak axial zones. With the relaxing of the lateral stresses combined with the weight of the overlying strata, a deeply buried layer of salt-rich material has flowed upward into the faulted area to create an anticline. The Dolores River has remained in its original streambed during this time and, in combination with other erosional forces, has removed the collapsing upper materials to form the valley. Contributing to the collapse have been the constant dissolution and removal of the underlying salt bed by ground water. These processes, which began 200 million years ago, are still active.

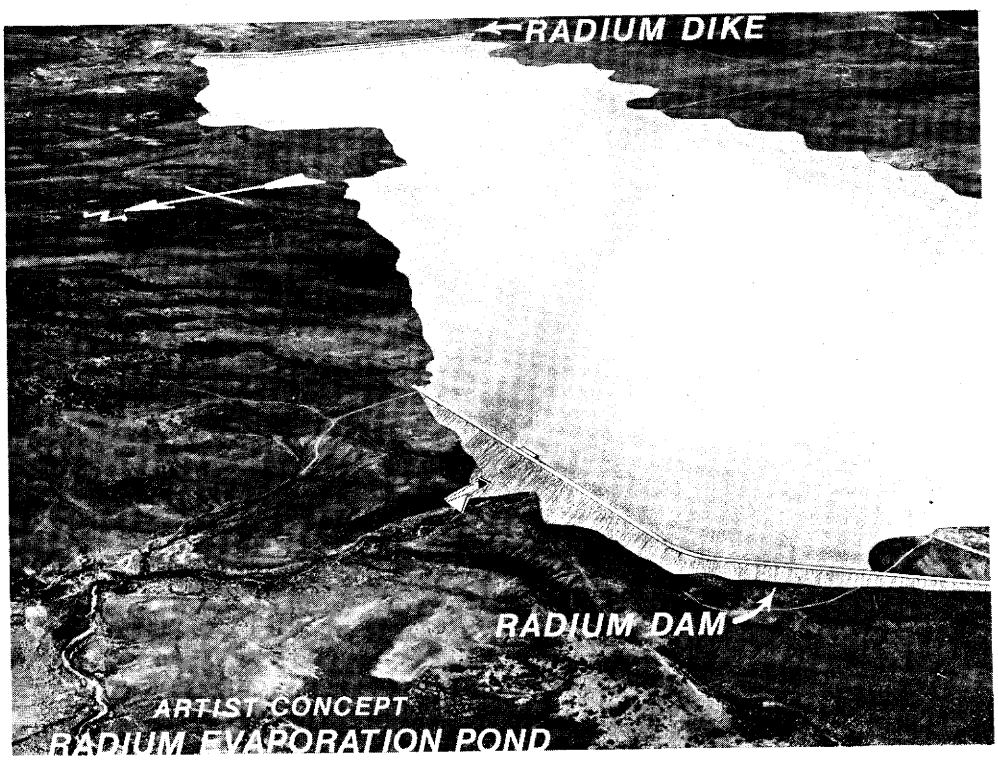
The floor of the valley is relatively flat and smooth, sloping gradually from both ends toward the Dolores River. In the southeastern half, the surface is broken by low outcrops of gypsum. The surrounding walls are nearly vertical and in some places rise nearly 1,500 feet above the floor, exposing brilliantly colored strata of sandstone and shale. Landslide materials and talus slopes are common along the bases of slopes. The Dolores River enters Paradox Valley at about the valley midpoint and crosses perpendicular to the valley's axis. Because of the very low slope in the riverbed, velocities of the river through the valley are very slow and extensive flood plains have been created on both sides of the river. Two areas of brine inflow have been identified in the river channel and are shown on the first photograph on the following page.

Dry Creek Basin, southeast of Paradox Valley, is separated from the valley by high mesas which have developed from the uplifted sedimentary flanks of the salt anticline. The West Fork of Dry Creek lies in a shallow structural syncline, or natural basin, with gently rising slopes. An artist's concept of Radium Dam and Evaporation Pond in Dry Creek Basin is shown in the second photograph on the following page. Mancos Shale, a brackish and impervious marine formation, underlies most of the basin and is frequently found in remnant form on the surface. The bedrock formation, consisting of Dakota Sandstone, is exposed along the north edge of the basin and dips sharply toward the center, disappearing under the Mancos Shale. The area is topographically breached on the north side, where the West Fork flows through to join Dry Creek.

Water resources

The major streams in the project area are the Dolores River and its largest tributary, the San Miguel River. Smaller tributaries of the 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 the valley. East Paradox Creek enters the river from the eastern part of the valley and is intermittent, having essentially no effect on riverflow. Dry Creek, which drains all of Radium Evaporation Pond site, is a tributary of the San Miguel River. The Dolores and San Miguel Rivers exhibit the large fluctuations characteristic

TYPICAL VIEW OF PARADOX VALLEY



ARTIST CONCEPT
RADIUM EVAPORATION POND

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. High flows occur in the summer and fall from afternoon thunderstorms but are of very short duration.

The Dolores River is relatively fresh as it enters the valley and saline as it leaves, especially during low flows. The flow-weighted average salinity nearly triples as the river crosses the valley because of emerging brine in the river bottom. This is the major water quality problem in the project area. The brine inflow areas along the river are shown in the first photograph on the preceding page.

Both sides of the Dolores River are underlain by nearly saturated brine with a total dissolved solids concentration of about 260,000 milligrams per liter (mg/l), containing approximately 87,400 mg/l sodium and 143,400 mg/l chloride. This brine ground water comes from the underlying formation of salt and salt-rich shale and discharges through seeps and springs at several points in the two brine inflow areas. Brine inflow rates are estimated to range from 0.2 to 2.1 cubic feet per second (cfs). The west portion of the valley has a relatively fresh ground water zone (1,500 mg/l) on top of the brine, whereas little fresh ground water is found in the east portion.

Unit Description

Plan of development

The annual inflow of salt into the Dolores River would be reduced by about 180,000 tons, or about 90 percent, by drilling 18 wells into the brine aquifer on both sides of the river and pumping brine from the wells at a rate sufficient to control the natural discharge into the river. This would lower the potentiometric head and the freshwater-brine interface, which would proportionately reduce the brine inflow. As part of a design data collection program, these wells are presently being drilled and tested.

The brine would be pumped from the wells and discharged into a pipe manifold system to a Hydrogen Sulfide Stripping Plant, which would remove the hydrogen sulfide gas that is present in the brine. This gas would have to be separated from the brine because of its toxicity, corrosiveness, and obnoxious odor. In the stripping plant the hydrogen sulfide gas would be converted to elemental sulfur and water through an air oxidation process.

A buried pipeline would convey the brine and elemental sulfur from the Hydrogen Sulfide Stripping Plant to the Radium Evaporation Pond. The pipeline would be 20.5 miles long, extending to the southeast along State Highway 90, then crossing the divide between Paradox Valley and Dry Creek

Basin, and terminating at Radium Evaporation Pond. Eight relift pumping plants would be required to achieve the total lift of about 2,040 feet between the well field and the top of the divide, with the first pumping plant located adjacent to the Hydrogen Sulfide Stripping Plant.

Radium Evaporation Pond would be formed by the construction of a dam on an intermittent tributary of the West Fork of Dry Creek and a dike on an intermittent tributary of the East Fork. All brine and natural inflow would be stored and evaporated at this facility.

For the Definite Plan Report and the Environmental Impact Statement all facilities are designed on the extreme condition that 5 cfs of brine with a salinity of 260,000 mg/l must be pumped constantly during the 100-year life of the unit to control the salt pickup by the Dolores River. The design data collection program, which is presently being carried out and is scheduled for completion by the end of fiscal year 1979, will be used to test and make modifications to the well field and to determine a final design capacity for the Hydrogen Sulfide Stripping Plant, the brine pipeline and pumping plants, and the evaporation pond.

Unit effects

Under the extreme condition that 5 cfs would have to be pumped constantly from the well field, the unit would cause a depletion of about 3,600 acre-feet annually from the Dolores River or a little more than 1 percent of the average annual flow. It is more likely, however, that a lesser pumping rate will be sufficient and the unit depletion should be considerably less. The average annual runoff in the two intermittent tributaries to Dry Creek of about 350 acre-feet would be stored and evaporated in Radium Evaporation Pond. The maximum average annual depletion from the Colorado River attributable to the Paradox Valley Unit would be about 3,950 acre-feet.

The Bureau of Reclamation estimates that the brine well field would effectively remove up to 180,000 tons of salt annually, or about 90 percent of the salt now entering the river. The overall effect of the unit would be to decrease the salinity of the Colorado River at Imperial Dam by 18.2 mg/l, or about 1.6 percent of the salinity level under 1976 modified conditions.1/ The reduction attributable to salt removal would actually be 18.6 mg/l but would be slightly offset by an increase of 0.4 mg/l caused by an average annual stream depletion of about 3,950 acre-feet. The unit effects on salinity are developed in more detail at the end of Chapter III.

1/ Conditions assuming all projects under construction in 1976 or nearing construction (final EIS filed) as being completed.

Unit Investigations

Much of the geologic and ground water information previously discussed was obtained through a series of drilling programs and pump tests. Feasibility investigations were initiated in 1971 to study control methods to prevent the salt from entering the Dolores River. After gathering available information from literature, maps, and drill logs, a program of exploratory drilling was initiated in the summer of 1972. At that time five 3-inch-diameter core holes were drilled on the east side of the river. A more comprehensive drilling program was initiated in late 1972 in which a total of 12 holes was drilled on both sides of the river.

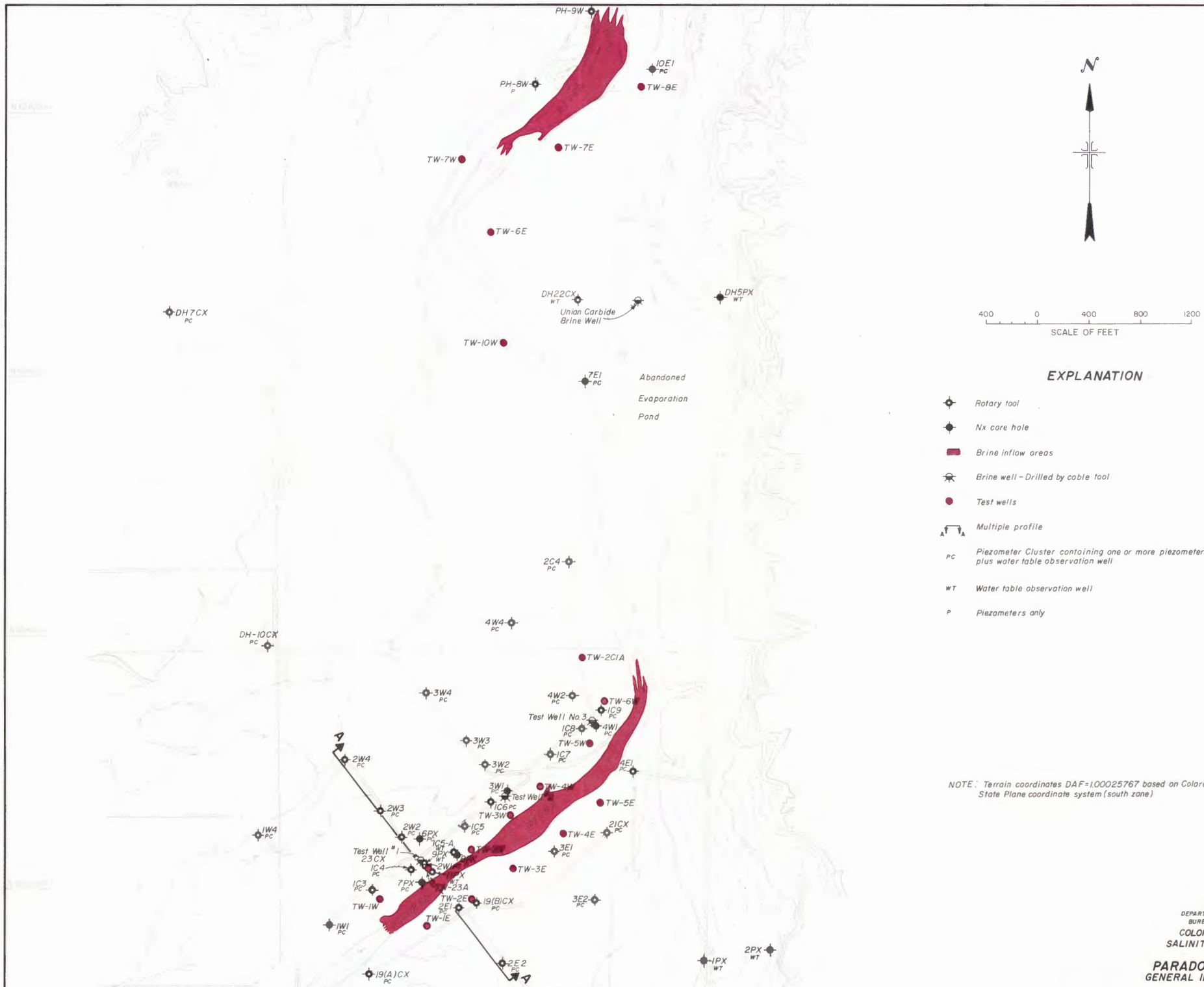
In 1973 a test well and three monitoring wells were drilled to test the aquifers. Two 48-hour pump tests were conducted in October and December 1973, one in the alluvium and one in the residual gypsum cap.

In the summer and fall of 1975 a ground water observation well network was installed, including piezometers of varying depths at 29 sites. At this time two additional test wells were drilled to pump from the gypsum cap.

A 30-day aquifer test was conducted in January 1976 utilizing two of the three test wells (one test well did not produce sufficient brine to pump).

In the summer of 1977, 18 test wells were installed in the alluvium as part of the design data collection program. Starting about September 1978 and continuing for about 1 to 1½ years, the 18 wells in various combinations will be pumped. The pumping rates of each well will be adjusted in order to determine the most efficient pumping rate and pattern.

General Investigations Map 1294-400-21, showing well location and the brine inflow areas, is included on the following page.



EXPLANATION

- Rotary tool
- Nx core hole
- Brine inflow areas
- Brine well – Drilled by coble tool
- Test wells
- Multiple profile
- PC — Piezometer Cluster contoining one or more piezometers plus water table observation well
- WT — Water table observation well
- P — Piezometers only

NOTE: Terrain coordinates DAF=1.00025767 based on Colorado State Plane coordinate system (south zone)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER BASIN
SALINITY CONTROL PROJECT
COLORADO

PARADOX VALLEY UNIT
GENERAL INVESTIGATIONS MAP

DECEMBER 1977

1294-400-21

CHAPTER II

WATER RESOURCES

Surface Water

Surface water measurements were initiated in 1971 when three stream gaging and water quality sampling stations were established. The first station was located where the Dolores River enters the valley, about 1.5 miles upstream from the brine seep area (Dolores River at Bedrock, Colo.); the second where the river leaves the valley, about 1.5 miles downstream from the brine seep area (Dolores River near Bedrock, Colo.); and the third on West Paradox Creek, 2.6 miles upstream from its mouth (West Paradox Creek above Bedrock, Colo.). These stations are being maintained by the Geological Survey. Except for West Paradox Creek, continuous flow measurements and weekly water quality samplings have been taken since 1971 and are continuing at present. Problems with bank caving and maintaining a workable cross section were encountered with the gage on West Paradox Creek, and it was discontinued September 1973; however, the sampling station has been maintained. A sampling station was also established on the Dolores River approximately 5 miles below the confluence of the San Miguel River.

The Geological Survey maintains both stream gaging and water sampling stations on both the San Miguel River at Uravan and Dry Creek near Naturita. The location of the station on Dry Creek is on the main fork and is above the Radium Evaporation Pond site.

Although no long-term streamflow records exist, partial records taken by the Geological Survey for the Dolores River at Bedrock are available for 1918 and 1922. Tabulations of the available streamflows for all pertinent gaging stations are shown in Tables 1 through 5.

Dolores River

The headwaters of the Dolores River are located on the south slopes of the San Juan Mountains and the west slopes of the La Plata Mountains. From its headwaters to the southeast of the unit area, the river flows in a southwesterly direction for about 50 miles, then makes an abrupt turn to flow in a northwesterly direction for about 115 miles to Paradox Valley and another 70 miles to its confluence with the Colorado River near Cisco, Utah. Under normal conditions the flows in the Dolores River are relatively low from July through March and high from April through June.

For the Dolores River at Bedrock the average annual flow was 299,400 acre-feet for 1972 through 1976, the years with continuous record. The

Table 1
Flow of Dolores River at Bedrock, Colo.
(Unit--1,000 acre-feet)

Water year	October	November	December	January	February	March	April	May	June	July	August	September	Total
1918								56.9	50.9	11.8	2.1	2.5	
1922	6.82	5.15	4.98					256.7	109.5	6.39	1.44	.26	
1971											8.69	.98	
1972	5.31	1.32	6.07	4.22	5.29	18.69	13.96	18.39	14.41	.16	.17	.87	89.1
1973	20.54	11.05	6.42	7.19	8.50	19.85	139.3	300.3	170.6	29.25	1.79		715.8
1974	.66	.81	2.63	2.93	2.52	6.71	16.02	49.35	4.77	2.36	.28	.16	89.2
1975	.46	1.11	1.80	2.50	2.52	4.64	73.24	163.4	133.7	45.37	1.33	1.49	431.6
1976	.41	.47	1.83	2.59	3.76	4.78	50.69	71.55	30.07	1.25	1.58	2.08	171.1
Average	5.7	3.3	4.0	3.9	4.5	11.0	58.6	130.9	73.4	13.8	2.2	1.2	
1972-76 average	5.5	3.0	3.8	3.9	4.5	11.0	58.6	120.6	70.7	15.7	1.0	1.1	299.4

Table 2
Flow of Dolores River near Bedrock, Colo.
(Unit--1,000 acre-feet)

Water year	October	November	December	January	February	March	April	May	June	July	August	September	Total
1971											7.96	1.23	
1972	5.12	1.97	6.27	4.56	5.69	19.03	14.61	18.70	15.05	0.20	.13	.77	92.1
1973	24.74	11.28	6.65	7.31	8.62	22.18	150.3	310.1	173.1	31.02	1.91	1.21	748.4
1974	1.08	1.11	2.74	3.02	2.66	9.12	16.86	49.95	5.27	3.02	.35	.22	95.4
1975	.56	1.24	1.93	2.61	3.05	5.30	76.53	171.1	135.3	47.35	1.81	1.97	448.8
1976	.78	1.00	2.25	2.89	4.63	5.42	55.04	73.23	31.60	1.28	1.80	2.83	182.7
Average	6.5	3.3	4.0	4.1	4.9	12.2	62.7	124.6	72.1	16.6	2.3	1.4	
1972-76 average	6.5	3.3	4.0	4.1	4.9	12.2	62.7	124.6	72.1	16.6	1.2	1.2	313.5

Table 3
Flow of San Miguel River at Uravan, Colo.
(Unit--1,000 acre-feet)

Water year	October	November	December	January	February	March	April	May	June	July	August	September	Total
1974	7.46	6.01	7.02	5.37	4.63	16.02	45.68	55.83	28.63	11.84	3.60	1.44	193.5
1975	4.80	4.69	3.97	4.05	4.49	6.56	24.93	87.20	74.38	60.92	14.69	6.19	298.5
1976	6.42	5.01	4.57	4.57	5.61	6.07	18.10	37.95	35.59	14.44	5.23	6.30	149.6
1974-76 average	6.2	5.2	5.2	4.7	4.9	9.6	29.6	60.3	46.2	29.1	7.8	4.6	213.9

Table 4
Flow of West Paradox Creek above Bedrock, Colo.
(Unit--1,000 acre-feet)

Water year	October	November	December	January	February	March	April	May	June	July	August	September	Total
1971											0.44	0.26	
1972	0.46	0.44	0.51	0.42	0.32	0.33	0.21	0.25	0.21	0.20	.18	.19	3.7
1973	.59	.41	.23	.37	.37	.49	2.06	2.34	1.61	.38	.30	.26	9.4
Average	.5	.4	.4	.4	.35	.4	1.1	1.3	.9	.3	.3	.2	
1972-73 average	.5	.4	.4	.4	.35	.4	1.1	1.3	.9	.3	.2	.2	6.6

Table 5
Flow of Dry Creek at Naturita, Colo.
(Unit--1,000 acre-feet)

Water year	October	November	December	January	February	March	April	May	June	July	August	September	Total
1966										0.03	0.15	0.12	
1967	0.08	0.09	0.07	0.02	0.04	0.02		0.10	0.06	.55	.40	.10	1.53
1968					.03	.05	0.08	.27		.11	.19		.73
1969	.03			.01		.29	.31	.42		.19	.14	.24	1.63
1970	.10	.01			.03	.05	.24	.71	.07	.22	.16	3.28	4.87
1971	.01	.01		.04	.03	.08	.28	.25	.02		.45		1.17
1972	.33		.06		.01	.03	.04	.02	.06	.02	.05	.25	.87
1973	.81	.06			.09	.28	.41	1.57	.46	.11	.04		3.83
1974	.01				.06	.35	.15	.16		.14	.01	.02	.90
1975	.01				.02	.19	.16	.42	.12	.01		.34	1.27
Average	.15	.02	.01	.01	.03	.15	.19	.44	.09	.15	.16	.47	1.87

maximum discharge at this station was 9,280 cfs on April 30, 1973, and the minimum was 0 cfs on September 30, 1974.

For the Dolores River near Bedrock for the same period, the average annual flow was 313,500 acre-feet. The increase in the flow of the river across the valley is due to the tributary inflow from West and East Paradox Creeks and relatively fresh and saline ground water inflow from springs and seeps. The maximum discharge recorded at this station was 9,500 cfs on April 30, 1973; the minimum was 0.44 cfs on August 1, 1972.

Dolores River flow patterns in Paradox Valley would be modified with the construction and completion of McPhee Dam, the main storage facility of the proposed Dolores Project located about 115 miles upstream from Paradox Valley. The construction of McPhee Dam should result in increased flows from August through November in wet and average years. In dry years the minimum releases would be such that they probably would not reach Paradox Valley, and streamflows would approximate historical flows. About 1 year out of 4 would fall in this category. McPhee Dam would cause decreased or unchanged flows from December through July, and therefore, Dolores River flows through Paradox Valley should be more uniform than historically. The increased summer and fall flows would be produced by reservoir releases for downstream water rights and for improved fish habitat. Decreases in monthly flows would primarily occur while accumulating storage in McPhee Reservoir during the high spring runoff. The historical and modified flows immediately downstream from McPhee Dam site are shown in Table 6.

Table 6
Dolores River--downstream at McPhee Dam site
(Unit--1,000 acre-feet)

Month	Historical average monthly flows (1923-73)	Modified average monthly flows
January	3.2	3.3
February	3.1	2.9
March	10.3	4.0
April	61.9	15.0
May	87.8	40.0
June	55.0	19.1
July	6.5	3.6
August	3.2	3.2
September	2.5	3.1
October	4.5	4.1
November	3.2	3.6
December	3.4	3.4
Total	244.6	105.3

West Paradox Creek

West Paradox Creek, formed on the eastern side of the La Sal Mountains in Utah by the confluence of Mellenthin and Buckeye Creeks, flows down to and through the western part of Paradox Valley and empties into the Dolores River in the middle of the well field area. Water from Buckeye Creek is stored in Buckeye Reservoir (capacity 1,600 acre-feet) and is used along with natural flows in West Paradox Creek for irrigation in the upper portions of the valley. During the irrigation season, excluding the high spring runoff period and thunderstorms, the only flows in the creek reaching the Dolores River are small amounts of irrigation return flow.

Dry Creek

The headwaters of Dry Creek are about 20 miles south of Naturita, Colo. It flows in a northwesterly direction draining all of Dry Creek Basin and then flows north emptying into the San Miguel River 3 miles east of Naturita. The proposed Radium Dam and Dike are on small intermittent tributaries that drain into Dry Creek.

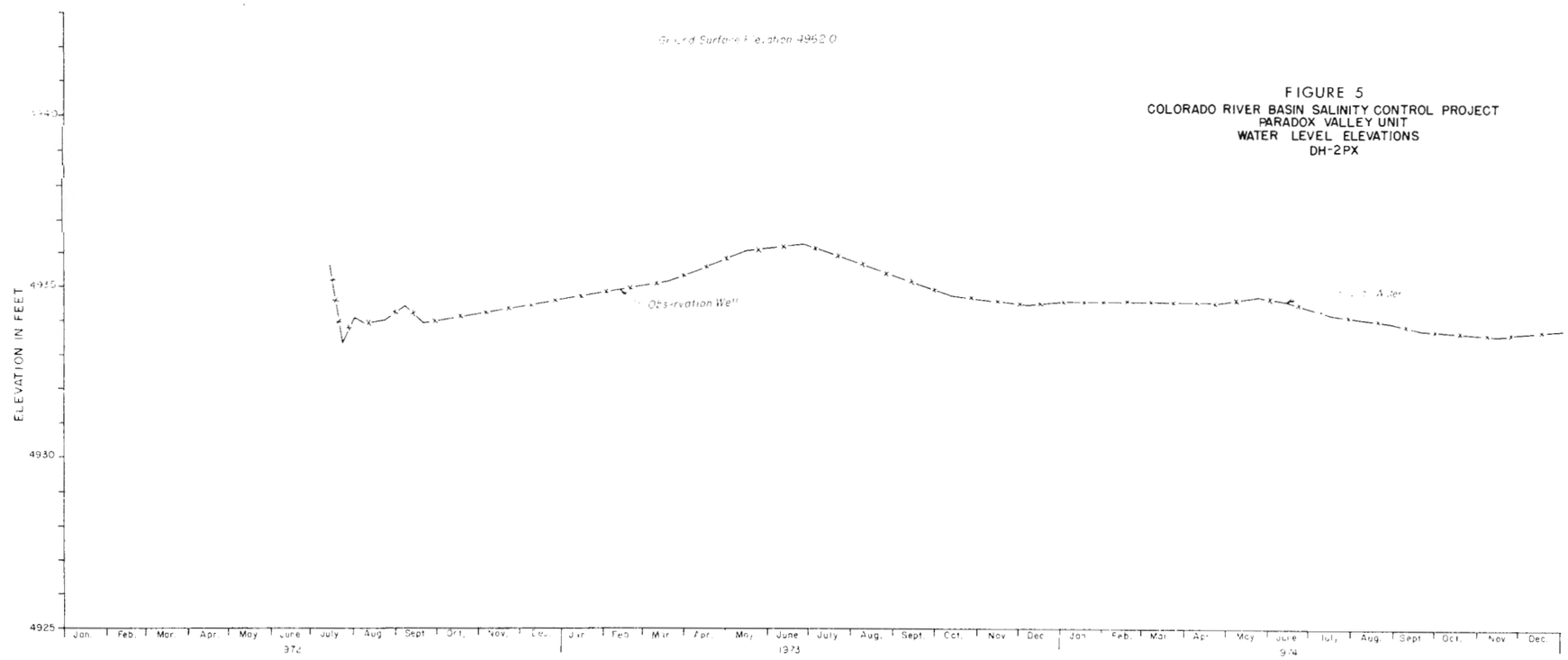
Ground Water

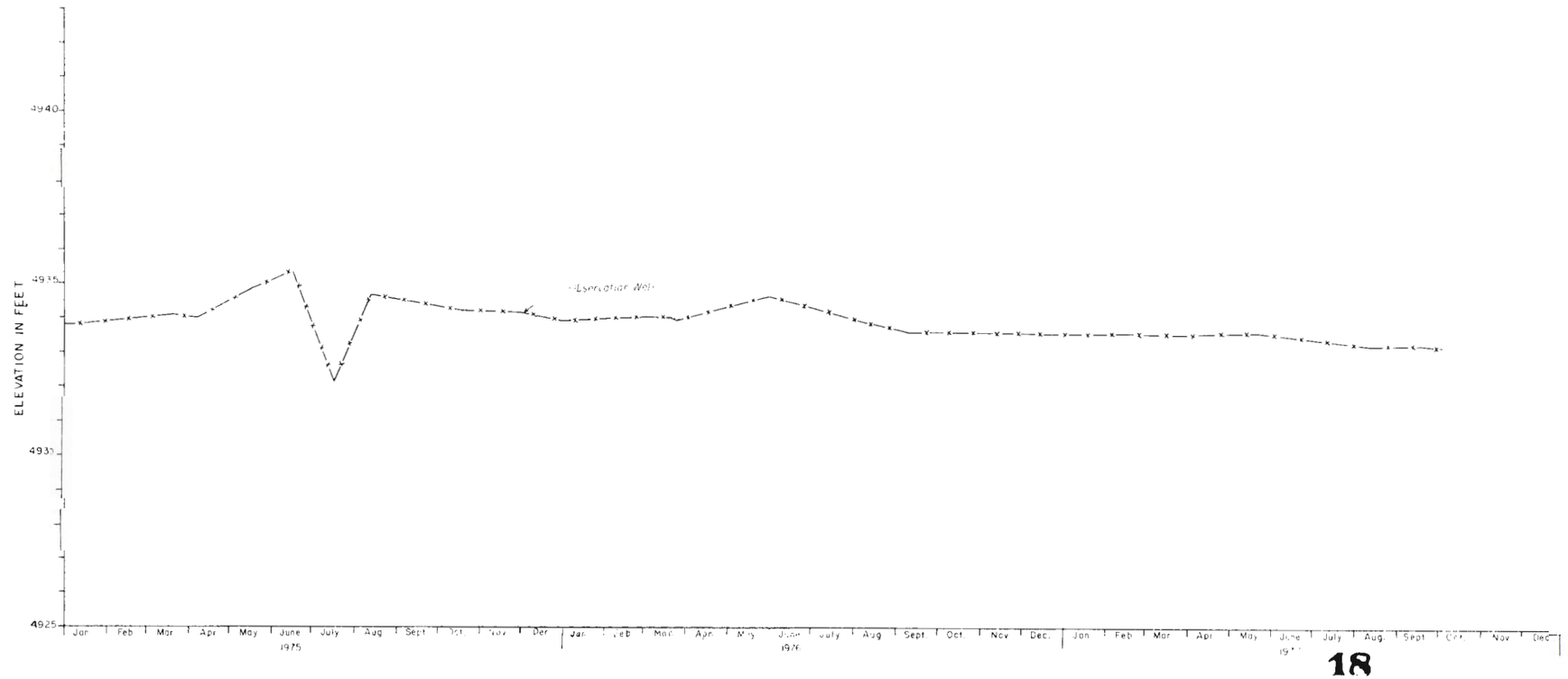
Paradox Valley

Ground water level measurements in Paradox Valley were started in 1971 on private wells and were expanded to include the Bureau-constructed wells as they were completed. The Bureau of Reclamation's observation well network consists of ground water table observation wells and piezometers that measure the piezometric head at different points in the brine aquifer. A series of piezometers were placed just above the gypsum bedrock in the alluvial overburden 56 to 80 feet deep (piezometer No. 2), and another group was placed in the gypsum itself 225 feet deep (piezometer No. 1). For a detailed explanation of the observation well network, see Chapter IV. The measurements included water level readings of both ground water table and deep artesian aquifers. The measurements were usually taken on a monthly basis; however, when personnel were working in the area or when aquifer tests were being conducted, measurements were taken at more frequent intervals. On one well a continuous recorder was installed to monitor the water level fluctuations.

Hydrographs showing water table levels and piezometric head elevations for selected wells throughout the well field area are shown in Figures 5 through 15. Measurements were started in mid-1972 for wells 2PX and 10CX, in mid-1973 for 6PX and 7PX, in early 1974 for 8PX, and in late 1975 for 1W1, 2W2, 4W1, 2C1, 2E1, and 3E1. Location of these wells is shown on the General Investigations Map on page 13.

FIGURE 5
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-2PX





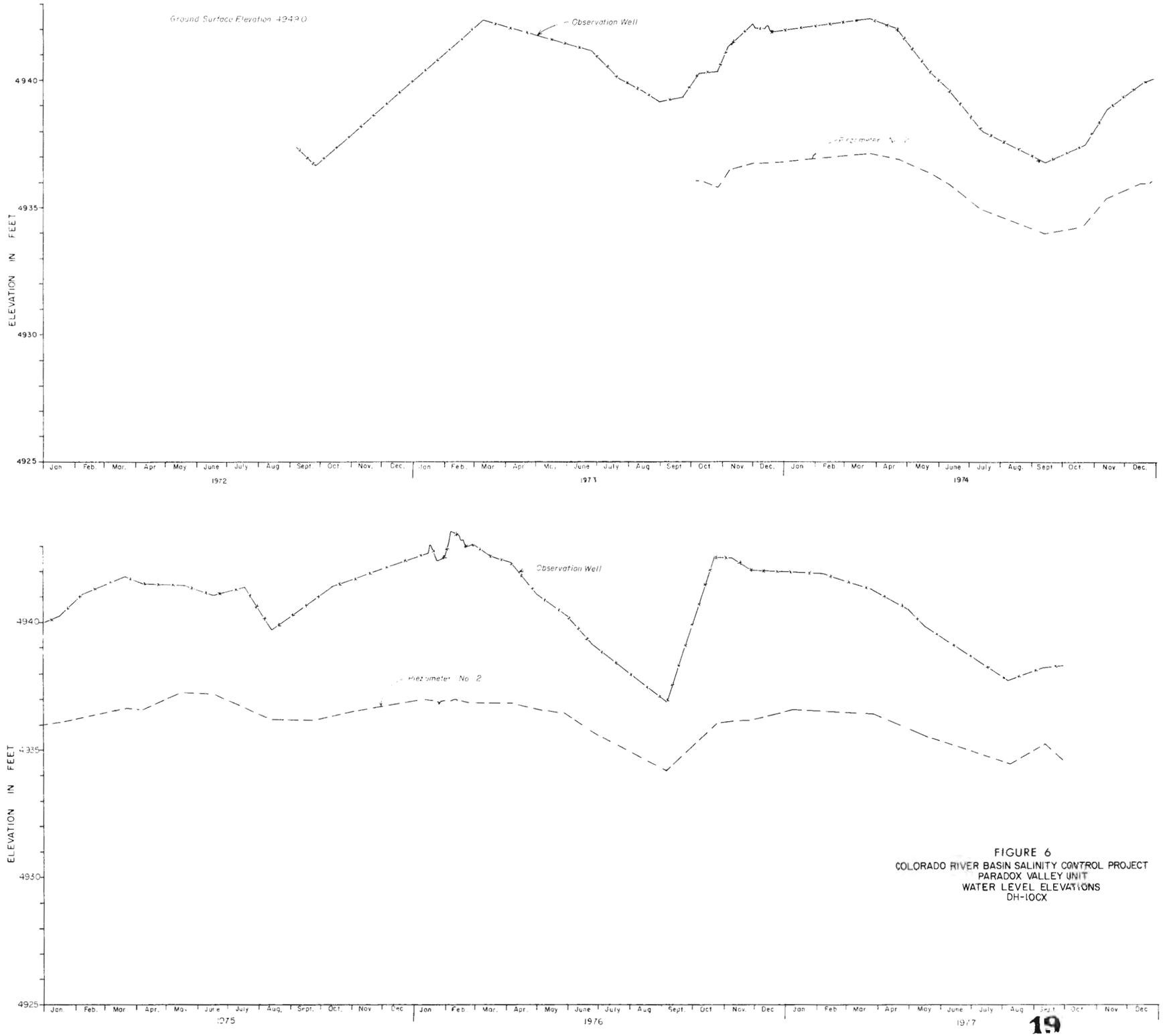
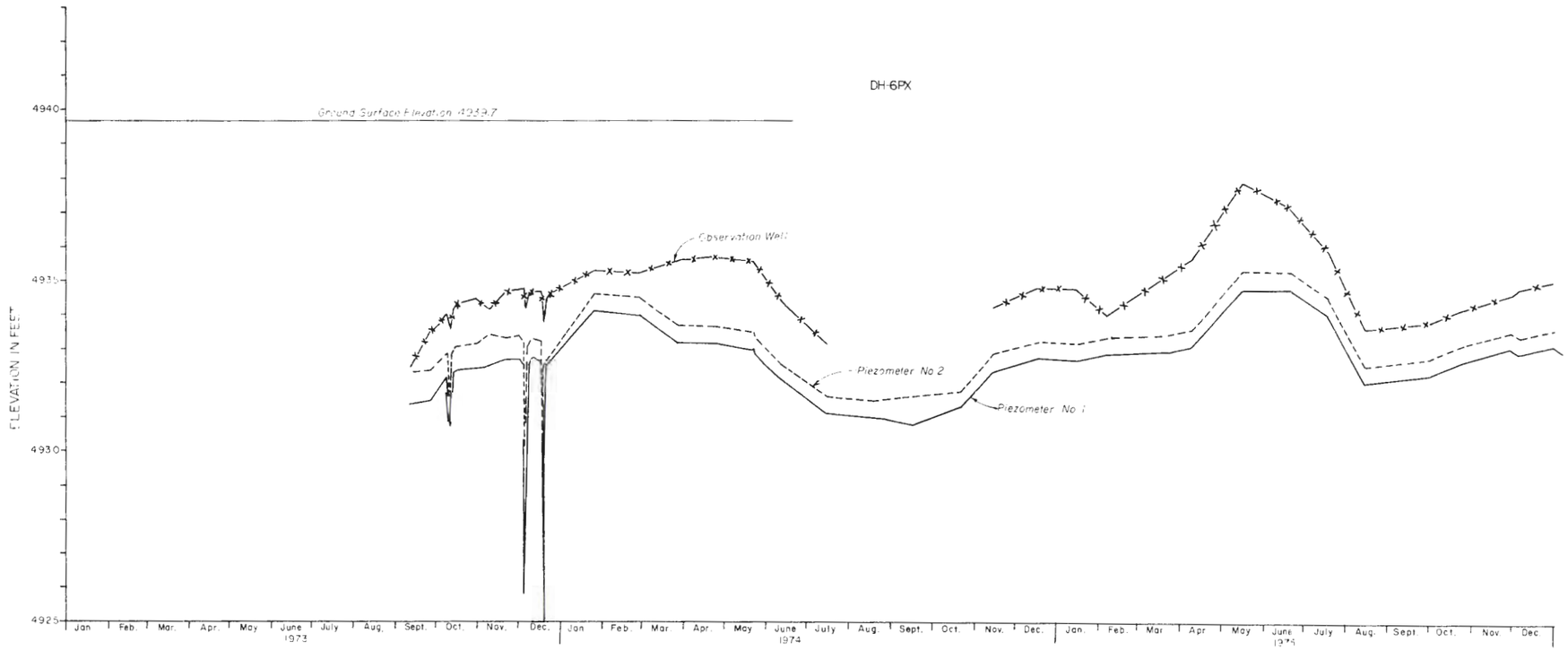


FIGURE 6
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-10CX



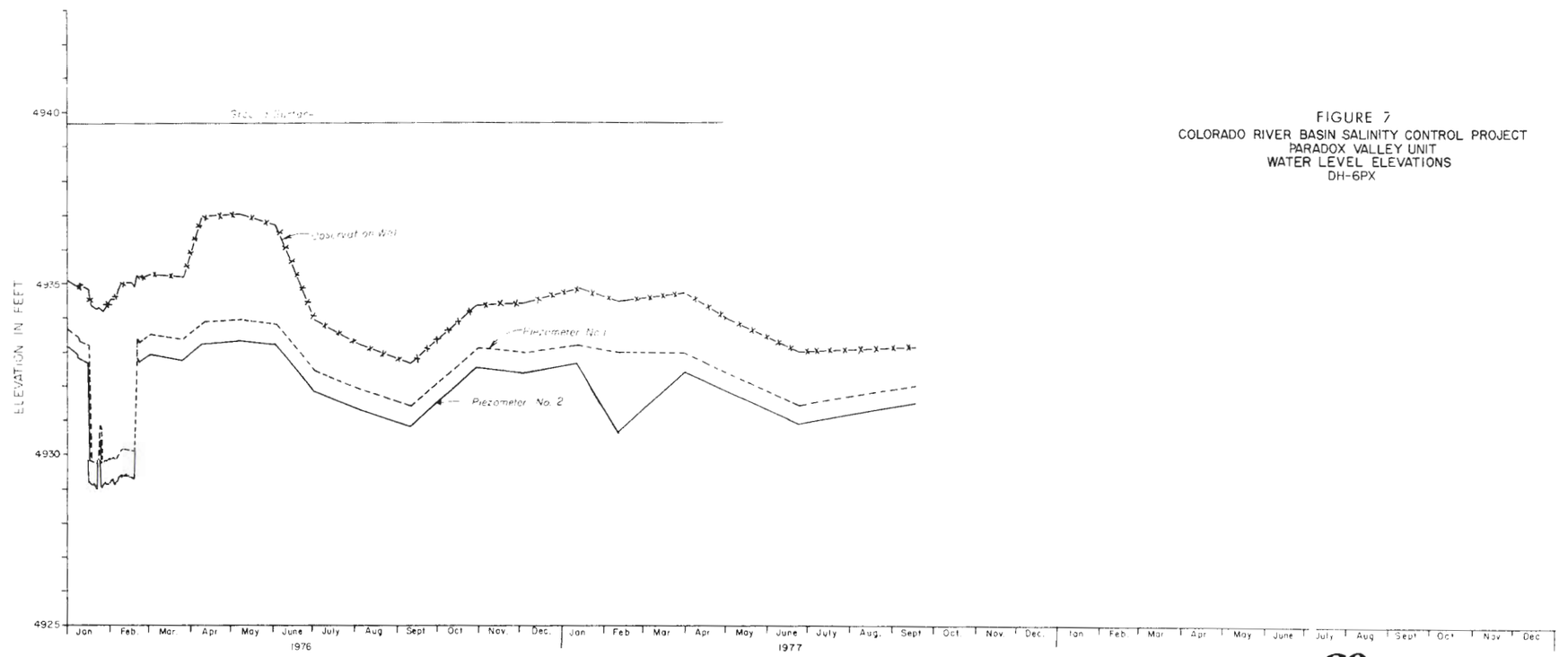
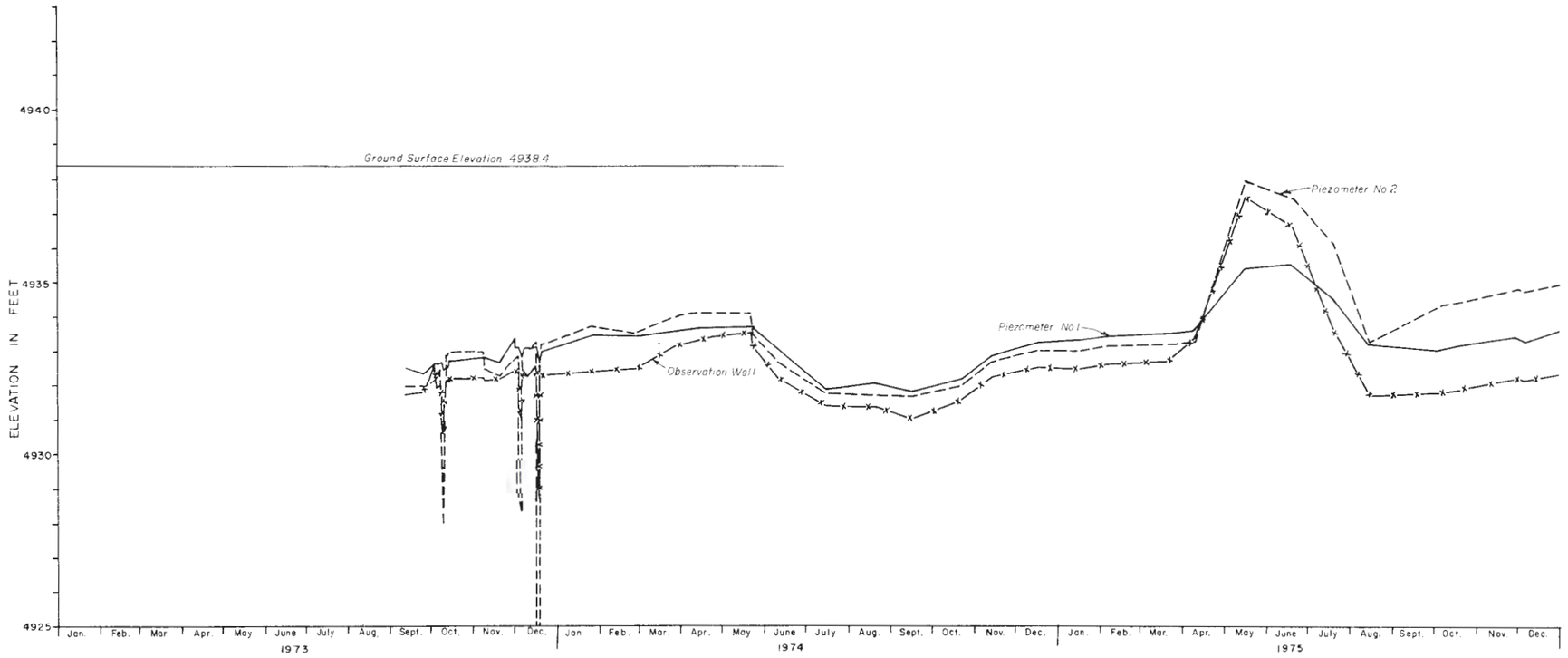


FIGURE 7
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-6PX



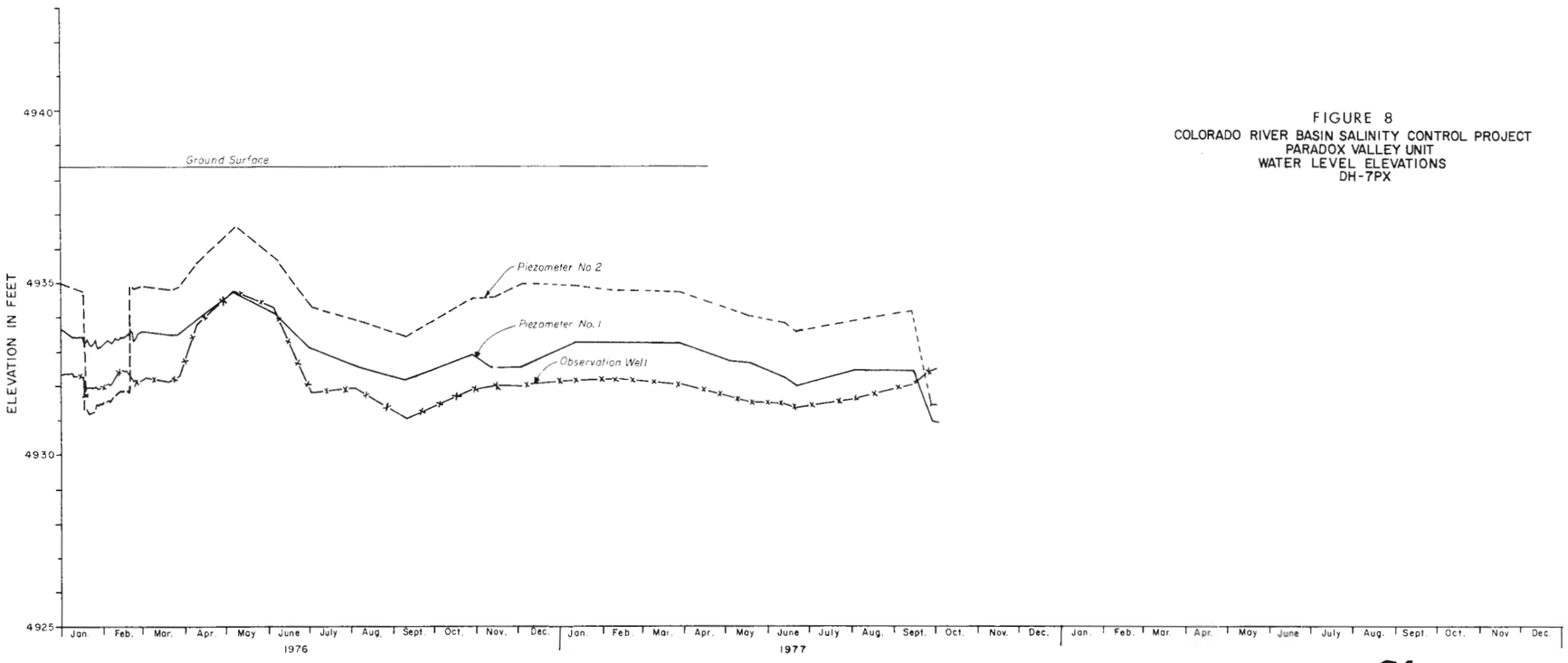


FIGURE 8
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-7PX

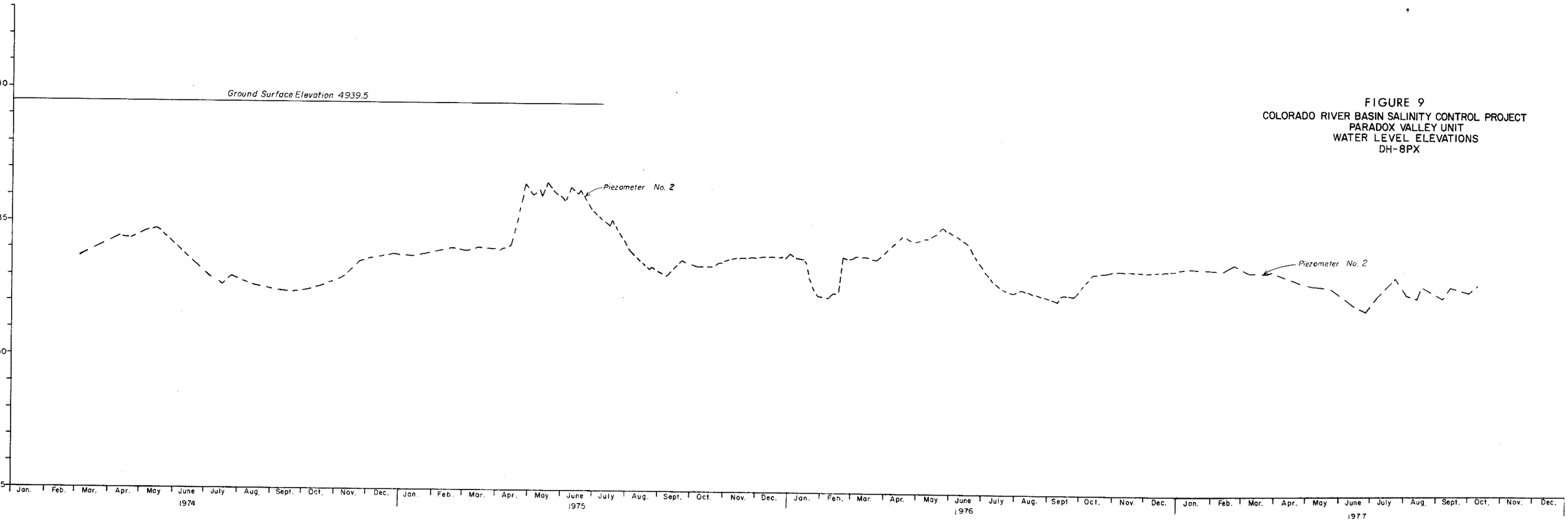
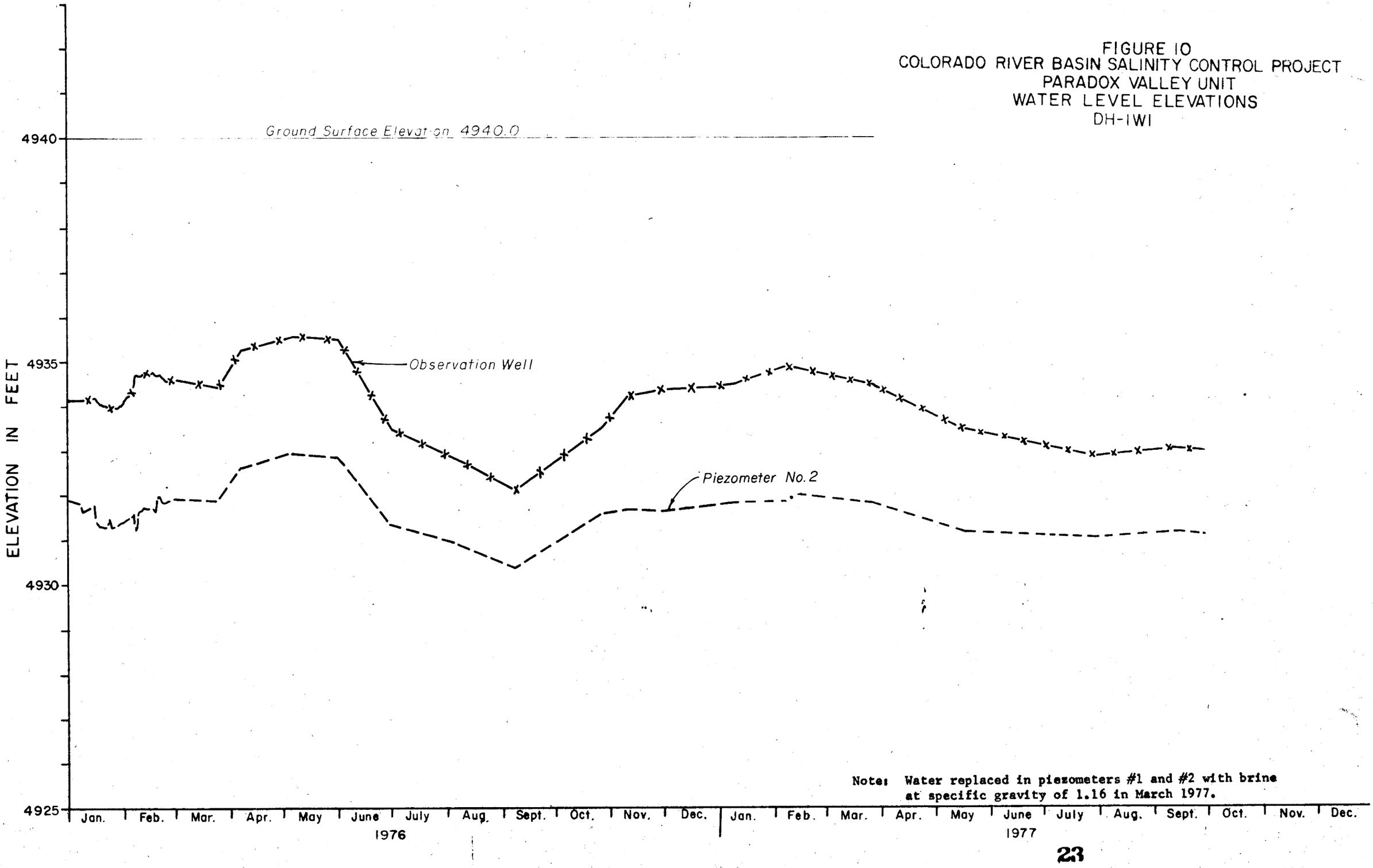


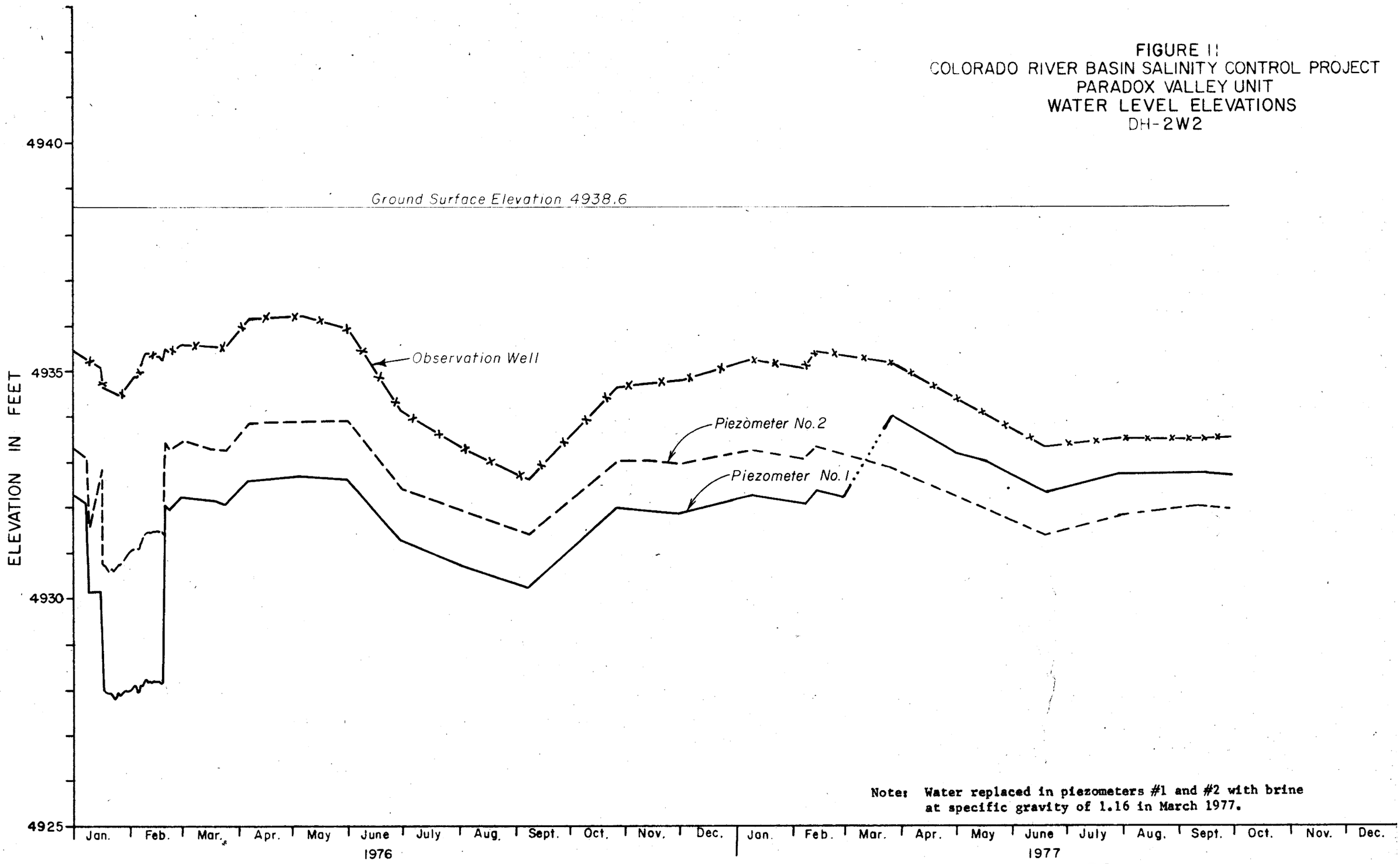
FIGURE 9
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-8PX

FIGURE 10
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-1WI



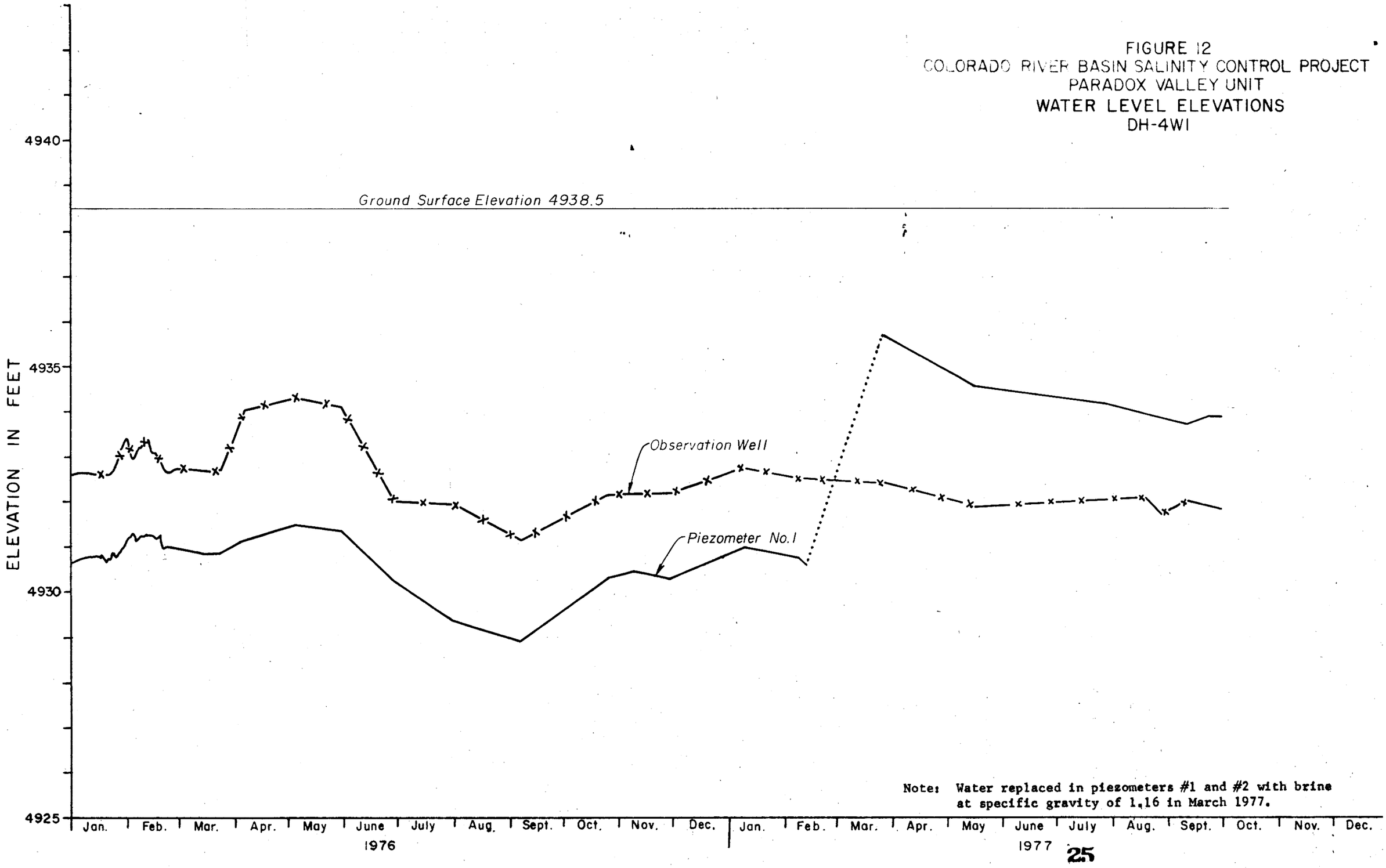
Note: Water replaced in piezometers #1 and #2 with brine at specific gravity of 1.16 in March 1977.

FIGURE 11
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-2W2



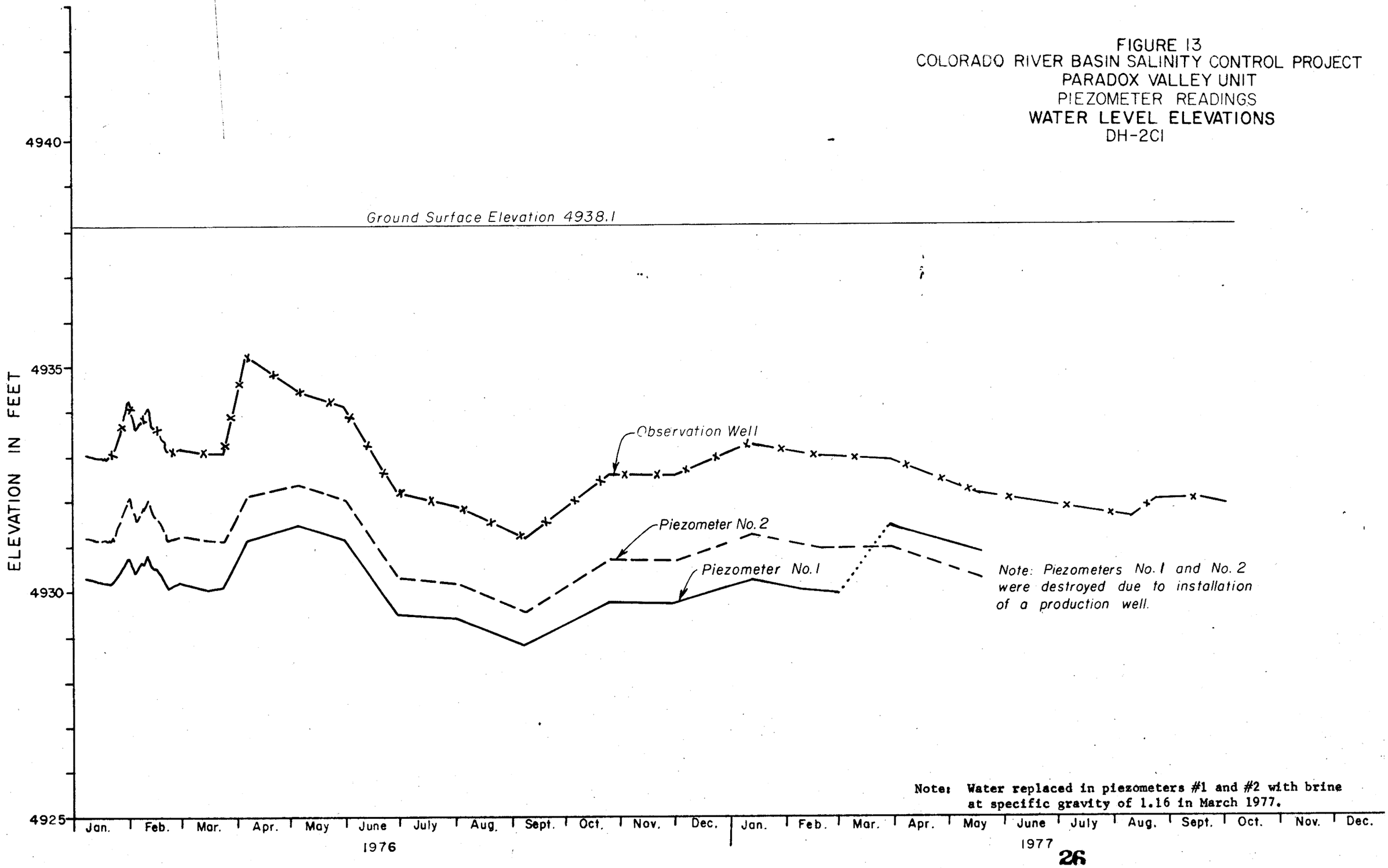
Note: Water replaced in piezometers #1 and #2 with brine at specific gravity of 1.16 in March 1977.

FIGURE 12
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-4WI



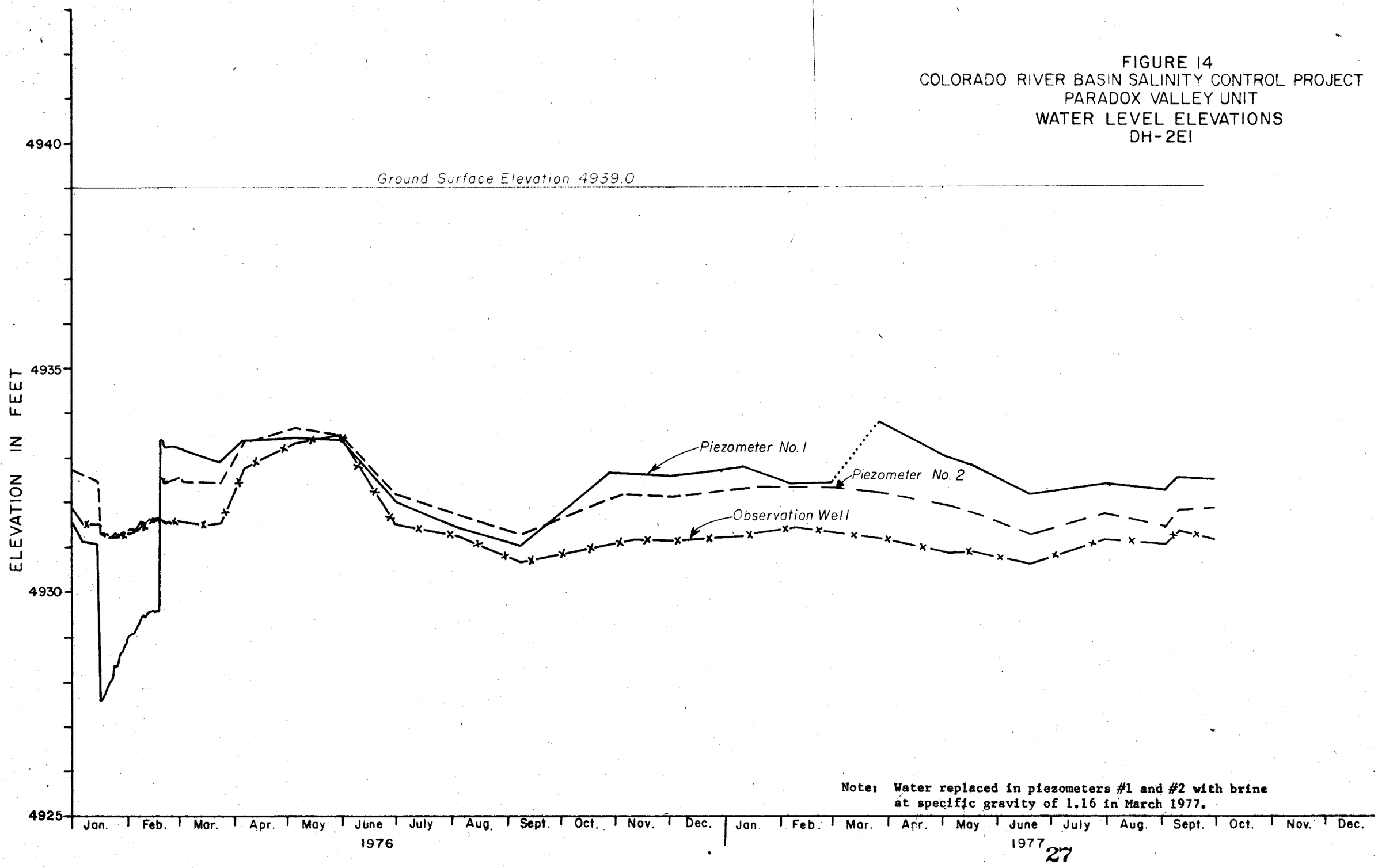
Note: Water replaced in piezometers #1 and #2 with brine at specific gravity of 1.16 in March 1977.

FIGURE 13
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
PIEZOMETER READINGS
WATER LEVEL ELEVATIONS
DH-2CI



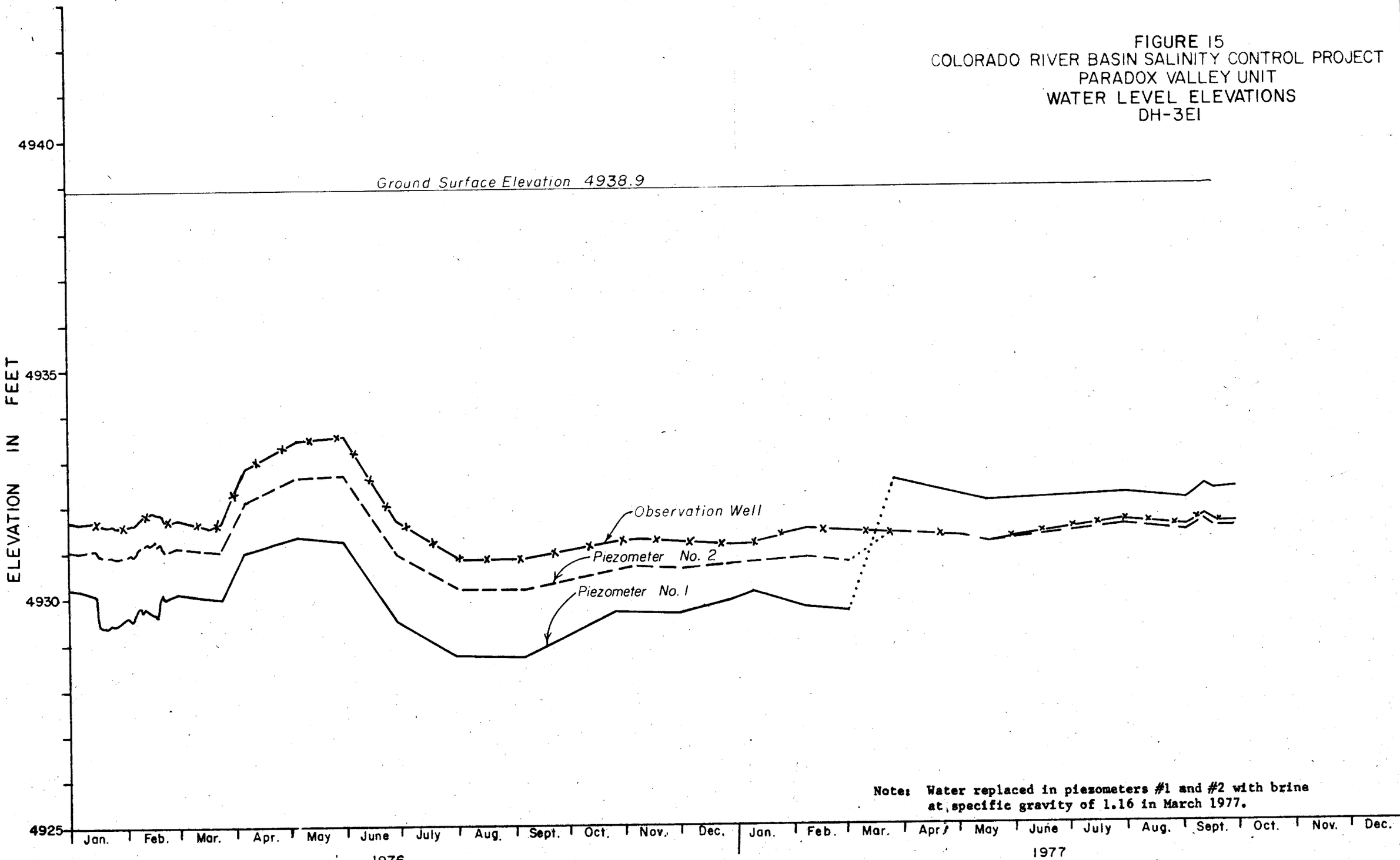
Note: Water replaced in piezometers #1 and #2 with brine at specific gravity of 1.16 in March 1977.

FIGURE 14
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-2E1



Note: Water replaced in piezometers #1 and #2 with brine at specific gravity of 1.16 in March 1977.

FIGURE 15
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
WATER LEVEL ELEVATIONS
DH-3EI



Note: Water replaced in piezometers #1 and #2 with brine at specific gravity of 1.16 in March 1977.

In March 1977, the brine in all the piezometers that were constructed during 1975 was replaced with brine having a density of 1.165. This was done to eliminate discrepancies caused by density differences. When the piezometers were constructed, they were cleaned out and filled with the formation brine. Testing of the formation brine has since shown density differences. As can be seen on the hydrographs for piezometer No. 1 in 2W2, 4W1, 2C1, and 2E1 and piezometers 1 and 2 in 3E1, replacing the formation brine with a brine having a density of 1.165 caused a jump in water levels. This indicates that the formation brine had a higher density and thus higher salt content than the replacement brine.

The greatest effect on the ground water system has been caused by high spring floodflows in the Dolores River and flooding on West Paradox Creek. This effect is shown on all the hydrographs during the period of April through June of each year. Little effect is shown at 2PX because of the distance away from the river. The effects of the pump tests conducted in October and December 1973 on the water levels can be seen on the hydrographs for 6PX, 7PX, and 8PX. The effect of the pump test conducted in January and February 1976 on the water levels can be seen in all the hydrographs except 2PX, 10CX, 4W1, and 2C1. Ice buildup on the flood plain and in West Paradox Creek and the ponding effect behind the ice on the west bank also affect water levels on the west bank and can be seen on the hydrographs usually during December, January, and February. During the pump test in January and February 1976, a large ice buildup occurred and then melted. The effect of this event can be seen on the hydrographs of 4W1, 2C1, and 10CX.

Brine Aquifer

Since 1972 the Bureau of Reclamation has accomplished considerable drilling on both sides of the Dolores River to determine the subsurface geology and ground water conditions in the brine discharge area. In addition, logs of private wells and exploratory drilling operations have been used to obtain information. Selected logs are shown in the Attachment Section pages 103 to 159, and all remaining logs are available in the Bureau's office in Durango, Colo. Well locations are shown on the General Investigations Map on page 13.

The logs indicate that the Dolores River has deposited considerable amounts of alluvium over the underlying Paradox Member of the Hermosa Formation. These deposits were encountered at depths to 129 feet. The alluvial deposits are stratified varying from fine, poorly graded sand to clay-filled gravels just above the residual gypsum cap. Discontinuous clay lenses occur at irregular intervals throughout the deposits.

The Paradox Member of the Hermosa Formation underlies the entire valley and is exposed in the eastern part as gypsum hills extending along the axis of the anticline. Along the river this member lies below the alluvial deposits. Drill hole information indicates that there is a general

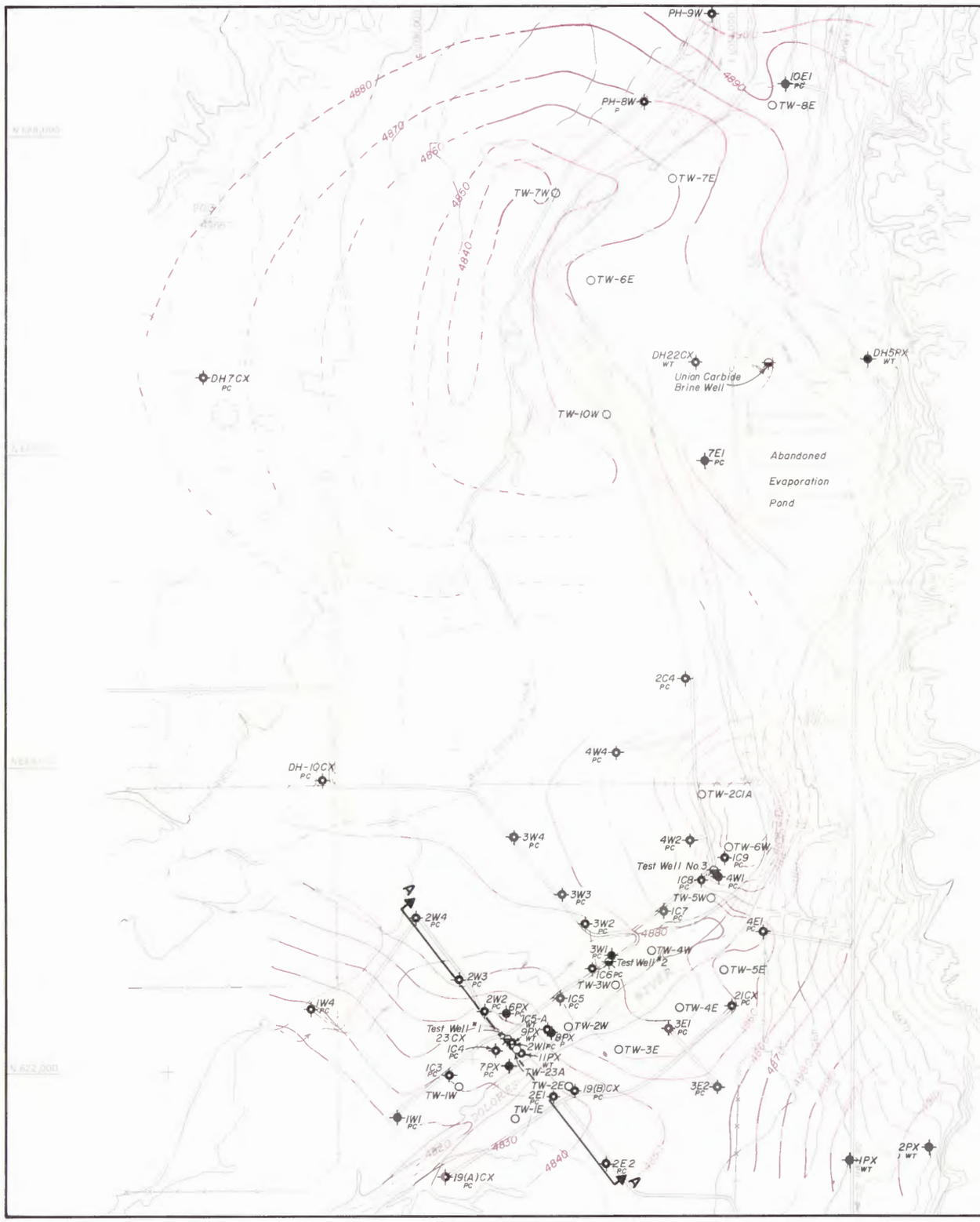
rise, or subsurface ridge, of the member extending along the middle of the valley in the well field area. The red contours of the map on the following page show elevations and locations of this ridge. The Paradox Member is predominantly salt, with arkose, carbonaceous shale, limestone, gypsum, anhydrite, and interbedded sandstone. The upper 650 to 1,000 feet have been leached to form the residual cap of predominantly gypsum with large amounts of crumbly, gypsiferous, and carbonaceous shale that is extensively brecciated and mixed with other clastics. Underlying the residual cap, the halite (sodium chloride) rich core was determined to extend to a depth of 14,000 feet in a wildcat hole about 1 mile west of the brine inflow area.

The most permeable brine aquifers are in the alluvial deposits and generally occur at about midway between the ground surface and the residual gypsum cap. The aquifers usually consist of fine, poorly graded sand but are sometimes sandy gravel. The discontinuous and erratic clay lenses form impermeable barriers which direct the flow of water through certain areas and create artesian conditions in places, but there is no extensive confining of the aquifers. The brine entering the river is derived from ground water circulating through fractured zones in the greatly faulted, folded, and brecciated residual gypsum cap until it comes in contact with the underlying salt core and thereby becomes brine. The extreme predominance of sodium chloride in the brine indicates that the source of salt is in the halite-rich salt core rather than in the leached residual cap.

Brine appears to underlie the entire length of the Paradox Valley at varying depths. Along the Dolores River flood plain from about the middle of the valley to the exit from the valley, brine surfaces in the river channel in two general areas as shown in Figure 16 on page 32 and also on the first photograph on page 9. The drill log of a well operated by the Jensen and Jensen Brine Company about a mile west of the river shows the top of the brine zone between depths of 102 and 109 feet. The exact location of the top of the brine aquifer west of the Jensen brine wells is not known. Although two irrigation wells in the northwest end of the valley penetrated the Paradox Member for several feet, there is no report of brine being encountered. To the east of the river on the valley floor the brine varies from 10 to 50 feet beneath the surface. The investigations indicate that brine ground water converges toward the river from both the east and west portions of the valley.

From water level and electrical conductivity measurements in the shallow water table observation wells, it can be seen that the freshwater-brine interface slopes downward away from the river (see Figure 17 on page 33). The interface gradient is steeper toward the river on the west side than on the east side.

Piezometric head measurements in two zones, one zone within the gypsum cap and one just above the gypsum cap, indicate that the brine



EXPLANATION

- Rotary tool
- Nx core hole
- Brine inflow areas
- Brine well – Drilled by cable tool
- Test wells
- Multiple profile
- PC — Piezometer Cluster containing one or more piezometers plus water table observation well
- WT — Water table observation well
- P — Piezometers only
- Gypsum contours
- Estimated Gypsum contours (no data)

NOTE: Terroin coordinates DAF=1.00025767 bosed on Colorado State Plane coordinate system (south zone)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER BASIN
SALINITY CONTROL PROJECT
COLORADO

PARADOX VALLEY UNIT
SURFACE OF GYPSUM BRECCIA

DECEMBER 1977

1294-400-22

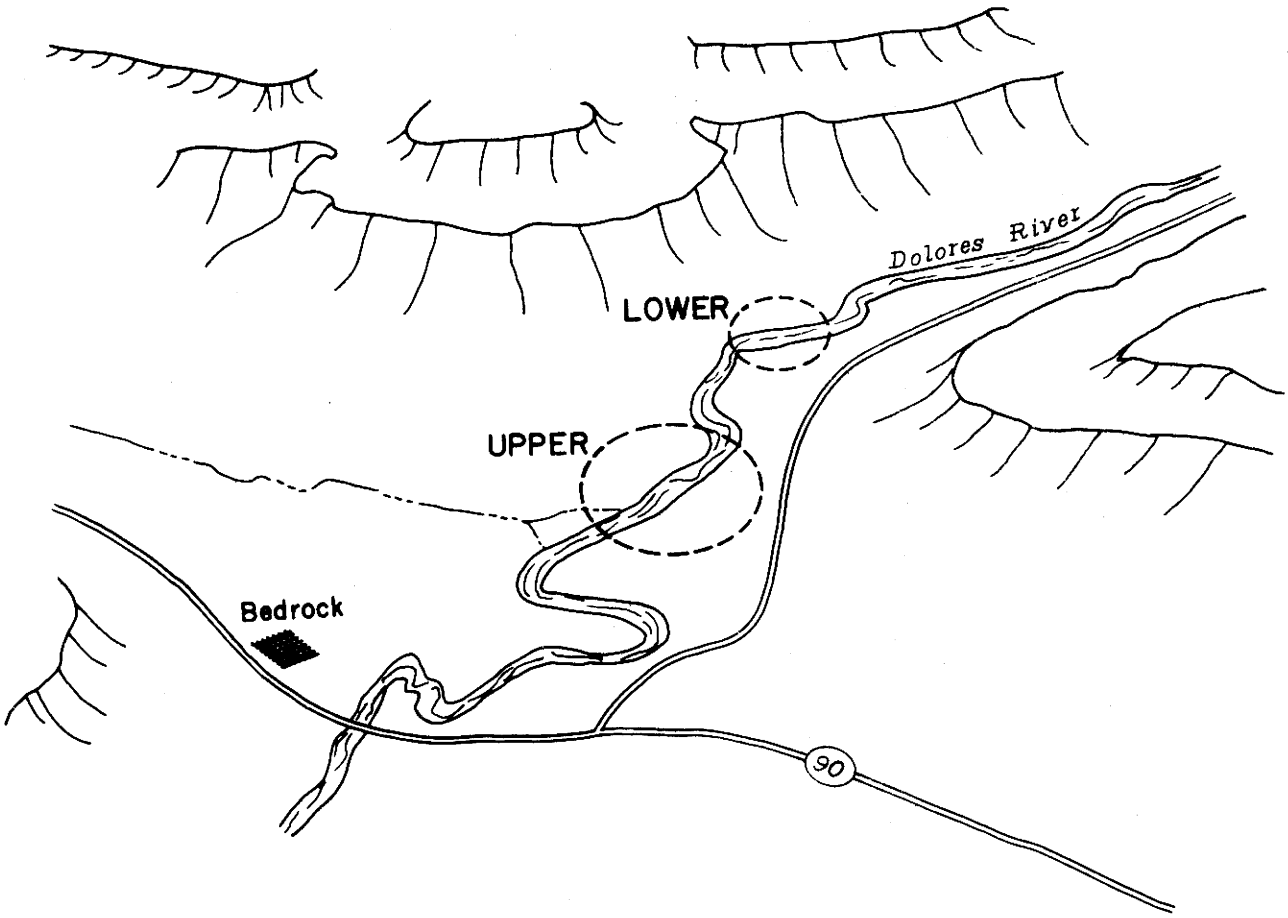
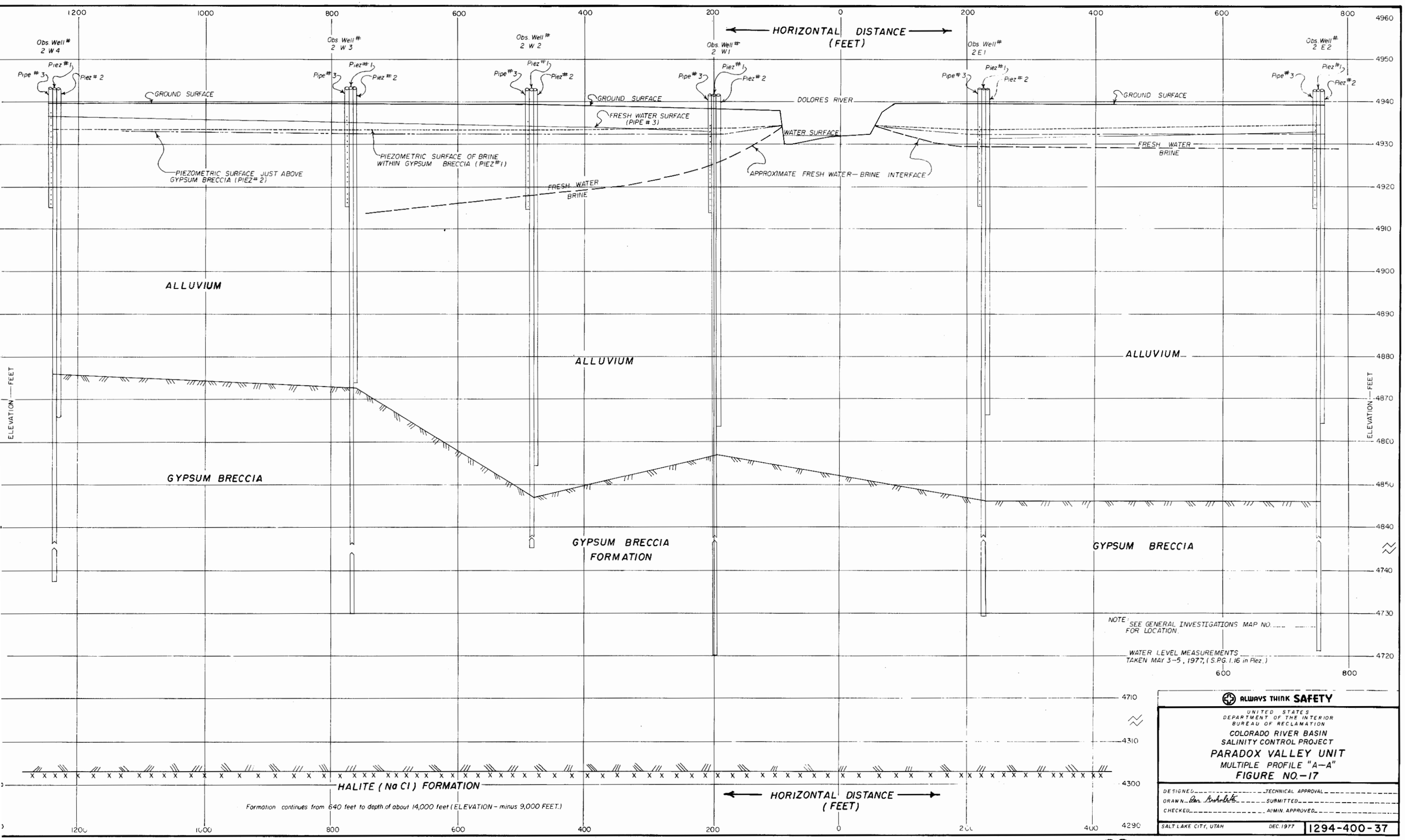


FIGURE 16
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
MAXIMUM BRINE INFLOW AREAS



NOTE: SEE GENERAL INVESTIGATIONS MAP NO. ____ FOR LOCATION.

WATER LEVEL MEASUREMENTS TAKEN MAY 3–5, 1977, (S.P.G. 1.16 in Piez.)

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER BASIN
SALINITY CONTROL PROJECT

PARADOX VALLEY UNIT

MULTIPLE PROFILE "A–A"

FIGURE NO.–17

DESIGNED	TECHNICAL APPROVAL
DRAWN Dan Archuleta	SUBMITTED
CHECKED	ALMIN. APPROVED
SALT LAKE CITY, UTAH DEC. 1977	1294-400-37

pressures are above the normal water surface of the river. See the green and blue contours of the map on the following page for the piezometric heads as measured in the gypsum cap and in the alluvium.

Freshwater Aquifer

A significant layer of relatively freshwater overlies the brine in western Paradox Valley with a hydraulic gradient toward the river. The top of this water lies from 6 to 40 feet below the ground surface, depending upon the location. See the red contours of the map on the following page for the ground water table elevations. In the flood plain, the water table depth is generally from 4 to 10 feet below the ground surface. Estimated to be at least 100 feet thick about a mile west of the river, the thickness of the layer gradually decreases toward the river and pinches out in the area of the surfacing brine. There are several irrigation wells in West Paradox Valley that pump from this freshwater source.

On the east side of the river little, if any, freshwater overlies the brine. Approximately 3 to 3.5 miles southeast of the river in East Paradox Valley, however, there are two wells from which water is pumped for livestock watering.

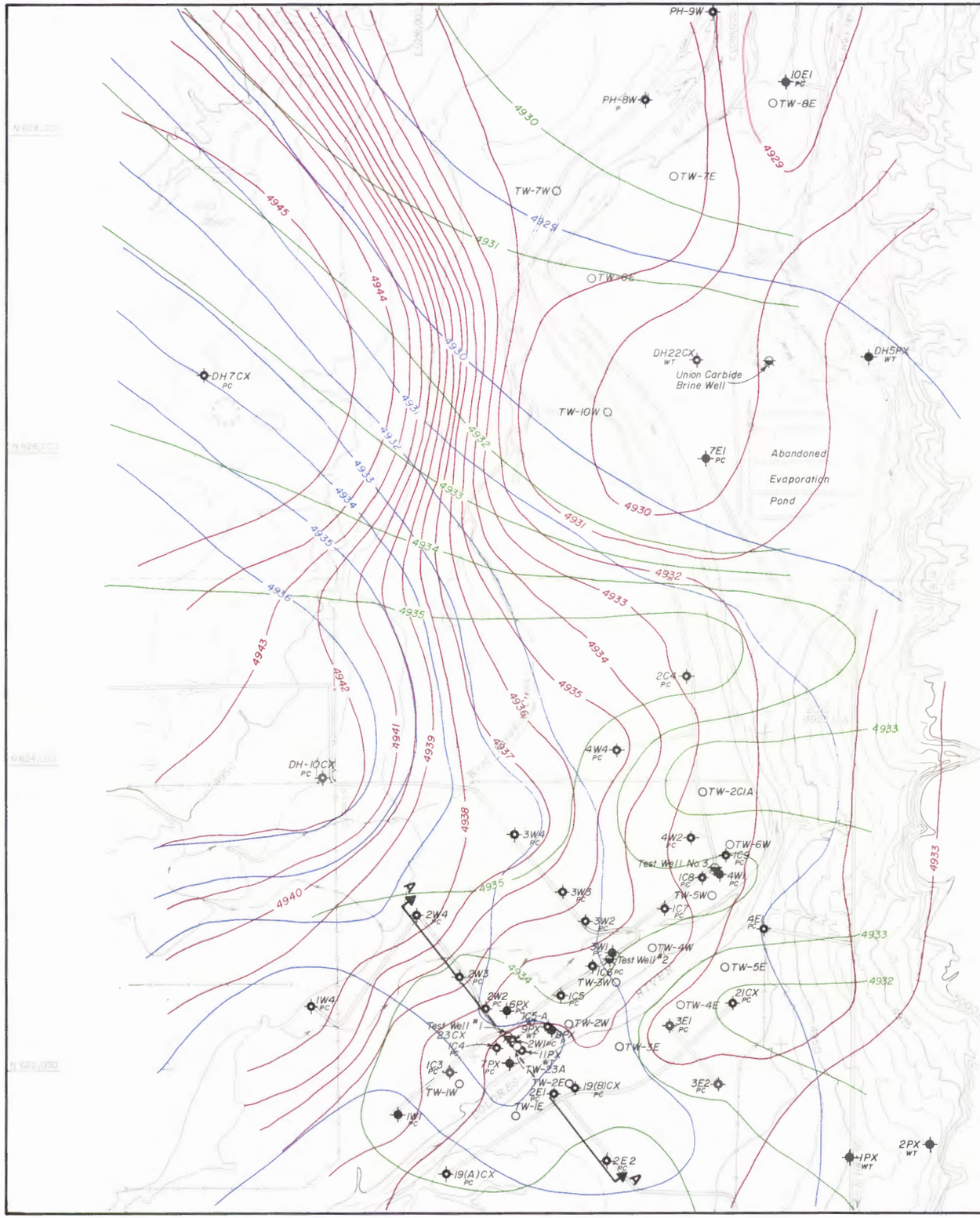
Freshwater springs near Bedrock on the west side of the river maintain a marshy area and feed some small impoundments (old river channel depressions). There are also two flowing springs just east of the river on the south side slope of the valley. Water from the spring nearest the river is piped to the Bedrock town site.

Recharge Sources

The brine and freshwater aquifers have a variety of potential recharge sources, including runoff from the La Sal Mountains, irrigation return flows from western Paradox Valley, seepage from West Paradox Creek, precipitation, and surface and subsurface runoff from the valley walls. Because brine evidently circulates through the salt core at depths of 650 feet or more before surfacing, it probably originates from the more distant recharge sources, while the freshwater originates from the nearer sources.

It is possible that some of the brine that discharges in Paradox Valley may be derived from deep sources below the Paradox Member, but this contribution is believed to be negligible. An unpublished report by the Geological Survey[1/] gave the following reasons: (1) the salt beds probably have a very low hydraulic conductivity and thus could not transmit ground water at a significant rate; (2) the only significant aquifer

1/ Konikow, L.R., and Bedlinger, M.S., 1975, Evaluation of Hydrogeologic Aspects of Proposed Salinity Program in Paradox Valley, Colorado, U.S. Geological Survey, Lakewood, Colo.



400 0 400 800 1200

SCALE OF FEET

EXPLANATION

- Rotary tool
- Nx core hole
- Brine inflow areas
- Brine well - Drilled by cable tool
- Test wells
- Multiple profile
- PC — Piezometer Cluster containing one or more piezometers plus water table observation well
- WT — Water table observation well
- P — Piezometers only
- Piezometer No.1 elevation of brine surface on 5-2-77
- Piezometer No.2 elevation of brine surface on 5-2-77
- Observation well-elevation of fresh water surface on 5-2-77

NOTE: Terrain coordinates DAF=1.00025767 based on Colorado State Plane coordinate system (south zone)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLORADO RIVER BASIN
SALINITY CONTROL PROJECT
COLORADO

PARADOX VALLEY UNIT
WATER & PIEZOMETRIC LEVELS

DECEMBER 1977

1294-400-23

of all the pre-Paradox rocks is the Leadville Formation of Mississippian Age; however, a potentiometric map of this aquifer does not indicate that it discharges water in Paradox Valley; and (3) the Leadville Formation is overlain by the Molas Formation of early Pennsylvania Age, which in turn is overlain by the Pinkerton Trail (lower member of the Hermosa Formation), and these units form an effective seal between the Paradox Member and the Leadville Formation.

Ground Water Discharge

The total discharge from the springs and seeps along the banks and in the bed of the Dolores River in Paradox Valley appears to range from 1.5 to 4 cfs. Directly measuring the discharge of the brine is impractical because of the large number of both fresh and brine springs and seeps, the diffuse nature of some of them, and the location of some in the riverbed. Consequently, the brine discharge has been calculated on the basis of total ground water inflow and total salt contribution, as follows. Samples of the seeps and springs have shown that they have either a low (1,500 mg/l) or high (250,000 mg/l with a density of 1.16) salt content depending upon sampling location. There seems to be little inflow with a salt content in the middle range. Using monthly averages of salt pickup by the river calculated from data for the period August 1971 to September 1976, the average daily salt pickup has ranged from a low of 115 tons per day to a high of 1,430 tons per day, as shown in Figure 18. In order to calculate the quantity of brine flowing into the river, it was assumed that the total salt pickup[1/] was from the brine springs and seeps, since only 16 tons per day would be added to the river if all the ground water were flowing into the river at 1,500 mg/l. At a concentration of 250,000 mg/l, it would require a brine inflow in the range of 0.2 to 2.1 cfs to contribute the 115 to 1,430 tons per day.

The brine ground water inflows to the river exhibit a degree of seasonal fluctuation, generally being at its lowest during the spring or summer and at its highest during the fall and winter.

Dry Creek Basin

Mancos Shale underlies most of the area of the proposed Radium Evaporation Pond extending from the base of the northeast ridge of Dry Creek Basin to the southwestern extremities of the pond site. Dakota Sandstone is exposed at intervals along the northeast slope of Dry Creek Basin between the proposed sites for Radium Dam and Dike. Stream deposits, residual soil, and a small amount of eolian soil comprise the overburden of the pond site. The stream deposits consist mostly of sand and silt with occasional gravel- to boulder-sized detritus from local sedimentary formations. Beyond the streambeds, the site is overlain by a relatively thin

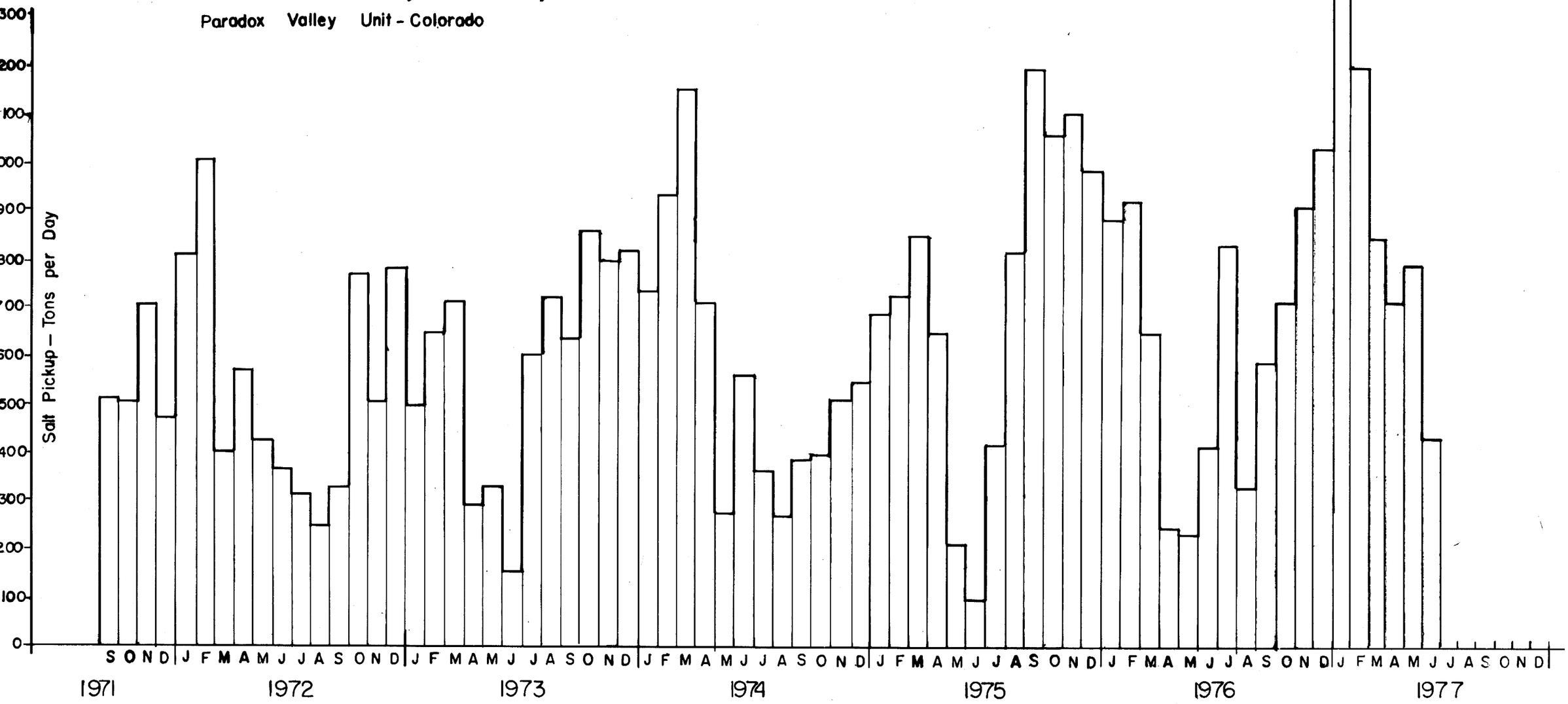
1/ The pickup is from ground water inflow to the river and does not include any salts in the flows from West Paradox Creek.

Figure 18

Average Daily Salt Pickup by Dolores River

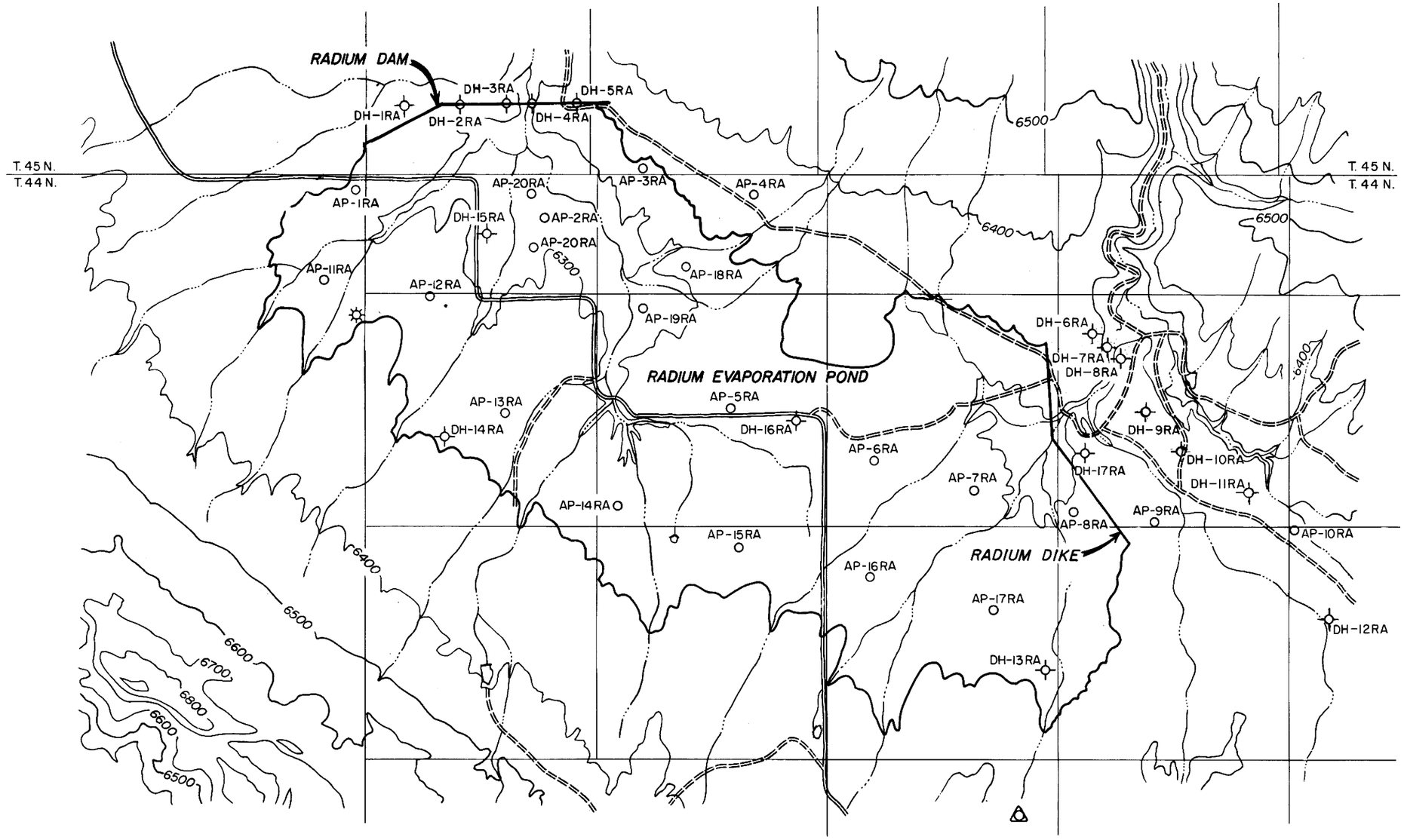
Colorado River Basin Salinity Control Project

Paradox Valley Unit - Colorado



covering of silt, lean clay, and fat clay derived from Mancos Shale, for the most part; it contains, however, weathered sandstone and sand layers from Dakota Sandstone along the northern fringe of the pond site. The residual soil derived from Mancos Shale sometimes has zones of soluble carbonate and/or sulfate mineral concentrations which are also typical of the parent material. Eolian soil of reddish-brown silt and lean clay often forms the upper 1 to 3 feet of overburden. No faulting or folding other than the major structure of Dry Creek syncline was observed at the site.

Water seeps in the West Fork and East Fork of Dry Creek indicate the water table to be at or near the elevation of the streambed. Drill hole 4RA in the West Fork of Dry Creek contacted the water table at a depth of 11.8 feet, and drill hole 7RA in the East Fork of Dry Creek had a slight artesian flow at 1.2 feet above ground level (see Map 1294-400-25 on the following page). The U-shaped warping of formations in the Dry Creek Basin syncline has created the artesian effect. The Dakota Sandstone serves as an aquifer overlain by impermeable Mancos Shale and underlain by impermeable Burro Canyon shale and mudstone. The Dakota aquifer is charged with water on the upturned flanks of the syncline. The power auger holes drilled in the pond basin were dry except for some water seepage at 14 feet in AP-8RA and at 9.9 feet in AP-17RA. Water level in core holes drilled in the pond basin ranged from about 4.5 to 24 feet (see logs in the Attachment Section on pages 160 through 168). A 607-foot-deep water well, drilled by the Bureau of Land Management at elevation 6,353 feet, located water in shale from the 65- to 100-foot depth and in sandstone at depth intervals of 450 to 460 feet, 490 to 500 feet, and 529 to 530 feet. This well and an oil-gas well which were converted to stock watering are shown on the following page.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT-COLORADO

RADIUM EVAPORATION POND
DRILL HOLE LOCATION
1294-400-25

CHAPTER III

WATER QUALITY

Surface Water

The salinity of the streams in the project area varies considerably because of the large fluctuations in flows and in the volume of saline ground water entering some of the streams. Salt concentrations are generally low during high runoff but increase progressively as the flows decrease. Water quality sampling stations are maintained on all the streams in the project area. Results of this sampling and other quality investigations are presented in this chapter.

Dolores River

Several times a year the electrical conductivity of the water in the valley was measured at intervals along the full length of the Dolores River on the same day. Also, measurements of seeps and springs were taken along the river banks. The measurements were obtained by using a portable conductivity meter and walking down the river. The investigations indicated where saline waters (possible irrigation return flows) and brine springs were entering the river. Two areas of concentrated brine inflow have been identified--one area in the river at about the valley midpoint approximately 2,600 feet long referred to as the upper area and the second area at the lower end of the valley approximately 1,200 feet long referred to as the lower area. These areas are identified in Figure 16 on page 32. The salinity measurements have indicated that approximately 75 percent of the salt pickup is entering the river in the upper area and 25 percent in the lower area. Figure 19 shows the percent increase in salt loading as the river crosses the valley and is plotted in terms of percent change of total salt loading. At the Bedrock Bridge where the river enters the valley, the percent change would be equal to zero, and where the river leaves the valley the percent change would be equal to 100 percent. In general, the salinity measurements were made during periods of low river flows.

In the fall of 1975, four continuous recording electrical conductivity meters were set up along the Dolores River in Paradox Valley located as follows: one just above the upper brine seepage area (EC Recorder No. 1), one between the upper and lower brine seepage area (EC Recorder No. 2), one just below the lower brine seepage area (EC Recorder No. 3), and one at the Dolores River near Bedrock stream gaging station (EC Recorder No. 4). Locations of these recorders are shown on Figure 19. In the summer of 1976, a fifth EC Recorder was set up at a location just above the Dolores River at Bedrock stream gaging station (EC Recorder No. 5). The electrical conductivity ranges of the recorders are shown in the tabulation on page 42.

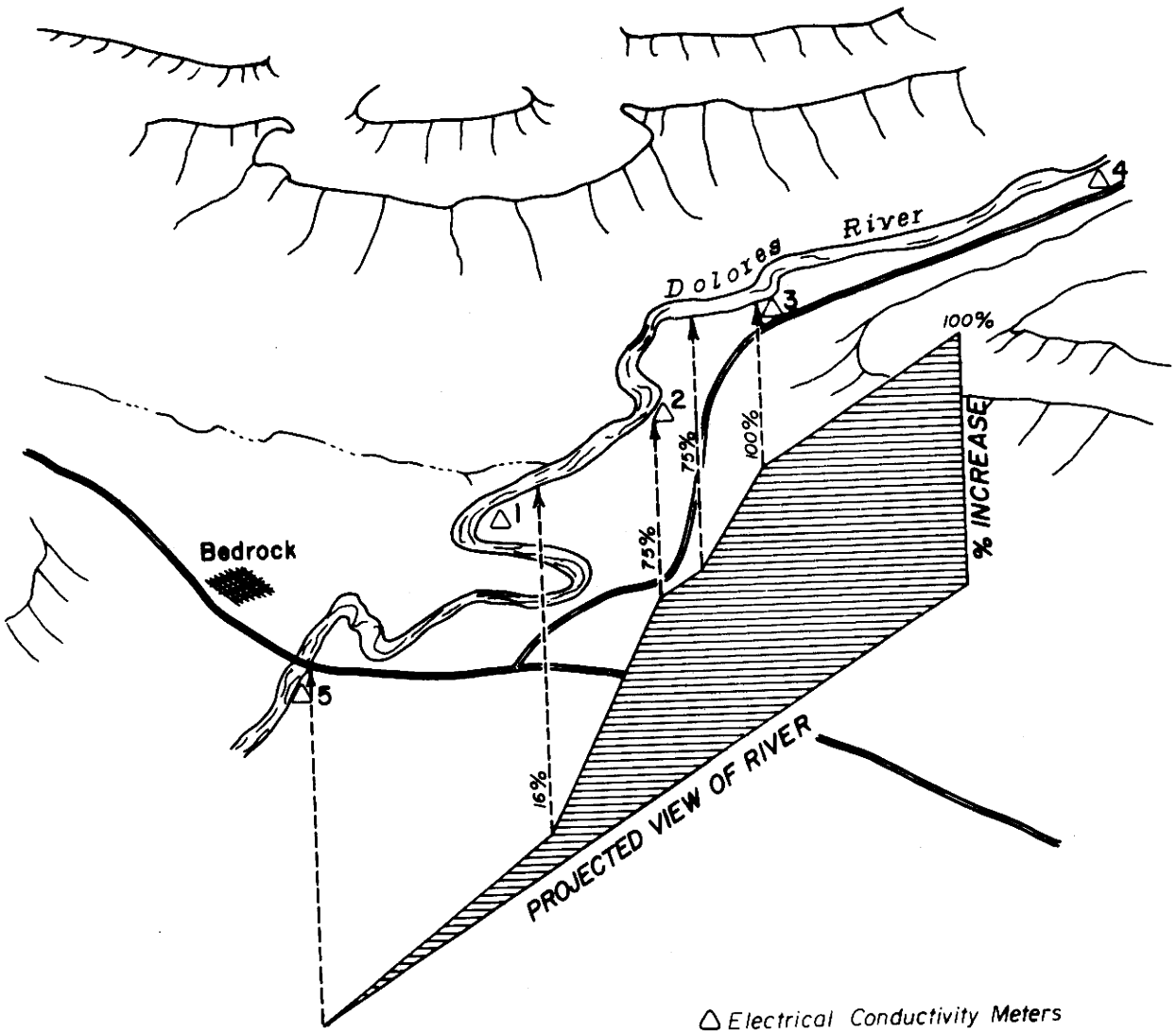


FIGURE 19

SALINITY INVESTIGATION STUDIES

Colorado River Basin Salinity Control Project

Paradox Valley Unit, Colorado

EC Recorder No. 5	0- 3,000 micromohes/cm
EC Recorder No. 1	0- 10,000 micromohes/cm
EC Recorder No. 2	0- 50,000 micromohes/cm
EC Recorder No. 3	0- 50,000 micromohes/cm
EC Recorder No. 4	0-100,000 micromohes/cm

Reasonably good results have been obtained from the recorders. There have been some problems with trash collecting on the probes or with sand shifting in the bottom of the river, causing the flow in the channel to change locations. During periods of high spring runoff, the recorders have been taken out of operation in order to prevent damage to the probes. Each time the recorders are serviced a water sample has been taken near each site and sent to the regional laboratory in Salt Lake City for analysis. Results of the chemical analysis of the water samples are used to interpret the recording charts, to check if the meter is operating correctly, and to determine the constituents of the dissolved solids in the water.

The recorders have been used to determine changes in the river salinity during periods of pumping, and in conjunction with the gaging and water sampling program, to better estimate the amount of salt being picked up in the valley. The data have shown that the electrical conductivity can change greatly during a 24-hour period. This is especially true during the winter months when freezing and thawing of the river is occurring above and through the valley and when the flow in the river is increasing or decreasing.

As stated in Chapter II, water sampling stations have been established at three locations on the Dolores River. In addition, various other State and Federal agencies have taken samples at various locations on the river within the project area.

Water samples collected on the Dolores River at Bedrock show dissolved oxygen and pH concentrations are compatible with biological productivity. Occasional high temperatures, high turbidity, and low flows, which occur most of the year, inhibit the productivity and diversity of the stream. The turbidity in the river, contributed largely by tributaries, is caused by natural erosion and man-caused soil disturbances. Nutrient levels are moderate. Occasional high levels of phosphorus and fecal coliform indicate the presence of upstream sewage discharges but do not cause problems of eutrophication. On occasion, small amounts of heavy metals and toxic substances are present in varying concentrations, primarily because of erosion. They would not prohibit the use of the water for livestock, although extensive treatment would be required for human consumption. Because of the temperature and chemical factors and their interaction, it is probable that heavy metals and toxic substances would remain in chemical forms unavailable for biological uptake. Data showing the amounts of the parameters stated above are shown in Table 7.

Table 7

Chemical analysis of water samples[1/]

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 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 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.

Table 7

Chemical analysis of water samples[1] (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, ¼ mile above confluence with San Miguel River[2] (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 River[3]									
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 River[4]									
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	96.0	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 River[3]									
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			

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 Colorado State Department of Health.

3/ Samples collected by the Bureau of Reclamation.

4/ 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.

Table 7

Chemical analysis of water samples[1/] (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 Gateway[2/]									
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 Gateway[3/]									
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 Gateway[4/]									
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
Fluoride (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.

Table 7

Chemical analysis of water samples[1/] (continued)

Constituents	Units	Number of samples	Sampling period	Concentration			Drinking water standards		
				Minimum	Average	Maximum	Public Health Service	Colorado	Number of times exceeded
Brine pumped from well near Dolores River, Paradox Valley[2/]									
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.

Salt pickup by the Dolores River is the major water quality problem in the project area. According to samples collected by the Bureau during a 5-year period, the salt concentration of the river at the entrance to the valley has ranged from 140 mg/l to 3,700 mg/l with a flow-weighted average of 264 mg/l. The predominant constituents have been sulfate, bicarbonate, chloride, sodium, and calcium. At the exit of the valley, the salt concentration has ranged from 150 to 166,000 mg/l with a flow-weighted average of 729 mg/l. The high concentration of salt in the river at the exit of the valley occurs when there is no flow entering the valley, and the water in the channel leaving the valley is composed entirely of surfacing ground water and irrigation return flow. The predominant constituents at the exit have been sodium and chloride. Table 7 on pages 43 through 46 shows the laboratory analysis of the samples collected on the river in Paradox Valley.

Using both quality and quantity data, it was calculated that the total salt load at the exit of the valley has averaged about 312,000 tons annually. This is approximately 205,000 tons larger than the average load at the entrance to the valley. The daily salt pickup varied from 115 to 1,430 tons per day and has averaged about 560 tons per day. The rate of salt pickup in Paradox Valley is shown on Figure 20. As stated above, the concentrations of sodium and chloride increase considerably as the river crosses the valley, with averages of 195 tons and 315 tons, respectively. Figure 21 on page 49 shows the rate and amounts of sodium and chloride that are picked up in the valley.

Salt pickup between the two sampling stations in the valley exhibits a degree of seasonal fluctuation, generally being at its lowest during the spring and summer and at its highest during the fall and winter. (See Figure 18, page 37.) It also appears that the amount of water in the river affects salt pickup. Salt pickup was at a minimum for the year during the spring of 1973, when flows in the river were unusually high. There is indication that initial high flows occurring in the fall flush salt out of the river channel that has accumulated during the drier summer months.

In addition to the sodium and chloride concentrations, other water chemistry parameters show large increases as the Dolores River flows through Paradox Valley. These parameters include electrical conductivity, total dissolved solids, and sodium adsorption ratio as well as calcium, sulfate, potassium, and magnesium.

The quality of the Dolores improves considerably because of the inflow of relatively freshwater below the confluence with the San Miguel River. Samples collected (Table 7 on pages 43 through 46) from September 1974 through May 1976 about 5 miles below the confluence had a flow-weighted average salinity of about 659 mg/l, with extremes of 171 and 7,920 mg/l.

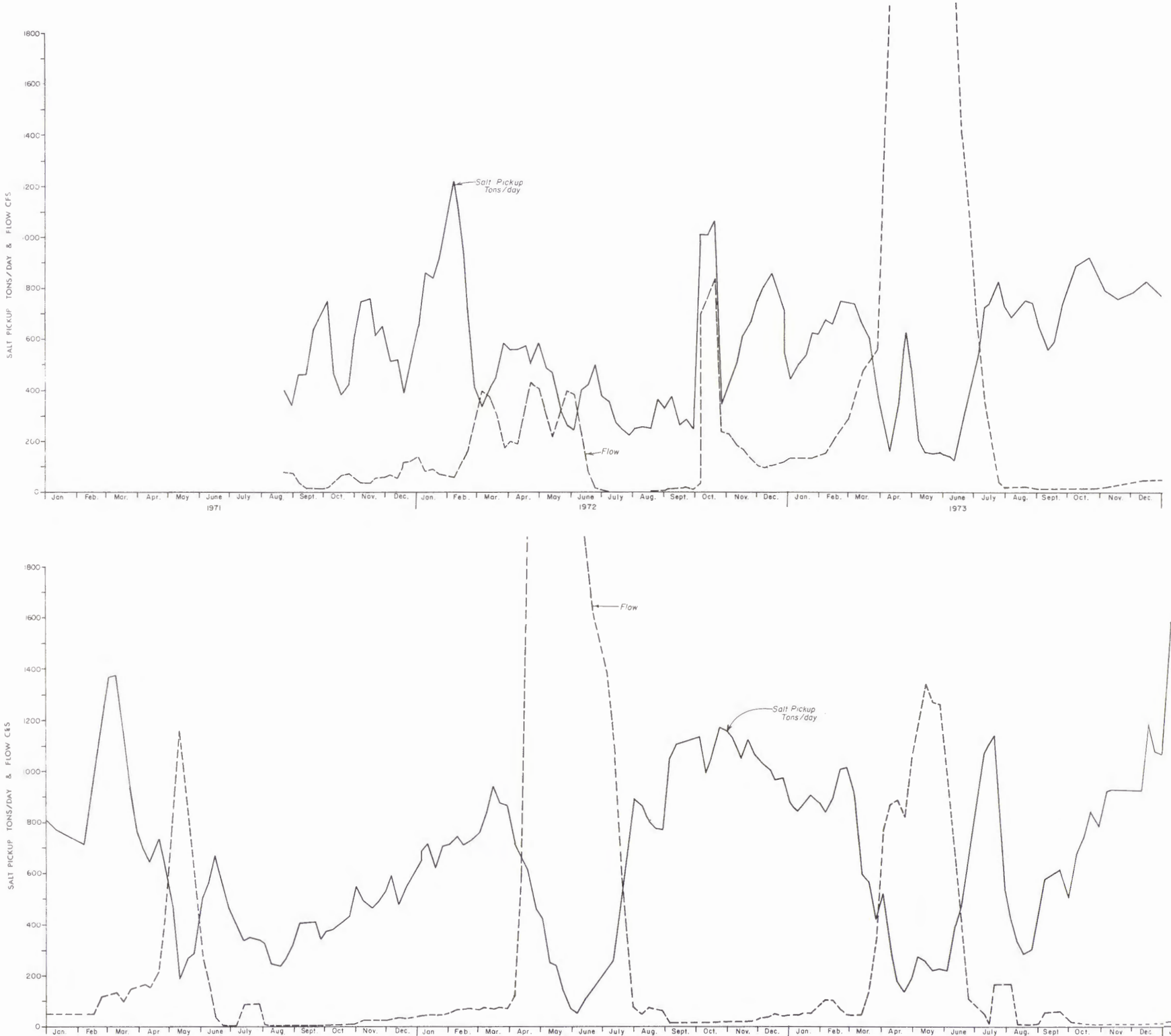


FIGURE 20
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
SALT PICKUP AND FLOW BETWEEN GAGING STATIONS

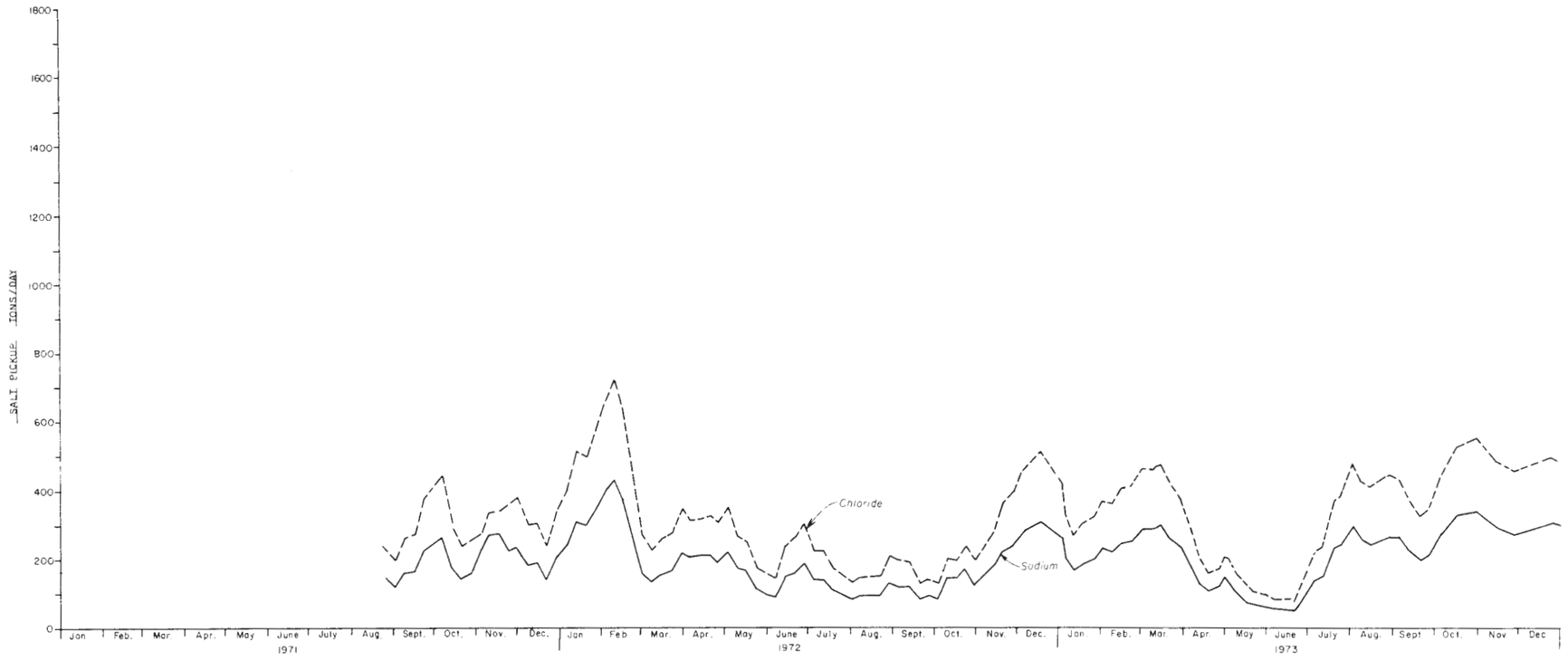
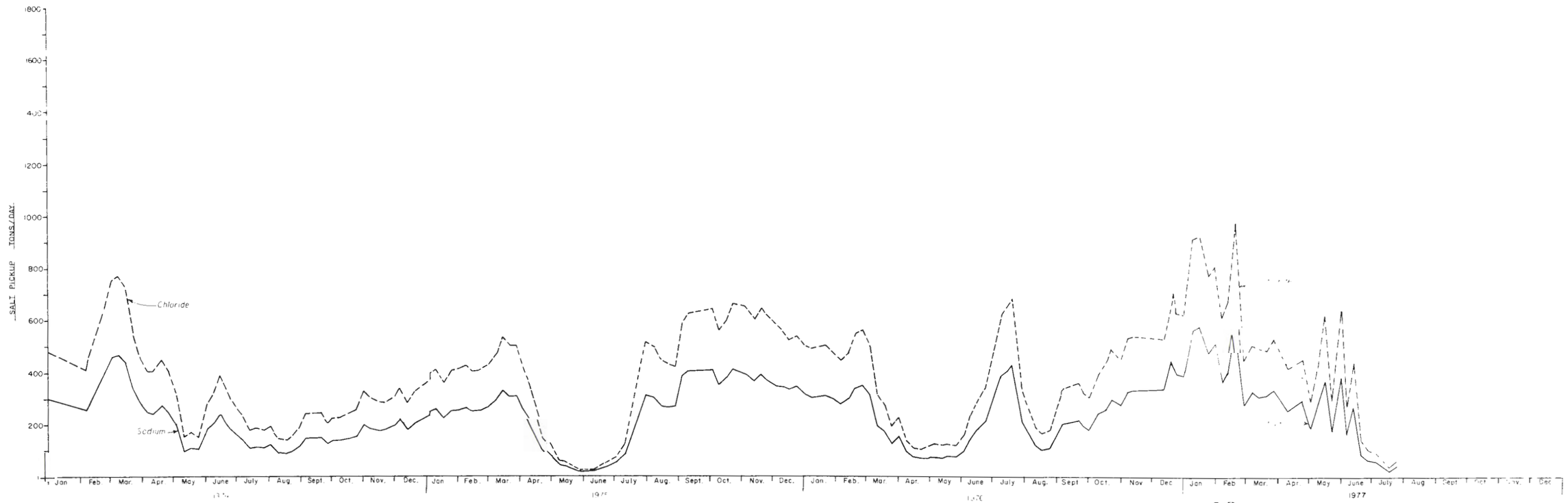


FIGURE 21
COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY
SODIUM AND CHLORIDE PICKUP BETWEEN GAGING STATIONS



West Paradox Creek

West Paradox Creek has been sampled since 1971 on a weekly to bi-weekly basis. During the sampling period, the salinity has a flow-weighted average of about 800 mg/l and has varied from 262 to 1,970 mg/l. The water contains predominantly sulfate, bicarbonate, calcium, and magnesium which is characteristic of waters containing irrigation return flows. Results of the sampling on West Paradox Creek are presented in Table 7 on pages 43 through 46. It is estimated that the creek contributes an average of about 14 tons of salt per day and 7,000 tons per year to the Dolores River.

Dry Creek

Samples have been taken from Dry Creek at its confluence with the San Miguel River near Naturita, Colo., since 1960. The flow-weighted average salinity for this period has been 1,460 mg/l and has varied from 414 to 9,800 mg/l. Table 7 on pages 43 through 46 presents results of the quality analysis. Sampling will continue at this station below the proposed Radium Evaporation Pond after the project is constructed to substantiate that no leakage is occurring from the pond.

Ground Water

Paradox Valley

The quality of the ground water in Paradox Valley ranges from a brine, having a density of 1.164, a salt content of 23 percent or greater of which 93 percent is sodium chloride, to moderately saline water in the shallow aquifers on the east and west sides of the river, to freshwater along the edges of East and West Paradox Valleys. Analyses of samples collected from the wells, seeps, and springs are given in Table 8.

Only a very small percentage of the ground water in the valley can be classified as fresh. Springs along the valley walls and Windmill Well No. 2 in East Paradox Valley contain approximately 300 to 500 mg/l total dissolved solids with a large percentage of bicarbonate salts.

All of the irrigation wells in Paradox Valley that were sampled can be classified as slightly to moderatly saline. Depending upon the time of year that they were sampled, TDS values ranged from 1,400 to as high as 3,500 mg/l. Windmill Well No. 1 in East Paradox ranged from 4,500 to 5,400 mg/l. Seeps from the west bank of the Dolores River above the salt submergence area have ranged from 1,500 to 4,000 mg/l. A large percentage of the salts in the samples is calcium, magnesium, and sulfate. Samples from the seeps in the Dolores River and the samples from the Redd Irrigation Well No. 2 toward the end of the irrigation season after the well has been pumped heavily for some time show larger percentages of sodium and chloride, indicating some mixing with the underlying brine.

PARADOX VALLEY UNIT

Lab No.	Field No.	Sampling Date	Flow gal/min.	EC x 10⁶ @ 25°C	pHa	Dissolved Solids mg/l	Boron p.p.m.	Sodium Adsorption Ratio	pHc	Saturation Index	Temperature °F	Milligrams per liter Ca++	Mg++	Na+	K+	$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$
Spring in East Paradox Valley NW¼SW¼NW¼ sec. 27, T. 47 N., R. 18 W.																			
6105		12-2-74	0.5	772	8.3	449		0.9			48	32	57.6	37.7	13.7	16.2	279	30.9	119
East Paradox Valley, Wind Mill Well #2 NE¼NE¼NW¼ sec. 1, T. 46 N., R. 18 W.																			
1479	1577	7-25-73		556	8.2	324		.7	7.3	0.9		33.6	36.1	25.8	5.5	None	246	29	614
West Paradox, Flowing Well, J.B. Riddle Ranch NE¼SE¼ sec. 35, T. 48 N., R. 19 W.																			
4045	P-74 -10	6-12-74	.08	2,790	7.9	2,710		.7	6.7	1.2		380	190	64.4	9.4	None	196	73.8	1,585
West Paradox Valley, Ray Lathan Well NE¼NW¼NW¼ sec. 17. T. 47 N., R. 18 W.																			
9052	P-75 -4	6-27-75		2,250	7.8	1,760		1.8			54	186	139	136	15.2	None	267	192	852
West Paradox Valley, Redd Well #1 1/ SW¼NW¼NE¼ sec. 18, T. 47 N., R. 18 W.																			
2676		11-9-73		1,790	8.0	1,440		1.2	7.2	.8		192	86.6	80.5	5.5	None	110	113	758
West Paradox Valley, Redd Irrigation Well #2 1/ SW¼SE¼SE¼ sec. 8, T. 47 N., R. 18 W.																			
1241		6-27-73		2,900	7.6	2,250		3.0	6.6	1.0	56	198	151	239	14.1	None	364	316	893
2270		9-25-73		3,460	7.8	2,490		4.7	6.6	1.2	54	204	156	363	20.3	None	373	517	883
4318		7-16-74		4,880	8.2	3,220		8.8			60	192	159	681	36.8	None	307	1,030	965
5014	P-74 -18	9-5-74		5,360	7.7	3,510		10.0			61	175	162	782	44.2	None	253	1,192	1,001
8423	P-75 -7	5-16-75		2,680	7.9	2,020		3.2			56	154	153	232	14.1	None	187	317	893
13381	P-75 -321	4-7-76		2,290	8.1	1,820		2.1			56	182	145	156	9.8	None	337	174	858
14228	D-76 -322	6-1-76		3,860	7.8	2,710		6.0			60	196	152	460	25.8	None	356	666	863
East Paradox Valley, Windmill Well #1 SW¼NW¼ sec. 26, T. 47 N., R. 18 W.																			
613	1391	4-17-73	1	4,560	7.3	5,290		.3	6.2	1.1		540	532	35.9	21.1	None	337	38.7	3,235
2578		10-29-73		4,600	7.8	5,360		.2	6.2	1.6		520	543	33.1	21.9	None	362	36.6	3,164
Dolores River Mid-Paradox Valley, above salt submergence area, seepage from west bank NE¼SW¼SW¼ sec. 16, T. 47 N., R. 18 W.																			
5662	P-74 -22	10-24-74		2,530	8.0	1,500		5.9				104	72.0	315	21.9	None	326	460	351

Lab No.	Field No.	Sampling Date	Flow c.f.s.	EC x 10⁶ @ 25°C	pHa	Dissolved Solids mg/l	Density g/cc	Sodium Adsorption Ratio	pHc	Saturation Index	Temperature °F	Milligrams per liter Ca++	Mg++	Na+	K+	$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$
Brine seeps in Dolores River NW¼NW¼SE¼ sec. 16, T. 47 N., R. 18 W.																			
4316		7-16-74	.05	218000	7.2	251000	1.159	387			70	1,350	1,525	88,800	4,770	0	274	143,400	8,880
U.S.B.R. Pump Test Well #1 23 CX NE¼NE¼SW¼ sec. 16, T. 47 N., R. 18 W.																			
2680		12-19-73		220000	6.9	267,100	1.164	418			58	1,400	1,708	98,440	5,161	None	274	164,000	5,880
3006		2-28-74		218400	6.7	269000	1.164	417	6.4	.3	58	1,440	1,610	95,700	5,161	None	287	155,000	6,910
West Paradox Valley, Jensen Brine Well #2 SW¼NE¼NE¼ sec. 17, T. 47 N., R. 18 W.																			
2273		10-5-73		225000	7.3	296000	1.180	439	6.8	.5		1,100	1,830	102000	5,940	None	225	170,800	6,580

Lab No.	Field No.	Sampling Date	Flow c.f.s.	EC x 10⁶ @ 25°C	pHa	Dissolved Solids mg/l	Density g/cc	Sodium Adsorption Ratio	pHc	Saturation Index	Temperature °F	Milligrams per liter Ca++	Mg++	Na+	K+	$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$
East Paradox Valley, Union Carbide Brine Well SW¼NE¼SE¼ sec. 9, T. 47 N., R. 18 W.																			
7810	D-75 -6	4-7-75		204200	6.3	252000	1.156	367			60	1,360	1,730	86,480	4,770	None	123	143400	7,435

Lab No.	Well No.	Sampling Date	Flow gpm	EC x 10⁶ @ 25°C	pHa	Dissolved Solids mg/l	Density g/cc	Sodium Adsorption Ratio	pHc		Temperature °F	Milligrams per liter Ca++	Mg++	Na+	K+	$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$
USBR Test Well (See Map 1294-400-21 page 13 for location)																			
21805	1E	6-14-77		197000	6.5	267,600	1.164	404			57	1,440	1,610	93,840	4,850	0	160	150,500	9,690
21807	2E	6-16-77		197000	7.1	260,500	1.163	397			61	1,500	1,562	92,000	4,540	0	102	149,100	8,990
23525	3E	9-14-77	75	216000		256600	1.161	422			57	1,420	1,600	97,500	4,850	0	142	153,300	6,580
23526	4E	9-21-77	102	220000		256600	1.164	379			59	1,360	2,110	95,700	4,850	0	113	153,300	7,100
23817	5E	9-28-77	90	229000	7.5	261000	1.166	403				1,360	1,710	94,800	5,000	0	184	150,500	7,200
23818	7E	10-11-77	32	223000	7.5	278900	1.176	417			57	1,240	1,960	101,200	5,790	0	182	160,500	7,150
23819	8E	10-13-77	82	232000	7.5	282,000	1.164	409			61	1,400	1,620	94,800	5,000	0	156	153,400	6,910
22874	3W	7-15-77	90	211000		256,100	1.164	410			54	1,380	1,670	95,700	5,000	0	63	153,400	6,380
23527	4W	9-2-77	51	219000		256000	1.162	387			55	1,400	1,920	94,800	5,000	0	199	153,300	6,770
22876	7W	8-24-77	10	210000		257000	1.164	397				1,100	1,950	94,800	5,320	0	87	150,500	6,190
22870	2C1A	8-26-77	380	200000		285000	1.183	422				1,200	2,170	105,800	5,940	0	137	176,000	7,490
22872	23A	8-3-77	240	209000		255000	1.163	407				1,420	1,630	94,800	4,850	0	158	147,700	6,910
								Equivalent Weights				20.0	12.2	23.0	39.1	30.0	61.0	35.5	48.0

1/ Samples taken from sprinkler head.

A sample taken from an open pit approximately 0.5 mile east of the river contained 117,500 mg/l TDS with a large percentage of the TDS being sodium chloride, indicating that brine remains near the surface in East Paradox Valley. Seepage flow into the Dolores River in the submergence area contains brine in the range of 250,000 mg/l. The brine in wells near the Dolores River that taps the brine aquifer has a salt content in the range of 252,000 to 296,000 mg/l TDS.

On a field trip to Paradox Valley, personnel from the Geological Survey collected a brine sample from a seep adjacent to the Dolores River in the lower portion (center of sec. 9, T. 47 N., R. 18 W.) of the brine seepage area for chemical analysis at the Geological Survey laboratory in Reston, Va. Results of the analysis are given in Table 9. It reported no other trace metals other than those reported could be detected using the atomic adsorption method and selenium could not be detected using the colorimetric method. An analysis of a hydrochloric acid extract of the sediment that had collected on the river bottom in the brine seepage area indicated the presence of iron, copper, a trace of zinc, but no cadmium, nickel, or cobalt. The sediment was mainly medium- to fine-grained quartz, with coatings of iron sulfide.

Table 9
Chemical analysis of brine seep in Paradox Valley1/

Constituent	Total (mg/l)
Sodium	80,600
Chloride	125,500
Potassium	4,060
Calcium	1,260
Magnesium	1,360
Bicarbonate	224
Sulfate	4,980
Sulfide	1.5
Iron (total)	.1
Fluoride	5.3
Boron	7.4
Phosphate	.1
Silica	123
Manganese	2.2
Total dissolved solids	220,200
pH	7.2
Density	1.141

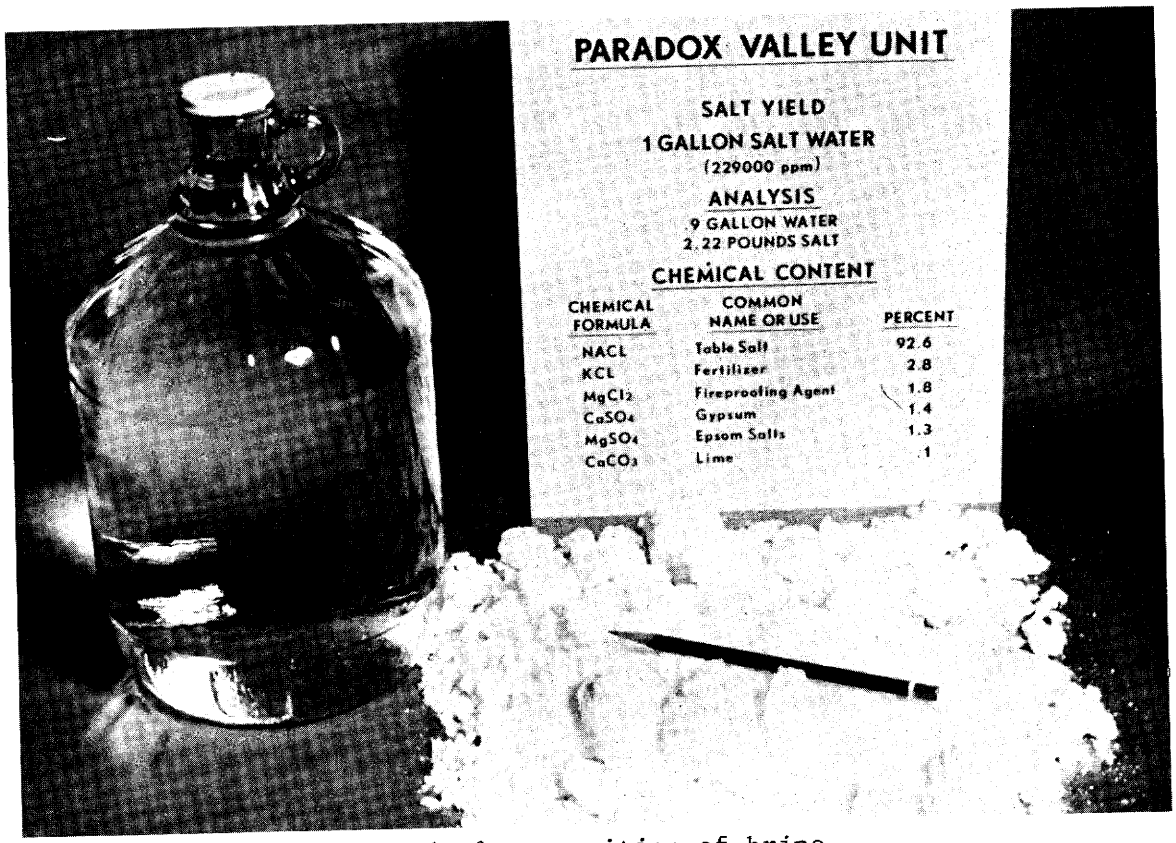
1/ Collected and analyzed by Geological Survey.

A sample of the brine was also taken from Test Well No. 1 (23CX) and sent to the chemistry laboratory at the Engineering and Research Center for heavy metal analysis. Results of the analysis are presented in Table

10. A theoretical composition of the brine is given in the photograph below.

Table 10
Chemical analysis of Paradox Valley Well No. 1 (D.H. 23CX). Collected March 19, 1975, Chemistry Laboratory No. D4367

	Total (mg/1)
Lead (mg/1)	2.90
Iron	2.40
Strontium	2.30
Zinc	.62
Cadmium	.47
Manganese	.37
Chromium	.26
Nickel	.23
Copper	.22
Lithium	.13
Sulfide (S=)	74.4
Oil in water	1



Theoretical composition of brine.

The brines from both 7PX and Test Well No. 1 have been analyzed for oil content. A sample from 7PX was collected and sent to the Engineering and Research Center for analysis during 1974. Brine from Test Well No. 1 was analyzed for oil content in 1976. No trace of oil above a detection limit of 1 mg/l was found in either sample.

The brine from Test Well No. 1 was also analyzed for the presence of radioactivity. A gamma radiation measurement with detection sensitivity of 0.47×10^{-12} Ci/ml found no indication of the presence of gamma emitting radioisotopes. A measurement for total alpha and beta radiation of a dried sample gave a similar indication. Present data indicate that there is not enough radioactivity present in the brine to constitute any hazard, even through concentration by evaporation.

Hydrogen sulfide gas is also associated with the brine. Bubbles of hydrogen sulfide gas can be seen surfacing anywhere in the river where brine seeps and springs exist. Anaylsis of brine samples that have been kept under pressure and not exposed to the atmosphere has shown the brine to contain approximately 100 mg/l of dissolved hydrogen sulfide gas. When the brine is pumped and discharged to the atmosphere some of the gas is released.

Dry Creek Basin

Sampling of the ground water in Dry Creek Basin (Table 11) has indicated that the proposed Radium Evaporation Pond is underlain by fresh to slightly saline water. The major salts encountered in this ground water are sodium, sulfate, and bicarbonate. As described in the Radium Evaporation Pond Section of Chapter IV, a quality monitoring system of eight wells would be installed before the construction of the proposed evaporation pond. Monitoring would continue after its construction to substantiate that no salt leakages occur.

Unit Effects

By preventing the annual inflow of 180,000 tons of salt, the unit would effectively remove about 90 percent of the salt now entering the Dolores River in Paradox Valley. This salt removal would be reflected downstream in the Dolores River and in the Colorado River below their confluence. The overall effect would be to decrease the salinity of the Colorado River at Imperial Dam. As Table 12 on page 56 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.

CHEMICAL ANALYSIS OF GROUND WATER

PARADOX VALLEY UNIT
DRY CREEK BASIN

Lab No.	Field No.	Sampling Date	Flow gpm	EC x 10^6 @ 25°C	pHa	Dissolved Solids p.p.m.	Boron p.p.m.	Sodium Adsorption Ratio	pHc	Saturation Index		Milligrams per liter							
												Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
Ed Netherton Well in Dry Creek Basin																			
16233	D-76 34A	9/10/76		1,760	7.8	1,160		20				22	5	396	29	0.0	747	18	293
Artesian well within the proposed Radium Evaporation Pond area sec. 8, T. 47 N., R. 16 W.																			
19669	P-77 26	3/16/77		743	8.4	462		8.1				17	5	149	8	17	269	31	110
Flowing well, Dry Creek Basin, southwest side of proposed Radium Evaporation Pond sec. 12, T. 44 N., R. 17 W.																			
6410	P-74 28	12/17/74	5	871	8.0	528		6.8				21	12	156	14	7	337	25	122
											Equivalent Weights	20.0	12.2	23.0	39.1	30.0	61.0	35.5	48.0

Table 11

Table 12
Average annual unit effects on water quality
(flow-weighted mg/l)

Location	Present level	With unit	Reduction
Dolores River			
Above Paradox Valley	264	No change	No change
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/ 1971-76 historical average.
2/ 1974-76 historical average.
3/ 1976 modified base condition--this assumes that all projects presently being constructed or near construction (final EIS filed) are a part of preproject conditions.

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. 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).

The reduction in the concentration 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 of the river leaving the valley by 30 mg/l. During normal to low flows, however, this improvement could range from 5,000 to 160,000 mg/l. Overall, the water quality of the river would be about the same just below the valley as it is just above. West Paradox Creek and irrigation return flows would still contribute small amounts of salt.

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 River.

CHAPTER IV

UNIT PLAN AND DESIGN

Brine Well Field

Pump testing

In 1973 Test Well No. 1 (DH-23CX on General Investigations Map on page 13) was drilled to a total depth of 300 feet, penetrating through 100 feet of lenticular river deposits and 200 feet of the brecciated gypsum cap of the salt dome. Pump tests were conducted in October and December 1973 in two brine producing aquifers consisting of the alluvial zone of sand, silt, and gravel deposits and the underlying zone of fractured gypsum breccia. Data from these tests gave hydraulic aquifer characteristics as summarized in Table 13. Because of the short test duration (48 hours) and the small area monitored during the tests, the data were insufficient to design a full-scale well field. Later pump tests have shown that the permeabilities in the deep, coarse gravel deposits just overlying the gypsum cap are low and that the permeabilities in the gypsum breccia are very low. Possible leakage around the casing from the sand and gravel zone to the deep zone could have influenced the pump test involving the deep zone and given incorrect results.

In 1975 NX core holes were drilled to locate sites for test wells which could be used to investigate the possibility of pumping brine from the residual gypsum breccia cap of the salt dome. Two of the sites were selected for proposed test well locations (Test Wells 2 and 3). Drilling the test wells was accomplished by drilling and advancing a 20-inch-diameter steel casing through the alluvium and drilling open hole in the gypsum breccia zone. Pump chamber casing and 200 feet of fiberglass reinforced plastic screen were placed in each well. Upon developing each well, it was found that Test Well No. 3 would produce less than 10 gallons per minute and Test Well No. 2 would produce approximately 30 gallons per minute. In addition to drilling the new wells, Test Well No. 1 was modified so only the deep aquifer could be pumped.

A 34-day aquifer test was conducted, utilizing Test Wells 1 and 2, and the results of the test from selected observations wells are listed in Table 13. In addition to observing the ground water system, the electrical conductivity at several locations on the river was also monitored for change in river salinity. Brine from the wells pumped during the test was piped to a temporary storage pond located at the lower end of the valley. Results from the test indicated that permeabilities in the gypsum breccia were very low, the amount of brine required to affect the brine aquifer could not be obtained from pumping from the gypsum breccia zone, and that pumping from the alluvium aquifer is the best alternative.

Table 13
Hydraulic aquifer characteristics

Test Well No. 1
Alluvial aquifer

Date = 12-17-73 to 12-19-73
Perforated zone = 63 feet to 98 feet
Pumping rate = 600 gallons per minute
Length of test = 48 hours
Maximum drawdown in test well = 26.39 feet

Maximum drawdown in DH 6PX = 7.87 feet
DH 7PX = 10.24 feet
DH 8PX = 4.54 feet

Well and piezometer	Tranmissivity (ft^2/min)	Storativity	Method of solution
DH 6PX	3.35	3.89×10^{-3}	Jacob's approximation
DH 7PX	2.94	3.04×10^{-4}	
DH 8PX	4.20	3.64×10^{-3}	
DH 19BCX	10.32	1.03×10^{-3}	
DH 6PX	2.82	5.37×10^{-3}	Distance drawdown
DH 7PX	3.23	3.07×10^{-4}	
DH 8PX	3.07	5.45×10^{-3}	
DH 19BCX	6.94	1.46×10^{-3}	

Test Well No. 1
Gypsum cap aquifer

Date = 12-4-73 to 12-6-73
Perforated zone = 229 feet to 280 feet
Pumping rate = 300 gallons per minute
Length of test = 48 hours
Maximum drawdown in test well = 63.70 feet

Maximum drawdown in DH 6PX = 6.45 feet
DH 7PX = 4.42 feet
DH 8PX = 2.50 feet
DH 19BCX = 1.21 feet

Well and piezometer	Tranmissivity (ft^2/min)	Storativity	Method of solution
DH 6PX	2.17	2.21×10^{-3}	Jacob's approximation
DH 7PX	3.19	6.91×10^{-4}	
DH 8PX	4.30	5.86×10^{-3}	
DH 19BCX	9.65	9.43×10^{-4}	
DH 6PX	1.83	2.81×10^{-3}	Distance drawdown
DH 7PX	2.58	5.17×10^{-4}	
DH 8PX	3.12	8.30×10^{-3}	
DH 19BCX	5.13	1.35×10^{-3}	

Test Well No. 1
Gypsum cap aquifer

Date = 1-15-76 to 2-18-76
Perforated zone = 229 feet to 280 feet
Pumping rate = 190 gallons per minute
Length of test = 34 days
Maximum drawdown to test well = 69.58 feet

Maximum drawdown in DH 2W1-1 = 5.78 feet
DH 2W1-2 = 5.94 feet
DH 2W2-2 = 2.37 feet
DH 2E1-1 = 3.54 feet
DH 2E1-2 = 1.23 feet
DH 2E2-2 = .25 feet
DH 1C4-2 = 4.83 feet

Well and piezometer	Transmissivity (ft^2/min)	Storativity	Method of solution
DH 2W1-1	2.311	6.852×10^{-3}	Jacob's approximation
DH 2W1-2	4.345		
DH 2W2-2	3.323	5.889×10^{-4}	
DH 2E1-1	1.579	9.584×10^{-4}	
DH 2E2-2	4.383	4.579×10^{-4}	
DH 1C4-2	1.103	4.757×10^{-4}	

The hydrographs presented in Chapter II for Observation Wells 6PX, 7PX, and 8PX show that by pumping from the brine aquifer the potentiometric head of the brine can be lowered in relation to the overlying freshwater zone, and therefore the freshwater-brine interface can be lowered.

Brine production wells

The Paradox Valley Unit would be designed to control salinity by pumping brine from a well field located on both sides of the Dolores River. Initially the well field would consist of 18 production wells with 10 wells on the west bank and 8 on the east bank. The wells surround two brine producing areas--one in the center of section 16 (upper area) and one in the center of section 9 (lower area)--where investigations indicate the major portion of brine is entering the river. (See Figure 16 on page 32.) There would be 13 wells surrounding the upper area and 5 surrounding the lower area. Additional wells would be constructed if it is determined after the field has been put into production that they would improve the efficiency and economics of well field operation.

All the wells except one would be designed to pump from an alluvial aquifer consisting of fine sand and gravel. Depth of wells in the alluvium would vary from 48 to 77 feet. One well would be drilled into the residual gypsum cap to a depth of 155 feet in order to pump from a cavity at 133 to 140 feet and intermittent small cavities from 140 to 150 feet.

The wells would have a total diameter of 20 inches with pump chamber casings having a diameter of 12 inches, the lower 15 to 40 feet of which would consist of commercial screens made from one of three materials--Type II polyvinyl chloride, epoxy filament wound fiberglass, or stainless steel. Gravel pack would be placed around the casing for its entire depth, both for stabilization and for excluding fine sand from the well. Table 14 gives the details of the wells that were installed as a part of the design data collection program. (See Figure 22 for typical test well installation.)

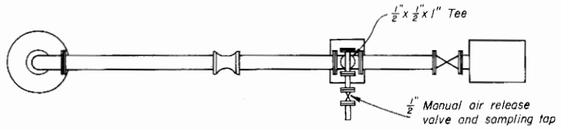
The well casing, which would extend 4 feet above the ground, would have a concrete pad around it at the ground surface and would be housed in a protective structure to prevent damage from floods and vandalism. The structure would have a removable roof in order to pull the pumps for repairs. Each pump would have an electrical control panel and would have observation pipes where the water levels, both inside and outside the well casing, could be measured. Each well would also have a pressure control valve, a manually operated control valve, a check valve, a flowmeter connection, and sampling taps to sample the quality of brine being pumped. The operator would be able to control the pumping rate and each well would have a demand meter to record power consumption. Power consumption records would be used to determine when the pumps need servicing or replacing. Design of the pumps will be determined during the design data collection program.

Table 14
Test well design specifications

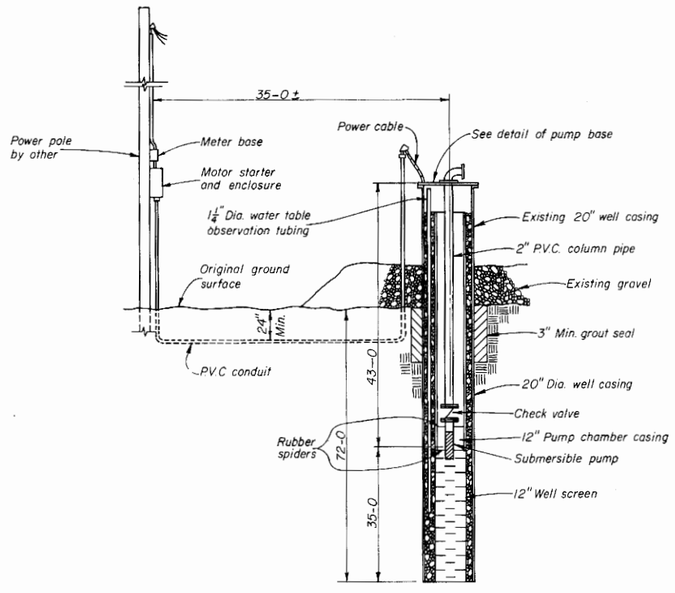
Well No.	Pump chamber casing Length (feet)	Pump chamber casing Diameter (inches)	Well screen Length (feet)	Well screen Diameter (inches)	Type of material1/
1E	45	12	30	12	PVC
1W	45	12	30	12	PVC
23(A)	45	12	30	12	PVC
2E	40	12	40	8.39	FRP
2W	43	12	30	12	PVC
3E	43	12	25	8	Wire wound
3W	35	12	30	12	PVC
4E	36	12	20	8.39	FRP
4W	41	12	15	8	Wire wound
5E	41	12	35	12	PVC
5W	45	12	30	12	PVC
6E	59	12	20	8	Wire wound
6W	40	12	35	12	PVC
7E	40	12	40	8.39	FRP
7W	42	12	20	8	Wire wound
8E	36	12	15	8	Wire wound
10W	43	12	30	12	PVC
2C1(A)		20	No screen		

1/ PVS--Type II polyvinyl chloride.
FRP--epoxy filament-wound fiberglass.
Wire wound--wire-wound stainless steel.

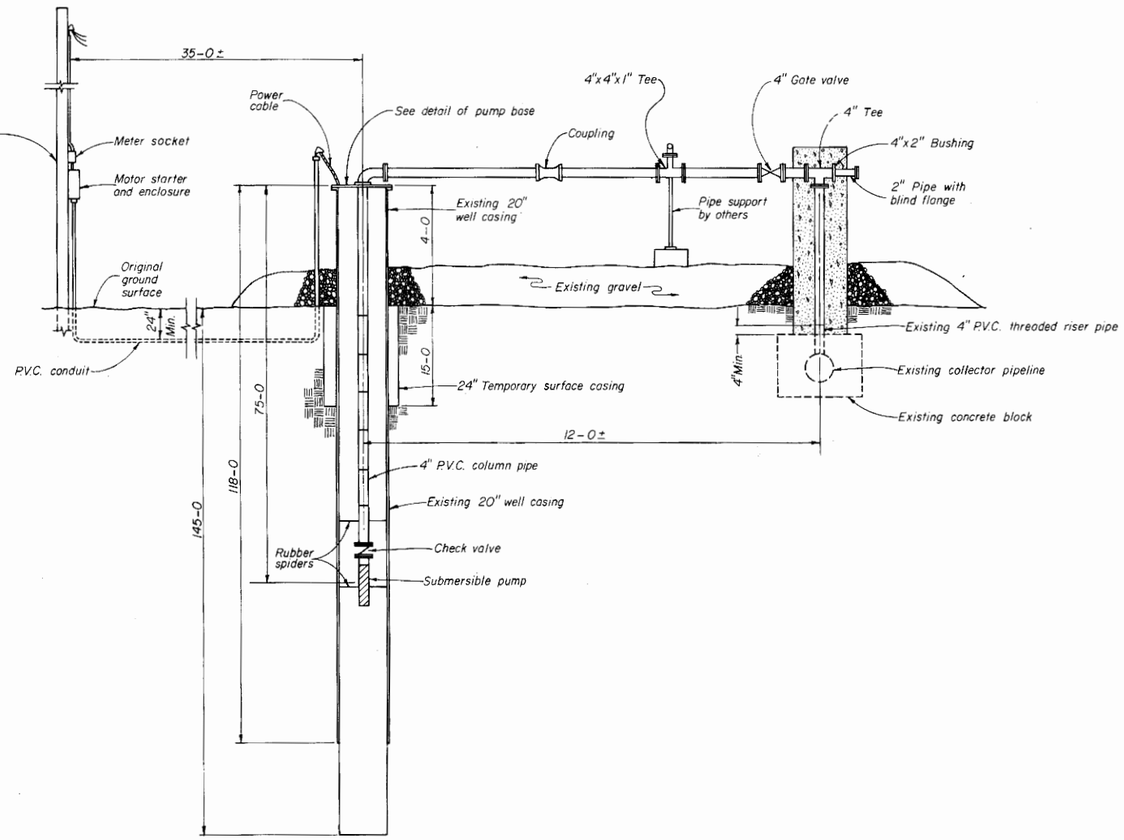
NOTE: Power pole and electrical connection are not shown in plan



PLAN AT TEST WELL 2C1A

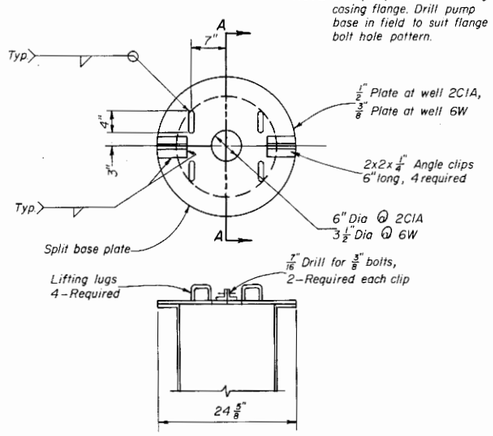


ELEVATION AT TEST WELL 6W



ELEVATION AT TEST WELL 2C1A

NOTE: Bolt pump base to existing cosing flange. Drill pump base in field to suit flange bolt hole pattern.



SECTION A-A

DETAIL OF PUMP BASE

FIGURE 2-2

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PARADOX VALLEY UNIT—COLORADO
COLORADO RIVER BASIN SALINITY CONTROL PROJECT

TEST WELL INSTALLATION
2C1A AND 6W

DESIGNED _____ TECHNICAL APPROVAL L R Murdock
DRAWN Casey Nielson SUBMITTED Robert D. Brunster
CHECKED Kenneth D. Bateman ADMIN. APPROVED _____
REGIONAL ENGINEER

SALT LAKE CITY, UTAH JULY 25, 1978 | 1294-400-36

Collection system

Buried pipelines on each side of the river would collect the brine from each well and convey it to the Hydrogen Sulfide Stripping Plant. The line on the west would cross the river near Well No. 1E and connect with the line on the east side. The connection at each well site would be equipped with a pressure regulating valve so if any one well were to shut down, it would not affect the total system.

The collected brine would then be conveyed to the stripping plant in a buried pipeline. The diameters of the pipelines will vary, depending on their location in the collection system. The pipeline running from the well field to the stripping plant will be approximately the same size as the pipeline running to the evaporation pond (i.e., 15 inches in diameter). Exact sizing of the pipeline will be determined after the design data collection program is completed.

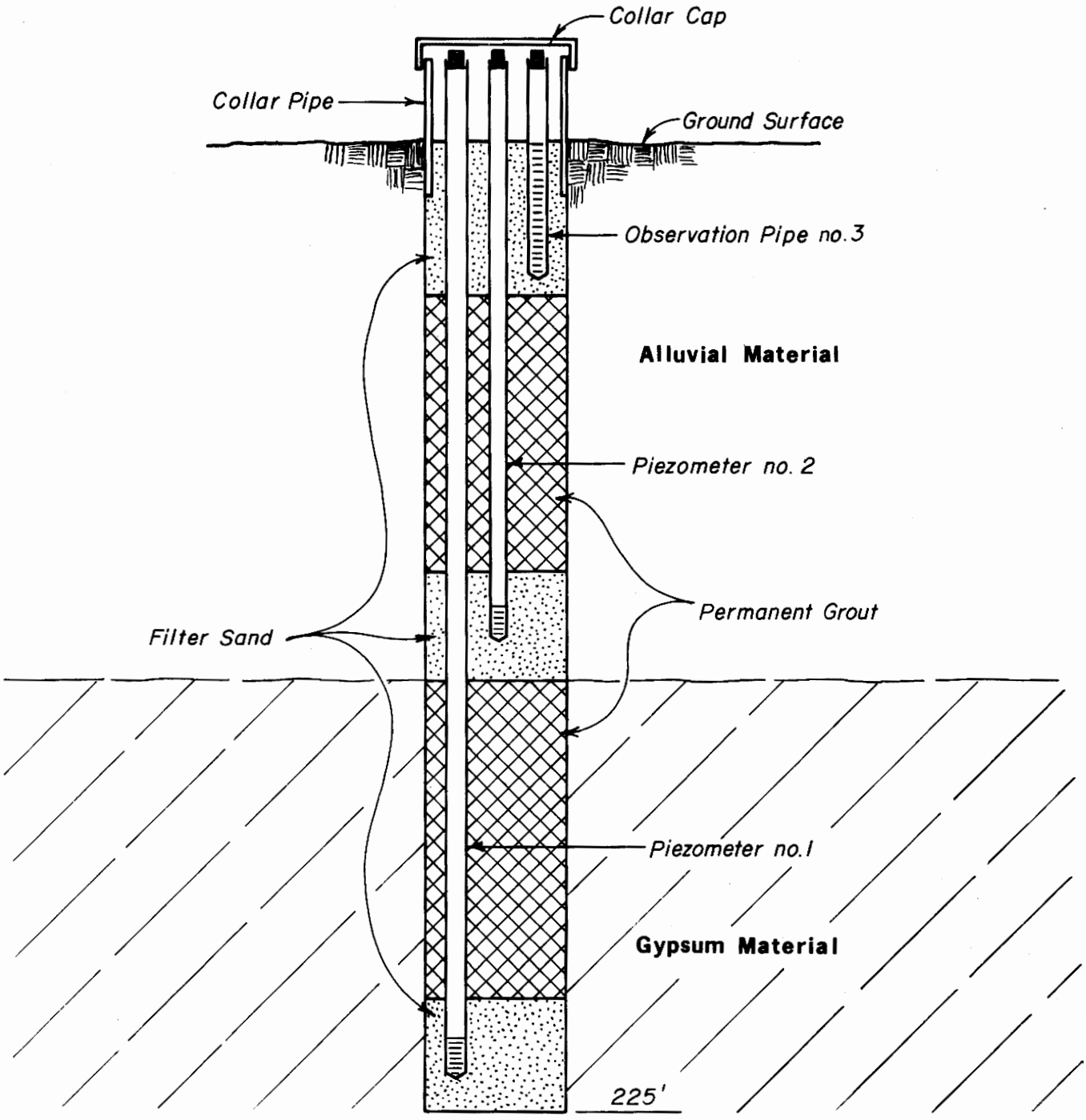
Ground water monitoring wells

A network of ground water monitoring wells has been installed during a series of drilling programs (see Chapter V). These observation wells are located near the brine production wells on both sides of the river and would be used to determine the effects of the pumping on the water table, the freshwater-brine interface, and the brine movement in the aquifer. The information obtained from the observation wells would be used to establish effective pumping rates and patterns for the production wells.

The monitoring system contains two types of wells. The first consists of shallow wells, generally about 20 to 25 feet deep and 1.5 inches in diameter, with PVC casing well screens placed between depths of 10 and 25 feet to allow ground water to enter the casing. Electrical conductivity meters could be lowered into the wells, and the conductivity measured periodically to determine the approximate depth of the freshwater-brine interface. A total of 39 of these wells of this type has already been drilled, and an undetermined number would be added as needed during the data collection program.

The second type of wells consists of 26 wells drilled to an average depth of about 225 feet and 3 drilled to about 300 feet. Each well contains two or three pipes of different lengths, with each pipe perforated in a different zone to allow ground water to enter from that point in the aquifer. The area between the perforated portions is permanently grouted to prevent any mixing of water from the various zones. Figure 23 on the following page shows a typical monitoring well installation.

Each of the 26 wells drilled to 225 feet contains 3 pipes. One pipe has an average depth of 25 feet and is perforated from 5 to 25 feet deep for use in observing the water table and, with electrical conductivity



TYPICAL MONITORING WELL INSTALLATION

FIGURE 23

meters, in locating the freshwater-brine interface. The second pipe is a piezometer extending to a depth of between 56 and 120 feet to the base of the alluvial aquifer, with the lower 5 feet perforated. By measuring how high the water entering the pipe is forced above the perforated section, the ground water pressure head in this part of the aquifer can be determined. The third pipe, extending into the gypsum bedrock that forms the residual cap of the salt dome, has a depth of from 215 to 225 feet and is perforated for the lower 5 feet. This pipe is also a piezometer, with measurements of the water elevation indicating the ground water piezometric head.

The remaining three wells, drilled to a depth of 300 feet, all contain a water table observation pipe about 25 feet deep and two have a piezometer pipe between 285 and 300 feet deep. The other well contains a piezometer pipe about 60 feet deep. Seventeen other wells in the valley that were drilled during earlier exploratory investigations are also being monitored.

During both the pumping tests and long-term operations, these wells would indicate changes in the ground water system near the river. The shallow wells and pipes would be used to measure the lowering of the water table and the freshwater-brine interface, while the piezometer pipes would be used to evaluate pressure changes at deeper zones in the aquifer which would indicate changes in ground water movement.

The well casings extend about 3 feet above the ground surface and were constructed with steel caps to prevent debris from entering and to discourage vandalism. All of the water table wells and piezometer pipes are read periodically to monitor water level changes. Some of the wells would have continuous recorders installed to monitor and record changes in the ground water system. Using the data from the observation wells, the well field operator would be able to adjust the pumping rate at any site and thereby operate the well field in an effective manner, minimizing pumping freshwater from the wells.

River monitoring system

To determine the overall effectiveness of the brine removal, the river would be monitored on a continuous basis at several locations. The five electrical conductivity meters described in Chapter III would be used during the design data collection program and during unit operation to monitor the electrical conductivity of the water in the river where it enters the valley, both upstream and downstream from the brine emerging areas and where the river leaves the valley. During servicing of the salinity meters, water samples would be taken and analyzed in the laboratory to determine the types and amounts of salt that are in the river water. The results of the samples would also be used to keep the meters calibrated. Streamflow gaging stations, both above and below the valley, will be maintained to keep a record of the flow entering and leaving the

valley. Water samples taken each week at the two gaging stations would be used to substantiate the accuracy of the meters and to measure the change in the chemical makeup of the water in the river.

Flooding in well field

The well field would be susceptible to flooding during high runoff years; water depths and velocities in places other than the river, however, will be low. Flood studies done in the valley indicate that the maximum water level in the well field area during the 100-year flood would be less than 4 feet. Facilities in the well field would be protected against flooding. The frequency flood peaks are shown in the following tabulation.

Frequency (years)	Peak (cfs)
5	6,700
10	8,800
25	11,600
50	13,900
100	16,400

Design Data Collection Program

The feasibility estimates used in the Definite Plan Report and the Environmental Impact Statement are based upon the extreme condition that 5 cfs of brine with a salinity of 260,000 mg/l would be pumped constantly during the 100-year life of the unit to control the brine inflow to the Dolores River. Such an operation is unlikely, however, since only about 0,9 cfs at that concentration is enough to produce essentially all the 198,000 tons of salt that is now entering the river each year from ground water.

If it were ultimately necessary to pump at this rate and concentration, six times more salt would be pumped than the amount entering the river. Although it is unlikely that this would be necessary, insufficient data exist to select a design rate. Contributing to the uncertainty is the lack of a complete understanding of the aquifer and recharge source; the need to remove a large reservoir of brine around and beneath the river to lower the freshwater-brine interface; and the possibility of pumping inefficiencies and, therefore, the need to mine some salt to achieve the desired results. For these reasons, it was decided to use the extreme condition for the designs and estimates in the Definite Plan Report and the Environmental Impact Statement.

The Bureau of Reclamation is now conducting a design data collection program which is scheduled for completion in 1979. The purposes of the program are to test a well field that would effectively lower the freshwater-brine interface and reduce the brine inflow to the river; to

determine a design pumping rate for each well and for the entire well field; and to determine the final design capacities of the Hydrogen Sulfide Stripping Plant, brine pipeline, pumping plants, and evaporation pond.

As part of this program 18 brine production wells were drilled, and short, 8-hour pump tests were conducted during the summer of 1977. Starting in 1978 and continuing for approximately 1 to 1½ years, all 18 wells and combinations of them will be pumped. The brine will be conveyed through a temporary pipeline to a temporary storage pond on the north side of the valley, west of the river. During the pump test, the ground water monitoring wells will be used to evaluate changes in the ground water system. Using the data obtained from the observation wells, the pumping rates of the wells will be adjusted as necessary to determine the most efficient pumping rate and pattern. Measurements in the monitoring wells will include water level readings to measure pressure variations and conductivity readings to measure the location of the freshwater-brine interface. Upon completion of the design data collection program, it is contemplated that the 18 existing production wells and the temporary pipeline would, with slight modifications, be converted to permanent operation.

The river monitoring system with recording electrical conductivity meters, gaging, and sampling stations would help to assess the changes in streamflow and water quality that will occur as a result of pumping the brine.

Environmental assessments and negative determinations have been prepared for the various stages of this work in compliance with the National Environmental Policy Act of 1969. The Environmental Protection Agency has given its approval to proceed with the testing program.

Radium Evaporation Pond

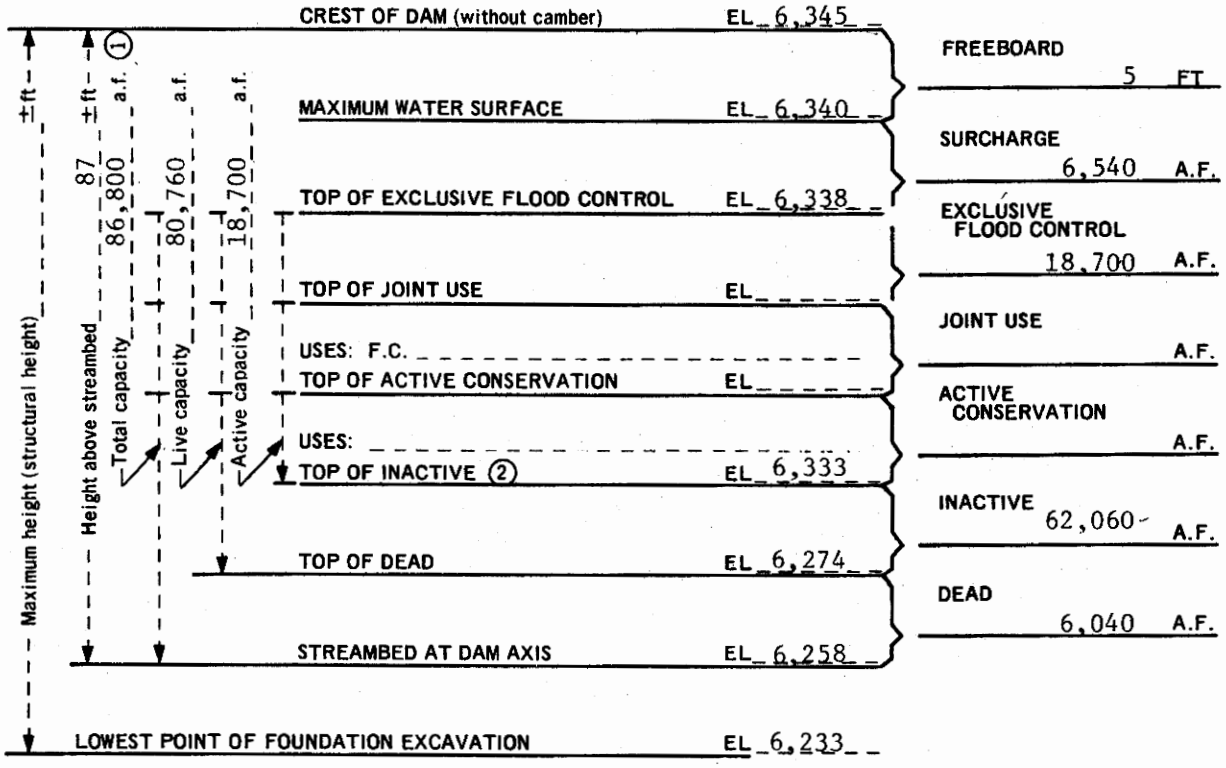
Radium Evaporation Pond would be formed by a dam across a tributary of the West Fork of Dry Creek and a dike across a tributary of the East Fork of Dry Creek. These tributaries are normally dry except for short periods of spring runoff and during thunderstorms. The pond would have a total capacity of 93,340 acre-feet, with an inactive storage capacity of 62,060 acre-feet, a dead storage capacity of 6,040 acre-feet, a flood control capacity of 18,700 acre-feet, and a surcharge capacity of 6,540 acre-feet. The pond storage allocations are summarized in Table 15. The top of the inactive pool would be at an elevation of 6,333 feet and would have a surface area of 3,295 acres. The dam would have an outlet works at elevation 6,274 feet. The outlet works would be used primarily for safety and draining during construction and would be covered by precipitated salt after a few years of operation. The basin is divided by a saddle into two ponded areas, with the west basin having a capacity of 16,690 acre-feet and a surface area of 1,200 acres and the east basin having a

7-1686 (2-72)
Bureau of Reclamation

Table 15

RESERVOIR CAPACITY ALLOCATIONS

TYPE OF DAM	Earthfill	REGION UC	STATE Colorado
OPERATED BY	Bureau of Reclamation	Radium Evaporation Pond	RESERVOIR
CREST LENGTH	1/ FT; CREST WIDTH 30 FT	Radium	DAM
VOLUME OF DAM	& Dike 2,500,000 CU YD	Colorado River Basin Salinity	PROJECT
CONSTRUCTION PERIOD	6 years	Control Point Surface	DIVISION
STREAM	Tributary to West Fork Dry Creek	Paradox Valley	UNIT
RES AREA	3,754 ACRES AT EL 6,340	Planning	STATUS OF DAM
ORIGINATED BY: (Initials) (Code) (Date)		APPROVED BY: (Initials) (Code) (Date)	



(1) Includes 2,400 a.f. allowance for 100 year sediment deposition between streambed and El _____, of which _____ a.f. is above El _____.

(2) Established by _____

REFERENCES AND COMMENTS:

1/ Crest length of dam, 8,300 feet,
Crest length of dike, 7,500 feet,

capacity of 5,920 acre-feet and a surface area of 592 acres. At an elevation of 6,316 feet, the two ponds would merge into one large pond. Because there would be no outlet works at the dike, the east basin is considered to be all dead storage (5,920 acre-feet). The west basin would have a dead storage of 120 acre-feet.

Blanketing

The major portion (83 percent) of the evaporation pond area is underlain by impervious Mancos Shale, which in some places exceeds 200 feet in depth. No blanketing or treatment would be needed in this area for a watertight pond. The other 17 percent of the pond area is underlain by Dakota Sandstone with a clay layer of varying thickness on top of the sandstone. In places, the sandstone is exposed. It has been determined that about 640 acres will require a 5-foot, compacted earth blanket to eliminate seepage. Figure 24 indicates the area to be blanketed.

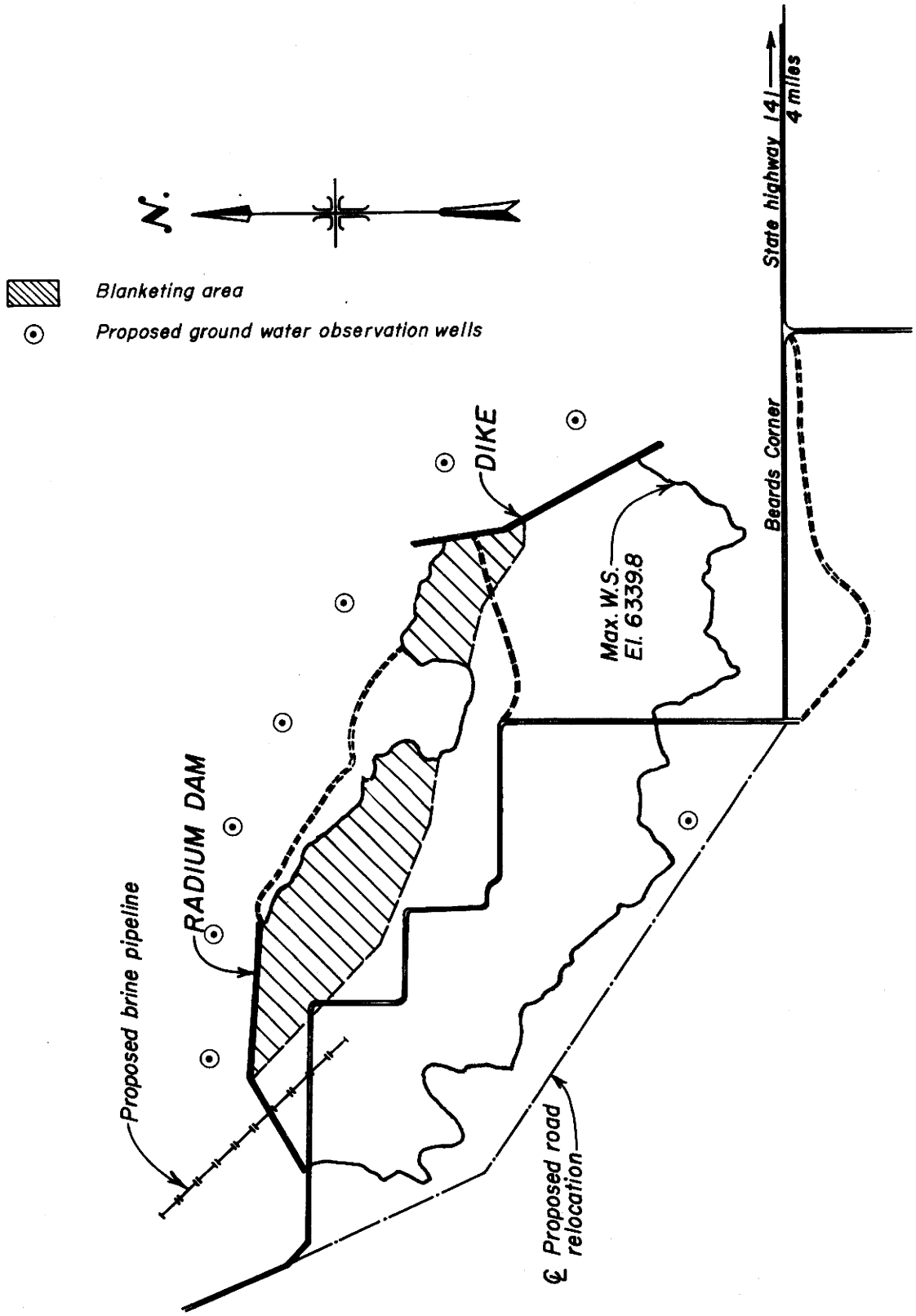
Sufficient ground water monitoring wells would be drilled adjacent to the pond to measure the water table, hydraulic pressure, and water quality, substantiating that brine was not seeping into the local ground water system. Tentative location of these wells is shown on Figure 24. Two wells would be located immediately downstream from the dam on either side of the tributary to the West Fork of Dry Creek, and two would be located just downstream from the dike on either side of the tributary to the East Fork. 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 contain one pipe 25 feet deep and another about 60 feet deep. The shallow pipe would have a screen from 5 feet to 25 feet to permit observation of the water table, and the deep pipe would have a 5-foot screen on the bottom to measure the pressure head in the aquifer. Readings and sampling would be conducted monthly.

Sedimentation

The total sediment inflow to Radium Evaporation Pond would be 2,400 acre-feet for the 100-year operational life of the project. The volume that this sediment would occupy is considered in the operation study as reservoir volume not available for precipitated salt.

Inflow design flood

The design annual inflow to Radium Reservoir is presented in Figure 25 on page 70 and would have a total annual volume of 22,200 acre-feet. The inflow design flood consists of three events, the hydrographs for which are presented in Figure 26 on page 71. The first event is a 100-year thunderstorm with a peak of 10,600 cfs and a volume of 890 acre-feet. This event is followed 24 hours later by the design thunderstorm event, which has a peak of 39,300 cfs and a volume of 5,020 acre-feet. A third flood event, representing the 50-year thunderstorm, follows the maximum



COLORADO RIVER BASIN SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
RADIUM EVAPORATION POND & BLANKETING AREA

FIGURE 24

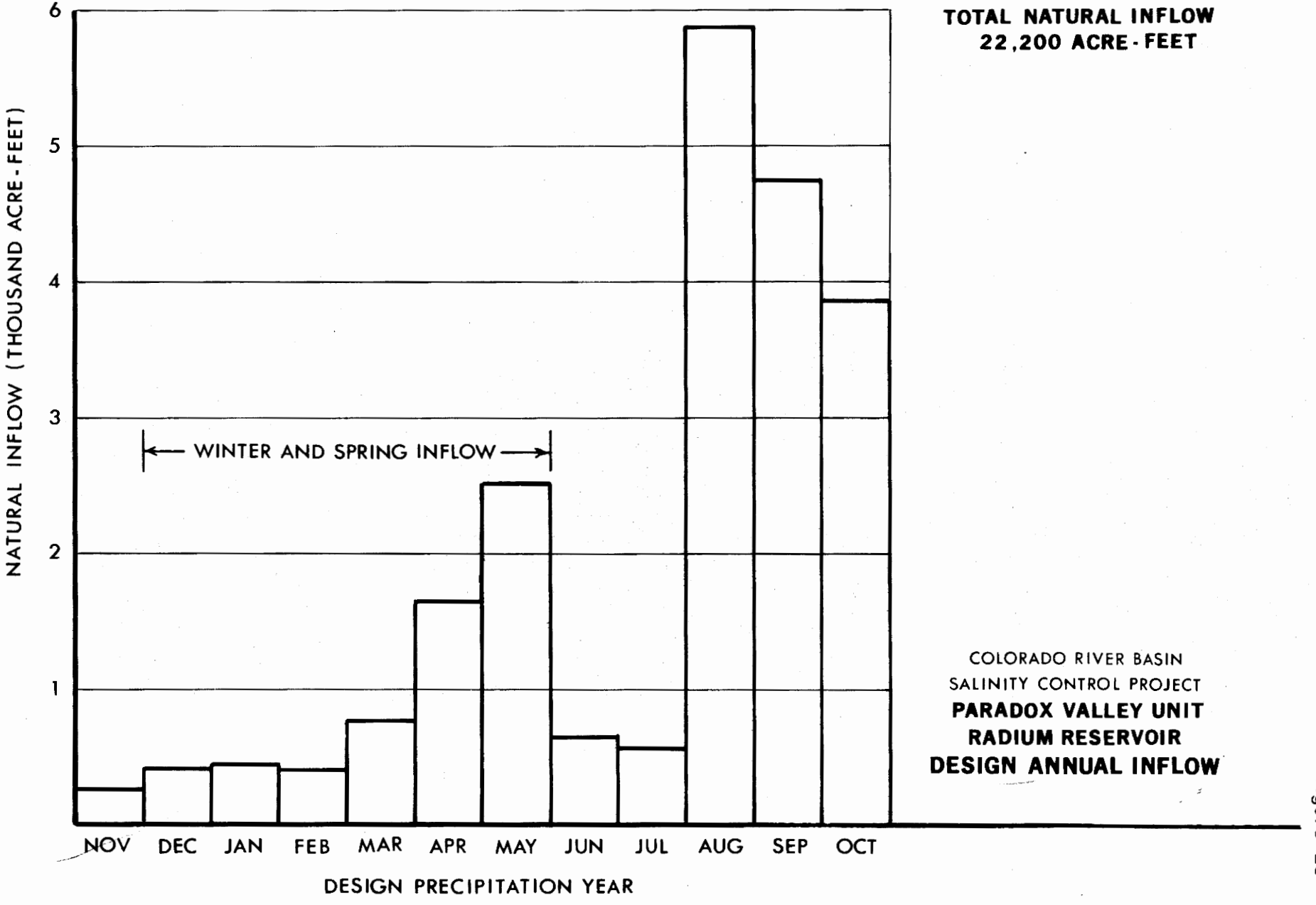
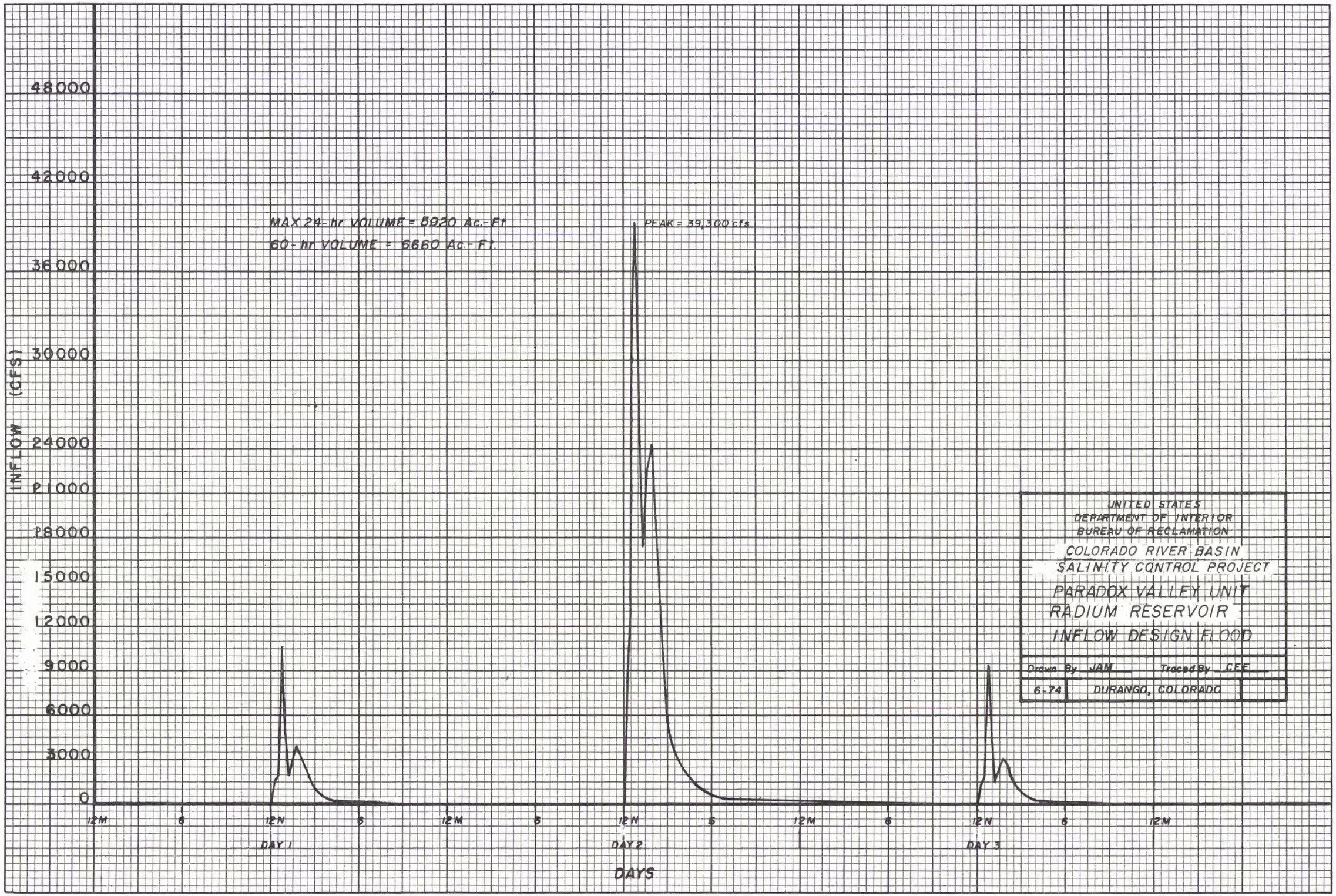

TOTAL NATURAL INFLOW
22,200 ACRE-FEET
NATURAL INFLOW (THOUSAND ACRE-FEET)
6
5
4
3
2
1
WINTER AND SPRING INFLOW
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
DESIGN PRECIPITATION YEAR
COLORADO RIVER BASIN
SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
RADIUM RESERVOIR
DESIGN ANNUAL INFLOW

Figure 25


48000
42000
36000
30000
24000
21000
18000
15000
12000
9000
6000
3000
0
INFLOW (CFS)
MAX 24-hr VOLUME = 5920 Ac.-Ft
60-hr VOLUME = 6660 Ac.-Ft
PEAK = 39,300 cfs
12M
6
12N
6
12M
6
12N
6
12M
6
12N
6
12M
DAY 1
DAY 2
DAY 3
DAYS
UNITED STATES
DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER BASIN
SALINITY CONTROL PROJECT
PARADOX VALLEY UNIT
RADIUM RESERVOIR
INFLOW DESIGN FLOOD
Drawn By JAN
Traced By CEF
6-74
DURANGO, COLORADO

71 FIGURE 26

probable event by 24 hours. This event has a peak of 9,400 cfs and a volume of 750 acre-feet. The total 60-hour volume for inflow design flood is 6,660 acre-feet.

Precipitation

Two years of precipitation data are available for Dry Creek Basin, with an average annual rate of 8.5 inches (see Weather Station Summary Data in the Attachment Section on pages 169 to 173). The average annual precipitation for the same 2 years at Norwood, Colo., which is the closest station with a longer period of record, is 12.1 inches. Natural vegetation near the two stations indicates that the rainfall at Dry Creek Basin is significantly less than at Norwood. For the operation study the ratio for the 2 years of record of 0.7 for the two stations was assumed to be correct. The average annual long-term precipitation rate for Norwood is 14.9, giving a synthetic long-term rate of 10.4 for Dry Creek Basin. Table 16 shows the synthetically generated precipitation for Dry Creek Basin.

Evaporation rate

Two years of freshwater-pan evaporation data were available for Dry Creek Basin (1975 and 1976). For these 2 years, the average pan evaporation was 55.2 inches compared to 42.1 inches at Montrose station where a long period of record is available (see Table 17 on page 74). The Radium Evaporation Pond site, located in Dry Creek Basin, is about 500 feet higher in elevation than Montrose, but there is considerably more wind in Dry Creek Basin that is normally from the southwest and very dry. These winds would maintain a low vapor pressure over the pond area much of the time. Because brine does not freeze, except at extremely low temperatures, evaporation would go on throughout the winter months. For the Montrose station, the winter evaporation rates were filled in by use of a correlation with temperature. The synthetically derived average annual pan evaporation rate for Montrose, assuming no winter freezing, is 58.3 inches for the 36-year data collection period. Because of the lack of sufficient data at Dry Creek Basin, it was decided to use this Montrose average in the operation study. This is a conservative estimate because if the proportion for the 2 years of concurrent data holds, the annual evaporation rate at Dry Creek Basin would be 76.0 inches. The evaporation rate is not critical because even at the Montrose rate sufficient surface area is available during the later years of operation to evaporate all accumulated brine and inflow. The critical factor for sizing the reservoir is the volume occupied by precipitated salts.

To convert the freshwater evaporation rate to a brine evaporation rate, a reduction factor is used which varies from 1 to 0.71, depending on the percent of salt in solution. A review of available literature supported the use of 0.71 at saturation. The saturation concentration used was 29.2 percent salt, equal to that of Great Salt Lake brine at

TABLE 16
SYNTHETIC GENERATED PRECIPITATION DRY CREEK BASIN
(UNIT--INCHES)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1933	1.4	1.1	1.1	1.1	1.1	.1	1.7	.7	1.7	1.4	1.2	1.0	13.5
1934	.3	1.7	0.0	1.3	.6	.3	.9	.8	1.0	.4	1.3	1.3	9.8
1935	1.1	.3	.7	1.2	2.0	0.0	1.3	2.7	1.4	.7	.1	1.2	12.8
1936	.2	2.3	1.0	.6	1.0	.9	1.7	2.9	.5	.7	.9	1.6	14.3
1937	.4	.9	1.3	.7	.2	.8	2.1	2.6	1.1	1.2	.4	.7	12.3
1938	.8	.8	.9	1.0	.7	.6	1.1	1.5	1.0	1.1	.5	.6	10.8
1939	1.2	.8	1.1	0.0	.2	0.0	.3	1.8	1.7	.9	0.0	.4	8.4
1940	1.6	1.4	.2	.7	.6	.3	.9	.8	3.1	1.1	.5	1.0	12.1
1941	1.1	1.0	1.7	3.6	1.3	1.5	1.1	2.9	1.0	1.1	.7	.7	17.7
1942	.5	.4	3.4	.3	.1	0.0	0.0	.5	1.0	.6	.3	1.1	8.2
1943	1.4	0.0	1.0	.3	1.3	.9	1.1	3.6	.1	.7	.3	.5	11.3
1944	.5	.8	.9	1.8	.2	1.2	.4	.7	.1	.5	1.2	.9	9.1
1945	.3	.4	.4	1.4	.2	.3	1.4	2.6	.6	1.6	.3	.8	10.3
1946	.4	.3	1.3	1.7	1.5	.0	1.0	2.1	.7	1.2	1.0	.2	11.3
1947	.2	.5	.6	.6	.6	1.8	1.9	2.9	1.0	1.9	.6	1.0	13.7
1948	.6	1.8	1.3	1.1	.2	1.4	.4	1.1	1.1	.4	.5	.9	10.7
1949	1.5	.5	.7	.7	1.0	2.0	1.2	.6	.2	1.1	.2	.5	10.2
1950	1.0	1.0	.7	.4	.3	.2	1.3	.3	.9	.1	.2	.5	6.9
1951	.6	.4	.0	.9	.6	.2	.4	1.7	.2	.7	.9	1.0	7.7
1952	1.1	.9	1.1	1.3	.8	.1	.8	1.3	1.3	0.0	.8	.5	9.9
1953	.4	.6	.5	1.0	.7	.4	1.5	1.7	0.0	1.8	1.3	.3	10.1
1954	.2	.1	.8	1.1	.7	.5	1.5	.6	3.0	1.0	.9	.3	10.6
1955	.4	1.1	.2	.8	.8	.4	.7	.7	.1	.1	.7	.4	6.3
1956	.9	.4	.4	.6	.4	.2	.7	1.0	.1	.5	.5	.6	6.3
1957	1.4	.4	.8	.9	2.5	.4	2.9	2.5	0.0	3.6	1.5	.4	17.2
1958	.3	.8	.7	.4	.2	.2	.4	1.3	1.3	.9	.7	.3	8.0
1959	.2	.8	.2	.7	.2	.2	1.0	1.5	1.1	1.7	.1	.8	8.5
1960	.4	1.2	1.0	.6	.4	.6	.6	.5	1.0	1.2	.5	.7	8.8
1961	.5	.7	1.7	.6	.7	.3	.7	1.7	2.6	1.2	.6	.7	11.9
1962	.4	1.4	.4	.3	.6	.4	.6	.4	1.5	1.1	.8	.6	8.3
1963	.7	.6	.8	.2	.1	.5	2.6	2.8	1.6	2.0	.5	.3	12.8
1964	.3	.3	.8	.9	.4	.3	1.4	1.5	1.0	0.0	1.0	1.0	8.9
1965	1.2	.6	1.3	1.1	.9	.6	1.9	1.8	2.2	1.0	.9	1.2	14.6
1966	.3	.5	.1	.5	.5	1.3	1.3	1.1	.8	.6	.9	.9	8.7
1967	.2	.3	.3	.4	1.6	1.1	2.5	.9	.7	.2	.3	.9	9.4
1968	.4	.7	.1	1.4	.6	.3	1.6	1.4	.1	.4	.5	.7	8.2
1969	.7	.8	.4	.1	.8	1.0	1.2	1.8	1.4	1.7	.5	.7	11.2
1970	.4	.2	1.8	.9	.0	1.0	.7	1.6	3.5	1.2	.3	.7	12.3
1971	.3	.8	.4	.7	.5	.0	.3	2.1	.3	2.9	1.2	1.4	10.4
1972	.2	.2	.1	.1	.1	1.3	1.1	.3	1.3	3.1	1.0	1.2	10.0
1973	.5	.2	1.0	.8	1.4	1.5	.8	1.1	.6	.5	.6	.7	9.6
1974	2.2	.3	.7	.9	0.0	.1	1.3	.4	.6	1.3	.6	.6	9.1
1975	.9	.8	1.8	.8	.8	.2	1.0	.5	.9	.4	.7	.5	9.3
1976	.6	.5	.3	.6	1.2	.3	1.7	1.0	1.4	.0	.1	.0	7.7
AVG	.7	.7	.8	.8	.7	.6	1.2	1.5	1.1	1.0	.7	.8	10.4

Table 17

Pan evaporation data

Month	Freshwater evaporation (inches) 1975	1976	Average	Brine evaporation (inches) 1975	1976	Average
			Dry Creek Basin			
January					0.66	0.66
February				1.35	1.26	1.31
March				3.19	2.81	3.00
April	5.94	5.17	5.56	5.11	4.59	4.85
May	7.55	7.69	7.62	5.55	4.83	5.19
June	11.23	1/11.23	11.23	9.69	1/9.69	9.69
July	10.44	1/10.44	10.44	7.22	1/7.22	7.22
August	10.60	9.35	9.98	8.51	6.71	7.61
September	6.49	6.02	6.26	5.40	5.41	5.41
October	5.41	2.88	4.15	4.36	3.61	3.99
November				2.40	3.10	2.75
December				.55	1.30	.93
Total	57.66	52.78	55.24	53.33	51.19	52.61
			Bedrock			
January						
February						
March	1.11	4.35	2.73			
April	6.11	7.26	6.69			
May	8.73	9.08	8.91			
June	11.01	12.87	11.94			
July	10.61	12.38	11.50			
August	10.29	9.55	9.92			
September	7.45	6.36	6.91			
October	5.54	4.57	5.06			
November	2.58	1.83	2.21			
December						
Total	63.43	68.25	65.87			
			Montrose			
				37-year average 1940-76		
January				1.32		
February				1.48		
March				3.59		
April	5.35	4.88	5.12	5.63		
May	5.98	6.08	6.03	7.71		
June	7.74	8.51	8.13	9.36		
July	7.62	1/7.62	7.62	9.29		
August	6.99	6.53	6.76	7.59		
September	4.87	4.02	4.45	5.73		
October	3.66	2.75	3.21	3.56		
November	1.56	1.76	.78	1.67		
December				1.32		
Total	43.77	42.15	42.10	58.25		

1/ Data used from previous year.

saturation.[1] After a few years of operation, the constituents of salt in Radium should be in similar proportions to those found in the Great Salt Lake.[2]

Operation study

A computer model was used to simulate the operation of the evaporation pond over its 100-year life. A computer printout with accompanying column descriptions is included in the Attachment Section on pages 82 through 102. For the purpose of the operation study, 5 cfs of brine at 260,000 mg/l were assumed to be pumped constantly for the entire 100 years. The use of this assumption for the sizing of project facilities is based on the extreme condition. Upon completion of the design data collection program in 1979, the operation study will be redone with a more accurate flow rate and salinity concentration. Sizing estimates will then be revised, and Radium Evaporation Pond will, undoubtedly, be reduced in size.

In the operation study, Pond 1 is the west basin, which was described earlier. It would fill and spill over into Pond 2 (east basin) after about 6 years of project operation. Pond 2 would need an additional 3 years to fill, at which time, the two ponds would merge into Pond 3.[3] After about 30 years of project operation, the pond would have sufficient surface area so that the average annual evaporation would exceed the average annual inflow. From about the 75th year to the 100th year, the pond would consist of only precipitated salt during some months of each year. Based on a constant 5 cfs inflow, the pond would have its entire inactive storage capacity (68,100 acre-feet) filled with precipitated salt after 100 years.

After 100 years of operation, the brine inflow would be discontinued. Because the total capacity of the reservoir would be 86,800 acre-feet, 18,700 acre-feet of capacity would be available for annual natural inflows. The design annual natural inflow of 22,200 acre-feet could be stored with a total evaporation during that year of 3,500 acre-feet. The average annual natural inflow would increase throughout the life of the unit as the surface area and, hence, the rain on the pond surface increased (100 percent of the rain on the pond surface is considered as natural runoff, whereas only about 10 percent of the rain on the surrounding basin would make it to the pond because of evapotranspiration). After

---

1/ Saturated Vapor Pressures Over Great Salt Lake Brine, Don R. Dickson, John H. Jepsen, and J. Vern Hales, Journal of Geophysical Research, Vol. 70, No. 2, January 13, 1965.

2/ A Thermodynamic Model of the Paradox Valley Unit Brine, Department of Soil Science and Biometeorology, Utah State University, February 1977.

3/ Pond 3 includes Ponds 1 and 2.

100 years, the average annual inflow would be approximately 3,600 acre-feet, compared to an average evaporation potential of about 8,000 acre-feet.

For safety purposes, a 50-cfs spillway would be provided at the top of the flood control pool, which, along with a 1.8-foot surcharge with a capacity of 6,540 acre-feet, would be sufficient to pass the inflow design flood. It is not anticipated that this spillway would ever have to be used because of the flood storage capacity that would be available after the 100-year life.

CHAPTER V

INVESTIGATIONS

Feasibility investigations were initiated in 1971 to study control methods of preventing salt from entering the Dolores River. After gathering available information from literature, maps, and drill logs, a resistivity survey was conducted along the river in April 1972 to locate subsurface anomalies for guidance in planning initial exploratory drilling. Unfortunately, the area surveyed contained a brine layer of very low resistance at a depth of about 10 feet which prevented penetration of the electric current. There were also lateral changes in resistivity, which produced irregular curves, making interpretation difficult. Information deduced from the soundings, however, was used to confine the exploratory drilling to the expected problem area. A copy of the resistivity survey is on file in the Durango Office.

Surface Water

As described in Chapter II, stream gaging and water quality sampling stations were established in 1971 at three locations--the Dolores River at Bedrock, Colo.; the Dolores River near Bedrock, Colo.; and West Paradox Creek above Bedrock, Colo. In addition, as discussed in Chapter III, five electrical conductivity meters were placed above, in, and below the area of emerging brine to continuously record changes in salinity.

Exploratory Drilling

Based on information obtained from field surveys, the resistivity survey, and a study of existing well logs, a drilling program was initiated. The locations of the wells discussed in the following section can be seen on the location map in Chapter I. During the summer of 1972, five core holes (DH 1PX-DH 5PX) located along the eastern limit of the river meander course were drilled using NX-sized (3-inch) core drilling equipment. Depths ranged from 74 feet to 200 feet and extended into consolidated portions of the valley fill. The core holes yielded information confirming shallow overburden, a shallow saline water table, and a brecciated gypsiferous formation below the overburden (see logs in the Attachment Section).

A more comprehensive exploratory drilling program was accomplished in late 1972 and included holes on both sides of the river. Twelve holes (numbered DH-CX) were drilled using a 6-inch rotary drill ranging in depth from 69 feet to 240 feet. Data obtained from this drilling included drillers' logs, material samples, drill fluid samples, and readings of

natural salinity and hydrogen sulfide gas. Perforated casings were installed in all drill holes for future water level readings and chemical sampling.

Information obtained from this drilling indicated a freshwater zone near the river from 1 to 20 feet below the ground surface extending to a maximum depth of about 100 feet to the west of the river. The major freshwater zone overlies brine in the valley fill along the west side of the river and is wedge shaped with the maximum thickness upriver and to the west along West Paradox Creek and tapering toward the river. The river deposits on the east side of the river are variable, but generally shallow, and contain only small amounts of freshwater overlying brine. In the river channel, the brine interface surfaces sharply about midvalley.

In January 1973, three core holes were drilled into brine producing aquifers (DH 6PX, DH 7PX, and DH 8PX) and a test well (DH 23CX-Test Well No. 1) to test the aquifers. The core holes were drilled with NX core drilling equipment. DH 7PX was drilled to a depth of 470 feet, DH 6PX to a depth of 192 feet, and DH 8PX to only 85 feet. Two piezometers and a water table observation pipe were installed in DH 6PX and DH 7PX with the piezometers measuring piezometric head at different levels. Because of flooding during the drilling operation, work on DH 8PX was stopped prematurely. The NX drill casing was left in DH 8PX and only the piezometric head of the zone at 84 to 85 feet can be measured. A water level recorder was placed over the pipe at DH 8PX to record water level changes, and a water table observation well was placed near DH 8PX.

Test Wells

As discussed in Chapter IV, in 1973 Test Well No. 1 was drilled to a total depth of 300 feet, Test Wells 2 and 3 were drilled in 1975 into the residual gypsum cap, and 18 test wells were drilled in the summer of 1977.

Observation Wells

Based upon data obtained from the initial drilling and the geological investigation, a ground water observation network described in Chapter IV was designed with lines of piezometers parallel and perpendicular to the river. The ground water observation network was installed during the summer and fall of 1975 and included piezometers at 27 sites. The sites were numbered 1W1-2C4 on the west side and from 2E1 through 10E1 on the east side. A 6-inch hole was first drilled to the top of the gypsum and then a 4½-inch hole was continued to a maximum depth of 225 feet. Problems prevented drilling to the desired depth in two holes. Piezometers were installed in each hole with one tip placed at the bottom of the hole and a second tip placed just above the gypsum cap in the course

gravel zone. A water table observation pipe to a depth of 25 feet was also placed at each site.

Pilot Holes

In October 1976, 18 pilot holes were drilled using a hammer drill at proposed test well sites. Locations can be seen on the Investigations Map on page 13. Data obtained from this drilling include the following.

1. Depth to water
2. Approximate depth to the freshwater-brine interface
3. Samples of aquifer material for mechanical analysis
4. Approximate locations of permeable brine producing aquifers
5. Depth to top of salt cap (gypsum breccia)
6. Samples of the brine encountered

These pilot holes were used in the design of the 18 production wells. Only 16 of the sites, however, were later used for production well sites. Test wells 23A and 2C1A are the two additional wells. The locations are shown on the General Investigations Map on page 13.

Evaporation Study and Weather Stations

To evaluate evaporation and other climatological parameters in the project area, two weather stations were established, one near Bedrock, Colo., and one in Dry Creek Basin. The stations were put into operation in January 1975 and are still functioning. The following tabulation lists the equipment in operation at each station.

Weather stations equipment
Minimum-maximum thermomter1/
Sling psychrometer1/
Standard-size Class A evaporation pan
Anemometer
Universal recording rain gage
8-inch nonrecording rain gage
Hygrothermograph1/2/
Standard Class A evaporation pans filled with brine2/3/

1/ Equipment is installed and maintained in a standard Weather Bureau instrument shelter house.

2/ Equipment is installed only at Dry Creek Basin station.

3/ One evaporation pan filled with brine containing 260,000 mg/l total dissolved solids is maintained at Dry Creek Basin station.

At both stations daily minimum and maximum temperatures are read from a minimum-maximum thermometer. At the Dry Creek Basin station, the temperatures are checked with readings obtained from a hygrothermograph chart which is changed weekly.

Relative humidity is measured daily at each station by using a sling psychrometer. At the Dry Creek Basin station, these readings are compared and correlated with the reading obtained from the hygrothermograph.

A weighting-type recording rain gage is set up at both weather stations. Charts on these gages are changed weekly. A wedge-type nonrecording rain gage is also set up at each station. These gages are read daily and are used to check the accuracy of the recording gages.

Anemometers are mounted on the northwest corner of the evaporation pan platforms so that the vanes are 0.25 foot above the evaporation pans. Daily readings of elapsed cumulative nautical miles are recorded daily.

The evaporation pans at the weather stations are the standard size Class "A" land pans set on platforms to allow free air circulation under them. Minimum and maximum temperatures of the water in the evaporation pans are obtained daily by using minimum-maximum mercury thermometers in the pans. The water level in the pans is read daily using a stilling well, which remains in the pan, and a hook gage. With accurate observation the water level can be read to the nearest hundredth of an inch.

In order to measure brine evaporation rates, one pan in Dry Creek Basin was initially filled with brine pumped from Test Well No. 1 in Paradox Valley. After the initial filling, freshwater was added when needed in an attempt to keep the brine pan filled and at nearly the same concentration. During the high evaporation months, there was some precipitation of salt in the brine pan; however, this salt went back into solution when freshwater was added and the contents of the pan were mixed. Summaries of the weather station data are included in the attachments.

Results from an evaporation study at the two weather stations for the 2 years have shown an average freshwater pan evaporation rate of 65 inches at the Bedrock station and 55 inches for the Dry Creek Basin station. The average evaporation rate for a pan located at the Dry Creek Basin station containing brine (23 percent salt) was 53 inches. There are significant seasonal variations, with about 48 percent of the evaporation occurring during June through August and 85 percent occurring during April through October.

As more data become available, the weather station information will provide an increasingly accurate estimate of evaporation and other climatological parameters. This information will be very useful during the design data collection program to help in the final sizing of unit facilities and during unit operation to closely monitor evaporation at Radium

Pond. Besides being useful for unit operation, accurate weather data will provide assistance in the planning and design of similar projects.

ATTACHMENTS

RADIUM EVAPORATION POND

Column Description for the Radium Evaporation Pond Operation Study

The pumped brine inflow is considered to be constant at 5 cfs. The following properties of salt brine are assumed constant throughout the 100-year operation study.

Percent salt in the pumped brine	22.3
Specific gravity of the pumped brine	1.16
Percent salt in saturated brine	29.2
Specific gravity of saturated brine	1.18
Specific gravity of precipitated salt	1.436
Bulking factor	1.0

A bulking factor is used to take into account increased volume when the precipitated salt is in hydrated form. For Paradox Valley brine, less than 5 percent of the salts fits into this category and, for this reason, a bulking factor of 1 was selected.

Brine inflow (acre-feet).--The input for pumped brine is in cfs. The brine inflow to Pond 2 is that amount which overflows Pond 1. The salt content of the brine inflow to Pond 2 is the same as the salt content of Pond 1 during that month.

Natural runoff (acre-feet).--Natural runoff is the volume of rain that falls directly on the reservoir surface plus the volume of runoff from the rain on the drainage area. The runoff is calculated from a correlation between monthly rainfall records at Norwood, Colo., versus the monthly flow volumes at Dry Creek.1/ This correlation can be expressed by these empirical equations:

$$\text{where } \log_{10}(\text{runoff}) = 1.001 + 0.531\,(\text{rainfall})$$
$$\text{rainfall} = 4.97 \text{ inches}$$
$$\text{and runoff} = 53.3\,(\text{rainfall}) - 221.3$$
$$\text{rainfall} = 4.97 \text{ inches}$$

Thirty-two years of precipitation records at Norwood, Colo., and 2 years of records at Dry Creek Basin were available. For these 2 years (1975 and 1976) the precipitation in Dry Creek Basin was 70 percent of that at Norwood. This proportion was used to generate 32 years of record for Dry Creek Basin and then used in a cyclic manner to generate 100 years of precipitation data for the operation study.

1/ Inflow Design Flood Study; Radium Damsite, Durango Colo., Water Resources Branch, June 1974.

Total inflow (acre-feet).--The total inflow is the sum of the brine inflow and the natural runoff for each month.

Evaporation (acre-feet).--The evaporation for any month is the product of the monthly evaporation from a freshwater reservoir, Adam's evaporation coefficient,1/ and the average reservoir surface area for that month. The monthly evaporation from a freshwater reservoir is calculated from data provided by the weather station at Montrose. The freshwater pan to freshwater reservoir evaporation ratio of 0.70 was used to arrive at the 40.8 inches of evaporation from a freshwater reservoir. Adam's evaporation coefficient, 100.29 - [1.005 x (percent salt - 100)] ranging between 1 and 0.71, adjusts the evaporation rate for varying salt concentrations in the brine. The evaporation column includes all volumes that leave solution, which is the volume of water that evaporates plus the volume the precipitated salt occupied while in solution.

End-of-month content (acre-feet).--The end-of-month (eom) content equals the previous month's eom content, plus the total inflow, minus the evaporation, plus the month's salt precipitate. The annual sediment deposition of 24 acre-feet a year is added to the eom content each December. When both Pond 1 and Pond 2 are receiving inflow, the sediment is equally divided between them. In the case where Pond 1 is overflowing to Pond 2, the overflow is subtracted from the end-of-month content of Pond 1.

End-of-month surface area (acres).--The end-of-month surface area is computed from the end-of-month content by interpolating between area-capacity data pairs that are input to the program.

Content as a percent of capacity (percent).--The end-of-month content is divided by the capacity of the pond under consideration to find the percent of contents in the pond.

Concentration of salt in solution (ppm).--The ppm is calculated for three separate cases. The first case is the most common. Whenever there is a brine solution, the ppm is the weight of total dissolved salts divided by the weight of solution. Case 2 occurs when the weight of solution is zero, that is, when the solution has evaporated and only precipitated salt remains in the reservoir. For this case, the ppm is set at the saturation level to eliminate any discontinuity. The final case occurs when Pond 2 has no solution from the month before and only natural runoff for the present month's inflow. The ppm is set at 1,000. Salt will precipitate out of solution at 292,000 ppm so the salt concentration will never exceed 29.2 percent.

Month's salt precipitate (acre-feet).--The amount of salt that settles out each month is the total precipitated salt in the reservoir minus

1/ Evaporation from Great Salt Lake, T.C. Adams, Bulletin American Meteorological Society, Vol. 15, No. 2, pp. 35-39, 1934.

the total precipitated salt in the reservoir from the month before. Windblown or runoff sediment is never included in this calculation.

Total salt precipitate (acre-feet).--The total weight of salt precipitate in the reservoir is found by subtracting the total weight of salt that can remain in solution at saturation for that month from the total weight of salt in the reservoir. The volume of the precipitated salt is found by dividing its weight by 1.436 (the specific gravity of precipitated salt) and by 1,359 (the tons per acre-foot conversion factor) then multiplying by 1 (the bulking factor). Sediment is added to the total salt precipitate each December. If two ponds are in operation, the sediment is divided equally between them. Once the salt precipitates, it is assumed it will not return to solution. Therefore, the total salt precipitate will never be less than the month before.

Salt precipitate as a percentage of reservoir capacity.--The percentage of salt precipitate in the reservoir is calculated by dividing the volume of the precipitated salt by the maximum capacity of the pond being considered.

RADIUM EVAPORATION POND, 5 CFS
EVAPORATION OPERATION STUDY

100 YEAR ANNUAL AVERAGES

BRINE INFLOW(AF):	3618.98	NATURAL RUNOFF(AF):	2578.08	TOTAL INFLOW(AF):	6197.06
EVAPORATION(AF):	6190.37	SALT PRECIPITATE(AF):	650.43		

THE EVAPORATION POND OPERATION STUDY WAS CARRIED OUT FOR 100 YEARS. THE FOLLOWING INPUT WAS ASSUMED TO BE CONSTANT THROUGHOUT THE PUMPING PERIOD:

1. PERCENT SALT CONTENT OF BRINE BEING PUMPED = 22.3
2. SPECIFIC GRAVITY OF BRINE BEING PUMPED = 1.16
3. PERCENT SALT CONTENT OF SATURATED BRINE = 29.2
4. SPECIFIC GRAVITY OF SATURATED BRINE = 1.20
5. SPECIFIC GRAVITY OF PRECIPITATED BRINE SALT = 1.44
6. T.C. ADMAS BRINE-FRESH WATER EVAPORATION COEFFICIENT AT SATURATION = .71

THE AVERAGE MONTHLY EVAPORATION FROM A FRESH WATER RESERVOIR IN FEET.

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	.077	.086	.209	.328	.450	.546	.542	.443	.334	.208	.097	.077

THE MONTLY EVAPORATION FROM A FRESH WATER RESERVOIR IS MULTIPLIED BY A FACTOR RANGING BETWEEN 1.0 AND 0.70944 DEPENDING UPON THE SALT CONTENT OF THE RESERVOIR. THIS ADJUSTED VALUE FOR EVAPORATION IS THEN MULTIPLIED BY THE AVERAGE AREA OF THE RESERVOIR FOR THAT MONTH TO GIVE A MONTHLY EVAPORATION VOLUME.

THE FOLLOWING SHOWS THE DISPOSITION OF THE RESERVOIR AT THE END OF 100 YEARS:

MAX. AREA	MAXIMUM CAPACITY	CONTENT	CONTENT AS PERCENT OF CAPACITY	SALT PRECIPITATE CONTENT	SALT PRECIPITATE AS A PERCENT OF RESERVOIR CAPACITY
3630.	86803.	68111.	78.5	67442.5	77.7

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHS SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
		* PUMPED INFLOW TO POND 1 + NATURAL RUNOFF TO POND 1 + 2 *										
							* POND 1 *					
1												
	JAN	307.4	14.8	322.2	1.7	320.5	53.6	1.9	214926.6	0.0	0.0	0.0
	FEB	277.6	8.8	286.4	5.1	601.8	95.2	3.6	217506.6	0.0	0.0	0.0
	MAR	307.4	13.2	320.6	18.8	903.6	130.6	5.4	220565.6	0.0	0.0	0.0
	APR	297.5	16.9	314.3	37.5	1180.4	159.7	7.1	224554.1	0.0	0.0	0.0
	MAY	307.4	21.4	328.7	61.0	1448.1	186.8	8.7	229611.1	0.0	0.0	0.0
	JUN	297.5	1.4	298.9	83.8	1663.2	208.1	10.0	238350.6	0.0	0.0	0.0
	JUL	307.4	48.1	355.5	91.4	1927.1	233.8	11.5	240612.5	0.0	0.0	0.0
	AUG	307.4	12.4	319.8	82.5	2164.4	256.4	13.0	244920.5	0.0	0.0	0.0
	SEP	297.5	55.7	353.2	68.0	2449.5	283.0	14.7	243356.0	0.0	0.0	0.0
	OCT	307.4	41.8	349.1	46.5	2752.2	306.9	16.5	241471.1	0.0	0.0	0.0
	NOV	297.5	37.0	334.5	23.4	3063.2	330.8	18.4	238758.5	0.0	0.0	0.0
	DEC	307.4	30.8	338.2	20.2	3393.2	357.2	20.3	236679.7	0.0	12.0	.1
	TOTAL	3619.0	302.3	3921.3	540.1					0.0		
							* POND 2 *					
1												
	JAN	0.0	15.9	15.9	.4	15.5	12.1	.3	1000.0	0.0	0.0	0.0
	FEB	0.0	5.6	5.6	1.2	19.9	15.5	.3	1000.0	0.0	0.0	0.0
	MAR	0.0	6.6	6.6	3.7	22.8	17.8	.4	1000.0	0.0	0.0	0.0
	APR	0.0	7.0	7.0	6.3	23.5	18.4	.4	1000.0	0.0	0.0	0.0
	MAY	0.0	8.0	8.0	8.6	22.9	17.9	.4	1000.0	0.0	0.0	0.0
	JUN	0.0	.2	.2	8.0	15.1	11.8	.3	1000.0	0.0	0.0	0.0
	JUL	0.0	18.6	18.6	8.6	25.0	19.6	.4	1000.0	0.0	0.0	0.0
	AUG	0.0	.9	.9	7.3	18.6	14.5	.3	1000.0	0.0	0.0	0.0
	SEP	0.0	19.5	19.5	6.5	31.6	24.7	.5	1000.0	0.0	0.0	0.0
	OCT	0.0	11.4	11.4	5.6	37.5	29.3	.6	1000.0	0.0	0.0	0.0
	NOV	0.0	9.2	9.2	3.0	43.7	34.2	.7	1000.0	0.0	0.0	0.0
	DEC	0.0	6.9	6.9	2.8	50.9	44.1	1.0	1000.0	0.0	12.0	.2
	TOTAL	0.0	109.8	109.8	61.9					0.0		
							* POND 1 *					
2												
	JAN	307.4	8.2	315.6	21.8	3687.0	381.5	22.1	236305.5	0.0	12.0	.1
	FEB	277.6	69.3	346.9	26.0	4007.9	408.8	24.0	233145.6	0.0	12.0	.1
	MAR	307.4	0.0	307.4	67.6	4247.7	429.6	25.5	235665.6	0.0	12.0	.1
	APR	297.5	53.9	351.3	111.1	4487.9	450.8	26.9	237459.2	0.0	12.0	.1
	MAY	307.4	21.7	329.0	158.3	4658.6	465.9	27.9	242593.7	0.0	12.0	.1
	JUN	297.5	9.9	307.4	195.8	4770.1	475.8	28.6	249610.1	0.0	12.0	.1
	JUL	307.4	41.5	348.8	196.8	4922.2	489.6	29.5	254808.1	0.0	12.0	.1
	AUG	307.4	34.6	342.0	164.2	5100.0	505.8	30.6	258531.8	0.0	12.0	.1
	SEP	297.5	48.6	346.0	127.6	5318.4	525.7	31.9	259903.8	0.0	12.0	.1
	OCT	307.4	15.6	323.0	82.5	5558.9	547.9	33.3	260606.9	0.0	12.0	.1
	NOV	297.5	68.8	366.2	40.3	5884.8	578.1	35.3	257643.3	0.0	12.0	.1
	DEC	307.4	68.6	376.0	34.0	6238.8	611.3	37.4	254716.4	0.0	24.0	.1
	TOTAL	3619.0	440.6	4059.6	1226.0					0.0		
							* POND 2 *					
2												
	JAN	0.0	.9	.9	3.4	57.3	43.5	1.0	1000.0	0.0	12.0	.2
	FEB	0.0	21.4	21.4	3.9	74.8	47.6	1.3	1000.0	0.0	12.0	.2
	MAR	0.0	0.0	0.0	9.9	64.9	45.3	1.1	1000.0	0.0	12.0	.2
	APR	0.0	12.7	12.7	15.0	62.7	44.8	1.1	1000.0	0.0	12.0	.2
	MAY	0.0	2.2	2.2	19.5	45.4	35.5	.8	1000.0	0.0	12.0	.2
	JUN	0.0	.9	.9	15.4	30.9	24.1	.5	1000.0	0.0	12.0	.2
	JUL	0.0	6.4	6.4	11.2	26.1	20.4	.4	1000.0	0.0	12.0	.2
	AUG	0.0	4.5	4.5	7.9	22.7	17.7	.4	1000.0	0.0	12.0	.2
	SEP	0.0	6.6	6.6	5.8	23.5	18.4	.4	1000.0	0.0	12.0	.2
	OCT	0.0	.5	.5	3.4	20.6	16.1	.3	1000.0	0.0	12.0	.2
	NOV	0.0	10.2	10.2	1.8	29.0	22.7	.5	1000.0	0.0	12.0	.2
	DEC	0.0	9.7	9.7	2.8	48.8	38.1	.8	1000.0	0.0	24.0	.4
	TOTAL	0.0	76.1	76.1	99.2					0.0		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHS SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							**********					
							* POND 1 *					
							**********					
3												
	JAN	307.4	59.0	366.4	36.1	6569.1	642.4	39.4	252475.4	0.0	24.0	.1
	FEB	277.6	13.2	290.8	42.2	6817.7	666.0	40.8	252224.2	0.0	24.0	.1
	MAR	307.4	44.2	351.6	106.6	7062.7	689.2	42.3	252905.5	0.0	24.0	.1
	APR	297.5	72.9	370.3	172.0	7261.0	706.3	43.5	254698.9	0.0	24.0	.1
	MAY	307.4	149.2	456.6	241.5	7476.0	724.8	44.8	256144.6	0.0	24.0	.1
	JUN	297.5	0.0	297.5	296.0	7477.5	724.9	44.8	263620.5	0.0	24.0	.1
	JUL	307.4	89.8	397.2	291.7	7583.0	734.0	45.4	268057.4	0.0	24.0	.1
	AUG	307.4	274.1	581.4	242.6	7921.9	761.7	47.5	265429.9	0.0	24.0	.1
	SEP	297.5	96.9	394.4	188.7	8127.5	777.3	48.7	266497.8	0.0	24.0	.1
	OCT	307.4	50.3	357.6	119.8	8365.3	795.4	50.1	266846.6	0.0	24.0	.1
	NOV	297.5	8.7	306.1	57.2	8614.3	813.8	51.6	266660.9	0.0	24.0	.1
	DEC	307.4	86.2	393.5	46.7	8973.1	838.0	53.8	264175.7	0.0	36.0	.2
	TOTAL	3619.0	944.4	4563.4	1841.1					0.0		
							**********					
							* POND 2 *					
							**********					
3												
	JAN	0.0	7.7	7.7	3.1	53.3	41.7	.9	1000.0	0.0	24.0	.4
	FEB	0.0	.8	.8	3.5	50.6	39.6	.9	1000.0	0.0	24.0	.4
	MAR	0.0	5.6	5.6	8.5	47.8	37.3	.8	1000.0	0.0	24.0	.4
	APR	0.0	10.2	10.2	12.5	45.4	35.5	.8	1000.0	0.0	24.0	.4
	MAY	0.0	34.6	34.6	19.5	60.5	44.3	1.0	1000.0	0.0	24.0	.4
	JUN	0.0	0.0	0.0	21.7	38.8	30.3	.7	1000.0	0.0	24.0	.4
	JUL	0.0	12.8	12.8	14.6	37.0	28.9	.6	1000.0	0.0	24.0	.4
	AUG	0.0	104.3	104.3	21.9	119.5	58.0	2.0	1000.0	0.0	24.0	.4
	SEP	0.0	15.1	15.1	19.1	115.4	57.0	2.0	1000.0	0.0	24.0	.4
	OCT	0.0	6.5	6.5	11.6	110.3	55.8	1.9	1000.0	0.0	24.0	.4
	NOV	0.0	.6	.6	5.3	105.6	54.7	1.8	1000.0	0.0	24.0	.4
	DEC	0.0	11.8	11.8	4.3	125.1	59.3	2.1	1000.0	0.0	36.0	.6
	TOTAL	0.0	209.9	209.9	145.5					0.0		
							**********					
							* POND 1 *					
							**********					
4												
	JAN	307.4	16.8	324.2	48.1	9249.2	856.6	55.4	263604.5	0.0	36.0	.2
	FEB	277.6	204.6	482.2	55.3	9676.1	883.5	58.0	258926.4	0.0	36.0	.2
	MAR	307.4	76.6	383.9	138.7	9921.4	898.3	59.4	259236.7	0.0	36.0	.2
	APR	297.5	47.4	344.9	220.3	10046.0	905.9	60.2	262045.4	0.0	36.0	.2
	MAY	307.4	79.3	386.7	303.1	10129.5	910.9	60.7	265889.9	0.0	36.0	.2
	JUN	297.5	72.8	370.2	366.7	10133.0	911.1	60.7	271310.6	0.0	36.0	.2
	JUL	307.4	151.0	458.4	361.7	10229.7	917.0	61.3	274707.1	0.0	36.0	.2
	AUG	307.4	348.0	655.4	297.9	10587.1	936.8	63.4	272117.9	0.0	36.0	.2
	SEP	297.5	39.4	336.9	228.5	10695.5	942.6	64.1	274926.8	0.0	36.0	.2
	OCT	307.4	52.5	359.9	143.0	10912.4	954.4	65.4	275462.1	0.0	36.0	.2
	NOV	297.5	79.0	376.5	67.7	11221.2	971.1	67.2	273862.7	0.0	36.0	.2
	DEC	307.4	138.2	445.6	54.9	11623.9	991.4	69.6	270850.4	0.0	48.0	.3
	TOTAL	3619.0	1305.7	4924.7	2285.9					0.0		
							**********					
							* POND 2 *					
							**********					
4												
	JAN	0.0	1.1	1.1	4.5	121.7	58.5	2.1	1000.0	0.0	36.0	.6
	FEB	0.0	53.0	53.0	5.5	169.3	69.5	2.9	1000.0	0.0	36.0	.6
	MAR	0.0	9.9	9.9	14.6	164.5	68.4	2.8	1000.0	0.0	36.0	.6
	APR	0.0	3.7	3.7	22.1	146.1	64.2	2.5	1000.0	0.0	36.0	.6
	MAY	0.0	10.1	10.1	28.3	127.9	59.9	2.2	1000.0	0.0	36.0	.6
	JUN	0.0	8.7	8.7	31.5	105.1	54.6	1.8	1000.0	0.0	36.0	.6
	JUL	0.0	25.6	25.6	29.3	101.4	53.8	1.7	1000.0	0.0	36.0	.6
	AUG	0.0	134.6	134.6	29.3	206.7	77.4	3.5	1000.0	0.0	36.0	.6
	SEP	0.0	2.8	2.8	25.0	184.5	72.7	3.1	1000.0	0.0	36.0	.6
	OCT	0.0	4.2	4.2	14.7	174.0	70.5	2.9	1000.0	0.0	36.0	.6
	NOV	0.0	9.8	9.8	6.8	177.0	71.1	3.0	1000.0	0.0	36.0	.6
	DEC	0.0	21.6	21.6	5.6	205.0	77.0	3.5	1000.0	0.0	48.0	.8
	TOTAL	0.0	285.1	285.1	217.2					0.0		
							**********					
							* POND 1 *					
							**********					
5												
	JAN	307.4	31.5	338.8	56.2	11906.5	1005.5	71.3	270126.0	0.0	48.0	.3
	FEB	277.6	78.0	355.7	63.7	12198.5	1020.2	73.1	268800.7	0.0	48.0	.3
	MAR	307.4	114.1	421.5	157.5	12462.5	1032.2	74.7	268501.7	0.0	48.0	.3
	APR	297.5	57.6	355.0	249.3	12568.3	1037.0	75.3	270981.7	0.0	48.0	.3
	MAY	307.4	19.4	326.7	341.5	12553.5	1036.3	75.2	275822.5	0.0	48.0	.3
	JUN	297.5	75.1	372.6	410.9	12515.2	1034.6	75.0	280958.3	0.0	48.0	.3
	JUL	307.4	214.0	521.4	405.0	12631.5	1039.8	75.7	283234.1	0.0	48.0	.3
	AUG	307.4	299.6	607.0	332.3	12906.2	1052.2	77.3	282453.8	0.0	48.0	.3
	SEP	297.5	98.8	396.2	253.0	13049.4	1058.6	78.2	284001.8	0.0	48.0	.3
	OCT	307.4	107.8	415.2	158.5	13306.1	1070.1	79.7	283560.2	0.0	48.0	.3
	NOV	297.5	38.4	335.9	74.8	13567.2	1081.1	81.3	282921.1	0.0	48.0	.3
	DEC	307.4	68.2	375.5	60.2	13894.5	1094.8	83.3	281489.3	0.0	60.0	.4
	TOTAL	3619.0	1202.5	4821.5	2562.8					0.0		
							**********					
							* POND 2 *					
							**********					
5												
	JAN	0.0	2.3	2.3	5.9	201.4	76.2	3.4	1000.0	0.0	48.0	.8
	FEB	0.0	9.5	9.5	6.6	204.4	76.9	3.5	1000.0	0.0	48.0	.8
	MAR	0.0	15.4	15.4	16.3	203.5	76.7	3.4	1000.0	0.0	48.0	.8
	APR	0.0	4.4	4.4	24.8	183.1	72.4	3.1	1000.0	0.0	48.0	.8
	MAY	0.0	1.4	1.4	31.5	152.9	65.7	2.6	1000.0	0.0	48.0	.8
	JUN	0.0	8.3	8.3	34.5	126.7	59.7	2.1	1000.0	0.0	48.0	.8
	JUL	0.0	42.7	42.7	32.9	136.5	61.9	2.3	1000.0	0.0	48.0	.8
	AUG	0.0	86.7	86.7	30.3	192.9	74.5	3.3	1000.0	0.0	48.0	.8
	SEP	0.0	11.4	11.4	24.2	180.0	71.7	3.0	1000.0	0.0	48.0	.8
	OCT	0.0	13.1	13.1	14.7	178.4	71.4	3.0	1000.0	0.0	48.0	.8
	NOV	0.0	2.6	2.6	6.8	174.2	70.5	2.9	1000.0	0.0	48.0	.8
	DEC	0.0	7.2	7.2	5.4	187.9	73.4	3.2	1000.0	0.0	60.0	1.0
	TOTAL	0.0	204.9	204.9	234.0					0.0		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHS SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							* POND 1 *					
6												
	JAN	307.4	71.7	379.0	61.1	14212.5	1108.2	85.2	280075.3	0.0	60.0	.4
	FEB	277.6	81.5	359.1	69.1	14502.5	1120.0	86.9	278804.7	0.0	60.0	.4
	MAR	307.4	89.4	396.7	170.1	14729.0	1128.8	88.3	278984.7	0.0	60.0	.4
	APR	297.5	100.2	397.7	268.5	14858.2	1133.8	89.0	280610.0	0.0	60.0	.4
	MAY	307.4	70.4	377.7	368.5	14867.4	1134.1	89.1	284281.2	0.0	60.0	.4
	JUN	297.5	55.7	353.1	444.0	14776.5	1130.6	88.5	289482.3	0.0	60.0	.4
	JUL	307.4	111.0	418.4	436.1	14782.0	1130.8	88.6	291986.9	23.2	83.2	.5
	AUG	307.4	151.8	459.2	355.5	14915.5	1136.0	89.4	291999.9	29.9	113.0	.7
	SEP	297.5	103.5	401.0	269.4	15068.3	1141.9	90.3	292000.0	21.2	134.3	.8
	OCT	307.4	112.8	420.2	168.9	15319.5	1151.6	91.8	291572.2	0.0	134.3	.8
	NOV	297.5	48.1	345.5	79.5	15585.5	1161.6	93.4	290803.6	0.0	134.3	.8
	DEC	307.4	62.0	369.4	63.8	15903.0	1172.7	95.3	289554.8	0.0	146.3	.9
	TOTAL	3619.0	1058.0	4676.9	2754.7					74.3		
							* POND 2 *					
6												
	JAN	0.0	7.5	7.5	5.7	189.7	73.8	3.2	1000.0	0.0	60.0	1.0
	FEB	0.0	8.8	8.8	6.4	192.1	74.3	3.2	1000.0	0.0	60.0	1.0
	MAR	0.0	9.7	9.7	15.6	186.2	73.0	3.1	1000.0	0.0	60.0	1.0
	APR	0.0	11.1	11.1	23.8	173.5	70.4	2.9	1000.0	0.0	60.0	1.0
	MAY	0.0	7.2	7.2	30.9	149.7	65.0	2.5	1000.0	0.0	60.0	1.0
	JUN	0.0	3.4	3.4	33.8	119.3	57.9	2.0	1000.0	0.0	60.0	1.0
	JUL	0.0	11.4	11.4	30.0	100.7	53.6	1.7	1000.0	0.0	60.0	1.0
	AUG	0.0	18.0	18.0	23.2	95.5	52.4	1.6	1000.0	0.0	60.0	1.0
	SEP	0.0	9.6	9.6	17.0	88.1	50.7	1.5	1000.0	0.0	60.0	1.0
	OCT	0.0	10.6	10.6	10.4	88.3	50.7	1.5	1000.0	0.0	60.0	1.0
	NOV	0.0	2.1	2.1	4.8	85.6	50.1	1.4	1000.0	0.0	60.0	1.0
	DEC	0.0	2.7	2.7	3.8	96.4	52.6	1.6	1000.0	0.0	72.0	1.2
	TOTAL	0.0	102.1	102.1	205.6					0.0		
							* POND 1 IS FULL AND OVERFLOWING INTO POND 2 *					
							* POND 1 *					
7												
	JAN	307.4	126.2	433.6	64.6	16272.0	1185.5	97.5	287383.4	0.0	146.3	.9
	FEB	277.6	78.1	355.8	73.1	16554.6	1195.3	99.2	286253.9	0.0	146.3	.9
	MAR	307.4	120.1	427.4	179.4	16690.0	1200.0	100.0	285995.0	0.0	146.3	.9
	APR	297.5	0.0	297.5	281.6	16690.0	1200.0	100.0	289050.8	0.0	146.3	.9
	MAY	307.4	20.3	327.7	384.7	16654.2	1198.8	99.8	291984.7	21.3	167.5	1.0
	JUN	297.5	0.0	297.5	463.8	16582.4	1196.3	99.6	291999.9	94.5	262.0	1.6
	JUL	307.4	29.3	336.7	459.1	16545.4	1195.0	99.1	292000.0	85.5	347.5	2.1
	AUG	307.4	200.1	507.5	375.8	16690.0	1200.0	100.0	292000.0	23.0	370.5	2.2
	SEP	297.5	181.3	478.7	284.3	16690.0	1200.0	100.0	292000.0	5.8	376.2	2.3
	OCT	307.4	95.1	402.4	177.1	16690.0	1200.0	100.0	291996.5	0.0	376.2	2.3
	NOV	297.5	0.0	297.5	82.6	16690.0	1200.0	100.0	292000.0	.7	376.9	2.3
	DEC	307.4	39.2	346.6	65.6	16690.0	1200.0	100.0	291161.5	0.0	388.9	2.3
	TOTAL	3619.0	889.7	4508.7	2891.7					230.7		
							* POND 2 *					
7												
	JAN	0.0	12.1	12.1	4.1	104.3	54.5	1.8	1000.0	0.0	72.0	1.2
	FEB	0.0	6.5	6.5	4.7	106.1	54.9	1.8	1000.0	0.0	72.0	1.2
	MAR	112.7	11.3	124.0	10.9	219.2	80.0	3.7	224911.2	0.0	72.0	1.2
	APR	15.8	0.0	15.8	20.5	214.6	79.0	3.6	261949.4	0.0	72.0	1.2
	MAY	0.0	1.4	1.4	25.6	192.1	74.3	3.2	291843.8	1.8	73.8	1.2
	JUN	0.0	0.0	0.0	27.7	171.2	69.9	2.9	291999.2	6.8	80.6	1.4
	JUL	0.0	1.8	1.8	25.7	153.1	65.8	2.6	292000.0	5.9	86.5	1.5
	AUG	10.1	29.5	39.6	21.2	171.5	70.0	2.9	26726R.4	0.0	86.5	1.5
	SEP	200.2	24.4	224.5	22.2	373.9	108.7	6.3	282835.2	0.0	86.5	1.5
	OCT	225.4	10.8	236.2	19.1	591.0	145.0	10.0	290867.1	0.0	86.5	1.5
	NOV	215.6	0.0	215.6	11.1	797.6	177.5	13.5	291994.1	2.2	88.7	1.5
	DEC	293.0	5.2	298.3	10.9	1098.2	221.4	18.6	292000.0	1.1	101.8	1.7
	TOTAL	1072.7	103.0	1175.7	203.7					17.8		
							* POND 1 *					
8												
	JAN	307.4	174.0	481.3	65.6	16690.0	1200.0	100.0	28833R.8	0.0	388.9	2.3
	FEB	277.6	143.9	421.5	73.6	16690.0	1200.0	100.0	286243.8	0.0	388.9	2.3
	MAR	307.4	18.2	325.6	179.4	16690.0	1200.0	100.0	287495.7	0.0	388.9	2.3
	APR	297.5	78.0	375.4	281.0	16690.0	1200.0	100.0	289402.5	0.0	388.9	2.3
	MAY	307.4	56.0	363.4	384.5	16687.6	1199.9	100.0	291986.5	18.8	407.7	2.4
	JUN	297.5	27.3	324.8	464.4	16635.9	1198.1	99.7	291999.9	87.9	495.6	3.0
	JUL	307.4	89.0	396.4	460.2	16643.1	1198.4	99.7	292000.0	71.1	566.7	3.4
	AUG	307.4	82.9	390.3	376.2	16690.0	1200.0	100.0	292000.0	51.9	618.6	3.7
	SEP	297.5	487.6	785.0	284.3	16690.0	1200.0	100.0	287743.6	0.0	618.6	3.7
	OCT	307.4	120.2	427.6	178.1	16690.0	1200.0	100.0	287436.5	0.0	618.6	3.7
	NOV	297.5	47.6	345.1	83.1	16690.0	1200.0	100.0	286835.0	0.0	618.6	3.7
	DEC	307.4	104.1	411.5	66.0	16690.0	1200.0	100.0	28510R.8	0.0	630.6	3.8
	TOTAL	3619.0	1428.8	5047.7	2896.6					229.7		
							* POND 2 *					
8												
	JAN	415.7	39.7	455.4	13.8	1539.8	274.8	26.0	286440.3	0.0	101.8	1.7
	FEB	347.9	36.8	384.7	17.9	1906.6	306.8	32.2	283841.0	0.0	101.8	1.7
	MAR	146.2	4.4	150.6	46.8	2010.3	314.6	34.0	289499.1	0.0	101.8	1.7
	APR	94.4	22.4	116.8	74.0	2060.9	317.9	34.8	291987.0	7.7	109.6	1.9
	MAY	0.0	14.8	14.8	100.9	1996.0	313.7	33.7	291999.9	21.2	130.7	2.2
	JUN	0.0	7.2	7.2	120.3	1910.7	307.1	32.3	292000.0	27.8	158.5	2.7
	JUL	0.0	25.6	25.6	116.5	1842.1	301.2	31.1	292000.0	22.4	180.9	3.1
	AUG	19.1	23.3	42.4	93.6	1808.2	298.2	30.6	292000.0	17.3	198.2	3.4
	SEP	500.7	246.1	746.8	76.5	2478.5	347.3	41.9	27235R.8	0.0	198.2	3.4
	OCT	249.4	36.4	285.8	53.9	2710.4	364.8	45.8	275494.3	0.0	198.2	3.4
	NOV	261.9	14.1	276.0	26.2	2960.2	382.6	50.0	277614.0	0.0	198.2	3.4
	DEC	357.4	35.2	392.7	22.1	3342.8	410.8	56.5	277471.9	0.0	210.2	3.6
	TOTAL	2392.8	505.9	2898.7	762.5					96.4		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCENT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHS SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
						* PONDS 1 AND 2 ARE FULL AND ALL INFLOW IS TO A SINGLE RESERVOIR *						
						* POND 1 *						
9												
	JAN	307.4	116.3	423.7	66.2	16690.0	1200.0	100.0	283236.6	0.0	630.6	3.8
	FEB	277.6	102.6	380.2	74.1	16690.0	1200.0	100.0	281823.5	0.0	630.6	3.8
	MAR	307.4	182.7	490.1	180.5	16690.0	1200.0	100.0	280718.5	0.0	630.6	3.8
	APR	297.5	798.2	1095.7	283.7	16690.0	1200.0	100.0	272364.4	0.0	630.6	3.8
	MAY	307.4	133.5	440.9	393.8	16690.0	1200.0	100.0	275223.9	0.0	630.6	3.8
	JUN	297.5	163.7	461.1	475.9	16675.3	1189.5	99.9	278871.8	0.0	630.6	3.8
	JUL	307.4	118.6	426.0	469.5	16631.8	1188.0	99.7	283060.7	0.0	630.6	3.8
	AUG	307.4	411.6	718.9	381.9	16690.0	1200.0	100.0	281524.6	0.0	630.6	3.8
	SEP	297.5	109.4	406.9	288.6	16690.0	1200.0	100.0	283148.0	0.0	630.6	3.8
	OCT	307.4	118.6	426.0	179.3	16690.0	1200.0	100.0	282950.1	0.0	630.6	3.8
	NOV	297.5	65.1	362.6	83.6	16690.0	1200.0	100.0	282146.4	0.0	630.6	3.8
	DEC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
	TOTAL	3311.6	2320.5	5632.1	2877.0					0.0		
						* POND 2 *						
9												
	JAN	357.5	41.8	399.3	23.7	3718.4	437.7	62.9	276830.8	0.0	210.2	3.6
	FEB	306.1	38.9	345.0	28.0	4035.4	458.9	68.2	276554.3	0.0	210.2	3.6
	MAR	309.6	76.7	386.3	71.3	4350.4	479.2	73.5	276557.9	0.0	210.2	3.6
	APR	812.0	539.4	1351.4	123.6	5578.2	561.9	94.3	257353.2	0.0	210.2	3.6
	MAY	47.1	61.3	108.4	188.0	5498.7	554.8	93.0	262830.1	0.0	210.2	3.6
	JUN	0.0	81.6	81.6	221.9	5358.4	542.3	90.6	268992.9	0.0	210.2	3.6
	JUL	0.0	57.0	57.0	213.2	5202.2	532.5	87.9	276210.7	0.0	210.2	3.6
	AUG	278.9	240.3	519.2	174.2	5547.2	559.1	93.8	273546.8	0.0	210.2	3.6
	SEP	118.3	51.7	170.0	135.9	5581.3	562.2	94.4	277435.5	0.0	210.2	3.6
	OCT	246.7	57.8	304.5	85.8	5800.0	581.7	98.1	278870.5	0.0	210.2	3.6
	NOV	278.9	30.9	309.8	41.5	5915.0	592.0	100.0	279458.8	0.0	210.2	3.6
	DEC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6
	TOTAL	2755.1	1277.4	4032.5	1306.9					0.0		
						* POND 3 *						
9												
	JAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	FEB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MAR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	APR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MAY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	JUN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	JUL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	AUG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SEP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OCT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	NOV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	DEC	307.4	142.9	450.2	100.9	23131.8	1837.1	26.6	280205.3	.0	864.8	1.0
	TOTAL	307.4	142.9	450.2	100.9					.0		
10												
	JAN	307.4	70.0	377.4	102.7	23406.5	1860.7	27.0	279795.8	0.0	864.8	1.0
	FEB	277.6	55.0	332.6	116.1	23623.0	1879.2	27.2	279766.5	0.0	864.8	1.0
	MAR	307.4	1156.1	1463.5	292.2	24794.3	1974.1	28.6	270359.8	0.0	864.8	1.0
	APR	297.5	47.5	344.9	473.8	24665.4	1966.5	28.4	273942.0	0.0	864.8	1.0
	MAY	307.4	23.0	330.4	642.5	24353.3	1941.8	28.1	279482.1	0.0	864.8	1.0
	JUN	297.5	0.0	297.5	759.7	23891.1	1902.2	27.5	286648.1	0.0	864.8	1.0
	JUL	307.4	0.0	307.4	729.5	23506.7	1869.3	27.1	291972.2	37.7	902.6	1.0
	AUG	307.4	85.7	393.0	582.9	23418.9	1861.7	27.0	291999.9	102.1	1004.6	1.2
	SEP	297.5	160.1	457.6	439.9	23485.8	1867.5	27.1	292000.0	49.2	1053.9	1.2
	OCT	307.4	95.3	402.7	275.3	23637.2	1880.4	27.2	292000.0	24.1	1078.1	1.2
	NOV	297.5	41.4	338.8	129.6	23848.5	1898.6	27.5	292000.0	2.1	1080.1	1.2
	DEC	307.4	181.8	489.2	104.6	24257.1	1933.6	27.9	290283.9	0.0	1104.1	1.3
	TOTAL	3619.0	1915.9	5534.9	4448.7					215.2		
11												
	JAN	307.4	250.6	557.9	106.9	24708.1	1969.0	28.5	287928.4	0.0	1104.1	1.3
	FEB	277.6	0.0	277.6	121.1	24864.6	1978.3	28.6	288447.9	0.0	1104.1	1.3
	MAR	307.4	179.8	487.2	296.4	25055.4	1989.6	28.9	288834.4	0.0	1104.1	1.3
	APR	297.5	51.1	348.5	465.4	24946.0	1983.1	28.7	291983.5	7.5	1111.6	1.3
	MAY	307.4	224.3	531.6	633.7	24924.4	1981.8	28.7	291999.9	80.5	1192.1	1.4
	JUN	297.5	151.8	449.3	765.6	24739.5	1970.9	28.5	292000.0	131.4	1323.4	1.5
	JUL	307.4	196.6	504.0	754.9	24605.7	1963.0	28.3	292000.0	117.1	1440.5	1.7
	AUG	307.4	1420.1	1727.4	626.0	25707.1	2028.1	29.6	282970.9	0.0	1440.5	1.7
	SEP	297.5	20.9	318.4	484.5	25541.0	2018.3	29.4	286902.6	0.0	1440.5	1.7
	OCT	307.4	113.1	420.4	299.7	25661.7	2025.4	29.6	288005.8	0.0	1440.5	1.7
	NOV	297.5	56.5	353.9	140.3	25875.3	2038.1	29.8	288084.1	0.0	1440.5	1.7
	DEC	307.4	88.7	396.0	112.4	26183.0	2056.3	30.2	287537.1	0.0	1464.5	1.7
	TOTAL	3619.0	2753.3	6372.3	4806.9					336.5		
12												
	JAN	307.4	84.7	392.1	113.5	26461.6	2072.7	30.5	287052.0	0.0	1464.5	1.7
	FEB	277.6	140.9	418.5	127.9	26752.2	2089.4	30.8	286245.6	0.0	1464.5	1.7
	MAR	307.4	161.4	468.8	313.7	26907.3	2097.6	31.0	286969.4	0.0	1464.5	1.7
	APR	297.5	354.7	652.2	493.7	27065.8	2105.9	31.2	287580.3	0.0	1464.5	1.7
	MAY	307.4	35.6	343.0	675.2	26759.1	2089.7	30.8	291977.0	25.5	1490.0	1.7
	JUN	297.5	230.2	527.7	808.0	26601.3	2081.0	30.6	291999.9	122.5	1612.5	1.9
	JUL	307.4	63.3	370.6	795.2	26336.6	2065.3	30.3	292000.0	159.8	1772.3	2.0
	AUG	307.4	113.4	420.8	645.6	26222.4	2058.6	30.2	292000.0	110.7	1883.0	2.2
	SEP	297.5	14.4	311.8	485.5	26146.0	2054.0	30.1	292000.0	96.3	1979.3	2.3
	OCT	307.4	88.4	395.8	302.7	26270.6	2061.4	30.3	292000.0	32.5	2011.8	2.3
	NOV	297.5	217.0	514.4	142.3	26642.7	2083.4	30.7	290440.0	0.0	2011.8	2.3
	DEC	307.4	161.7	469.0	114.5	27021.2	2103.6	31.1	289170.6	0.0	2035.8	2.3
	TOTAL	3619.0	1665.7	5284.7	5017.7					547.3		
13												
	JAN	307.4	54.9	362.3	115.7	27267.8	2116.5	31.4	288986.3	0.0	2035.8	2.3
	FEB	277.6	67.7	345.3	130.1	27483.1	2127.9	31.7	288894.8	0.0	2035.8	2.3
	MAR	307.4	73.1	380.4	317.9	27545.6	2131.2	31.7	290492.4	0.0	2035.8	2.3
	APR	297.5	257.8	555.2	498.4	27604.0	2134.3	31.8	291992.2	1.6	2037.4	2.3
	MAY	307.4	38.7	346.0	680.1	27407.5	2123.9	31.6	292000.0	137.5	2174.9	2.5
	JUN	297.5	57.2	354.6	819.4	27110.6	2108.3	31.2	292000.0	167.9	2342.8	2.7
	JUL	307.4	264.3	571.6	808.2	26987.6	2101.8	31.1	292000.0	113.5	2456.4	2.8
	AUG	307.4	587.8	895.1	661.3	27221.5	2114.1	31.4	291912.4	0.0	2456.4	2.8
	SEP	297.5	101.9	399.3	499.4	27197.5	2112.8	31.3	291999.5	76.0	2532.4	2.9
	OCT	307.4	297.3	604.7	312.2	27489.9	2128.2	31.7	291328.2	0.0	2532.4	2.9
	NOV	297.5	59.2	356.7	146.7	27700.0	2139.3	31.9	291411.5	0.0	2532.4	2.9
	DEC	307.4	151.7	459.0	117.4	28065.6	2158.6	32.3	290281.5	0.0	2556.4	2.9
	TOTAL	3619.0	2011.3	5630.3	5106.6					496.6		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHS SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
						POND 3						
14												
	JAN	307.4	65.1	372.5	118.6	28319.5	2171.9	32.6	290019.6	0.0	2556.4	2.9
	FEB	277.6	45.5	323.1	133.2	28509.4	2182.0	32.8	290163.5	0.0	2556.4	2.9
	MAR	307.4	249.4	556.8	326.0	28740.2	2194.1	33.1	290125.9	0.0	2556.4	2.9
	APR	297.5	340.2	637.7	513.8	28864.0	2200.6	33.3	291025.2	0.0	2556.4	2.9
	MAY	307.4	301.6	609.0	704.3	28822.2	2198.4	33.2	291994.9	53.5	2609.9	3.0
	JUN	297.5	7.7	305.2	847.5	28466.9	2179.7	32.8	292000.0	187.0	2796.8	3.2
	JUL	307.4	182.9	490.2	834.5	28262.6	2169.0	32.6	292000.0	140.0	2936.9	3.4
	AUG	307.4	453.0	760.4	681.0	28377.8	2175.0	32.7	292000.0	35.9	2972.7	3.4
	SEP	297.5	117.6	415.0	513.7	28357.0	2173.9	32.7	292000.0	77.9	3050.6	3.5
	OCT	307.4	231.3	538.7	320.9	28576.5	2185.5	32.9	292000.0	1.8	3052.4	3.5
	NOV	297.5	180.5	477.9	150.7	28903.8	2202.6	33.3	290946.5	0.0	3052.4	3.5
	DEC	307.4	35.8	343.1	120.7	29150.2	2214.3	33.6	290981.7	0.0	3076.4	3.5
	TOTAL	3619.0	2210.6	5829.5	5265.0					496.0		
15												
	JAN	307.4	37.3	344.7	121.4	29373.4	2224.9	33.8	291007.9	0.0	3076.4	3.5
	FEB	277.6	90.6	368.3	136.3	29605.4	2235.9	34.1	290747.7	0.0	3076.4	3.5
	MAR	307.4	106.7	414.1	333.1	29689.0	2239.9	34.2	291993.5	2.6	3079.1	3.5
	APR	297.5	112.5	409.9	521.6	29658.4	2238.4	34.2	292000.0	81.1	3160.1	3.6
	MAY	307.4	112.5	419.8	713.8	29492.0	2230.5	34.0	292000.0	127.7	3287.8	3.8
	JUN	297.5	380.3	677.8	863.7	29405.5	2226.4	33.9	292000.0	99.3	3387.1	3.9
	JUL	307.4	391.8	699.2	854.6	29343.7	2223.5	33.8	292000.0	93.6	3480.7	4.0
	AUG	307.4	803.7	1111.0	700.7	29754.0	2243.0	34.3	290244.1	0.0	3480.7	4.0
	SEP	297.5	194.6	492.0	531.6	29732.2	2241.9	34.3	291990.9	17.8	3498.4	4.0
	OCT	307.4	400.4	707.7	331.4	30108.5	2259.8	34.7	290585.1	0.0	3498.4	4.0
	NOV	297.5	114.0	411.4	156.0	30364.0	2272.0	35.0	290249.4	0.0	3498.4	4.0
	DEC	307.4	203.0	510.3	124.9	30773.4	2291.4	35.5	288806.4	0.0	3522.4	4.1
	TOTAL	3619.0	2947.4	6566.4	5389.2					422.0		
16												
	JAN	307.4	107.7	415.1	126.1	31062.4	2305.2	35.8	288260.8	0.0	3522.4	4.1
	FEB	277.6	377.2	654.9	142.1	31575.1	2328.1	36.4	285570.2	0.0	3522.4	4.1
	MAR	307.4	256.7	564.1	349.7	31789.5	2337.4	36.6	285714.4	0.0	3522.4	4.1
	APR	297.5	219.7	517.2	549.6	31757.0	2336.0	36.6	287925.3	0.0	3522.4	4.1
	MAY	307.4	32.8	340.1	748.6	31391.0	2320.0	36.2	291978.8	42.4	3564.8	4.1
	JUN	297.5	295.4	592.8	897.3	31214.9	2312.3	36.0	291999.9	128.5	3693.3	4.3
	JUL	307.4	75.7	383.0	884.5	30892.2	2297.1	35.6	292000.0	178.7	3872.0	4.5
	AUG	307.4	222.3	529.6	719.3	30804.6	2292.9	35.5	292000.0	102.0	3974.0	4.6
	SEP	297.5	212.5	509.9	542.1	30833.9	2294.3	35.5	292000.0	61.5	4035.5	4.6
	OCT	307.4	85.4	392.8	338.0	30930.5	2298.9	35.6	292000.0	41.9	4077.4	4.7
	NOV	297.5	94.9	392.3	158.3	31164.5	2310.0	35.9	291851.4	0.0	4077.4	4.7
	DEC	307.4	183.2	490.5	126.6	31552.4	2327.1	36.3	290594.2	-.0	4101.4	4.7
	TOTAL	3619.0	2163.4	5782.4	5582.3					555.0		
17												
	JAN	307.4	314.4	621.8	128.0	32046.3	2348.7	36.9	288219.8	0.0	4101.4	4.7
	FEB	277.6	96.8	374.4	144.4	32276.3	2358.7	37.2	288013.7	0.0	4101.4	4.7
	MAR	307.4	134.6	441.9	352.7	32365.6	2362.6	37.3	289226.8	0.0	4101.4	4.7
	APR	297.5	135.2	432.7	552.3	32251.6	2357.7	37.2	291945.6	5.7	4107.1	4.7
	MAY	307.4	196.8	504.2	752.3	32119.8	2351.9	37.0	291999.9	116.4	4223.5	4.9
	JUN	297.5	445.9	743.4	910.9	32047.0	2348.7	36.9	292000.0	94.8	4318.3	5.0
	JUL	307.4	240.5	547.9	900.1	31836.8	2339.5	36.7	292000.0	142.0	4460.3	5.1
	AUG	307.4	112.0	419.3	732.0	31656.5	2331.6	36.5	292000.0	132.3	4592.5	5.3
	SEP	297.5	43.5	340.9	550.5	31552.0	2327.1	36.3	292000.0	105.1	4697.6	5.4
	OCT	307.4	228.8	536.2	343.3	31752.8	2335.8	36.6	292000.0	7.9	4705.6	5.4
	NOV	297.5	47.5	345.0	160.7	31945.3	2344.3	36.8	292000.0	8.3	4713.8	5.4
	DEC	307.4	106.3	413.6	128.4	32254.6	2357.8	37.2	291455.7	0.0	4737.8	5.5
	TOTAL	3619.0	2102.3	5721.3	5655.6					612.5		
18												
	JAN	307.4	198.6	506.0	129.3	32631.2	2374.3	37.6	290109.5	0.0	4737.8	5.5
	FEB	277.6	213.3	490.9	145.7	32976.4	2389.4	38.0	288879.3	0.0	4737.8	5.5
	MAR	307.4	152.7	460.1	356.9	33079.6	2393.9	38.1	289964.3	0.0	4737.8	5.5
	APR	297.5	82.5	379.9	558.8	32941.3	2387.8	37.9	291989.4	40.6	4778.5	5.5
	MAY	307.4	64.2	371.6	761.0	32703.1	2377.4	37.7	291999.9	151.1	4929.6	5.7
	JUN	297.5	47.3	344.7	917.4	32324.9	2360.9	37.2	292000.0	194.4	5124.0	5.9
	JUL	307.4	266.7	574.0	904.9	32130.7	2352.4	37.0	292000.0	136.7	5260.8	6.1
	AUG	307.4	50.8	358.2	735.5	31901.5	2342.3	36.8	292000.0	148.2	5409.0	6.2
	SEP	297.5	178.9	476.4	553.7	31896.8	2342.1	36.7	292000.0	72.6	5481.6	6.3
	OCT	307.4	15.0	322.4	344.9	31935.2	2343.8	36.8	292000.0	60.9	5542.5	6.4
	NOV	297.5	32.7	330.2	161.3	32116.1	2351.7	37.0	292000.0	12.0	5554.5	6.4
	DEC	307.4	97.1	404.4	128.8	32415.8	2364.8	37.3	291531.2	0.0	5578.5	6.4
	TOTAL	3619.0	1399.7	5018.7	5698.1					816.7		
19												
	JAN	307.4	125.1	432.5	129.6	32718.7	2378.1	37.7	290823.1	0.0	5578.5	6.4
	FEB	277.6	77.5	355.1	145.6	32928.1	2387.3	37.9	290776.4	0.0	5578.5	6.4
	MAR	307.4	4.2	311.5	355.1	32917.6	2386.8	37.9	291993.6	33.0	5611.5	6.5
	APR	297.5	187.0	484.5	556.1	32917.2	2386.8	37.9	292000.0	71.2	5682.7	6.5
	MAY	307.4	117.1	424.5	761.1	32718.8	2378.1	37.7	292000.0	138.2	5820.9	6.7
	JUN	297.5	34.8	332.2	917.5	32331.0	2361.1	37.2	292000.0	197.5	6018.4	6.9
	JUL	307.4	82.9	390.3	903.5	31999.4	2346.6	36.9	292000.0	181.6	6200.0	7.1
	AUG	307.4	358.5	665.9	735.9	32001.9	2346.7	36.9	292000.0	72.6	6272.6	7.2
	SEP	297.5	42.3	339.8	554.0	31894.0	2342.0	36.7	292000.0	106.3	6378.9	7.3
	OCT	307.4	151.4	458.8	345.3	32034.9	2348.2	36.9	292000.0	27.5	6406.3	7.4
	NOV	297.5	189.1	486.5	161.8	32359.6	2362.4	37.3	290974.8	0.0	6406.3	7.4
	DEC	307.4	198.7	506.1	129.6	32760.1	2379.9	37.7	289556.5	0.0	6430.3	7.4
	TOTAL	3619.0	1568.6	5187.6	5695.1					827.8		
20												
	JAN	307.4	237.7	545.1	131.0	33174.2	2398.0	38.2	287829.9	0.0	6430.3	7.4
	FEB	277.6	182.5	460.1	147.6	33486.7	2411.7	38.6	286869.5	0.0	6430.3	7.4
	MAR	307.4	219.7	527.0	361.4	33652.3	2418.7	38.8	287447.2	0.0	6430.3	7.4
	APR	297.5	272.1	569.5	567.4	33654.4	2418.8	38.8	289427.0	0.0	6430.3	7.4
	MAY	307.4	162.6	469.9	774.4	33411.1	2408.4	38.5	291986.6	61.1	6491.4	7.5
	JUN	297.5	16.9	314.4	929.0	33001.2	2390.5	38.0	291999.9	204.7	6696.2	7.7
	JUL	307.4	165.4	472.8	915.3	32722.9	2378.3	37.7	292000.0	164.2	6860.4	7.9
	AUG	307.4	271.1	578.4	745.1	32652.5	2375.2	37.6	292000.0	96.4	6956.8	8.0
	SEP	297.5	262.3	559.7	561.8	32704.5	2377.5	37.7	292000.0	54.1	7010.9	8.1
	OCT	307.4	0.0	307.4	350.0	32727.7	2378.5	37.7	292000.0	65.9	7076.7	8.2
	NOV	297.5	173.9	471.3	163.9	33035.2	2391.9	38.1	291140.3	0.0	7076.7	8.2
	DEC	307.4	101.4	408.8	131.1	33336.9	2405.1	38.4	290650.7	0.0	7100.7	8.2
	TOTAL	3619.0	2065.4	5684.4	5778.0					646.4		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
						* POND 3 *						
21												
	JAN	307.4	83.9	391.3	131.9	33596.2	2416.5	38.7	290342.2	0.0	7100.7	8.2
	FEB	277.6	115.3	392.9	148.1	33841.0	2426.0	39.0	289970.3	0.0	7100.7	8.2
	MAR	307.4	94.6	402.0	361.5	33881.6	2427.5	39.0	291690.8	0.0	7100.7	8.2
	APR	297.5	212.7	510.2	545.8	33885.0	2427.6	39.0	291998.4	59.1	7159.8	8.2
	MAY	307.4	138.9	446.3	774.3	33693.1	2420.3	38.8	292000.0	136.0	7295.8	8.4
	JUN	297.5	70.7	368.2	934.2	33319.8	2404.4	38.4	292000.0	192.8	7488.6	8.6
	JUL	307.4	327.8	635.2	922.0	33158.9	2397.4	38.2	292000.0	125.9	7614.5	8.8
	AUG	307.4	361.7	669.0	751.7	33152.0	2397.0	38.2	292000.0	75.7	7690.2	8.9
	SEP	297.5	0.0	297.5	565.6	33003.3	2390.5	38.0	292000.0	119.5	7809.8	9.0
	OCT	307.4	402.9	710.3	353.2	33360.4	2406.2	38.4	290713.8	0.0	7809.8	9.0
	NOV	297.5	263.1	560.5	166.2	33754.7	2422.6	38.9	289036.8	0.0	7809.8	9.0
	DEC	307.4	59.1	366.4	133.1	34012.1	2432.5	39.2	288985.1	0.0	7833.8	9.0
	TOTAL	3619.0	2130.8	5749.8	5807.7					709.1		
22												
	JAN	307.4	39.6	347.0	133.7	34225.4	2440.7	39.4	289121.2	0.0	7833.8	9.0
	FEB	277.6	15.6	293.3	149.7	34368.9	2446.2	39.6	289699.1	0.0	7833.8	9.0
	MAR	307.4	160.9	468.3	364.8	34472.4	2450.2	39.7	290846.4	0.0	7833.8	9.0
	APR	297.5	242.4	539.8	571.9	34471.5	2450.2	39.7	291994.0	31.1	7864.9	9.1
	MAY	307.4	151.1	458.4	781.5	34283.2	2442.9	39.5	292000.0	134.8	7999.7	9.2
	JUN	297.5	104.2	401.7	943.5	33928.3	2429.3	39.1	292000.0	186.8	8186.6	9.4
	JUL	307.4	327.5	634.8	931.8	33759.7	2422.8	38.9	292000.0	128.4	8315.0	9.6
	AUG	307.4	124.4	431.8	758.3	33568.9	2415.3	38.7	292000.0	135.7	8450.6	9.7
	SEP	297.5	858.9	1156.4	574.2	34151.1	2437.9	39.3	288465.2	0.0	8450.6	9.7
	OCT	307.4	210.6	517.9	361.4	34307.6	2443.9	39.5	289148.8	0.0	8450.6	9.7
	NOV	297.5	181.4	478.9	169.0	34617.5	2455.8	39.9	288304.6	0.0	8450.6	9.7
	DEC	307.4	54.2	361.6	135.1	34868.0	2465.4	40.2	288323.1	0.0	8474.6	9.8
	TOTAL	3619.0	2470.9	6089.9	5874.8					616.9		
23												
	JAN	307.4	86.1	393.4	135.7	35125.8	2475.3	40.5	288052.4	0.0	8474.6	9.8
	FEB	277.6	231.5	509.1	152.3	35482.7	2489.0	40.9	2866R3.6	0.0	8474.6	9.8
	MAR	307.4	43.4	350.8	372.4	35461.1	2488.2	40.9	288964.4	0.0	8474.6	9.8
	APR	297.5	173.2	470.6	581.9	35349.9	2483.9	40.7	291984.2	.1	8474.8	9.8
	MAY	307.4	174.5	481.9	792.4	35171.1	2477.1	40.5	291999.9	131.7	8606.5	9.9
	JUN	297.5	78.2	375.6	956.4	34786.8	2462.3	40.1	292000.0	196.4	8802.9	10.1
	JUL	307.4	136.8	444.2	943.0	34466.0	2450.0	39.7	292000.0	178.1	8981.0	10.3
	AUG	307.4	152.5	459.9	767.1	34289.7	2443.2	39.5	292000.0	130.9	9111.9	10.5
	SEP	297.5	12.8	310.3	576.8	34142.3	2437.5	39.3	292000.0	119.1	9231.0	10.6
	OCT	307.4	18.5	325.8	359.0	34172.7	2438.7	39.4	292000.0	63.5	9294.6	10.7
	NOV	297.5	136.2	433.7	167.9	34438.4	2448.9	39.7	291525.8	0.0	9294.6	10.7
	DEC	307.4	74.0	381.4	134.1	34709.7	2459.3	40.0	291313.0	0.0	9318.6	10.7
	TOTAL	3619.0	1317.8	4936.8	5939.0					819.9		
24												
	JAN	307.4	194.7	502.1	134.9	35076.9	2473.5	40.4	289948.0	0.0	9318.6	10.7
	FEB	277.6	83.4	361.1	151.6	35286.4	2481.5	40.7	289905.8	0.0	9318.6	10.7
	MAR	307.4	76.6	384.0	369.7	35300.7	2482.1	40.7	291928.7	0.0	9318.6	10.7
	APR	297.5	118.9	416.4	577.8	35230.7	2479.4	40.6	291999.6	91.5	9410.0	10.8
	MAY	307.4	81.1	388.5	790.4	34983.0	2469.8	40.3	292000.0	154.2	9564.3	11.0
	JUN	297.5	44.8	342.2	953.4	34575.7	2454.2	39.8	292000.0	203.9	9768.1	11.3
	JUL	307.4	153.0	460.4	940.0	34269.4	2442.4	39.5	292000.0	173.3	9941.5	11.5
	AUG	307.4	203.2	510.6	765.0	34132.9	2437.2	39.3	292000.0	118.0	10059.4	11.6
	SEP	297.5	15.6	313.1	575.4	33988.7	2431.6	39.2	292000.0	118.1	10177.5	11.7
	OCT	307.4	100.6	407.9	358.3	34081.4	2435.2	39.3	292000.0	43.2	10220.7	11.8
	NOV	297.5	97.7	395.2	167.6	34309.0	2443.9	39.5	291899.8	0.0	10220.7	11.8
	DEC	307.4	122.2	429.6	133.8	34628.8	2456.2	39.9	291179.6	0.0	10244.7	11.8
	TOTAL	3619.0	1291.9	4910.9	5918.0					902.1		
25												
	JAN	307.4	294.5	601.8	134.8	35095.8	2474.2	40.4	288767.8	0.0	10244.7	11.8
	FEB	277.6	82.0	359.6	151.9	35303.4	2482.2	40.7	288751.3	0.0	10244.7	11.8
	MAR	307.4	175.3	482.6	370.7	35415.4	2486.5	40.8	289887.9	0.0	10244.7	11.8
	APR	297.5	198.9	496.4	580.9	35352.8	2484.1	40.7	291989.0	21.9	10266.6	11.8
	MAY	307.4	630.1	937.5	795.2	35515.4	2490.3	40.9	291999.9	20.4	10287.0	11.9
	JUN	297.5	81.4	378.8	961.5	35129.6	2475.5	40.5	292000.0	196.9	10483.9	12.1
	JUL	307.4	834.1	1141.4	952.2	35326.9	2483.1	40.7	292000.0	9.1	10492.9	12.1
	AUG	307.4	636.7	944.1	780.3	35505.8	2489.9	40.9	292000.0	15.1	10508.0	12.1
	SEP	297.5	0.0	297.5	587.8	35340.4	2483.6	40.7	292000.0	125.0	10633.0	12.2
	OCT	307.4	1495.4	1802.8	369.9	36773.3	2537.0	42.4	280433.4	0.0	10633.0	12.2
	NOV	297.5	327.8	625.2	177.8	37220.7	2553.1	42.9	278452.5	0.0	10633.0	12.2
	DEC	307.4	75.6	383.0	142.3	37485.4	2562.6	43.2	278429.0	0.0	10657.0	12.3
	TOTAL	3619.0	4831.7	8450.7	6006.4					388.3		
26												
	JAN	307.4	169.6	477.0	143.0	37819.3	2574.6	43.6	277585.5	0.0	10657.0	12.3
	FEB	277.6	170.4	448.0	160.6	38106.7	2584.9	43.9	276964.2	0.0	10657.0	12.3
	MAR	307.4	161.7	469.0	392.3	38183.5	2587.6	44.0	278367.6	0.0	10657.0	12.3
	APR	297.5	83.1	380.6	613.7	37950.3	2579.3	43.7	282412.2	0.0	10657.0	12.3
	MAY	307.4	51.3	358.7	833.1	37475.9	2562.2	43.2	288776.8	0.0	10657.0	12.3
	JUN	297.5	48.1	345.5	993.6	36955.5	2543.6	42.6	291983.2	127.7	10784.7	12.4
	JUL	307.4	76.0	383.3	973.8	36565.6	2529.6	42.1	291999.9	200.6	10985.3	12.7
	AUG	307.4	292.2	599.6	792.9	36475.1	2526.3	42.0	292000.0	102.9	11088.2	12.8
	SEP	297.5	276.4	573.8	587.7	36510.7	2527.6	42.1	292000.0	59.4	11147.7	12.8
	OCT	307.4	195.3	502.7	372.7	36664.1	2533.1	42.2	292000.0	23.4	11171.1	12.9
	NOV	297.5	160.0	457.4	174.4	36947.1	2543.3	42.6	291371.1	0.0	11171.1	12.9
	DEC	307.4	59.1	366.5	139.2	37198.3	2552.3	42.9	291356.1	0.0	11195.1	12.9
	TOTAL	3619.0	1743.1	5362.0	6187.2					514.1		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							* POND 3 *					
27												
	JAN	307.4	32.7	340.0	139.7	37398.6	2559.5	43.1	291596.9	0.0	11195.1	12.9
	FEB	277.6	182.1	459.7	156.6	37701.7	2570.3	43.4	290664.2	0.0	11195.1	12.9
	MAR	307.4	46.4	353.8	382.4	37700.5	2570.3	43.4	291993.1	27.4	11222.5	12.9
	APR	297.5	156.6	454.1	598.4	37645.3	2568.3	43.4	292000.0	89.1	11311.6	13.0
	MAY	307.4	37.5	344.9	818.5	37343.5	2557.5	43.0	292000.0	171.9	11483.5	13.2
	JUN	297.5	49.4	346.8	987.4	36914.1	2542.1	42.5	292000.0	211.1	11694.6	13.5
	JUL	307.4	222.5	529.9	974.3	36634.3	2532.0	42.2	292000.0	164.7	11859.3	13.7
	AUG	307.4	336.2	643.5	793.9	36576.3	2529.9	42.1	292000.0	92.4	11951.6	13.8
	SEP	297.5	230.1	527.6	598.3	36576.5	2530.0	42.1	292000.0	71.0	12022.6	13.9
	OCT	307.4	395.4	702.8	373.6	36905.7	2541.8	42.5	290958.6	0.0	12022.6	13.9
	NOV	297.5	29.5	327.0	175.1	37057.6	2547.2	42.7	291621.4	0.0	12022.6	13.9
	DEC	307.4	176.4	483.7	139.5	37425.8	2560.4	43.1	290457.6	0.0	12046.6	13.9
	TOTAL	3619.0	1894.8	5513.7	6137.8					827.5		
28												
	JAN	307.4	84.9	392.2	140.4	37677.6	2569.5	43.4	290213.1	0.0	12046.6	13.9
	FEB	277.6	270.8	548.5	157.6	38068.5	2583.5	43.9	289441.8	0.0	12046.6	13.9
	MAR	307.4	226.5	533.8	386.0	38216.3	2588.8	44.0	289199.4	0.0	12046.6	13.9
	APR	297.5	136.0	433.4	605.0	38068.2	2583.5	43.9	291985.4	23.5	12070.1	13.9
	MAY	307.4	83.1	390.4	823.5	37797.0	2573.8	43.5	291999.9	161.9	12232.0	14.1
	JUN	297.5	120.4	417.8	994.1	37416.0	2560.1	43.1	292000.0	195.3	12427.3	14.3
	JUL	307.4	134.7	442.1	980.6	37065.3	2547.5	42.7	292000.0	187.8	12615.1	14.5
	AUG	307.4	107.1	414.5	797.4	36831.9	2539.1	42.4	292000.0	149.6	12764.6	14.7
	SEP	297.5	229.5	527.0	600.5	36830.0	2539.1	42.4	292000.0	71.7	12836.3	14.8
	OCT	307.4	256.4	563.8	374.6	37028.1	2546.2	42.7	292000.0	8.8	12845.1	14.8
	NOV	297.5	106.6	404.1	175.3	37256.9	2554.4	42.9	291888.4	0.0	12845.1	14.8
	DEC	307.4	164.3	471.7	139.9	37612.7	2567.1	43.3	290815.9	0.0	12869.1	14.8
	TOTAL	3619.0	1920.4	5539.3	6174.9					798.5		
29												
	JAN	307.4	101.5	408.9	140.7	37880.9	2576.8	43.6	290399.7	0.0	12869.1	14.8
	FEB	277.6	144.0	421.7	157.9	38144.7	2586.2	43.9	289820.2	0.0	12869.1	14.8
	MAR	307.4	381.3	688.6	386.1	38447.3	2597.1	44.3	289090.5	0.0	12869.1	14.8
	APR	297.5	128.7	426.2	607.0	38291.0	2591.5	44.1	291984.9	24.6	12893.8	14.9
	MAY	307.4	159.6	466.9	826.5	38075.3	2583.7	43.9	291999.9	143.8	13037.6	15.0
	JUN	297.5	61.9	359.4	997.6	37647.6	2568.4	43.4	292000.0	210.5	13248.1	15.3
	JUL	307.4	142.7	450.1	983.8	37300.5	2555.9	43.0	292000.0	186.6	13434.7	15.5
	AUG	307.4	390.9	698.3	801.7	37277.9	2555.1	42.9	292000.0	80.8	13515.5	15.6
	SEP	297.5	677.9	975.3	606.2	37647.0	2568.4	43.4	290438.8	0.0	13515.5	15.6
	OCT	307.4	265.3	572.6	379.7	37839.9	2575.3	43.6	290781.6	0.0	13515.5	15.6
	NOV	297.5	128.8	426.3	177.6	38088.6	2584.2	43.9	290481.3	0.0	13515.5	15.6
	DEC	307.4	164.6	471.9	141.8	38442.8	2596.9	44.3	289449.5	0.0	13539.5	15.6
	TOTAL	3619.0	2747.2	6366.2	6206.5					646.4		
30												
	JAN	307.4	80.1	387.4	142.6	38687.6	2605.7	44.6	289279.0	0.0	13539.5	15.6
	FEB	277.6	309.8	587.4	160.0	39115.0	2619.7	45.1	287135.8	0.0	13539.5	15.6
	MAR	307.4	79.3	386.6	391.6	39109.9	2619.5	45.1	289383.4	0.0	13539.5	15.6
	APR	297.5	73.5	370.9	611.7	38915.9	2613.3	44.8	291986.4	46.8	13586.3	15.7
	MAY	307.4	131.4	438.8	833.4	38673.7	2605.2	44.6	291999.9	152.4	13738.8	15.8
	JUN	297.5	82.2	379.7	1006.0	38255.0	2590.2	44.1	292000.0	207.6	13946.4	16.1
	JUL	307.4	124.2	431.6	992.0	37887.8	2577.0	43.6	292000.0	193.2	14139.6	16.3
	AUG	307.4	76.8	384.1	806.5	37624.7	2567.6	43.3	292000.0	159.2	14298.8	16.5
	SEP	297.5	329.7	627.2	607.6	37693.0	2570.0	43.4	292000.0	48.8	14347.6	16.5
	OCT	307.4	235.0	542.4	379.1	37871.5	2576.4	43.6	292000.0	15.2	14362.8	16.5
	NOV	297.5	178.2	475.7	177.4	38169.8	2587.1	44.0	291159.2	0.0	14362.8	16.5
	DEC	307.4	132.3	439.7	141.8	38491.7	2598.7	44.3	290416.7	0.0	14386.8	16.6
	TOTAL	3619.0	1832.6	5451.5	6249.8					823.3		
31												
	JAN	307.4	148.2	455.5	142.6	38804.7	2609.7	44.7	289540.0	0.0	14386.8	16.6
	FEB	277.6	132.2	409.8	160.0	39054.4	2617.7	45.0	289095.5	0.0	14386.8	16.6
	MAR	307.4	179.6	487.0	390.5	39150.9	2620.8	45.1	290402.7	0.0	14386.8	16.6
	APR	297.5	41.3	338.8	611.0	38960.1	2614.7	44.9	291991.7	81.5	14468.3	16.7
	MAY	307.4	15.3	322.6	833.3	38630.5	2603.7	44.5	292000.0	181.0	14649.2	16.9
	JUN	297.5	102.0	399.5	1005.5	38227.0	2589.2	44.0	292000.0	202.6	14851.9	17.1
	JUL	307.4	699.5	1006.8	995.6	38290.9	2591.5	44.1	292000.0	52.6	14904.5	17.2
	AUG	307.4	773.4	1080.7	814.9	38556.7	2601.0	44.4	291571.8	0.0	14904.5	17.2
	SEP	297.5	379.1	676.6	616.1	38645.9	2604.2	44.5	291997.8	28.7	14933.2	17.2
	OCT	307.4	466.6	773.9	384.7	39035.1	2617.1	45.0	290304.0	0.0	14933.2	17.2
	NOV	297.5	138.4	435.8	180.6	39290.3	2625.3	45.3	289939.0	0.0	14933.2	17.2
	DEC	307.4	74.8	382.2	144.0	39552.5	2633.8	45.6	289826.5	0.0	14957.2	17.2
	TOTAL	3619.0	3150.3	6769.3	6278.9					546.4		
32												
	JAN	307.4	65.9	373.3	144.5	39781.3	2641.1	45.8	289809.9	0.0	14957.2	17.2
	FEB	277.6	75.4	353.0	161.8	39972.5	2647.2	46.0	289948.0	0.0	14957.2	17.2
	MAR	307.4	172.0	479.3	304.4	40057.4	2650.0	46.1	291347.1	0.0	14957.2	17.2
	APR	297.5	196.7	494.2	617.6	40001.7	2648.2	46.1	291996.6	67.7	15024.9	17.3
	MAY	307.4	91.3	398.6	844.3	39721.0	2639.2	45.8	292000.0	165.0	15189.9	17.5
	JUN	297.5	74.1	371.5	1019.3	39286.1	2625.2	45.3	292000.0	212.9	15402.8	17.7
	JUL	307.4	330.5	637.9	1007.1	39063.1	2618.0	45.0	292000.0	146.2	15549.0	17.9
	AUG	307.4	346.6	654.0	821.0	38992.5	2615.8	44.9	292000.0	96.4	15645.4	18.0
	SEP	297.5	231.1	528.5	618.7	38978.1	2615.3	44.9	292000.0	75.8	15721.2	18.1
	OCT	307.4	0.0	307.4	385.2	38974.8	2615.2	44.9	292000.0	74.5	15795.7	18.2
	NOV	297.5	216.3	513.7	180.1	39308.4	2625.9	45.3	290773.9	0.0	15795.7	18.2
	DEC	307.4	233.1	540.5	144.0	39728.9	2639.4	45.8	289006.9	0.0	15819.7	18.2
	TOTAL	3619.0	2033.0	5651.9	6338.1					838.5		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							* POND 3 *					
33												
	JAN	307.4	284.2	591.6	145.2	40175.3	2653.8	46.3	286791.3	0.0	15819.7	18.2
	FEB	277.6	126.6	404.2	163.4	40416.1	2661.5	46.6	286460.8	0.0	15819.7	18.2
	MAR	307.4	295.4	602.8	398.8	40620.2	2668.1	46.8	286719.4	0.0	15819.7	18.2
	APR	297.5	255.8	553.3	626.1	40547.3	2665.7	46.7	289640.8	0.0	15819.7	18.2
	MAY	307.4	209.5	516.9	853.3	40291.5	2657.5	46.4	291987.7	80.5	15900.2	18.3
	JUN	297.5	130.5	428.0	1026.7	39893.5	2644.7	46.0	291999.9	200.8	16101.1	18.5
	JUL	307.4	446.3	753.7	1015.2	39751.7	2640.1	45.8	292000.0	119.7	16220.8	18.7
	AUG	307.4	419.4	726.7	828.3	39730.5	2639.5	45.8	292000.0	80.3	16301.1	18.8
	SEP	297.5	554.2	851.6	625.5	39956.6	2646.7	46.0	291913.3	0.0	16301.1	18.8
	OCT	307.4	221.9	529.3	390.4	40114.6	2651.8	46.2	291999.5	19.2	16320.3	18.8
	NOV	297.5	196.2	493.7	182.6	40425.7	2661.8	46.6	291037.0	0.0	16320.3	18.8
	DEC	307.4	288.1	595.5	146.0	40899.3	2677.0	47.1	288775.2	0.0	16344.3	18.8
	TOTAL	3619.0	3428.3	7047.2	6401.5					500.6		
34												
	JAN	307.4	66.9	374.3	147.1	41126.5	2684.3	47.4	288784.0	0.0	16344.3	18.8
	FEB	277.6	122.0	399.6	164.8	41361.3	2691.9	47.6	288499.9	0.0	16344.3	18.8
	MAR	307.4	12.5	319.9	401.5	41279.7	2689.2	47.6	291555.7	0.0	16344.3	18.8
	APR	297.5	110.0	407.5	626.2	41157.4	2685.3	47.4	291997.7	96.4	16440.8	18.9
	MAY	307.4	108.2	415.6	856.2	40880.6	2676.4	47.1	292000.0	163.7	16604.5	19.1
	JUN	297.5	296.2	593.7	1035.1	40601.3	2667.4	46.8	292000.0	162.1	16766.6	19.3
	JUL	307.4	295.2	602.6	1023.0	40339.6	2659.0	46.5	292000.0	158.8	16925.4	19.5
	AUG	307.4	250.1	557.4	833.3	40187.0	2654.1	46.3	292000.0	123.2	17048.6	19.6
	SEP	297.5	180.5	477.9	627.6	40127.7	2652.2	46.2	292000.0	90.4	17139.0	19.7
	OCT	307.4	134.4	441.8	390.9	40221.4	2655.2	46.3	292000.0	42.9	17181.9	19.8
	NOV	297.5	204.7	502.1	182.8	40540.7	2665.5	46.7	290919.0	0.0	17181.9	19.8
	DEC	307.4	210.1	517.5	146.1	40936.1	2678.2	47.2	289399.1	0.0	17205.9	19.8
	TOTAL	3619.0	1990.9	5609.9	6434.6					837.5		
35												
	JAN	307.4	45.2	352.5	147.0	41141.6	2684.8	47.4	289625.7	0.0	17205.9	19.8
	FEB	277.6	68.8	346.4	164.6	41323.5	2690.6	47.6	289865.5	0.0	17205.9	19.8
	MAR	307.4	58.0	365.4	400.6	41301.5	2689.9	47.6	291988.9	13.2	17219.1	19.8
	APR	297.5	92.7	390.2	625.9	41177.3	2685.9	47.4	291999.9	111.6	17330.7	20.0
	MAY	307.4	379.1	686.4	857.8	41103.4	2683.6	47.4	292000.0	97.5	17428.2	20.1
	JUN	297.5	264.3	561.7	1037.7	40798.1	2673.8	47.0	292000.0	170.6	17598.8	20.3
	JUL	307.4	676.1	983.5	1027.8	40820.1	2674.5	47.0	292000.0	66.3	17665.1	20.4
	AUG	307.4	217.9	525.3	838.0	40639.6	2668.7	46.8	292000.0	132.3	17797.4	20.5
	SEP	297.5	166.9	464.3	630.9	40567.6	2666.4	46.7	292000.0	94.6	17891.9	20.6
	OCT	307.4	40.4	347.7	392.8	40589.0	2667.0	46.8	292000.0	66.4	17958.4	20.7
	NOV	297.5	57.5	354.9	183.5	40771.8	2672.9	47.0	292000.0	11.4	17969.8	20.7
	DEC	307.4	209.2	516.6	146.3	41166.1	2685.6	47.4	290439.8	0.0	17993.8	20.7
	TOTAL	3619.0	2276.0	5895.0	6452.8					763.9		
36												
	JAN	307.4	100.0	407.4	147.3	41426.2	2693.9	47.7	290085.1	0.0	17993.8	20.7
	FEB	277.6	152.2	429.8	165.1	41691.0	2701.6	48.0	289460.0	0.0	17993.8	20.7
	MAR	307.4	31.5	338.8	402.4	41639.0	2700.2	48.0	291986.8	11.6	18005.4	20.7
	APR	297.5	319.5	617.0	629.0	41683.5	2701.4	48.0	291999.9	56.5	18061.9	20.8
	MAY	307.4	140.3	447.7	861.6	41426.8	2694.0	47.7	292000.0	157.2	18219.1	21.0
	JUN	297.5	63.0	360.4	1040.4	40967.6	2679.2	47.2	292000.0	220.8	18439.9	21.2
	JUL	307.4	371.2	678.6	1028.0	40759.5	2672.5	47.0	292000.0	141.3	18581.2	21.4
	AUG	307.4	335.4	642.8	838.0	40667.7	2669.6	46.9	292000.0	103.4	18684.6	21.5
	SEP	297.5	20.2	317.7	630.6	40485.3	2663.7	46.6	292000.0	130.5	18815.1	21.7
	OCT	307.4	77.6	385.0	392.5	40535.0	2665.3	46.7	292000.0	57.2	18872.3	21.7
	NOV	297.5	110.2	407.6	183.4	40759.2	2672.5	47.0	291928.2	0.0	18872.3	21.7
	DEC	307.4	170.0	477.4	146.3	41114.4	2683.9	47.4	290740.8	0.0	18896.3	21.8
	TOTAL	3619.0	1891.2	5510.2	6464.5					878.6		
37												
	JAN	307.4	162.6	470.0	147.2	41437.2	2694.3	47.7	289677.9	0.0	18896.3	21.8
	FEB	277.6	194.4	472.0	165.2	41744.0	2703.2	48.1	288578.5	0.0	18896.3	21.8
	MAR	307.4	99.2	406.6	403.3	41747.3	2703.3	48.1	291000.5	0.0	18896.3	21.8
	APR	297.5	28.4	325.9	629.7	41549.3	2697.6	47.9	291994.8	105.7	19002.1	21.9
	MAY	307.4	180.5	487.9	860.6	41323.6	2690.7	47.6	292000.0	147.0	19149.1	22.1
	JUN	297.5	229.7	527.2	1040.2	40990.4	2679.9	47.2	292000.0	179.8	19328.9	22.3
	JUL	307.4	284.5	591.9	1027.7	40717.1	2671.2	46.9	292000.0	162.6	19491.4	22.5
	AUG	307.4	420.2	727.5	838.0	40689.2	2670.3	46.9	292000.0	82.5	19574.0	22.5
	SEP	297.5	327.6	625.0	631.9	40737.6	2671.8	46.9	292000.0	55.3	19629.2	22.6
	OCT	307.4	402.1	709.5	394.4	41052.6	2681.9	47.3	290954.6	0.0	19629.2	22.6
	NOV	297.5	112.3	409.7	184.9	41277.5	2689.2	47.6	290884.9	0.0	19629.2	22.6
	DEC	307.4	164.6	471.9	147.4	41626.0	2699.8	48.0	289773.4	0.0	19653.2	22.6
	TOTAL	3619.0	2606.1	6225.1	6470.3					732.9		
38												
	JAN	307.4	92.7	400.1	148.1	41878.0	2707.0	48.2	289497.8	0.0	19653.2	22.6
	FEB	277.6	36.3	313.9	165.9	42026.0	2711.2	48.4	290131.3	0.0	19653.2	22.6
	MAR	307.4	451.1	758.5	404.3	42380.1	2721.4	48.8	288743.7	0.0	19653.2	22.6
	APR	297.5	203.2	500.7	636.5	42258.3	2717.9	48.7	291983.1	14.0	19667.2	22.7
	MAY	307.4	7.9	315.3	866.2	41898.2	2707.6	48.3	291999.9	190.9	19858.1	22.9
	JUN	297.5	224.4	521.9	1046.9	41555.9	2697.8	47.9	292000.0	182.7	20040.8	23.1
	JUL	307.4	165.8	473.1	1033.9	41188.4	2686.3	47.5	292000.0	193.3	20234.1	23.3
	AUG	307.4	380.8	688.2	842.5	41127.4	2684.3	47.4	292000.0	93.3	20327.4	23.4
	SEP	297.5	1474.7	1772.2	639.5	42260.1	2717.9	48.7	281564.0	0.0	20327.4	23.4
	OCT	307.4	270.5	577.8	406.9	42431.1	2722.8	48.9	282261.0	0.0	20327.4	23.4
	NOV	297.5	66.6	364.0	189.9	42605.2	2727.8	49.1	282831.1	0.0	20327.4	23.4
	DEC	307.4	158.8	466.2	151.2	42944.1	2737.5	49.5	281959.9	0.0	20351.4	23.4
	TOTAL	3619.0	3532.8	7151.8	6531.8					674.2		

PAPADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							* POND 3 *					
39												
	JAN	307.4	57.4	364.7	151.8	43157.0	2743.6	49.7	282188.9	0.0	20351.4	23.4
	FEB	277.6	196.3	473.9	170.0	43461.0	2752.3	50.1	281223.9	0.0	20351.4	23.4
	MAR	307.4	83.4	390.7	414.8	43436.9	2751.6	50.0	283925.0	0.0	20351.4	23.4
	APR	297.5	154.3	451.8	647.7	43240.9	2746.0	49.8	288382.4	0.0	20351.4	23.4
	MAY	307.4	114.0	421.4	880.1	42868.7	2735.4	49.4	291981.2	86.5	20437.9	23.5
	JUN	297.5	4.8	302.2	1056.3	42353.6	2720.6	48.8	291999.9	239.0	20677.0	23.8
	JUL	307.4	65.2	372.6	1042.4	41904.0	2707.7	48.3	292000.0	220.1	20897.1	24.1
	AUG	307.4	525.6	833.0	850.1	41946.5	2709.0	48.3	292000.0	59.6	20956.6	24.1
	SEP	297.5	67.8	365.3	640.3	41792.7	2704.6	48.1	292000.0	121.2	21077.8	24.3
	OCT	307.4	504.3	811.7	399.5	42204.9	2716.4	48.6	289793.7	0.0	21077.8	24.3
	NOV	297.5	285.0	582.4	187.7	42599.7	2727.7	49.1	287782.1	0.0	21077.8	24.3
	DEC	307.4	462.7	770.1	150.4	43243.4	2746.1	49.8	283436.0	0.0	21101.8	24.3
	TOTAL	3619.0	2520.9	6139.8	6591.0					726.4		
40												
	JAN	307.4	49.5	356.8	152.0	43448.3	2752.0	50.1	283742.5	0.0	21101.8	24.3
	FEB	277.6	40.1	317.7	170.0	43596.0	2756.2	50.2	284417.6	0.0	21101.8	24.3
	MAR	307.4	28.9	336.3	413.4	43518.8	2754.0	50.1	287767.4	0.0	21101.8	24.3
	APR	297.5	16.1	313.5	644.3	43229.4	2745.7	49.8	291978.0	41.4	21143.2	24.4
	MAY	307.4	24.1	331.4	875.1	42874.8	2735.5	49.4	291999.9	189.1	21332.3	24.6
	JUN	297.5	321.9	619.3	1058.2	42597.4	2727.6	49.1	292000.0	161.5	21493.8	24.8
	JUL	307.4	261.6	569.0	1046.1	42293.0	2718.9	48.7	292000.0	172.7	21666.6	25.0
	AUG	307.4	71.4	378.8	851.5	41991.9	2710.3	48.4	292000.0	171.6	21838.2	25.2
	SEP	297.5	307.8	605.2	641.4	42018.3	2711.0	48.4	292000.0	62.5	21900.7	25.2
	OCT	307.4	982.6	1290.0	401.4	42906.8	2736.5	49.4	284108.4	0.0	21900.7	25.2
	NOV	297.5	231.7	529.2	190.5	43245.4	2746.2	49.8	282813.7	0.0	21900.7	25.2
	DEC	307.4	276.0	583.3	152.3	43700.5	2759.2	50.3	280618.3	0.0	21924.7	25.3
	TOTAL	3619.0	2611.6	6230.6	6596.3					798.8		
41												
	JAN	307.4	104.3	411.7	153.4	43958.8	2766.6	50.6	280372.9	0.0	21924.7	25.3
	FEB	277.6	35.5	313.1	171.7	44100.2	2770.6	50.8	281151.0	0.0	21924.7	25.3
	MAR	307.4	246.0	553.3	417.9	44235.6	2774.5	51.0	282228.6	0.0	21924.7	25.3
	APR	297.5	190.3	487.7	654.8	44068.5	2769.7	50.8	286514.3	0.0	21924.7	25.3
	MAY	307.4	338.3	645.6	891.1	43823.1	2762.7	50.5	291815.5	0.0	21924.7	25.3
	JUN	297.5	368.8	666.3	1069.2	43568.9	2755.4	50.2	291999.0	148.7	22073.4	25.4
	JUL	307.4	184.2	491.5	1056.3	43198.4	2744.8	49.8	292000.0	194.3	22267.6	25.7
	AUG	307.4	249.2	556.6	860.4	43024.7	2739.8	49.6	292000.0	130.1	22397.7	25.8
	SEP	297.5	138.9	436.4	647.8	42918.9	2736.8	49.4	292000.0	105.6	22503.3	25.9
	OCT	307.4	113.2	420.6	403.4	42987.2	2738.8	49.5	292000.0	51.1	22554.4	26.0
	NOV	297.5	146.7	444.2	188.5	43242.9	2746.1	49.8	291545.4	0.0	22554.4	26.0
	DEC	307.4	155.0	462.4	150.3	43578.9	2755.7	50.2	290521.1	0.0	22578.4	26.0
	TOTAL	3619.0	2270.4	5889.4	6664.7					629.8		
42												
	JAN	307.4	584.2	891.6	151.4	44319.1	2776.7	51.1	284649.2	0.0	22578.4	26.0
	FEB	277.6	71.0	348.6	171.3	44496.4	2781.1	51.3	285006.6	0.0	22578.4	26.0
	MAR	307.4	152.4	459.8	417.0	44539.1	2782.2	51.3	287099.5	0.0	22578.4	26.0
	APR	297.5	221.5	519.0	652.2	44405.9	2778.8	51.2	291084.7	0.0	22578.4	26.0
	MAY	307.4	0.0	307.4	886.9	44004.6	2767.9	50.7	291995.2	178.2	22756.6	26.2
	JUN	297.5	32.4	329.8	1069.1	43500.7	2753.5	50.1	292000.0	235.4	22992.0	26.5
	JUL	307.4	311.4	618.8	1056.3	43226.2	2745.6	49.8	292000.0	163.0	23154.9	26.7
	AUG	307.4	92.9	400.3	859.9	42935.0	2737.3	49.5	292000.0	168.4	23323.4	26.9
	SEP	297.5	138.9	436.3	647.2	42829.6	2734.2	49.3	292000.0	105.4	23428.8	27.0
	OCT	307.4	303.1	610.5	403.4	43041.1	2740.3	49.6	292000.0	4.4	23433.2	27.0
	NOV	297.5	130.8	428.2	188.6	43280.7	2747.2	49.9	291727.2	0.0	23433.2	27.0
	DEC	307.4	147.1	454.4	150.3	43608.8	2756.6	50.2	290755.1	0.0	23457.2	27.0
	TOTAL	3619.0	2185.7	5804.7	6653.6					854.8		
43												
	JAN	307.4	220.6	528.0	151.1	43985.7	2767.3	50.7	288934.4	0.0	23457.2	27.0
	FEB	277.6	189.4	467.0	169.9	44282.8	2775.7	51.0	287853.1	0.0	23457.2	27.0
	MAR	307.4	440.3	747.6	415.1	44615.4	2784.1	51.4	286648.7	0.0	23457.2	27.0
	APR	297.5	194.1	491.6	653.0	44454.0	2780.0	51.2	291117.1	0.0	23457.2	27.0
	MAY	307.4	182.4	489.8	888.0	44190.8	2773.2	50.9	291995.4	135.0	23592.2	27.2
	JUN	297.5	42.1	339.6	1071.2	43692.7	2759.0	50.3	292000.0	233.5	23825.7	27.4
	JUL	307.4	240.5	547.9	1058.0	43363.4	2749.5	50.0	292000.0	180.8	24006.6	27.7
	AUG	307.4	107.5	414.9	861.2	43082.2	2741.5	49.6	292000.0	165.1	24171.7	27.8
	SEP	297.5	219.8	517.3	648.4	43036.9	2740.2	49.6	292000.0	85.8	24257.5	27.9
	OCT	307.4	84.6	392.0	403.8	43083.4	2741.5	49.6	292000.0	58.3	24315.8	28.0
	NOV	297.5	153.2	450.7	188.7	43345.3	2749.0	49.9	291422.7	0.0	24315.8	28.0
	DEC	307.4	124.8	432.1	150.5	43651.0	2757.8	50.3	290702.0	0.0	24339.8	28.0
	TOTAL	3619.0	2199.5	5818.4	6658.9					858.6		
44												
	JAN	307.4	330.3	637.6	151.3	44137.3	2771.7	50.8	287440.6	0.0	24339.8	28.0
	FEB	277.6	250.8	528.4	170.5	44495.2	2781.1	51.3	285602.8	0.0	24339.8	28.0
	MAR	307.4	257.0	564.4	416.8	44642.7	2784.8	51.4	286606.3	0.0	24339.8	28.0
	APR	297.5	259.6	557.0	653.4	44546.4	2782.4	51.3	290464.5	0.0	24339.8	28.0
	MAY	307.4	277.1	584.4	889.9	44340.7	2777.2	51.1	291992.0	99.9	24439.7	28.2
	JUN	297.5	22.7	320.2	1072.7	43826.8	2762.8	50.5	292000.0	238.7	24678.4	28.4
	JUL	307.4	424.1	731.4	1060.5	43634.1	2757.3	50.3	292000.0	136.3	24814.7	28.6
	AUG	307.4	154.4	461.8	863.9	43386.3	2750.2	50.0	292000.0	154.3	24968.9	28.8
	SEP	297.5	427.0	724.5	651.2	43495.2	2753.3	50.1	292000.0	35.6	25004.5	28.8
	OCT	307.4	331.6	638.9	406.3	43727.8	2760.0	50.4	291899.6	0.0	25004.5	28.8
	NOV	297.5	284.3	581.8	190.1	44119.5	2771.2	50.8	289636.0	0.0	25004.5	28.8
	DEC	307.4	230.0	537.4	152.2	44528.7	2781.9	51.3	287632.2	0.0	25028.5	28.8
	TOTAL	3619.0	3248.9	6867.8	6678.7					664.6		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA (POND 3)	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHS SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
45												
	JAN	307.4	66.4	373.8	153.1	44749.4	2787.5	51.6	287737.3	0.0	25028.5	28.8
	FEB	277.6	414.5	692.1	171.5	45270.0	2800.5	52.2	283922.3	0.0	25028.5	28.8
	MAR	307.4	0.0	307.4	420.2	45157.1	2797.7	52.0	288081.7	0.0	25028.5	28.8
	APR	297.5	312.3	609.8	655.2	45111.7	2796.6	52.0	291342.9	0.0	25028.5	28.8
	MAY	307.4	137.2	444.6	892.8	44816.1	2789.1	51.6	291996.6	152.6	25181.0	29.0
	JUN	297.5	60.3	357.8	1077.8	44336.7	2776.9	51.1	292000.0	230.7	25411.7	29.3
	JUL	307.4	223.0	530.4	1064.8	43979.1	2767.2	50.7	292000.0	186.8	25598.5	29.5
	AUG	307.4	183.1	490.5	867.1	43750.5	2760.6	50.4	292000.0	148.0	25746.5	29.7
	SEP	297.5	246.8	544.3	653.0	43722.1	2759.8	50.4	292000.0	80.3	25826.8	29.8
	OCT	307.4	83.6	391.0	406.7	43765.6	2761.0	50.4	292000.0	59.2	25886.1	29.8
	NOV	297.5	319.9	617.4	190.2	44192.7	2773.3	50.9	289150.5	0.0	25886.1	29.8
	DEC	307.4	308.3	615.7	152.4	44680.0	2785.7	51.5	286049.2	0.0	25910.1	29.8
	TOTAL	3619.0	2355.5	5974.5	6704.8					857.6		
46												
	JAN	307.4	257.2	564.5	153.7	45090.8	2796.0	51.9	283750.4	0.0	25910.1	29.8
	FEB	277.6	58.6	336.2	172.7	45254.3	2800.1	52.1	284337.0	0.0	25910.1	29.8
	MAR	307.4	179.9	487.2	420.3	45321.3	2801.8	52.2	286405.2	0.0	25910.1	29.8
	APR	297.5	282.2	579.7	657.6	45243.4	2799.9	52.1	290204.5	0.0	25910.1	29.8
	MAY	307.4	520.9	828.3	896.8	45212.8	2799.1	52.1	291990.7	38.0	25948.0	29.9
	JUN	297.5	0.0	297.5	1081.3	44675.3	2785.6	51.5	292000.0	246.4	26194.4	30.2
	JUL	307.4	323.8	631.2	1068.9	44400.6	2778.7	51.2	292000.0	163.0	26357.4	30.4
	AUG	307.4	802.4	1109.8	873.5	44636.9	2784.6	51.4	291847.9	0.0	26357.4	30.4
	SEP	297.5	338.7	636.2	659.3	44670.3	2785.5	51.5	291999.2	56.5	26413.9	30.4
	OCT	307.4	175.5	482.8	410.7	44780.0	2788.2	51.6	292000.0	37.6	26451.6	30.5
	NOV	297.5	30.8	328.3	191.8	44936.5	2792.2	51.8	292000.0	20.0	26471.6	30.5
	DEC	307.4	285.9	593.3	152.8	45401.0	2803.8	52.3	289160.9	0.0	26495.6	30.5
	TOTAL	3619.0	3256.0	6874.9	6738.5					561.5		
47												
	JAN	307.4	57.1	364.5	153.9	45611.6	2809.1	52.5	289382.5	0.0	26495.6	30.5
	FEB	277.6	599.3	877.0	172.6	46315.9	2826.8	53.4	283147.7	0.0	26495.6	30.5
	MAR	307.4	239.7	547.0	425.1	46437.9	2829.8	53.5	284500.3	0.0	26495.6	30.5
	APR	297.5	150.3	447.8	665.6	46220.1	2824.4	53.2	289941.3	0.0	26495.6	30.5
	MAY	307.4	240.7	548.0	903.8	45967.1	2818.0	53.0	291989.3	102.8	26598.4	30.6
	JUN	297.5	219.2	516.7	1089.7	45588.6	2808.5	52.5	291999.9	194.5	26792.9	30.9
	JUL	307.4	438.2	745.5	1078.3	45393.0	2803.6	52.3	292000.0	137.2	26930.1	31.0
	AUG	307.4	878.2	1185.6	881.5	45697.1	2811.2	52.6	290952.7	0.0	26930.1	31.0
	SEP	297.5	119.4	416.9	665.7	45543.6	2807.4	52.5	291994.6	95.4	27025.5	31.1
	OCT	307.4	157.1	464.5	413.9	45637.1	2809.7	52.6	292000.0	42.9	27068.4	31.2
	NOV	297.5	228.2	525.7	193.5	45969.4	2818.1	53.0	290493.0	0.0	27068.4	31.2
	DEC	307.4	387.2	694.6	154.6	46533.3	2832.2	53.6	286490.4	0.0	27092.4	31.2
	TOTAL	3619.0	3714.7	7333.7	6798.2					572.8		
48												
	JAN	307.4	90.6	398.0	156.1	46775.2	2838.3	53.9	286345.0	0.0	27092.4	31.2
	FEB	277.6	216.7	494.3	174.9	47094.7	2846.3	54.3	284981.2	0.0	27092.4	31.2
	MAR	307.4	311.1	618.5	427.0	47286.2	2850.9	54.5	285465.4	0.0	27092.4	31.2
	APR	297.5	159.7	457.1	669.6	47073.7	2845.8	54.2	290777.2	0.0	27092.4	31.2
	MAY	307.4	53.2	360.6	908.8	46691.5	2836.2	53.8	291993.6	166.1	27258.5	31.4
	JUN	297.5	201.6	499.0	1096.6	46294.5	2826.2	53.3	292000.0	200.6	27459.0	31.6
	JUL	307.4	548.1	855.5	1085.6	46176.3	2823.3	53.2	292000.0	112.0	27571.0	31.8
	AUG	307.4	732.5	1039.9	887.1	46346.9	2827.5	53.4	292000.0	17.8	27588.8	31.8
	SEP	297.5	261.1	558.5	669.0	46317.1	2826.8	53.4	292000.0	80.8	27669.6	31.9
	OCT	307.4	282.3	589.7	417.0	46502.7	2831.5	53.6	292000.0	12.9	27682.4	31.9
	NOV	297.5	102.2	399.6	194.8	46710.8	2836.7	53.8	292000.0	3.2	27685.7	31.9
	DEC	307.4	176.8	484.1	155.2	47063.7	2845.5	54.2	290663.6	0.0	27709.7	31.9
	TOTAL	3619.0	3135.9	6754.9	6841.7					593.3		
49												
	JAN	307.4	184.2	491.6	156.0	47399.3	2853.5	54.6	289287.1	0.0	27709.7	31.9
	FEB	277.6	207.3	484.9	175.0	47709.2	2860.8	55.0	287998.6	0.0	27709.7	31.9
	MAR	307.4	225.3	532.7	427.2	47814.7	2863.3	55.1	289505.9	0.0	27709.7	31.9
	APR	297.5	250.6	548.0	669.0	47727.6	2861.2	55.0	291987.0	33.8	27743.5	32.0
	MAY	307.4	175.3	482.7	912.7	47458.7	2854.9	54.7	291999.9	161.1	27904.6	32.1
	JUN	297.5	140.1	437.5	1103.7	47009.9	2844.2	54.2	292000.0	217.4	28122.1	32.4
	JUL	307.4	274.1	581.4	1091.1	46681.0	2835.9	53.8	292000.0	180.7	28302.8	32.6
	AUG	307.4	371.6	678.9	889.7	46577.4	2833.3	53.7	292000.0	107.2	28410.0	32.7
	SEP	297.5	254.7	552.2	670.4	46541.9	2832.4	53.6	292000.0	82.7	28492.6	32.8
	OCT	307.4	275.8	583.1	417.8	46721.9	2837.0	53.8	292000.0	14.7	28507.3	32.8
	NOV	297.5	118.9	416.4	195.2	46943.1	2842.5	54.1	291955.8	0.0	28507.3	32.8
	DEC	307.4	152.2	459.6	155.5	47271.2	2850.5	54.5	290906.4	0.0	28531.3	32.9
	TOTAL	3619.0	2630.0	6249.0	6863.2					797.7		
50												
	JAN	307.4	302.4	609.8	156.2	47724.8	2861.2	55.0	287962.7	0.0	28531.3	32.9
	FEB	277.6	186.9	464.5	175.8	48013.5	2867.9	55.3	286926.7	0.0	28531.3	32.9
	MAR	307.4	284.5	591.8	429.0	48176.3	2871.8	55.5	287762.2	0.0	28531.3	32.9
	APR	297.5	0.0	297.5	671.9	47865.4	2864.5	55.1	291978.0	63.6	28594.9	32.9
	MAY	307.4	48.6	356.9	913.3	47500.5	2855.9	54.7	291999.9	192.4	28787.4	33.2
	JUN	297.5	0.0	297.5	1103.4	46946.3	2842.6	54.1	292000.0	251.8	29039.2	33.5
	JUL	307.4	69.8	377.2	1089.5	46464.5	2830.5	53.5	292000.0	230.6	29269.7	33.7
	AUG	307.4	461.4	768.8	888.3	46429.8	2829.6	53.5	292000.0	84.8	29354.5	33.8
	SEP	297.5	418.2	715.7	670.0	46517.8	2831.8	53.6	292000.0	42.3	29396.9	33.9
	OCT	307.4	221.3	528.7	417.6	46656.9	2835.3	53.8	292000.0	28.1	29424.9	33.9
	NOV	297.5	0.0	297.5	195.0	46787.7	2838.6	53.9	292000.0	28.4	29453.3	33.9
	DEC	307.4	92.6	399.9	155.2	47056.5	2845.4	54.2	291722.4	0.0	29477.3	34.0
	TOTAL	3619.0	2085.6	5704.6	6865.3					922.0		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 6 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
						POND 3						
51												
	JAN	307.4	402.6	710.0	155.9	47410.6	2858.5	54.8	287203.9	0.0	29477.3	34.0
	FEB	277.6	335.9	613.5	175.9	48048.2	2868.7	55.4	284157.2	0.0	29477.3	34.0
	MAR	307.4	43.4	350.8	430.4	47968.6	2866.9	55.3	288248.8	0.0	29477.3	34.0
	APR	297.5	184.4	481.8	670.8	47811.3	2863.2	55.1	291980.5	31.7	29509.0	34.0
	MAY	307.4	133.8	441.2	913.2	47510.7	2856.1	54.7	291999.9	171.5	29680.4	34.2
	JUN	297.5	65.1	362.5	1103.8	47005.3	2844.1	54.2	292000.0	235.9	29916.3	34.5
	JUL	307.4	209.0	516.4	1090.8	46627.6	2834.6	53.7	292000.0	196.6	30113.0	34.7
	AUG	307.4	194.3	501.7	888.5	46391.2	2828.7	53.4	292000.0	150.5	30263.5	34.9
	SEP	297.5	1030.5	1327.9	671.6	47047.6	2845.1	54.2	285476.0	0.0	30263.5	34.9
	OCT	307.4	279.8	587.1	423.6	47211.2	2849.1	54.4	286448.3	0.0	30263.5	34.9
	NOV	297.5	112.8	410.3	197.6	47423.8	2854.1	54.6	286593.0	0.0	30263.5	34.9
	DEC	307.4	243.9	551.3	157.3	47841.8	2863.9	55.1	284305.0	0.0	30287.5	34.9
	TOTAL	3619.0	3235.6	6854.5	6879.3					786.2		
52												
	JAN	307.4	273.1	580.5	158.4	48263.9	2873.8	55.6	281735.3	0.0	30287.5	34.9
	FEB	277.6	242.0	519.7	178.1	48605.4	2881.8	56.0	280029.2	0.0	30287.5	34.9
	MAR	307.4	427.2	734.6	435.5	48904.4	2888.8	56.3	279221.9	0.0	30287.5	34.9
	APR	297.5	1602.6	1900.1	688.5	50116.0	2917.2	57.7	267298.6	0.0	30287.5	34.9
	MAY	307.4	317.7	625.1	963.7	49777.4	2909.3	57.3	274222.0	0.0	30287.5	34.9
	JUN	297.5	388.9	686.4	1154.0	49309.8	2898.4	56.8	282875.8	0.0	30287.5	34.9
	JUL	307.4	282.9	590.3	1126.3	48790.2	2886.2	56.2	291952.6	16.5	30304.0	34.9
	AUG	307.4	901.3	1208.7	907.4	49091.5	2893.2	56.6	290990.0	0.0	30304.0	34.9
	SEP	297.5	259.6	557.0	685.6	49029.5	2891.8	56.5	291994.8	66.5	30370.4	35.0
	OCT	307.4	281.3	588.7	426.6	49207.1	2896.0	56.7	292000.0	15.5	30385.9	35.0
	NOV	297.5	156.8	454.3	199.3	49462.0	2901.9	57.0	291515.9	0.0	30385.9	35.0
	DEC	307.4	185.9	493.3	158.8	49820.5	2910.4	57.4	290120.5	0.0	30409.9	35.0
	TOTAL	3619.0	5319.5	8938.5	7082.2					98.4		
53												
	JAN	307.4	111.9	419.2	159.6	50080.2	2916.4	57.7	289707.6	0.0	30409.9	35.0
	FEB	277.6	86.7	364.3	178.7	50265.8	2920.6	57.9	289951.4	0.0	30409.9	35.0
	MAR	307.4	1390.4	1697.7	436.9	51526.7	2949.2	59.4	277765.9	0.0	30409.9	35.0
	APR	297.5	72.0	369.4	699.9	51196.2	2941.7	59.0	284178.2	0.0	30409.9	35.0
	MAY	307.4	34.4	341.8	948.2	50634.2	2929.0	58.3	291959.3	44.5	30454.4	35.1
	JUN	297.5	0.0	297.5	1131.7	50058.7	2915.9	57.7	291999.9	258.8	30713.2	35.4
	JUL	307.4	0.0	307.4	1117.5	49503.2	2902.9	57.0	292000.0	254.6	30967.8	35.7
	AUG	307.4	132.2	439.6	909.8	49204.0	2895.9	56.7	292000.0	171.0	31138.8	35.9
	SEP	297.5	244.1	541.6	685.2	49149.3	2894.6	56.6	292000.0	88.9	31227.7	36.0
	OCT	307.4	148.4	455.8	426.7	49226.6	2896.4	56.7	292000.0	48.2	31275.9	36.0
	NOV	297.5	64.1	361.6	199.3	49402.6	2900.5	56.9	292000.0	13.7	31289.6	36.0
	DEC	307.4	272.9	580.3	158.7	49848.1	2911.0	57.4	289358.6	0.0	31313.6	36.1
	TOTAL	3619.0	2557.1	6176.1	7052.1					879.7		
54												
	JAN	307.4	368.3	675.6	159.9	50363.8	2922.9	58.0	285616.7	0.0	31313.6	36.1
	FEB	277.6	0.0	277.6	180.0	50461.4	2925.1	58.1	287031.6	0.0	31313.6	36.1
	MAR	307.4	260.9	568.3	437.4	50592.3	2928.0	58.3	288287.3	0.0	31313.6	36.1
	APR	297.5	75.2	372.6	684.8	50340.0	2922.3	58.0	291980.7	59.7	31373.3	36.1
	MAY	307.4	321.8	629.1	932.7	50166.4	2918.4	57.8	291999.9	130.0	31503.4	36.3
	JUN	297.5	219.4	516.9	1128.6	49758.7	2908.9	57.3	292000.0	204.0	31707.4	36.5
	JUL	307.4	283.6	591.0	1116.1	49418.1	2900.9	56.9	292000.0	184.5	31891.9	36.7
	AUG	307.4	1624.0	1931.3	914.7	50434.8	2924.5	58.1	281318.7	0.0	31891.9	36.7
	SEP	297.5	30.6	328.0	701.8	50060.9	2916.0	57.7	289259.0	0.0	31891.9	36.7
	OCT	307.4	163.4	470.8	431.6	50100.1	2916.9	57.7	291810.1	0.0	31891.9	36.7
	NOV	297.5	81.6	379.0	200.7	50284.7	2921.1	57.9	291999.0	6.3	31898.2	36.7
	DEC	307.4	127.6	435.0	159.7	50584.0	2927.8	58.3	291331.4	0.0	31922.2	36.8
	TOTAL	3619.0	3556.3	7175.3	7048.1					584.7		
55												
	JAN	307.4	121.1	428.5	160.3	50852.2	2933.9	58.6	290774.0	0.0	31922.2	36.8
	FEB	277.6	196.9	474.6	179.5	51147.2	2940.6	58.9	289603.6	0.0	31922.2	36.8
	MAR	307.4	224.2	531.5	438.1	51240.6	2942.7	59.0	291314.1	0.0	31922.2	36.8
	APR	297.5	479.9	777.4	686.3	51349.8	2945.2	59.2	291996.4	18.1	31940.3	36.8
	MAY	307.4	49.8	357.2	939.0	50966.4	2936.5	58.7	292000.0	198.5	32138.8	37.0
	JUN	297.5	315.8	613.2	1136.0	50625.8	2928.8	58.3	292000.0	182.2	32321.0	37.2
	JUL	307.4	89.0	396.3	1122.9	50133.2	2917.6	57.8	292000.0	234.1	32555.0	37.5
	AUG	307.4	160.1	467.5	914.6	49851.5	2911.1	57.4	292000.0	165.3	32720.4	37.7
	SEP	297.5	20.4	317.8	688.1	49625.9	2905.8	57.2	292000.0	144.7	32865.0	37.9
	OCT	307.4	125.4	432.7	428.3	49684.5	2907.2	57.2	292000.0	54.3	32919.3	37.9
	NOV	297.5	300.8	598.3	200.2	50082.6	2916.5	57.7	289383.3	0.0	32919.3	37.9
	DEC	307.4	223.9	531.2	160.1	50477.7	2925.4	58.2	287358.8	0.0	32943.3	38.0
	TOTAL	3619.0	2307.3	5926.2	7053.5					997.1		
56												
	JAN	307.4	76.7	384.0	161.0	50700.8	2930.5	58.4	287446.7	0.0	32943.3	38.0
	FEB	277.6	93.9	371.6	180.1	50892.2	2934.8	58.6	287660.8	0.0	32943.3	38.0
	MAR	307.4	100.9	408.3	438.2	50862.3	2934.1	58.6	291205.0	0.0	32943.3	38.0
	APR	297.5	347.3	644.7	684.1	50872.2	2934.3	58.6	291995.9	49.2	32992.5	38.0
	MAY	307.4	53.1	360.5	935.6	50493.8	2925.8	58.2	292000.0	196.8	33189.3	38.2
	JUN	297.5	78.6	376.1	1130.9	49978.3	2914.1	57.6	292000.0	239.2	33428.5	38.5
	JUL	307.4	356.6	664.0	1118.4	49691.0	2907.3	57.2	292000.0	167.1	33595.7	38.7
	AUG	307.4	749.6	1057.0	913.5	49854.6	2911.2	57.4	292000.0	20.1	33615.7	38.7
	SEP	297.5	140.7	438.2	688.5	49719.4	2908.0	57.3	292000.0	115.1	33730.9	38.9
	OCT	307.4	399.2	706.6	429.1	49996.9	2914.5	57.6	291198.8	0.0	33730.9	38.9
	NOV	297.5	81.4	378.9	200.8	50175.0	2918.6	57.8	291809.1	0.0	33730.9	38.9
	DEC	307.4	204.7	512.1	156.7	50551.4	2927.1	58.2	289925.3	0.0	33754.9	38.9
	TOTAL	3619.0	2682.9	6301.9	7039.8					787.6		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCENT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
						* POND 3 *						
57												
	JAN	307.4	88.6	396.0	160.5	50786.9	2932.4	58.5	289802.2	0.0	33754.9	38.9
	FEB	277.6	61.5	339.1	179.6	50946.5	2936.0	58.7	290457.7	0.0	33754.9	38.9
	MAR	307.4	330.0	637.4	437.1	51146.8	2940.6	58.9	290831.1	0.0	33754.9	38.9
	APR	297.5	444.0	741.4	686.2	51221.9	2942.3	59.0	291993.9	19.9	33774.8	38.9
	MAY	307.4	394.3	701.7	939.4	51098.1	2939.5	58.9	292000.0	113.8	33888.6	39.0
	JUN	297.5	10.3	307.7	1135.8	50527.2	2926.5	58.2	292000.0	257.2	34145.9	39.3
	JUL	307.4	241.8	549.1	1122.8	50150.0	2918.0	57.8	292000.0	196.5	34342.3	39.6
	AUG	307.4	582.2	889.6	916.2	50185.3	2918.8	57.8	292000.0	61.9	34404.2	39.6
	SEP	297.5	158.2	455.6	690.4	50061.9	2916.0	57.7	292000.0	111.3	34515.6	39.8
	OCT	307.4	305.6	612.9	430.2	50255.1	2920.4	57.9	292000.0	10.4	34526.0	39.8
	NOV	297.5	238.6	536.1	201.1	50590.1	2928.0	58.3	290183.5	0.0	34526.0	39.8
	DEC	307.4	47.7	355.1	160.5	50808.7	2932.9	58.5	290672.8	0.0	34550.0	39.8
	TOTAL	3619.0	2902.8	6521.8	7059.6					771.1		
58												
	JAN	307.4	49.6	356.9	160.6	51005.0	2937.4	58.8	291125.3	0.0	34550.0	39.8
	FEB	277.6	119.9	397.5	179.6	51222.9	2942.3	59.0	290919.6	0.0	34550.0	39.8
	MAR	307.4	140.6	448.0	437.4	51268.5	2943.3	59.1	291994.4	35.0	34584.9	39.8
	APR	297.5	147.8	445.2	684.9	51141.3	2940.4	58.9	292000.0	112.5	34697.5	40.0
	MAY	307.4	147.7	455.0	937.9	50832.5	2933.5	58.6	292000.0	174.1	34871.6	40.2
	JUN	297.5	485.3	782.7	1135.6	50620.0	2928.6	58.3	292000.0	140.4	35012.0	40.3
	JUL	307.4	499.4	806.8	1124.7	50435.7	2924.5	58.1	292000.0	133.5	35145.5	40.5
	AUG	307.4	957.3	1264.7	919.6	50780.8	2932.3	58.5	290088.4	0.0	35145.5	40.5
	SEP	297.5	252.1	549.5	695.7	50684.7	2930.3	58.4	291990.1	60.0	35205.6	40.6
	OCT	307.4	507.6	815.0	432.6	51077.0	2939.0	58.8	289531.2	0.0	35205.6	40.6
	NOV	297.5	148.8	446.2	203.0	51320.3	2944.5	59.1	289175.1	0.0	35205.6	40.6
	DEC	307.4	260.4	567.8	161.7	51750.3	2954.2	59.6	286507.6	0.0	35229.6	40.6
	TOTAL	3619.0	3716.4	7335.4	7073.3					655.6		
59												
	JAN	307.4	139.3	446.7	162.8	52034.2	2960.6	59.9	285725.4	0.0	35229.6	40.6
	FEB	277.6	473.3	750.9	182.6	52602.5	2973.5	60.6	280656.5	0.0	35229.6	40.6
	MAR	307.4	324.1	631.4	448.7	52785.2	2977.6	60.8	281383.5	0.0	35229.6	40.6
	APR	297.5	276.7	574.1	703.6	52655.7	2974.7	60.7	286307.3	0.0	35229.6	40.6
	MAY	307.4	41.7	349.1	956.0	52155.6	2963.4	60.1	291970.4	106.9	35336.5	40.7
	JUN	297.5	370.3	667.7	1146.6	51848.1	2956.4	59.7	291999.8	171.4	35507.8	40.9
	JUL	307.4	96.7	404.1	1133.6	51353.3	2945.2	59.2	292000.0	234.8	35742.6	41.2
	AUG	307.4	281.3	588.6	923.7	51156.1	2940.8	58.9	292000.0	137.8	35880.4	41.3
	SEP	297.5	269.5	566.9	695.9	51112.4	2939.8	58.9	292000.0	85.3	35965.7	41.4
	OCT	307.4	109.6	417.0	433.3	51155.5	2940.8	58.9	292000.0	59.4	36025.1	41.5
	NOV	297.5	121.6	419.1	202.4	51372.5	2945.7	59.2	292000.0	.3	36025.3	41.5
	DEC	307.4	231.6	539.0	161.1	51774.3	2954.8	59.6	289580.0	0.0	36049.3	41.5
	TOTAL	3619.0	2735.6	6354.6	7150.4					795.8		
60												
	JAN	307.4	393.0	700.4	162.3	52312.4	2966.9	60.3	284847.4	0.0	36049.3	41.5
	FEB	277.6	122.6	400.2	183.0	52529.6	2971.8	60.5	284730.6	0.0	36049.3	41.5
	MAR	307.4	169.8	477.1	445.7	52561.1	2972.6	60.6	287681.0	0.0	36049.3	41.5
	APR	297.5	170.1	467.5	696.0	52372.1	2968.3	60.3	291977.6	39.5	36088.8	41.6
	MAY	307.4	245.0	552.3	947.1	52179.8	2963.8	60.1	291999.9	152.5	36241.3	41.8
	JUN	297.5	545.2	842.6	1147.2	51953.7	2958.8	59.9	292000.0	128.5	36369.7	41.9
	JUL	307.4	299.2	606.5	1135.4	51610.3	2951.0	59.5	292000.0	185.4	36555.2	42.1
	AUG	307.4	141.2	448.6	925.0	51306.4	2944.2	59.1	292000.0	172.5	36727.7	42.3
	SEP	297.5	54.9	352.4	696.1	51100.8	2939.5	58.9	292000.0	138.1	36865.8	42.5
	OCT	307.4	285.8	593.2	433.6	51276.6	2943.5	59.1	292000.0	16.1	36881.9	42.5
	NOV	297.5	60.0	357.4	202.5	51447.0	2947.4	59.3	292000.0	15.5	36897.4	42.5
	DEC	307.4	133.9	441.3	161.2	51751.1	2954.2	59.6	291076.9	0.0	36921.4	42.5
	TOTAL	3619.0	2620.7	6239.7	7135.0					848.1		
61												
	JAN	307.4	246.8	554.1	161.8	52143.4	2963.1	60.1	288360.9	0.0	36921.4	42.5
	FEB	277.6	263.9	541.5	182.0	52502.9	2971.2	60.5	285937.9	0.0	36921.4	42.5
	MAR	307.4	188.5	495.9	444.9	52554.0	2972.4	60.5	288742.5	0.0	36921.4	42.5
	APR	297.5	102.4	399.8	694.7	52334.9	2967.4	60.3	291983.1	75.9	36997.3	42.6
	MAY	307.4	79.7	387.1	946.2	51968.7	2959.2	59.9	291999.9	192.9	37190.2	42.8
	JUN	297.5	58.8	356.2	1143.7	51428.5	2946.9	59.2	292000.0	247.2	37437.4	43.1
	JUL	307.4	328.2	635.5	1130.9	51110.3	2939.7	58.9	292000.0	177.2	37614.6	43.3
	AUG	307.4	63.5	370.8	921.2	50750.7	2931.6	58.5	292000.0	190.7	37805.4	43.6
	SEP	297.5	221.9	519.4	693.6	50672.9	2929.8	58.4	292000.0	96.4	37901.8	43.7
	OCT	307.4	18.8	326.1	431.7	50648.7	2929.3	58.3	292000.0	81.3	37983.1	43.8
	NOV	297.5	41.0	338.4	201.5	50805.5	2932.8	58.5	292000.0	19.9	38003.0	43.8
	DEC	307.4	121.3	428.6	160.4	51097.8	2939.5	58.9	291177.8	0.0	38027.0	43.8
	TOTAL	3619.0	1734.7	5353.7	7112.6					1081.6		
62												
	JAN	307.4	155.8	463.2	160.9	51400.0	2946.3	59.2	289759.0	0.0	38027.0	43.8
	FEB	277.6	96.1	373.8	180.5	51593.3	2950.7	59.4	289975.9	0.0	38027.0	43.8
	MAR	307.4	5.2	312.5	439.0	51526.2	2949.1	59.4	291989.5	59.4	38086.4	43.9
	APR	297.5	228.9	526.3	686.5	51459.0	2947.6	59.3	291999.9	93.0	38179.4	44.0
	MAY	307.4	144.6	451.9	940.2	51146.2	2940.5	58.9	292000.0	175.5	38354.8	44.2
	JUN	297.5	42.9	340.4	1136.4	50599.5	2928.2	58.3	292000.0	249.4	38604.2	44.5
	JUL	307.4	102.7	410.0	1122.8	50117.5	2917.3	57.7	292000.0	230.7	38834.8	44.7
	AUG	307.4	437.0	744.3	915.5	50043.8	2915.6	57.7	292000.0	97.5	38932.3	44.9
	SEP	297.5	52.7	350.1	689.3	49841.6	2910.8	57.4	292000.0	137.0	39069.3	45.0
	OCT	307.4	186.7	494.1	429.2	49945.9	2913.3	57.5	292000.0	39.4	39108.7	45.1
	NOV	297.5	232.7	530.2	200.6	50275.6	2920.9	57.9	289506.0	0.0	39108.7	45.1
	DEC	307.4	243.9	551.3	160.3	50690.5	2930.2	58.4	286004.3	0.0	39132.7	45.1
	TOTAL	3619.0	1929.2	5548.2	7061.1					1081.7		

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
						* POND 3 *						
63												
	JAN	307.4	290.1	597.5	161.7	51126.3	2940.1	58.9	281815.5	0.0	39132.7	45.1
	FEB	277.6	222.2	499.8	182.2	51443.9	2947.3	59.3	279742.8	0.0	39132.7	45.1
	MAR	307.4	266.3	573.6	445.3	51572.3	2950.2	59.4	281827.8	0.0	39132.7	45.1
	APR	297.5	328.1	625.5	696.9	51501.0	2948.6	59.3	287631.7	0.0	39132.7	45.1
	MAY	307.4	196.5	503.9	946.4	51169.4	2941.1	58.9	291977.3	110.9	39243.6	45.2
	JUN	297.5	20.6	318.1	1136.5	50605.8	2928.3	58.3	291999.9	254.9	39498.5	45.5
	JUL	307.4	200.7	508.1	1123.3	50197.3	2919.1	57.8	292000.0	206.7	39705.2	45.7
	AUG	307.4	328.6	636.0	915.7	50041.8	2915.5	57.6	292000.0	124.2	39829.3	45.9
	SEP	297.5	318.5	615.9	690.0	50039.5	2915.5	57.6	292000.0	71.8	39901.1	46.0
	OCT	307.4	0.0	307.4	429.6	50002.7	2914.6	57.6	292000.0	85.4	39986.6	46.1
	NOV	297.5	211.6	509.0	200.6	50311.1	2921.7	58.0	289815.3	0.0	39986.6	46.1
	DEC	307.4	124.2	431.5	160.7	50606.4	2928.3	58.3	288784.2	0.0	40010.6	46.1
	TOTAL	3619.0	2507.4	6126.4	7088.3					853.9		
64												
	JAN	307.4	102.3	409.7	160.8	50855.3	2934.0	58.6	288311.4	0.0	40010.6	46.1
	FEB	277.6	140.2	417.8	180.1	51093.0	2939.3	58.9	287615.7	0.0	40010.6	46.1
	MAR	307.4	114.8	422.1	438.9	51087.8	2939.2	58.9	291977.2	11.6	40022.2	46.1
	APR	297.5	255.2	552.7	684.2	51042.1	2938.2	58.8	291999.9	85.9	40108.1	46.2
	MAY	307.4	168.1	475.5	937.3	50749.3	2931.6	58.5	292000.0	168.9	40277.0	46.4
	JUN	297.5	85.6	383.1	1133.1	50237.3	2920.0	57.9	292000.0	238.1	40515.1	46.7
	JUL	307.4	392.0	699.3	1120.9	49974.8	2914.0	57.6	292000.0	159.0	40674.1	46.9
	AUG	307.4	432.3	739.6	914.4	49898.3	2912.2	57.5	292000.0	98.4	40772.5	47.0
	SEP	297.5	0.0	297.5	688.3	49657.2	2906.5	57.2	292000.0	149.7	40922.2	47.1
	OCT	307.4	480.4	787.7	429.1	50015.9	2914.9	57.6	288338.2	0.0	40922.2	47.1
	NOV	297.5	316.0	613.5	201.8	50427.6	2924.3	58.1	283390.3	0.0	40922.2	47.1
	DEC	307.4	71.5	378.8	161.8	50668.6	2929.7	58.4	283792.3	0.0	40946.2	47.2
	TOTAL	3619.0	2558.4	6177.4	7050.8					911.7		
65												
	JAN	307.4	47.8	355.2	162.0	50861.7	2934.1	58.6	284762.0	0.0	40946.2	47.2
	FEB	277.6	18.8	296.4	180.9	50977.2	2936.7	58.7	28703A.8	0.0	40946.2	47.2
	MAR	307.4	191.9	499.3	439.0	51037.5	2938.1	58.8	291146.9	0.0	40946.2	47.2
	APR	297.5	287.9	585.4	684.9	51007.5	2937.4	58.8	291995.6	69.6	41015.8	47.3
	MAY	307.4	179.7	487.1	937.0	50723.6	2931.0	58.4	292000.0	166.0	41181.8	47.4
	JUN	297.5	125.0	422.4	1133.1	50241.3	2920.1	57.9	292000.0	228.4	41410.2	47.7
	JUL	307.4	388.1	695.4	1120.9	49975.8	2914.0	57.6	292000.0	160.0	41570.2	47.9
	AUG	307.4	149.6	457.0	913.4	49687.1	2907.2	57.2	292000.0	167.6	41737.8	48.1
	SEP	297.5	967.3	1264.7	689.9	50262.0	2920.5	57.9	281520.5	0.0	41737.8	48.1
	OCT	307.4	250.9	558.2	437.1	50383.0	2923.3	58.0	284690.2	0.0	41737.8	48.1
	NOV	297.5	215.7	513.1	203.3	50692.9	2930.3	58.4	282366.2	0.0	41737.8	48.1
	DEC	307.4	64.8	372.2	162.4	50926.7	2935.6	58.7	283007.3	0.0	41761.8	48.1
	TOTAL	3619.0	2887.5	6506.5	7064.0					791.6		
66												
	JAN	307.4	102.6	410.0	162.6	51174.1	2941.2	59.0	282649.5	0.0	41761.8	48.1
	FEB	277.6	273.1	550.7	182.1	51542.7	2949.5	59.4	278750.2	0.0	41761.8	48.1
	MAR	307.4	51.5	358.9	445.8	51455.8	2947.6	59.3	286718.5	0.0	41761.8	48.1
	APR	297.5	203.7	501.1	691.2	51315.6	2944.4	59.1	291972.6	49.9	41811.7	48.2
	MAY	307.4	205.2	512.6	939.3	51049.2	2938.4	58.8	291999.9	160.3	41972.0	48.4
	JUN	297.5	92.7	390.1	1135.8	50540.5	2926.8	58.2	292000.0	237.0	42208.9	48.6
	JUL	307.4	162.5	469.9	1122.5	50103.7	2917.0	57.7	292000.0	215.9	42424.8	48.9
	AUG	307.4	180.3	487.7	914.4	49837.3	2910.7	57.4	292000.0	160.3	42585.2	49.1
	SEP	297.5	15.3	312.7	688.0	49607.9	2905.4	57.1	292000.0	145.9	42731.1	49.2
	OCT	307.4	22.0	329.4	428.1	49588.8	2904.9	57.1	292000.0	79.6	42810.7	49.3
	NOV	297.5	162.5	459.9	199.9	49848.8	2911.0	57.4	290509.4	0.0	42810.7	49.3
	DEC	307.4	88.1	395.5	159.5	50108.8	2917.1	57.7	290184.7	0.0	42834.7	49.3
	TOTAL	3619.0	1559.5	5178.5	7069.3					1048.9		
67												
	JAN	307.4	229.5	536.9	160.0	50485.7	2925.6	58.2	285316.0	0.0	42834.7	49.3
	FEB	277.6	98.8	376.5	180.3	50681.8	2930.0	58.4	285713.9	0.0	42834.7	49.3
	MAR	307.4	90.5	397.9	438.7	50657.9	2929.5	58.4	291967.3	16.8	42851.5	49.4
	APR	297.5	140.3	437.7	681.7	50527.5	2926.6	58.2	291999.8	113.6	42965.1	49.5
	MAY	307.4	95.7	403.1	933.3	50183.0	2918.8	57.8	292000.0	185.8	43150.9	49.7
	JUN	297.5	52.9	350.3	1128.0	49650.2	2906.4	57.2	292000.0	244.8	43395.7	50.0
	JUL	307.4	179.9	487.2	1114.6	49232.5	2896.5	56.7	292000.0	209.7	43605.4	50.2
	AUG	307.4	239.1	546.5	908.2	49015.0	2891.4	56.5	292000.0	144.3	43749.7	50.4
	SEP	297.5	18.5	316.0	683.5	48791.5	2886.2	56.2	292000.0	144.0	43893.7	50.6
	OCT	307.4	119.5	426.8	425.5	48847.9	2887.5	56.3	292000.0	55.0	43948.7	50.6
	NOV	297.5	116.0	413.5	198.7	49063.5	2892.6	56.5	292000.0	.8	43949.5	50.6
	DEC	307.4	144.9	452.2	158.2	49381.5	2900.0	56.9	288823.4	0.0	43973.5	50.7
	TOTAL	3619.0	1525.6	5144.6	7010.7					1114.8		
68												
	JAN	307.4	344.5	651.9	159.5	49873.9	2911.6	57.5	277715.7	0.0	43973.5	50.7
	FEB	277.6	96.6	374.2	181.4	50066.8	2916.1	57.7	278605.4	0.0	43973.5	50.7
	MAR	307.4	204.7	512.1	441.2	50137.7	2917.7	57.8	285051.6	0.0	43973.5	50.7
	APR	297.5	231.8	529.3	685.9	50031.0	2915.3	57.6	291963.9	49.9	44023.4	50.7
	MAY	307.4	714.2	1021.5	931.9	49153.9	2918.1	57.8	291999.8	33.3	44056.7	50.8
	JUN	297.5	95.4	392.8	1127.9	49653.2	2906.4	57.2	292000.0	234.4	44291.1	51.0
	JUL	307.4	927.4	1234.7	1118.1	49796.6	2909.8	57.4	292000.0	26.7	44317.8	51.1
	AUG	307.4	721.1	1028.5	914.2	49938.1	2913.1	57.5	292000.0	27.2	44345.0	51.1
	SEP	297.5	0.0	297.5	688.6	49696.8	2907.4	57.3	292000.0	149.8	44494.8	51.3
	OCT	307.4	1588.1	1895.5	431.1	51161.2	2940.9	58.9	244595.8	0.0	44494.8	51.3
	NOV	297.5	377.9	675.4	216.2	51620.4	2951.3	59.5	238855.8	0.0	44494.8	51.3
	DEC	307.4	87.6	394.9	173.5	51865.9	2956.8	59.8	240632.6	0.0	44518.8	51.3
	TOTAL	3619.0	5389.3	9008.3	7069.2					521.3		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHS SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							POND 3					
69												
	JAN	307.4	194.8	502.2	173.5	52194.6	2964.3	60.1	239349.5	0.0	44518.8	51.3
	FEB	277.6	195.3	472.9	194.6	52472.9	2970.6	60.5	238764.9	0.0	44518.8	51.3
	MAR	307.4	185.0	492.3	474.2	52491.1	2971.0	60.5	245693.7	0.0	44518.8	51.3
	APR	297.5	95.4	392.9	736.5	52147.5	2963.2	60.1	262622.3	0.0	44518.8	51.3
	MAY	307.4	58.9	366.3	984.0	51529.8	2949.2	59.4	290425.0	0.0	44518.8	51.3
	JUN	297.5	55.2	352.7	1142.1	50977.2	2936.7	58.7	291991.8	236.9	44755.7	51.6
	JUL	307.4	87.5	394.9	1126.0	50481.3	2925.5	58.2	292000.0	235.2	44990.8	51.8
	AUG	307.4	335.0	642.3	917.7	50329.0	2922.1	58.0	292000.0	123.1	45113.9	52.0
	SEP	297.5	317.3	614.8	691.6	50324.6	2922.0	58.0	292000.0	72.5	45186.4	52.1
	OCT	307.4	224.6	531.9	430.9	50456.2	2924.9	58.1	292000.0	30.5	45216.9	52.1
	NOV	297.5	183.9	481.3	201.3	50736.2	2931.3	58.4	289193.7	0.0	45216.9	52.1
	DEC	307.4	68.3	375.6	160.9	50975.0	2936.7	58.7	289750.1	0.0	45240.9	52.1
	TOTAL	3619.0	2001.2	5620.1	7233.2					698.1		
70												
	JAN	307.4	37.6	345.0	161.0	51158.9	2940.8	58.9	291553.6	0.0	45240.9	52.1
	FEB	277.6	208.2	485.8	179.8	51464.9	2947.8	59.3	287459.6	0.0	45240.9	52.1
	MAR	307.4	53.2	360.6	440.2	51432.4	2947.0	59.3	291976.4	47.1	45288.0	52.2
	APR	297.5	178.6	476.0	685.9	51327.8	2944.7	59.1	291999.9	105.2	45393.2	52.3
	MAY	307.4	43.0	350.3	938.9	50939.4	2935.9	58.7	292000.0	200.1	45593.3	52.5
	JUN	297.5	56.6	354.1	1134.7	50404.3	2923.8	58.1	292000.0	245.6	45838.9	52.8
	JUL	307.4	254.1	561.5	1121.7	50037.3	2915.4	57.6	292000.0	193.2	46032.0	53.0
	AUG	307.4	383.2	690.6	914.7	49923.6	2912.8	57.5	292000.0	110.5	46142.5	53.2
	SEP	297.5	263.4	560.8	689.2	49880.4	2911.8	57.5	292000.0	85.2	46227.7	53.3
	OCT	307.4	449.7	757.0	429.8	50207.6	2919.3	57.8	285593.7	0.0	46227.7	53.3
	NOV	297.5	34.0	331.4	202.6	50336.4	2922.2	58.0	291209.6	0.0	46227.7	53.3
	DEC	307.4	201.4	508.8	160.0	50709.2	2930.7	58.4	284337.0	0.0	46251.7	53.3
	TOTAL	3619.0	2163.0	5782.0	7058.4					986.7		
71												
	JAN	307.4	97.3	404.6	162.0	50951.9	2936.2	58.7	283798.2	0.0	46251.7	53.3
	FEB	277.6	307.5	585.2	181.5	51355.5	2945.3	59.2	274556.5	0.0	46251.7	53.3
	MAR	307.4	256.9	564.3	448.2	51471.7	2947.9	59.3	280221.4	0.0	46251.7	53.3
	APR	297.5	154.9	452.3	697.4	51280.0	2943.6	59.1	291938.8	53.5	46305.2	53.3
	MAY	307.4	94.6	401.9	938.7	50930.7	2935.7	58.7	291999.7	187.4	46492.5	53.6
	JUN	297.5	137.2	434.7	1134.9	50456.2	2924.9	58.1	292000.0	225.8	46718.3	53.8
	JUL	307.4	153.8	461.2	1121.8	50013.5	2914.9	57.6	292000.0	217.8	46936.2	54.1
	AUG	307.4	122.5	429.9	913.5	49704.2	2907.6	57.3	292000.0	174.3	47110.5	54.3
	SEP	297.5	261.3	558.7	688.0	49660.3	2906.6	57.2	292000.0	85.4	47195.9	54.4
	OCT	307.4	291.8	599.1	428.8	49844.1	2910.9	57.4	292000.0	13.5	47209.3	54.4
	NOV	297.5	122.0	419.5	200.3	50063.3	2916.1	57.7	291885.7	0.0	47209.3	54.4
	DEC	307.4	186.8	494.2	159.5	50422.0	2924.2	58.1	283307.3	0.0	47233.3	54.4
	TOTAL	3619.0	2186.6	5805.6	7074.5					957.7		
72												
	JAN	307.4	115.8	423.2	161.9	50683.3	2930.1	58.4	281333.9	0.0	47233.3	54.4
	FEB	277.6	163.9	441.5	181.7	50943.1	2936.0	58.7	278246.1	0.0	47233.3	54.4
	MAR	307.4	428.7	736.0	444.8	51234.4	2942.5	59.0	275075.4	0.0	47233.3	54.4
	APR	297.5	145.9	443.3	701.1	51027.3	2937.9	58.8	291912.0	50.6	47284.0	54.5
	MAY	307.4	179.9	487.3	937.1	50743.4	2931.4	58.5	291999.5	166.0	47450.0	54.7
	JUN	297.5	70.2	367.7	1133.0	50219.9	2919.6	57.9	292000.0	241.8	47691.8	54.9
	JUL	307.4	162.1	469.5	1119.7	49784.9	2909.5	57.4	292000.0	215.3	47907.1	55.2
	AUG	307.4	439.9	747.3	913.0	49715.3	2907.9	57.3	292000.0	96.1	48003.2	55.3
	SEP	297.5	748.9	1046.4	689.4	50072.3	2916.3	57.7	275120.3	0.0	48003.2	55.3
	OCT	307.4	299.6	607.0	440.5	50238.9	2920.0	57.9	282992.6	0.0	48003.2	55.3
	NOV	297.5	146.3	443.7	203.5	50479.0	2925.5	58.2	281604.5	0.0	48003.2	55.3
	DEC	307.4	185.6	493.0	162.3	50833.7	2933.5	58.6	273342.5	0.0	48027.2	55.3
	TOTAL	3619.0	3086.9	6705.9	7088.0					769.9		
73												
	JAN	307.4	90.5	397.9	164.6	51067.0	2938.8	58.8	274107.2	0.0	48027.2	55.3
	FEB	277.6	347.2	624.8	184.2	51507.6	2948.7	59.3	258996.1	0.0	48027.2	55.3
	MAR	307.4	89.3	396.7	458.0	51446.2	2947.3	59.3	279743.2	0.0	48027.2	55.3
	APR	297.5	82.6	380.1	697.5	51219.3	2942.2	59.0	291936.3	90.5	48117.7	55.4
	MAY	307.4	147.8	455.2	938.4	50910.3	2935.2	58.7	291999.7	174.2	48291.9	55.6
	JUN	297.5	92.6	390.0	1134.6	50402.4	2923.7	58.1	292000.0	236.7	48528.6	55.9
	JUL	307.4	140.1	447.5	1121.2	49949.7	2913.4	57.5	292000.0	221.1	48749.7	56.2
	AUG	307.4	86.7	394.1	912.9	49613.9	2905.5	57.2	292000.0	183.0	48932.7	56.4
	SEP	297.5	370.2	667.6	687.8	49652.3	2906.4	57.2	292000.0	58.5	48991.2	56.4
	OCT	307.4	264.5	571.9	428.7	49815.6	2910.2	57.4	292000.0	20.2	49011.4	56.5
	NOV	297.5	200.6	498.0	200.3	50113.3	2917.2	57.7	273803.4	0.0	49011.4	56.5
	DEC	307.4	149.4	456.8	163.6	50430.5	2924.4	58.1	265258.3	0.0	49035.4	56.5
	TOTAL	3619.0	2061.6	5680.5	7091.9					984.2		
74												
	JAN	307.4	166.9	474.3	166.0	50738.8	2931.7	58.5	257645.3	0.0	49035.4	56.5
	FEB	277.6	148.6	426.2	187.7	50977.2	2936.7	58.7	257275.2	0.0	49035.4	56.5
	MAR	307.4	200.7	508.1	457.4	51027.9	2937.9	58.8	280476.4	0.0	49035.4	56.5
	APR	297.5	46.3	343.8	694.5	50794.5	2932.6	58.5	291940.1	117.3	49152.7	56.6
	MAY	307.4	17.1	324.5	934.9	50389.6	2923.4	58.1	291999.7	205.5	49358.2	56.9
	JUN	297.5	114.5	411.9	1130.1	49901.6	2912.3	57.5	292000.0	230.2	49588.4	57.1
	JUL	307.4	764.5	1071.9	1119.5	49921.0	2912.7	57.5	292000.0	67.1	49655.5	57.2
	AUG	307.4	841.3	1148.6	915.5	50154.1	2918.1	57.8	288010.4	0.0	49655.5	57.2
	SEP	297.5	422.0	719.4	694.8	50224.2	2919.7	57.9	291979.3	45.6	49701.0	57.3
	OCT	307.4	516.7	824.1	431.1	50617.3	2928.6	58.3	245287.8	0.0	49701.0	57.3
	NOV	297.5	155.1	452.5	214.9	50854.9	2934.0	58.6	250656.2	0.0	49701.0	57.3
	DEC	307.4	83.7	391.1	169.8	51100.2	2939.5	58.9	258146.9	0.0	49725.0	57.3
	TOTAL	3619.0	3477.4	7096.3	7116.3					665.7		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							POND 3					
75												
	JAN	307.4	73.6	381.0	168.4	51312.8	2944.3	59.1	264771.0	0.0	49725.0	57.3
	FEB	277.6	84.1	361.7	186.7	51487.8	2948.3	59.3	271602.4	0.0	49725.0	57.3
	MAR	307.4	190.8	498.2	450.3	51544.1	2949.5	59.4	291894.0	8.4	49733.5	57.3
	APR	297.5	218.0	515.5	686.5	51468.7	2947.8	59.3	291999.4	95.7	49829.1	57.4
	MAY	307.4	101.5	408.9	940.1	51123.5	2940.0	58.9	292000.0	186.0	50015.1	57.6
	JUN	297.5	82.5	379.9	1136.4	50606.7	2928.3	58.3	292000.0	239.6	50254.8	57.9
	JUL	307.4	365.9	673.3	1025.2	50396.7	2923.6	58.1	292000.0	141.9	50396.7	58.1
	AUG	307.4	383.9	691.3	691.3	50452.1	2924.8	58.1	292000.0	55.4	50452.1	58.1
	SEP	297.5	257.0	554.4	554.4	50505.6	2926.1	58.2	292000.0	53.6	50505.6	58.2
	OCT	307.4	0.0	307.4	307.4	50561.0	2927.3	58.2	292000.0	55.4	50561.0	58.2
	NOV	297.5	241.0	538.5	201.6	50897.9	2934.9	58.6	199778.1	0.0	50561.0	58.2
	DEC	307.4	259.6	567.0	181.5	51307.3	2944.2	59.1	190547.0	0.0	50585.0	58.3
	TOTAL	3619.0	2258.0	5877.0	6529.9					836.0		
76												
	JAN	307.4	315.5	622.9	184.3	51746.0	2954.1	59.6	179999.7	0.0	50585.0	58.3
	FEB	277.6	141.1	418.7	209.0	51955.7	2958.9	59.9	196770.2	0.0	50585.0	58.3
	MAR	307.4	326.7	634.1	498.7	52091.0	2961.9	60.0	221846.9	0.0	50585.0	58.3
	APR	297.5	282.7	580.2	758.0	51913.2	2957.9	59.8	289408.5	0.0	50585.0	58.3
	MAY	307.4	231.5	538.8	946.9	51657.5	2952.1	59.5	291986.5	152.3	50737.4	58.5
	JUN	297.5	144.8	442.3	1141.9	51184.0	2941.4	59.0	291999.9	225.5	50962.9	58.7
	JUL	307.4	490.9	798.2	1019.3	51072.6	2938.9	58.8	292000.0	109.7	51072.6	58.8
	AUG	307.4	462.0	769.4	769.4	51128.0	2940.1	58.9	292000.0	55.4	51128.0	58.9
	SEP	297.5	607.3	904.8	697.0	51338.2	2944.9	59.1	292000.0	2.5	51130.5	58.9
	OCT	307.4	246.1	553.5	434.3	51483.4	2948.2	59.3	292000.0	26.1	51156.5	58.9
	NOV	297.5	217.4	514.9	202.9	51795.4	2955.2	59.7	254648.7	0.0	51156.5	58.9
	DEC	307.4	318.4	625.8	170.3	52274.9	2966.1	60.2	215225.5	0.0	51180.5	59.0
	TOTAL	3619.0	3784.5	7403.5	7031.5					571.5		
77												
	JAN	307.4	74.2	381.6	179.8	52476.7	2970.6	60.5	232373.3	0.0	51180.5	59.0
	FEB	277.6	135.1	412.7	196.7	52692.7	2975.5	60.7	238929.0	0.0	51180.5	59.0
	MAR	307.4	13.9	321.2	474.6	52555.2	2972.4	60.5	291724.2	15.9	51196.4	59.0
	APR	297.5	121.6	419.0	691.5	52403.3	2969.0	60.4	291998.6	120.6	51317.0	59.1
	MAY	307.4	119.6	427.0	946.9	52066.7	2961.4	60.0	292000.0	183.2	51500.3	59.3
	JUN	297.5	325.8	623.3	1145.7	51726.3	2953.7	59.6	292000.0	182.1	51682.4	59.5
	JUL	307.4	324.9	632.3	676.3	51748.5	2954.2	59.6	292000.0	66.2	51748.5	59.6
	AUG	307.4	275.8	583.1	583.1	51803.9	2955.4	59.7	292000.0	55.4	51803.9	59.7
	SEP	297.5	200.2	497.6	497.6	51857.5	2956.6	59.7	292000.0	53.6	51857.5	59.7
	OCT	307.4	149.9	457.3	436.2	51928.7	2958.3	59.8	292000.0	50.2	51907.7	59.8
	NOV	297.5	227.4	524.8	203.6	52249.9	2965.5	60.2	213787.4	0.0	51907.7	59.8
	DEC	307.4	233.0	540.4	180.2	52634.1	2974.2	60.6	203590.8	0.0	51931.7	59.8
	TOTAL	3619.0	2201.3	5820.3	6212.3					727.1		
78												
	JAN	307.4	50.2	357.6	182.9	52808.8	2978.2	60.8	237162.7	0.0	51931.7	59.8
	FEB	277.6	76.4	354.0	195.9	52966.8	2981.7	61.0	257094.2	0.0	51931.7	59.8
	MAR	307.4	64.3	371.7	464.3	52917.3	2980.6	61.0	291818.6	43.1	51974.7	59.9
	APR	297.5	102.7	400.1	693.4	52749.7	2976.8	60.8	291999.1	125.7	52100.4	60.0
	MAY	307.4	416.7	724.1	950.5	52634.4	2974.2	60.6	292000.0	111.0	52211.5	60.1
	JUN	297.5	291.4	588.8	1011.8	52369.1	2968.2	60.3	292000.0	157.6	52369.1	60.3
	JUL	307.4	733.4	1040.8	1040.8	52424.5	2969.5	60.4	292000.0	55.4	52424.5	60.4
	AUG	307.4	241.0	548.3	548.3	52479.8	2970.7	60.5	292000.0	55.4	52479.8	60.5
	SEP	297.5	184.7	482.2	482.2	52533.4	2971.9	60.5	292000.0	53.6	52533.4	60.5
	OCT	307.4	45.0	352.4	352.4	52588.8	2973.2	60.6	292000.0	55.4	52588.8	60.6
	NOV	297.5	64.1	361.6	204.6	52760.7	2977.1	60.8	292000.0	15.0	52603.8	60.6
	DEC	307.4	232.2	539.6	162.8	53161.5	2986.0	61.2	218554.9	0.0	52627.8	60.6
	TOTAL	3619.0	2502.3	6121.3	6290.0					672.1		
79												
	JAN	307.4	111.3	418.7	180.3	53399.9	2991.1	61.5	237327.5	0.0	52627.8	60.6
	FEB	277.6	169.1	446.7	196.8	53649.8	2996.5	61.8	239079.6	0.0	52627.8	60.6
	MAR	307.4	34.9	342.3	477.9	53550.9	2994.4	61.7	291725.0	36.7	52664.4	60.7
	APR	297.5	352.1	649.6	697.2	53568.6	2994.8	61.7	291998.6	65.3	52729.7	60.7
	MAY	307.4	155.6	462.9	955.3	53252.7	2988.0	61.3	292000.0	176.5	52906.2	60.9
	JUN	297.5	69.8	367.3	713.8	53045.0	2983.5	61.1	292000.0	138.8	53045.0	61.1
	JUL	307.4	409.0	716.3	716.3	53100.4	2984.7	61.2	292000.0	55.4	53100.4	61.2
	AUG	307.4	371.8	679.1	679.1	53155.7	2985.9	61.2	292000.0	55.4	53155.7	61.2
	SEP	297.5	22.6	320.1	320.1	53209.3	2987.1	61.3	292000.0	53.6	53209.3	61.3
	OCT	307.4	87.0	394.3	394.3	53264.7	2988.2	61.4	292000.0	55.4	53264.7	61.4
	NOV	297.5	123.7	421.2	205.7	53480.8	2992.9	61.6	292000.0	.6	53265.3	61.4
	DEC	307.4	189.8	497.2	163.7	53838.3	3000.6	62.0	241574.0	0.0	53289.3	61.4
	TOTAL	3619.0	2096.7	5715.7	5700.4					637.5		
80												
	JAN	307.4	181.3	488.6	175.8	54151.1	3007.3	62.4	233655.8	0.0	53289.3	61.4
	FEB	277.6	216.3	493.9	198.9	54446.1	3013.6	62.7	228025.4	0.0	53289.3	61.4
	MAR	307.4	110.6	418.0	487.7	54378.2	3012.1	62.6	291667.5	1.7	53291.0	61.4
	APR	297.5	31.7	329.1	700.5	54151.7	3007.3	62.4	291998.3	144.9	53435.9	61.6
	MAY	307.4	200.3	507.6	959.4	53866.4	3001.2	62.1	292000.0	166.5	53602.4	61.8
	JUN	297.5	254.9	552.4	816.4	53720.9	2998.0	61.9	292000.0	118.5	53720.9	61.9
	JUL	307.4	315.7	623.1	623.1	53776.3	2999.2	62.0	292000.0	55.4	53776.3	62.0
	AUG	307.4	466.2	773.6	773.6	53831.7	3000.4	62.0	292000.0	55.4	53831.7	62.0
	SEP	297.5	366.0	663.4	663.4	53885.2	3001.6	62.1	292000.0	53.6	53885.2	62.1
	OCT	307.4	447.9	755.3	443.1	54197.4	3008.3	62.4	219970.6	0.0	53885.2	62.1
	NOV	297.5	126.1	423.6	228.1	54392.9	3012.5	62.7	259788.1	0.0	53885.2	62.1
	DEC	307.4	183.8	491.1	172.2	54735.8	3019.8	63.1	243090.5	0.0	53909.2	62.1
	TOTAL	3619.0	2900.7	6519.7	6242.2					596.0		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							* POND 3 *					
81												
	JAN	307.4	103.8	411.1	176.5	54970.4	3024.9	63.3	251807.1	0.0	53909.2	62.1
	FEB	277.6	40.6	318.2	195.2	55093.4	3027.5	63.5	273423.3	0.0	53909.2	62.1
	MAR	307.4	498.5	805.9	461.7	55437.6	3034.9	63.9	257759.6	0.0	53909.2	62.1
	APR	297.5	225.7	523.2	740.6	55276.4	3031.4	63.7	291822.0	56.2	53965.5	62.2
	MAY	307.4	8.9	316.2	966.3	54841.5	3022.1	63.2	291999.1	215.3	54180.8	62.4
	JUN	297.5	249.2	546.7	1168.9	54425.9	3013.2	62.7	292000.0	206.6	54387.4	62.7
	JUL	307.4	184.3	491.7	530.3	54452.2	3013.7	62.7	292000.0	64.9	54452.2	62.7
	AUG	307.4	422.2	729.5	729.5	54507.6	3014.9	62.8	292000.0	55.4	54507.6	62.8
	SEP	297.5	1548.4	1845.8	717.2	55636.2	3039.1	64.1	65133.5	0.0	54507.6	62.8
	OCT	307.4	301.7	609.0	592.4	55652.8	3039.5	64.1	125338.6	0.0	54507.6	62.8
	NOV	297.5	74.4	371.9	258.3	55766.4	3041.9	64.2	165717.0	0.0	54507.6	62.8
	DEC	307.4	177.2	484.5	196.1	56078.8	3048.6	64.6	179193.6	0.0	54531.6	62.8
	TOTAL	3619.0	3834.8	7453.8	6733.0					598.3		
82												
	JAN	307.4	63.9	371.3	193.3	56256.9	3052.4	64.8	199027.8	0.0	54531.6	62.8
	FEB	277.6	217.6	495.2	211.0	56541.1	3058.3	65.1	201794.0	0.0	54531.6	62.8
	MAR	307.4	92.7	400.0	511.7	56429.5	3055.9	65.0	243838.0	0.0	54531.6	62.8
	APR	297.5	171.4	468.8	759.5	56175.7	3050.7	64.7	291749.7	37.0	54568.5	62.9
	MAY	307.4	126.5	433.9	972.8	55824.7	3043.2	64.3	291998.7	187.9	54756.4	63.1
	JUN	297.5	5.3	302.8	1176.0	55219.9	3030.2	63.6	292000.0	268.3	55024.8	63.4
	JUL	307.4	72.6	380.0	575.0	55128.1	3028.2	63.5	292000.0	103.3	55128.1	63.5
	AUG	307.4	577.8	885.2	885.2	55183.5	3029.4	63.6	292000.0	55.4	55183.5	63.6
	SEP	297.5	76.0	373.5	373.5	55237.1	3030.6	63.6	292000.0	53.6	55237.1	63.6
	OCT	307.4	556.8	864.2	448.0	55653.3	3039.5	64.1	170229.2	0.0	55237.1	63.6
	NOV	297.5	317.7	615.2	245.4	56023.1	3047.4	64.5	176651.0	0.0	55237.1	63.6
	DEC	307.4	511.8	819.2	194.1	56672.2	3061.0	65.3	150881.0	0.0	55261.1	63.7
	TOTAL	3619.0	2790.4	6409.3	6545.5					705.5		
83												
	JAN	307.4	55.2	362.6	200.8	56834.0	3064.3	65.5	177861.1	0.0	55261.1	63.7
	FEB	277.6	44.7	322.3	217.3	56939.1	3066.5	65.6	201635.4	0.0	55261.1	63.7
	MAR	307.4	32.2	339.6	513.1	56765.5	3062.9	65.4	261293.1	0.0	55261.1	63.7
	APR	297.5	17.9	315.3	743.2	56451.5	3056.4	65.0	291840.4	113.9	55375.0	63.8
	MAY	307.4	26.8	334.1	974.4	56024.1	3047.5	64.5	291999.2	212.8	55587.8	64.0
	JUN	297.5	356.2	653.6	1089.9	55748.7	3041.6	64.2	292000.0	160.9	55748.7	64.2
	JUL	307.4	290.0	597.4	597.4	55804.1	3042.7	64.3	292000.0	55.4	55804.1	64.3
	AUG	307.4	79.7	387.1	387.1	55859.4	3043.9	64.4	292000.0	55.4	55859.4	64.4
	SEP	297.5	343.2	640.7	640.7	55913.0	3045.1	64.4	292000.0	53.6	55913.0	64.4
	OCT	307.4	1058.1	1365.5	450.5	56828.0	3064.2	65.5	82065.0	0.0	55913.0	64.4
	NOV	297.5	258.8	556.2	273.7	57110.5	3070.0	65.8	120268.8	0.0	55913.0	64.4
	DEC	307.4	307.2	614.6	208.7	57540.4	3078.9	66.3	134236.8	0.0	55937.0	64.4
	TOTAL	3619.0	2870.0	6488.9	6296.7					651.9		
84												
	JAN	307.4	116.5	423.9	205.9	57758.4	3083.4	66.5	155792.7	0.0	55937.0	64.4
	FEB	277.6	39.5	317.2	224.5	57851.0	3085.4	66.6	179281.8	0.0	55937.0	64.4
	MAR	307.4	272.7	580.1	531.2	57900.0	3086.4	66.7	207045.4	0.0	55937.0	64.4
	APR	297.5	210.9	508.4	804.4	57603.8	3080.2	66.4	272819.8	0.0	55937.0	64.4
	MAY	307.4	373.8	681.2	1009.7	57380.2	3075.6	66.1	291900.3	104.9	56041.9	64.6
	JUN	297.5	407.1	704.6	1190.1	57067.6	3069.2	65.7	291999.5	173.0	56214.9	64.8
	JUL	307.4	204.3	511.6	1177.4	56620.9	3059.9	65.2	292000.0	219.1	56434.0	65.0
	AUG	307.4	276.5	583.9	770.7	56535.3	3058.1	65.1	292000.0	101.3	56535.3	65.1
	SEP	297.5	155.0	452.4	452.4	56588.9	3059.2	65.2	292000.0	53.6	56588.9	65.2
	OCT	307.4	126.5	433.9	433.9	56644.3	3060.4	65.3	292000.0	55.4	56644.3	65.3
	NOV	297.5	164.2	461.6	210.6	56895.3	3065.6	65.5	258581.7	0.0	56644.3	65.3
	DEC	307.4	173.2	480.5	175.6	57224.3	3072.4	65.9	240050.3	0.0	56668.3	65.3
	TOTAL	3619.0	2520.3	6139.2	7186.6					707.3		
85												
	JAN	307.4	641.2	948.5	180.7	57992.2	3088.3	66.8	159893.5	0.0	56668.3	65.3
	FEB	277.6	79.1	356.7	223.8	58125.0	3091.0	67.0	186359.7	0.0	56668.3	65.3
	MAR	307.4	169.4	476.8	527.4	58074.5	3090.0	66.9	235591.0	0.0	56668.3	65.3
	APR	297.5	245.1	542.5	776.5	57875.5	3085.9	66.7	291706.8	35.0	56703.3	65.3
	MAY	307.4	0.0	307.4	983.6	57420.9	3076.5	66.2	291998.5	221.7	56925.0	65.6
	JUN	297.5	35.9	333.4	829.3	57100.5	3069.8	65.8	292000.0	175.6	57100.5	65.8
	JUL	307.4	344.4	651.8	651.8	57155.9	3071.0	65.8	292000.0	55.4	57155.9	65.8
	AUG	307.4	103.8	411.2	411.2	57211.3	3072.1	65.9	292000.0	55.4	57211.3	65.9
	SEP	297.5	155.7	453.2	453.2	57264.8	3073.2	66.0	292000.0	53.6	57264.8	66.0
	OCT	307.4	338.9	646.2	453.8	57465.3	3077.4	66.2	292000.0	8.0	57272.9	66.0
	NOV	297.5	147.1	444.5	211.8	57698.1	3082.2	66.5	283228.9	0.0	57272.9	66.0
	DEC	307.4	165.1	472.5	170.6	58024.0	3088.9	66.8	260099.5	0.0	57296.9	66.0
	TOTAL	3619.0	2425.7	6044.7	5873.6					604.6		
86												
	JAN	307.4	246.3	553.6	176.6	58401.0	3096.7	67.3	235471.1	0.0	57296.9	66.0
	FEB	277.6	211.2	488.8	204.3	58685.6	3102.6	67.6	231966.7	0.0	57296.9	66.0
	MAR	307.4	487.5	794.9	500.1	58980.3	3108.7	67.9	231856.1	0.0	57296.9	66.0
	APR	297.5	216.0	513.4	785.1	58732.1	3103.6	67.7	291647.4	23.4	57320.3	66.0
	MAY	307.4	202.8	510.2	989.9	58425.7	3097.3	67.3	291998.4	173.4	57493.6	66.2
	JUN	297.5	47.0	344.5	1197.1	57836.3	3085.1	66.6	292000.0	263.3	57756.9	66.5
	JUL	307.4	267.5	574.9	654.3	57831.8	3085.0	66.6	292000.0	74.9	57831.8	66.6
	AUG	307.4	120.3	427.7	427.7	57887.2	3086.1	66.7	292000.0	55.4	57887.2	66.7
	SEP	297.5	246.1	543.6	543.6	57940.8	3087.2	66.7	292000.0	53.6	57940.8	66.7
	OCT	307.4	95.4	402.8	402.8	57996.1	3088.4	66.8	292000.0	55.4	57996.1	66.8
	NOV	297.5	172.8	470.3	212.6	58253.8	3093.7	67.1	252767.5	0.0	57996.1	66.8
	DEC	307.4	140.6	447.9	178.5	58547.2	3099.8	67.4	251469.6	0.0	58020.1	66.8
	TOTAL	3619.0	2453.6	6072.6	6272.6					699.2		

PARADOX VALLEY UNIT - STAGE TWO - RADIUM EVAP. POND 5 CFS
RADIUM EVAP. RESERVOIR OPERATION STUDY

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
							POND 3					
87												
	JAN	307.4	369.0	676.3	179.4	59044.2	3110.1	68.0	201338.7	0.0	58020.1	66.8
	FEB	277.6	280.2	557.8	214.4	59387.6	3117.3	68.4	197175.6	0.0	58020.1	66.8
	MAR	307.4	286.8	594.1	525.0	59456.7	3118.8	68.5	231225.0	0.0	58020.1	66.8
	APR	297.5	289.3	586.8	788.4	59274.7	3114.8	68.3	291684.1	19.5	58039.7	66.9
	MAY	307.4	308.5	615.9	993.8	59045.1	3110.1	68.0	291998.4	148.3	58188.0	67.0
	JUN	297.5	25.4	322.9	1179.9	58452.4	3097.8	67.3	292000.0	264.4	58452.4	67.3
	JUL	307.4	470.7	778.1	778.1	58507.7	3099.0	67.4	292000.0	55.4	58507.7	67.4
	AUG	307.4	173.2	480.6	480.6	58563.1	3100.1	67.5	292000.0	55.4	58563.1	67.5
	SEP	297.5	476.1	773.6	735.3	58645.6	3101.8	67.6	292000.0	44.2	58607.3	67.5
	OCT	307.4	371.7	679.1	457.6	58867.9	3106.4	67.8	292000.0	.9	58608.2	67.5
	NOV	297.5	318.4	615.9	213.9	59269.9	3114.7	68.3	220139.6	0.0	58608.2	67.5
	DEC	307.4	257.6	564.9	187.7	59671.2	3123.5	68.7	207880.7	0.0	58632.2	67.5
	TOTAL	3619.0	3627.1	7246.0	6734.1					588.0		
88												
	JAN	307.4	74.6	382.0	191.1	59862.0	3127.6	69.0	228876.9	0.0	58632.2	67.5
	FEB	277.6	461.0	738.6	208.3	60392.4	3139.2	69.6	198661.3	0.0	58632.2	67.5
	MAR	307.4	0.0	307.4	527.2	60172.5	3134.4	69.3	261805.9	0.0	58632.2	67.5
	APR	297.5	347.9	645.4	760.9	60093.8	3132.7	69.2	291843.1	76.7	58868.9	67.6
	MAY	307.4	153.6	461.0	999.1	59743.4	3125.0	68.8	291999.2	187.7	58856.6	67.8
	JUN	297.5	67.5	365.0	1207.8	59161.5	3112.5	68.2	292000.0	260.9	59117.5	68.1
	JUL	307.4	248.8	556.2	600.2	59183.6	3112.9	68.2	292000.0	66.2	59183.6	68.2
	AUG	307.4	204.5	511.9	511.9	59239.0	3114.1	68.2	292000.0	55.4	59239.0	68.2
	SEP	297.5	277.0	574.4	574.4	59292.6	3115.2	68.3	292000.0	53.6	59292.6	68.3
	OCT	307.4	94.5	401.8	401.8	59348.0	3116.4	68.4	292000.0	55.4	59348.0	68.4
	NOV	297.5	359.0	656.4	214.6	59789.7	3126.1	68.9	156586.3	0.0	59348.0	68.4
	DEC	307.4	345.7	653.1	203.8	60263.0	3136.4	69.4	157741.1	0.0	59372.0	68.4
	TOTAL	3619.0	2634.2	6253.2	6401.2					715.8		
89												
	JAN	307.4	288.2	595.6	204.2	60654.4	3144.9	69.9	164568.0	0.0	59372.0	68.4
	FEB	277.6	66.0	343.6	226.6	60771.3	3147.5	70.0	193169.1	0.0	59372.0	68.4
	MAR	307.4	201.4	508.8	532.5	60747.6	3147.0	70.0	240160.1	0.0	59372.0	68.4
	APR	297.5	315.4	612.8	786.3	60601.7	3143.8	69.8	291730.6	27.6	59399.6	68.4
	MAY	307.4	577.1	884.4	1004.0	60567.0	3143.0	69.8	291998.6	84.8	59484.4	68.5
	JUN	297.5	0.0	297.5	1214.5	59929.1	3129.1	69.0	292000.0	279.1	59763.5	68.8
	JUL	307.4	361.3	668.7	834.3	59859.6	3127.6	69.0	292000.0	96.1	59859.6	69.0
	AUG	307.4	874.3	1181.7	984.1	60063.9	3132.0	69.2	292000.0	6.8	59866.4	69.0
	SEP	297.5	379.0	676.4	741.4	60068.5	3132.1	69.2	292000.0	69.6	59935.9	69.0
	OCT	307.4	196.5	503.9	461.8	60155.6	3134.0	69.3	292000.0	45.0	59980.9	69.1
	NOV	297.5	34.7	332.1	215.6	60297.1	3137.1	69.5	292000.0	24.9	60005.8	69.1
	DEC	307.4	319.5	626.9	171.6	60776.4	3147.6	70.0	212032.2	0.0	60029.8	69.2
	TOTAL	3619.0	3613.4	7232.4	7376.9					633.9		
90												
	JAN	307.4	64.1	371.5	191.6	60956.3	3151.5	70.2	240988.9	0.0	60029.8	69.2
	FEB	277.6	661.1	938.7	206.7	61688.3	3167.5	71.1	178375.6	0.0	60029.8	69.2
	MAR	307.4	267.5	574.8	545.9	61717.2	3168.1	71.1	212484.5	0.0	60029.8	69.2
	APR	297.5	168.4	465.8	820.0	61376.4	3160.7	70.7	291586.7	13.4	60043.3	69.2
	MAY	307.4	268.1	575.5	1008.2	61105.5	3154.8	70.4	291997.9	161.8	60205.1	69.4
	JUN	297.5	244.2	541.6	1220.0	60647.5	3144.8	69.9	292000.0	220.4	60425.5	69.6
	JUL	307.4	485.9	793.3	1015.3	60535.5	3142.3	69.7	292000.0	110.0	60535.5	69.7
	AUG	307.4	950.6	1258.0	988.4	60805.1	3148.2	70.0	250081.7	0.0	60535.5	69.7
	SEP	297.5	133.9	431.4	700.9	60644.4	3144.7	69.9	291782.9	109.0	60644.4	69.9
	OCT	307.4	176.0	483.3	463.7	60714.6	3146.2	69.9	291998.9	50.5	60695.0	69.9
	NOV	297.5	254.5	552.0	216.6	61050.0	3153.6	70.3	205853.3	0.0	60695.0	69.9
	DEC	307.4	430.1	737.5	193.6	61617.8	3165.9	71.0	162764.2	0.0	60719.0	70.0
	TOTAL	3619.0	4104.4	7723.4	7571.0					665.1		
91												
	JAN	307.4	101.4	408.7	204.8	61821.8	3170.4	71.2	193410.2	0.0	60719.0	70.0
	FEB	277.6	241.1	518.7	220.7	62119.8	3176.9	71.6	196852.1	0.0	60719.0	70.0
	MAR	307.4	345.5	652.8	535.3	62237.3	3179.5	71.7	223725.1	0.0	60719.0	70.0
	APR	297.5	178.2	475.6	811.2	61938.9	3173.0	71.4	291645.2	37.2	60756.2	70.0
	MAY	307.4	59.3	366.7	1011.4	61508.2	3163.6	70.9	291998.2	213.9	60970.1	70.2
	JUN	297.5	223.8	521.2	1059.3	61156.0	3155.9	70.5	292000.0	185.9	61156.0	70.5
	JUL	307.4	603.2	910.6	910.6	61211.4	3157.1	70.5	292000.0	55.4	61211.4	70.5
	AUG	307.4	798.9	1106.3	992.9	61352.3	3160.2	70.7	292000.0	27.5	61238.9	70.5
	SEP	297.5	290.7	588.2	701.6	61320.4	3159.5	70.6	292000.0	81.5	61320.4	70.6
	OCT	307.4	313.9	621.3	466.1	61492.8	3163.2	70.8	292000.0	17.2	61337.6	70.7
	NOV	297.5	114.2	411.7	217.6	61692.7	3167.6	71.1	292000.0	5.9	61343.4	70.7
	DEC	307.4	196.7	504.1	173.2	62047.5	3175.3	71.5	252521.5	0.0	61367.4	70.7
	TOTAL	3619.0	3467.0	7085.9	7304.7					624.4		
92												
	JAN	307.4	204.8	512.2	183.4	62376.3	3182.5	71.9	238916.5	0.0	61367.4	70.7
	FEB	277.6	230.3	507.9	209.0	62675.3	3188.6	72.2	232144.9	0.0	61367.4	70.7
	MAR	307.4	250.2	557.5	513.4	62719.3	3189.5	72.3	268906.2	0.0	61367.4	70.7
	APR	297.5	277.9	575.4	766.6	62598.3	3187.1	72.1	291880.0	70.1	61437.5	70.8
	MAY	307.4	194.5	501.9	1016.6	62265.5	3180.1	71.7	291999.4	182.0	61619.5	71.0
	JUN	297.5	156.0	453.5	1099.4	61832.0	3170.6	71.2	292000.0	212.5	61832.0	71.2
	JUL	307.4	303.8	611.2	611.2	61887.3	3171.8	71.3	292000.0	55.4	61887.3	71.3
	AUG	307.4	411.6	718.9	718.9	61942.7	3173.0	71.4	292000.0	55.4	61942.7	71.4
	SEP	297.5	284.1	581.6	581.6	61996.3	3174.2	71.4	292000.0	53.6	61996.3	71.4
	OCT	307.4	307.5	614.9	468.5	62162.1	3177.8	71.6	292000.0	19.3	62015.6	71.4
	NOV	297.5	133.3	430.8	218.7	62375.6	3182.5	71.9	292000.0	1.4	62017.0	71.4
	DEC	307.4	170.5	477.9	174.0	62703.5	3189.1	72.2	261954.4	0.0	62041.0	71.5
	TOTAL	3619.0	2924.7	6543.6	6561.3					649.6		
93												
	JAN	307.4	336.6	644.0	181.9	63165.6	3198.2	72.8	219461.5	0.0	62041.0	71.5
	FEB	277.6	208.2	485.8	215.4	63436.0	3203.5	73.1	221162.1	0.0	62041.0	71.5
	MAR	307.4	316.2	623.6	523.3	63536.3	3205.4	73.2	248081.0	0.0	62041.0	71.5
	APR	297.5	0.0	297.5	791.7	63153.7	3197.9	72.8	291771.7	111.7	62152.7	71.6
	MAY	307.4	54.2	361.6	1019.6	62712.9	3189.3	72.2	291998.8	217.2	62369.9	71.9
	JUN	297.5	0.0	297.5	640.4	62507.9	3185.3	72.0	292000.0	137.9	62507.9	72.0
	JUL	307.4	78.0	385.3	385.3	62563.2	3186.4	72.1	292000.0	55.4	62563.2	72.1
	AUG	307.4	512.9	820.2	820.2	62618.6	3187.5	72.1	292000.0	55.4	62618.6	72.1
	SEP	297.5	467.7	765.2	755.2	62679.7	3188.7	72.2	292000.0	51.1	62669.7	72.2
	OCT	307.4	248.3	555.7	470.2	62799.5	3191.0	72.3	292000.0	34.4	62704.1	72.2
	NOV	297.5	0.0	297.5	219.5	62911.9	3193.2	72.5	292000.0	34.4	62738.5	72.3
	DEC	307.4	104.2	411.5	174.5	63172.9	3198.3	72.8	284765.6	0.0	62762.5	72.3
	TOTAL	3619.0	2326.3	5945.2	6197.3					697.5		

YR.	MO.	BRINE INFLOW (AF)	NATURAL RUNOFF (AF)	TOTAL INFLOW (AF)	EVAP. (AF)	END OF MONTH CONTENT (AF)	END OF MONTH SURFACE AREA (POND 3)	CONTENT AS PERCNT OF CAPACITY	CONCENTRATION OF SALT IN SOLUTION (PPM)	MONTHLY SALT PRECIPITATE (AF)	TOTAL SALT PRECIP. (AF)	SALT PRECIP. AS A PERCENT OF RESERVOIR CAPACITY
94												
	JAN	307.4	449.0	756.3	176.8	63752.4	3209.6	73.4	195169.2	0.0	62762.5	72.3
	FEB	277.6	375.0	652.6	223.0	64182.0	3218.0	73.9	181991.9	0.0	62762.5	72.3
	MAR	307.4	48.7	356.1	551.7	63986.4	3214.2	73.7	256425.8	0.0	62762.5	72.3
	APR	297.5	205.9	503.4	785.5	63785.0	3210.3	73.5	291815.1	80.7	62843.2	72.4
	MAY	307.4	150.0	457.3	1023.8	63413.2	3203.0	73.1	291999.0	194.7	63037.9	72.6
	JUN	297.5	73.0	370.4	745.7	63183.8	3198.5	72.8	292000.0	145.9	63183.8	72.8
	JUL	307.4	233.5	540.8	540.8	63239.2	3199.6	72.9	292000.0	55.4	63239.2	72.9
	AUG	307.4	218.0	525.4	525.4	63294.5	3200.7	72.9	292000.0	55.4	63294.5	72.9
	SEP	297.5	1113.4	1410.9	760.5	63945.0	3213.4	73.7	109667.2	0.0	63294.5	72.9
	OCT	307.4	315.0	622.4	596.4	63971.0	3213.9	73.7	202014.7	0.0	63294.5	72.9
	NOV	297.5	127.4	424.9	249.2	64146.6	3217.3	73.9	234476.4	0.0	63294.5	72.9
	DEC	307.4	273.7	581.1	190.3	64561.4	3225.4	74.4	217744.4	0.0	63318.5	72.9
	TOTAL	3619.0	3582.6	7201.6	6369.1					532.0		
95												
	JAN	307.4	306.1	613.5	195.0	64979.9	3233.6	74.9	205810.9	0.0	63318.5	72.9
	FEB	277.6	271.2	548.8	221.6	65307.1	3240.0	75.2	203685.5	0.0	63318.5	72.9
	MAR	307.4	476.2	783.6	541.4	65549.2	3244.7	75.5	211620.5	0.0	63318.5	72.9
	APR	297.5	1680.3	1977.7	844.7	66682.3	3267.3	76.8	164990.3	0.0	63318.5	72.9
	MAY	307.4	354.3	661.6	1230.1	66113.9	3255.9	76.2	216771.8	0.0	63318.5	72.9
	JUN	297.5	432.3	729.8	1393.4	65447.1	3243.1	75.4	291609.0	16.9	63335.4	73.0
	JUL	307.4	314.9	622.3	1244.1	65053.6	3235.0	74.9	291998.0	208.3	63543.8	73.2
	AUG	307.4	975.5	1282.9	1016.8	65319.6	3240.2	75.3	286248.3	0.0	63543.8	73.2
	SEP	297.5	289.5	587.0	773.0	65222.8	3238.3	75.1	291970.1	89.3	63633.0	73.3
	OCT	307.4	313.5	620.9	477.6	65386.2	3241.5	75.3	291999.8	20.1	63653.2	73.3
	NOV	297.5	175.6	473.0	223.1	65636.2	3246.4	75.6	287960.4	0.0	63653.2	73.3
	DEC	307.4	207.3	514.6	178.5	65996.3	3253.6	76.0	276518.6	0.0	63677.2	73.4
	TOTAL	3619.0	5796.7	9415.7	8339.4					334.6		
96												
	JAN	307.4	125.1	432.5	181.8	66247.0	3258.6	76.3	275524.9	0.0	63677.2	73.4
	FEB	277.6	96.9	374.5	203.6	66417.9	3262.0	76.5	279546.9	0.0	63677.2	73.4
	MAR	307.4	1466.7	1774.1	494.6	67697.5	3287.6	78.0	215313.8	0.0	63677.2	73.4
	APR	297.5	80.3	377.8	847.8	67227.4	3278.2	77.4	256102.9	0.0	63677.2	73.4
	MAY	307.4	38.3	345.7	1098.1	66591.8	3265.5	76.7	291813.4	116.8	63793.9	73.5
	JUN	297.5	0.0	297.5	1261.8	65918.2	3252.0	75.9	291999.0	290.8	64084.7	73.8
	JUL	307.4	0.0	307.4	1246.8	65265.1	3239.2	75.2	292000.0	286.4	64371.1	74.2
	AUG	307.4	147.5	454.9	1015.6	64897.7	3232.0	74.8	292000.0	193.3	64564.4	74.4
	SEP	297.5	271.3	568.8	764.8	64803.5	3230.1	74.7	292000.0	101.8	64666.2	74.5
	OCT	307.4	165.7	473.0	476.2	64856.5	3231.2	74.7	292000.0	56.2	64722.3	74.6
	NOV	297.5	71.5	369.0	222.3	65020.7	3234.4	74.9	292000.0	17.5	64739.8	74.6
	DEC	307.4	303.0	610.3	176.9	65478.1	3243.3	75.4	216530.8	0.0	64763.8	74.6
	TOTAL	3619.0	2766.4	6385.4	7990.2					1062.7		
97												
	JAN	307.4	407.9	715.2	196.4	65996.9	3253.6	76.0	184874.4	0.0	64763.8	74.6
	FEB	277.6	0.0	277.6	228.7	66045.9	3254.5	76.1	222045.8	0.0	64763.8	74.6
	MAR	307.4	289.1	596.5	531.0	66111.4	3255.9	76.2	256647.9	0.0	64763.8	74.6
	APR	297.5	83.6	381.1	795.2	65806.5	3249.8	75.8	291816.3	109.2	64873.0	74.7
	MAY	307.4	355.8	663.2	1037.1	65579.9	3245.3	75.6	291999.0	147.3	65020.4	74.9
	JUN	297.5	243.0	540.5	1100.1	65211.6	3238.1	75.1	292000.0	191.2	65211.6	75.1
	JUL	307.4	313.9	621.3	621.3	65266.9	3239.2	75.2	292000.0	55.4	65266.9	75.2
	AUG	307.4	1695.8	2003.2	1022.3	66247.8	3258.6	76.3	76825.9	0.0	65266.9	75.2
	SEP	297.5	34.2	331.6	1005.4	65607.5	3245.8	75.6	290881.7	33.4	65300.3	75.2
	OCT	307.4	182.1	489.5	478.2	65671.3	3247.1	75.7	291994.2	52.6	65353.0	75.3
	NOV	297.5	90.7	388.2	223.4	65849.1	3250.6	75.9	292000.0	13.1	65366.0	75.3
	DEC	307.4	142.0	449.4	177.7	66144.8	3256.5	76.2	276525.2	0.0	65390.0	75.3
	TOTAL	3619.0	3838.2	7457.2	7416.7					602.2		
98												
	JAN	307.4	134.7	442.1	181.9	66405.0	3261.7	76.5	271787.5	0.0	65390.0	75.3
	FEB	277.6	218.2	495.8	204.9	66695.9	3267.6	76.8	259217.0	0.0	65390.0	75.3
	MAR	307.4	248.2	555.6	507.5	66745.9	3268.6	76.9	291829.6	2.0	65392.0	75.3
	APR	297.5	528.2	825.7	761.3	66848.0	3270.6	77.0	291999.1	37.8	65429.7	75.4
	MAY	307.4	55.3	362.7	1042.9	66390.5	3261.5	76.5	292000.0	222.6	65652.4	75.6
	JUN	297.5	348.9	646.4	1261.8	65980.0	3253.2	76.0	292000.0	204.9	65857.3	75.9
	JUL	307.4	98.8	406.2	528.8	65942.8	3252.5	76.0	292000.0	85.5	65942.8	76.0
	AUG	307.4	177.9	485.3	485.3	65998.2	3253.6	76.0	292000.0	55.4	65998.2	76.0
	SEP	297.5	22.8	320.2	320.2	66051.8	3254.7	76.1	292000.0	53.6	66051.8	76.1
	OCT	307.4	140.4	447.7	447.7	66107.2	3255.8	76.2	292000.0	55.4	66107.2	76.2
	NOV	297.5	335.6	633.1	224.2	66516.0	3264.0	76.6	167945.5	0.0	66107.2	76.2
	DEC	307.4	249.6	557.0	209.8	66887.2	3271.4	77.1	182930.3	0.0	66131.2	76.2
	TOTAL	3619.0	2558.7	6177.7	6176.5					717.2		
99												
	JAN	307.4	85.8	393.1	206.4	67073.9	3275.1	77.3	216627.0	0.0	66131.2	76.2
	FEB	277.6	105.0	382.6	221.3	67235.3	3278.4	77.5	238089.1	0.0	66131.2	76.2
	MAR	307.4	112.8	420.1	523.5	67155.4	3276.8	77.4	291719.8	23.6	66154.7	76.2
	APR	297.5	385.5	683.0	762.9	67148.8	3276.6	77.4	291998.5	73.2	66228.0	76.3
	MAY	307.4	59.3	366.6	1044.8	66692.8	3267.5	76.8	292000.0	222.2	66450.1	76.6
	JUN	297.5	87.8	385.3	627.9	66563.4	3264.9	76.7	292000.0	113.3	66563.4	76.7
	JUL	307.4	395.9	703.2	703.2	66618.8	3266.0	76.7	292000.0	55.4	66618.8	76.7
	AUG	307.4	821.3	1128.6	1027.8	66750.2	3268.7	76.9	292000.0	30.6	66649.3	76.8
	SEP	297.5	158.3	455.8	556.6	66727.7	3268.2	76.9	292000.0	78.4	66727.7	76.9
	OCT	307.4	444.9	752.2	482.6	66997.4	3273.6	77.2	249980.4	0.0	66727.7	76.9
	NOV	297.5	91.6	389.0	238.6	67153.4	3276.7	77.4	291781.6	5.6	66733.3	76.9
	DEC	307.4	228.9	536.3	179.2	67534.6	3284.4	77.8	248779.6	0.0	66757.3	76.9
	TOTAL	3619.0	2977.1	6596.0	6574.8					602.2		
100												
	JAN	307.4	99.5	406.8	190.5	67750.9	3288.7	78.1	260637.4	0.0	66757.3	76.9
	FEB	277.6	69.0	346.6	209.7	67887.9	3291.5	78.2	279404.2	0.0	66757.3	76.9
	MAR	307.4	367.9	675.2	497.4	68065.7	3295.0	78.4	290187.8	0.0	66757.3	76.9
	APR	297.5	493.2	790.7	769.4	68133.0	3296.4	78.5	291990.6	46.0	66803.4	77.0
	MAY	307.4	438.5	745.9	1052.3	67957.3	3292.8	78.3	292000.0	130.7	66934.1	77.1
	JUN	297.5	11.5	309.0	1272.6	67284.2	3279.4	77.5	292000.0	290.6	67224.7	77.4
	JUL	307.4	269.7	577.0	636.6	67294.7	3279.6	77.5	292000.0	70.0	67294.7	77.5
	AUG	307.4	643.0	950.4	950.4	67350.1	3280.7	77.6	292000.0	55.4	67350.1	77.6
	SEP	297.5	178.1	475.5	475.5	67403.6	3281.8	77.7	292000.0	53.6	67403.6	77.7
	OCT	307.4	341.7	649.0	484.5	67583.1	3285.3	77.9	292000.0	14.9	67418.5	77.7
	NOV	297.5	267.5	565.0	226.1	67921.9	3292.1	78.2	230255.5	0.0	67418.5	77.7
	DEC	307.4	53.7	361.0	195.7	68111.3	3295.9	78.5	268940.2	0.0	67442.5	77.7
	TOTAL	3619.0	3233.3	6852.3	6960.8					661.2		

Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-1W LOCATION West of Dolores River GROUND ELEV. 4939.46' DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-11-76 FINISHED 10-11-76 DEPTH OF OVERBURDEN 107.0' +.? TOTAL DEPTH 107.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (F, Co, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill. DRILL EQUIPMENT Becker, Model No.180 truck-mounted, air-hammer drive, 5½"O.D. double wall casing of 3¼"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube. DRILLING MEDIUM Air medium throughout the hole. CASING & BACKFILL Placed 5½"O.D. casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled. GROUNDWATER Interval — Condition 0-9.0 Dry 9.0-12.0 Moist 12.0-25.0 Wet 25.0-32.0 Water Flow 32.0-36.0 Wet 36.0-47.5 Water Flow 47.5-48.0 Wet 48.0-64.0 Water Flow 64.0-68.0 Wet 68.0-72.0 Water Flow 72.0-76.0 Moist 76.0-90.0 Dry 90.0-94.0 Water Flow 94.0-95.0 Wet 95.0-102.0 Some Water Flow 102.0-107.0 Dry NOTE: Lower dry zones may have lost moisture in blowing air medium.	5.5"OD BD	AS	Not Required		By Specifications			4939.46	0.0		
								4927.46	12.0		
								4916.46	23.0		
								4904.46	35.0		
								4900.46	39.0		
								4891.46	48.0		
								4889.46	50.0		
								4883.46	56.0		
								4867.46	72.0		
								4849.46	90.0		
								4845.46	94.0		
								4844.46	95.0		
	5.5"OD BD	AS						4839.46	100.0		

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-12.0': SILTY SAND; 20% medium sand, 50% fine sand, 30% non-plastic fines, subangular, loose consistency on ground surfaces, tan, strong reaction to HCl (SM)

12.0'-23.0': SAND; 15% gravel up to ½" size, 25% coarse sand, 30% medium sand, 30% fine sand, subangular to subrounded tan, moderate reaction to HCl (SW).

23.0'-35.0: SANDY GRAVEL; 60% gravel up to 1" size, 15% coarse sand, 25% medium to fine sand, subangular to subrounded, strong reaction to HCl, (GW)

35.0'-39.0': FAT CLAY; high plasticity, brown, high dry strength and toughness, slight reaction to HCl (CH).

39.0'-48.0' SILTY SAND; 10% gravel to 1", 60% fine sand 30% non-plastic fines, subangular to subrounded, brown, occurred in slurry, strong reaction to HCl (SM)

48.0'-50.0': LEAN CLAY; Medium to high plasticity, may grade to FAT CLAY, medium to moderately high dry strength and toughness, brown, highly reactive to HCl (CL).

50.0'-56.0': GRAVELLY SAND; 25% gravel up to ½" size, 50% coarse sand, 25% medium to fine sand, subrounded to occasionally subangular, strong reaction to HCl (SW).

56.0'-72.0': GRAVEL; 20% coarse gravel to 2" size, 70% fine to medium gravel, 10% sand, subrounded to occasionally subangular, some white evaporite coating on dried samples, slight to strong reaction to HCl (GW).

72.0'-90.0': GRAVEL; 30% coarse gravel up to 2" size with angular breaks indicating possible cobbles, 40% medium to fine gravel also with angular breaks, 30% sand, subangular to subrounded, some evaporite coating on dried sample, moderate to strong reaction to HCl, (GW).

90.0'-94.0': FAT CLAY; high plasticity gray, high dry strength and toughness, violently reactive to HCl (CH).

94.0'-95.0': SILTY SAND; 5% coarse sand to occ. fine gravel up to ½" size, 65% fine sand, 30% non-plastic fines, subrounded to subangular, occurred as slurry, dark gray-brown, white evaporite coating on dried sample, strong reaction to HCl (SM).

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS - Air (blown) Sample

Type of hole . . . D = Diamond, H = Hayerstellite, S = Shot, C = Chrom
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1 7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1 1/8", Bx = 1-5/8", Nx = 2 1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2 1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1 1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE: Brine Well Field PROJECT: Paradox Unit, CRBSCP STATE: Colorado

HOLE NO.: PH-1W LOCATION: West of Dolores River GROUND ELEV.: 4939.46 DIP (ANGLE FROM HORIZ.): 90°

COORDS. N: E:

BEGUN: 10-11-76 FINISHED: 10-11-76 DEPTH OF OVERBURDEN: 107.0' TOTAL DEPTH: 107.0' BEARING:

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes LOGGED BY: R. L. Crutchfield LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
	5.5" OD BD	AS						4839.46	100.0			Drilled by Becker Drills, Inc. Spec. No. 400C-610
								4834.96	104.5			95.0'-104.5': SANDY GRAVEL;25% coarse gravel up to ½" size with angular breaks indicating possible cobbles, 20% medium gravel, 25% fine gravel, 30% sand, subangular to subrounded, trace of clay, some evaporite coating on dried sample, strong reaction to HCl (GW).
								4833.46	106.0			104.5'-106.0': SAND;5% fine gravel up to ¼" size, 20% coarse sand, 50% medium sand, 25% fine sand, subangular to subrounded, gray, moderately strong reaction to HCl (SW).
								4832.46	107.0			106.0'-107.0': SANDY GRAVEL; as 95.0'-104.5' above (GW).
												107.0': Hermosa Formation; according to driller (no sample).
			Bottom of Hole									
Stopped drilling because no further information needed. Drilling was hard and time consuming at this depth; Driller thought we were in formation material but no samples were recovered.												

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole: D = Diamond, H = Hawksetillite, S = Shot, C = Churn
Hole sealed: P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series): Ex = 1-1 2", Ax = 1-7 8", Bx = 2-3 8", Nx = 3"
Approx. size of core (X-series): Ex = 7/8", Ax = 1-1 8", Bx = 1-5 8", Nx = 2-1 8"
Outside dia. of casing (X-series): Ex = 1-13 16", Ax = 2 1 4", Bx = 2 7 8", Nx = 3-1 2"
Inside dia. of casing (X-series): Ex = 1-1/2", Ax = 1-29 32", Bx = 3 3", Nx = 3"

7-1337 (9-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE: Brine Well Field | PROJECT: Paradox Unit, CRBSCP | STATE: Colorado
HOLE NO.: PH-2W | LOCATION: West of Dolores River | COORDS. N. ..... E. ..... | GROUND ELEV.: 4838.87 | DIP (ANGLE FROM HORIZ.): 90°
BEGUN: 10-12-76 | FINISHED: 10-12-76 | DEPTH OF OVERBURDEN: 70.0' | TOTAL DEPTH: 72.0' | BEARING:
DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes | LOGGED BY: R. L. Crutchfield | LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.	5.5" BD	AS	Not Required By Specifications					4838.87	0.0		
DRILL EQUIPMENT: Becker, Model No.180, truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3½" I.D. with 600 C.F.M. air compressor and cyclone assembly with sample tube.								4833.87	5.0		
								4828.87	10.0		
								4823.87	15.0		
									20		
DRILLING MEDIUM: Air medium throughout hole.								4808.37	30.5		
								4807.87	31.0		
								4803.87	35.0		
CASING & BACKFILL: Placed 5½"O.D. casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.			36.0'	45.0'				4802.87	36.0		
			15.0	to 30.5					40		
			above (SW)					4793.87	45.0		
								4792.87	46.0		
									50		
								4785.87	53.0		
								4782.87	56.0		
									60		
								4768.87	70.0		
	5.5" BD	AS	Bottom of Hole					4766.87	72.0		
			Stopped drilling when encountered formation.						80		
									90		

GROUNDWATER

Interval	Condition
0.0-7.0	Dry
7.0-11.0	Moist
13.0-22.0	Wet
22.0-56.0	Water Flow
56.0-65.0	Wet
65.0-68.0	Water Flow
68.0-70.0	Moist
70.0-72.0	Dry

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-5.0': SILTY SAND;60% fine sand, 40% non-plastic fines, subangular, tan to brown, loose consistency on ground surface, strong reaction to HCl (SM).

5.0'-10.0': SAND; 20% coarse sand, 50% medium sand, 30% fine sand, subrounded to subangular, tan, strong reaction to HCl (SW).

10.0'-15.0': SILTY SAND; 70% fine sand, 30% non-plastic fines, subangular to occasionally subrounded, brown, occurred in slurry, strong HCl reaction. (SM)

15.0'-30.5': SAND; 10% fine gravel to 1" size, 10% coarse sand, 20% medium sand, 40% fine sand, 20% non-plastic fines, subangular to occasionally subrounded, brown to dark gray, traces of clay, strong HCl reaction. (SW)

30.5'-31.0': FAT CLAY; high plasticity, gray, high dry strength and toughness, strong HCl reaction. (CH)

31.0'-35.0': SAND; as 15.0' to 30.5' above. (SW)

35.0-36.0': FAT CLAY; as 30.5 to 31.0' above (CH).

45.0'-46.0': GRAVEL; 80% coarse gravel about 1½" to 2" size in 20% sand as above, gravel is subrounded and hard, some evaporite coating or dried samples, slight to strong HCl reaction in sand. (GP)

46.0'-53.0': SAND;as from 15.0'-30.5' above. (SW)

53.0'-56.0': SANDY GRAVEL;30% coarse gravel to 1½", 40% medium gravel, 30% sand as above, gravel is subrounded and hard, some evaporite coating, slight HCl reaction. (GW)

56.0'-70.0': GRAVEL;25% coarse gravel to 2" size with angular breaks indicating possible cobbles, 50% medium gravel, 25% fine gravel with some sand slurry from 65.0' to 68.0', subrounded with frequent angular breaks, some evaporite coating, hard grains, slight to strong HCl reaction. (GW)

70.0'-72.0': GYPSIFEROUS BRECCIA; soft, gray-brown shale. (Hermosa Formation).

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole ..... D = Diamond, H = Hayssellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) .. Ex = 1 1/2" Ax = 1 7/8" Bx = 2 3/8" Nx = 3"
Approx. size of core (X-series) .. Ex = 7/8" Ax = 1 1/8" Bx = 1 5/8" Nx = 2 1/8"
Outside dia. of casing (X-series) Ex = 1 13/16" Ax = 2 1/4" Bx = 2 7/8" Nx = 3 1/2"
Inside dia. of casing (X-series) .. Ex = 1 1/2" Ax = 1 29/32" Bx = 2 3/8" Nx = 3"

Sheet 3 of 66

FEATURE: Brine Well Field | PROJECT: CRBSCP | STATE: Colorado | SHEET: 1 OF 1 | HOLE NO: PH-2W

7-1337 (9-69) Bureau of Reclamation GPO 684-401

GEOLOGIC LOG OF DRILL HOLE

SHEET..... OF.....

FEATURE. Brine Well Field PROJECT. Paradox Unit, CRBSCP STATE. Colorado

HOLE NO. PH-3W LOCATION. West of Dolores River GROUND ELEV. 4939.39 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-12-76 FINISHED. 10-12-76 DEPTH OF OVERBURDEN 61.0' TOTAL DEPTH. 62.0' BEARING.

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED. See Notes. LOGGED BY. R. L. Crutchfield LOG REVIEWED BY.

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (F, Co, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.	5.5 BD	AS	Not Required By Specifications					4939.39	0.0		
DRILL EQUIPMENT Becker, Model No.180 truck-mounted air-hammer drive, 5½" O.D. double wall casing of 3½"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.								4929.39	10.0		
DRILLING MEDIUM Air medium throughout the hole.								4919.39	20.0		
CASING & BACKFILL Placed 5½"O.D. casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.								4914.39	25.0		
GROUNDWATER Interval — Condition 0.0–7.0 Dry 7.0–14.0 Moist 14.0–50.0 Water Flow 50.0–62.0 Dry								4909.39	30.0		
								4895.39	44.0		
								4894.89	44.5		
								4889.39	50.0		
								4887.39	52.0		
NOTE: Lower dry zone may have lost some moisture in blowing air medium.	5.5" BD	AS	Bottom of Hole					4878.39	61.0		
			Stopped drilling when encountered formation.					4877.39	62.0		

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-10.0': SILTY SAND; 70% fine sand, 30% non-plastic fines, subangular to occasionally subrounded, tan to brown, loose consistancy on ground surface, strong reaction to HCl. (SM)

10.0'-20.0': GRAVELLY SAND; 20% fine gravel to 1" size, 30% coarse sand, 30% medium sand, 20% fine sand, subangular to subrounded with coarse grains occasionally angular, occurred in slurry beyond 14.0'; moderate HCl reaction to 14.0' and strong HCl reaction beyond 14.0' (SW).

20.0'-25.0': SAND; 15% coarse sand, 50% medium sand, 25% fine sand, 10% non-plastic fines, subrounded to occasionally subangular, gray, strong HCl reaction. (SW)

25.0'-30.0': CLAYEY SAND; 60% fine sand, subrounded to occasionally subangular, 30% plastic and non-plastic fines and about 10% gray, fat clay seams, gray, some evaporite coating on dried samples, strong reaction to HCl.

30.0'-44.0': SAND; 10% fine gravel to 1" size, 25% coarse sand, 45% medium sand, 20% fine sand, subrounded to subangular, gray, evaporite coating on dried sample, strong reaction to HCl. (SW)

44.0'-44.5': FAT CLAY; high plasticity, gray, high dry strength and toughness, strong HCl reaction. (CH)

44.5'-50.0': SAND; as in 30.0 to 44.0 above.

50.0'-52.0': LEAN CLAY; medium plasticity grading to moderately high plasticity in places, contains about 20% fine sand and zones of fine sand concentration, gray to brown, contains some brown organic material, medium to high dry strength, medium toughness, strong reaction to HCl. (CL)

52.0'-61.0': GRAVEL; 30% coarse gravel to 3" size with some angular breaks indicating possible cobbles, 40% medium gravel, 30% fine gravel, subrounded to subangular with angular breaks, well graded, individual grains are hard, dried samples are coated with evaporites, coating reaction strongly to HCl. (GW)

61.0'-62.0': GYPSIFEROUS BRECCIA; shale, soft, gray brown. (Hermosa Formation)

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole ..... D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series) ..	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"
Approx. size of core (X-series) ..	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"
Outside dia. of casing (X-series).	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"
Inside dia. of casing (X-series).	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-4W LOCATION West of Dolores River GROUND ELEV. 4938.59 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-11-76 FINISHED 10-11-76 DEPTH OF OVERBURDEN 53.0' TOTAL DEPTH 59.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.	9.5" BD	AS	Not Required By Specifications					4938.59	0.0		
DRILL EQUIPMENT: Becker, Model No.180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3¾I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.								4925.59	13.0		
DRILLING MEDIUM: Air medium throughout the hole.								4924.09	14.5		
CASING & BACKFILL: Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.								4920.59	18.0		
								4910.59	28.0		
								4908.59	30.0		
								4904.59	34.0		
								4898.59	40.0		
								4890.59	48.0		
								4885.59	53.0		
GROUNDWATER Interval Condition 0.0-13.0 Dry 13.0-14.5 Moist 14.5-48.0 Water Flow 48.0-53.0 Wet 53.0-59.0 Moist	5.5" BD	AS	Bottom of Hole					4879.59	59.0		
NOTE: Trace of oil-like globules on water at about 45.0'			Stopped drilling because in formation.								

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-13.0': SILTY SAND; 10% medium sand, 50% fine sand, 40% non-plastic fines, subangular to subrounded, loose consistency on ground surface, tan to brown, strong reaction to HCl. (SM)

13.0'-14.5': CLAYEY SAND: 10% coarse sand, 10% medium sand, 40% fine sand, 40% plastic and non-plastic fines, subrounded to subangular, tan to brown, some evaporite coating on dried sample, strong reaction to HCl. (SC)

14.5'-18.0': SILTY SAND: 10% coarse to medium sand, 60% fine sand, 30% non-plastic fines, subangular to subrounded, tan to brown, occurred as slurry, strong reaction to HCl. (SM)

18.0'-28.0': LEAN CLAY; medium to moderately high plasticity and may grade to fat clay in places, contains about 20% fine sand and has zones of fine sand concentration, brown, contains some organic material, occurred with black H_2S smelling water, strong reaction to HCl. (CL)

28.0'-30.0': GRAVELLY SAND; 25% fine gravel to ½" size, 35 % coarse sand, 20% medium sand, 20% fine sand, subangular to subrounded, well sorted, gray, some evaporite coating on dried sample, strong HCl reaction. (SW)

30.0'-34.0': GRAVEL; 5% coarse gravel to 2", 50% medium gravel, 35% fine gravel, 10% sand, subrounded, dried samples coated with some evaporite, slight to moderate HCl reaction. (GW)

34.0'-40.0': SAND; 15% coarse sand with occasional fine gravel to ¼" size, 70% medium sand, 15% fine sand, subangular to subrounded, contains thin (1" to 2") clay seams at about 38.0', gray, evaporite coating on dried sample, strong reaction to HCl. (SW)

40.0'-48.0': SANDY GRAVEL; 60% fine gravel to 1" size, 40% coarse sand, 2" clay seam at about 48.0', subrounded to occasional subangular sand, some evaporite coating on dried sample, strong HCl reaction. (GP)

48.0'-53.0': GRAVEL; 15% medium gravel to 1" size, 70% fine gravel mostly about ¼" size, 15% coarse sand, occasionally subrounded but mostly subangular to angular, individual grains are quite hard, some evaporite coating, slight to moderate HCl reaction. (GP)

53.0'-59.0': GYPSIFEROUS BRECCIA; Shale and sandstone, gray (Hermosa Formation)

Sheet 5 of 66

CORE LOSS / CORE RECOVERY

EXPLANATION

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE Brine Well Field PROJECT CRBSCP STATE Colorado SHEET 1 OF 1 HOLE NO PH-4W

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE ... Brine Well Field ... PROJECT ... Paradox Unit, CRBSCP ... STATE Colorado

HOLE NO. PH-5W ... LOCATION ... West of Dolores River ... GROUND ELEV. 4939.15 ... DIP (ANGLE FROM HORIZ.) 90°

COORDS. N ... E ...

BEGUN 10-12-76 ... FINISHED 10-12-76 ... DEPTH OF OVERBURDEN 70.0' ... TOTAL DEPTH 70.0' ... BEARING ...

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes ... LOGGED BY R. L. Crutchfield ... LOG REVIEWED BY ...

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.

DRILL EQUIPMENT

Becker, Model No. 180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3½" I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM

Air medium throughout the hole.

CASING & BACKFILL

Placed 5½" O.D. casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-14.0	Moist
14.0-50.0	Water Flow
50.0-54.0	Wet
54.0-60.0	Moist
60.0-70.0	Water Flow
70.0-79.0	Dry

NOTE: Strong flow of white brine between 42.0' and 46.0'.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs & Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
5.5" BD	AS	Not Required By Specifications					4939.15	0.0		
							4928.15	11.0		
							4925.15	14.0		
							4924.15			
							4894.15	45.0		
							4884.15	55.0		
							4879.15	60.0		
							4874.15	65.0		
							4869.15	70.0		
5.5" BD	AS	Bottom of Hole					4860.15	79.0		

Stopped drilling because in formation

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-11.0': SILTY SAND; 65% fine sand, 35% non-plastic fines, subangular, tan, strong reaction to HCl (SM).

11.0'-14.0': SAND; 20% fine gravel to 1" size, 20% coarse sand, 30% medium sand, 30% fine sand, subangular to subrounded, well graded, tan, strong reaction to HCl (SW).

14.0'-15.0': SILTY SAND; 65% fine sand, 35% non-plastic fines, tan, occurred as slurry, strong reaction to HCl (SM).

15.0'-45.0': GRAVELLY SAND; 25% gravel up to 1" size, 15% coarse sand, 20% medium sand, 40% fine sand, subangular to occasionally subrounded, well graded, gray, trace of wood, some evaporite coating on dried sample, moderate to strong reaction to HCl. (SW)

45.0'-55.0': SANDY GRAVEL; 20% coarse gravel up to 2" size with angular breaks indicating possible cobbles, 30% medium gravel, 20% fine gravel, 30% fine to coarse sand occurring in slurry, subangular to subrounded, well graded, gray, evaporite coating on dried sample, slight to strong reaction to HCl. (GW)

55.0'-60.0': SANDY GRAVEL; 10% medium gravel, 50% fine gravel, 40% clayey sand, subrounded to subangular, gray, some evaporite coating on dried sample, strong reaction to HCl. (GW)

60.0'-65.0': SILTY SAND; 5% gravel to 1" size, 65% fine sand, 30% non-plastic fines, subangular, occurred as a black slurry, strong HCl reaction. (SM)

65.0'-70.0': SILTY SAND; as 60.0' to 65.0' above but contains about 15% gravel to 1" size (some of gravel is sandstone and shale).

70.0'-79.0': GYPSIFEROUS BRECCIA; shale, soft, gray. (Hermosa Formation)

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole ..... D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) .. Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) .. Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) .. Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) .. Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-6W LOCATION West of Dolores River GROUND ELEV. 4938.16 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-11-76 FINISHED 10-11-76 DEPTH OF OVERBURDEN 129.0' TOTAL DEPTH 129.5' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.	5.5" BD	AS	Not Required		By Specification			4938.16	0.0		
								4932.66	5.5		
								4932.16	6.0		
								4926.16	12.0		
								4910.16	28.0		
								4906.16	32.0		
								4905.66	32.5		
								4904.16	34.0		
								4899.66	38.5		
								4895.16	43.0		
								4869.16	69.0		
								4866.16	72.0		
								4864.16	74.0		
								4850.16	88.0		
								4844.16	94.0		
	5.5" BD	AS						4838.16	100.0		

DRILL EQUIPMENT

Becker, Model No. 180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3¼"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM

Air medium throughout the hole.

CASING & BACKFILL

Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-12.0	Dry-Moist
12.0-46.5	Water Flow
46.5-54.0	Wet
54.0-74.0	Moist
74.0-88.0	Wet
88.0-118.0	Moist
118.0-122.0	Wet
122.0-129.5	Moist

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-5.5': SILTY SAND; 70% sand, 30% non-plastic fines, subangular to subrounded, tan, loose consistancy on ground surface, strong reaction to HCl. (SM)

5.5'-6.0': FAT CLAY; high plasticity, brown, high dry strength and toughness, strong reaction to HCl. (CH)

6.0'-12.0': SAND; 10% coarse, 60% medium, 30% fine sand, subrounded to occasionally subangular, tan, strong reaction to HCl. (SW)

12.0'-28.0': GRAVELLY SAND; 30% fine gravel to 1" size, concentration of gravel increases with depth, 20% coarse sand, 30% medium, 20% fine sand, subrounded, gray, some evaporite coating on dried sample, strongly reactive to HCl. (SW)

28.0'-32.0': SAND; 10% coarse sand, 50% medium sand, 40% fine sand, subangular to subrounded, gray, some evaporite coating on dried sample, moderately strong reaction to HCl. (SW)

32.0'-32.5': FAT CLAY; high strength, gray, high dry strength and toughness, moderately reactive to HCl. (CH)

32.5'-34.0': GRAVELLY SAND; 20% fine gravel to 1" size, 20% coarse sand, 30% medium sand, 30% fine sand, subangular to subrounded, some evaporite coating on dried sample, gray, strong reaction to HCl. (SW)

34.0'-38.5': SANDY GRAVEL; 60% gravel to 1" size, 15% coarse sand, 25% medium to fine sand, subangular to subrounded, gray, some evaporite coating on dried sample, strong reaction to HCl, (GW)

38.5'-43.0': GRAVELLEY SAND; as 32.5' to 34.0' above. (SW)

43.0'-69.0': GRAVEL ; 20% coarse gravel to 2½" size with angular breaks indicating possible cobbles, 40% medium gravel, 20% fine gravel, 20% sand, subrounded to angular. Some evaporite coating on dried samples, slight to strong reaction to HCl. (GW)

69.0'-72.0': SANDY GRAVEL; 70% fine gravel up to ½" size, 30% sand, subrounded to subangular, gray, some evaporite coating on dried sample, strongly reactive to HCl. (GP)

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2"	Ax = 1-7/8"	Bx = 2-3/8"	Nx = 3"
Approx. size of core (X-series)	Ex = 7/8"	Ax = 1-1/8"	Bx = 1-5/8"	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16"	Ax = 2-1/4"	Bx = 2-7/8"	Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2"	Ax = 1-29/32"	Bx = 2-3/8"	Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-6W LOCATION West of Dolores River GROUND ELEV. 4938.16 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-11-76 FINISHED 10-11-76 DEPTH OF OVERBURDEN 129.0' TOTAL DEPTH 129.5' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cp or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								4838.16	100.0			Drilled by Becker Drills, Inc. Spec. No. 400C-610
	5.5" BD	AS						4828.16	110.0			72.0'-74.0': FAT CLAY; high plasticity gray, high dry strength and toughness, strong reaction to HCl. (CH)
								4820.16	118.0			74.0'-88.0': CLAYEY SAND; 70% fine sand, 30% plastic fines, occ. thin lenses of sandy clay, subangular, gray, some white evaporite coating on dried sample, moderate to strong reaction to HCl. (SC)
								4809.16	129.0			88.0'-94.0': SANDY GRAVEL; 30% coarse gravel to 1½" size with some angular breaks which indicate possible cobbles, 20% medium gravel, 10% fine gravel, 40% silty sand, subangular to subrounded, gray, some evaporite coating on dried sample, strong reaction to HCl. (GW)
								4808.66	129.5			94.0'-100.0': CLAYEY SAND; 10% coarse sand with occ. fine gravel, 60% fine sand, 30% plastic fines, subangular, gray, some evaporite coating on dried sample, strong reaction to HCl. (SC)
												100.0'-110.0': CLAYEY GRAVEL; 20% coarse gravel to 1" size, 20% medium gravel, 30% fine gravel, 30% very clayey sand, subangular to subrounded, gray, some evaporite coating on dried sample, strong reaction to HCl (GC).
												110.0'-118.0': CLAYEY GRAVEL; occasional coarse gravel to 2½" size with angular breaks indicating possible cobble, 70% fine gravel to 1" size, 30% sandy clay, subrounded, gray, some evaporite coating on dried sample, strong reaction to HCl. (GC)
												118.0'-129.0': CLAYEY GRAVEL; 30% medium gravel, 40% fine gravel, 30% sandy clay, subangular, dark gray, some evaporite coating on dried sample, moderate reaction to HCl. (GC)
												129.0'-129.5': GYPSIFEROUS BRECCIA; shale, gray and some sandstone (Hermosa Formation)
												Bottom of Hole — Stopped drilling when encountered formation.

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

7-1337 (4-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado
HOLE NO. PH-7W LOCATION West of Dolores River GROUND ELEV. 4936.86 DIP (ANGLE FROM HORIZ.) 90°
COORDS. N. E.
BEGUN 10-12-76 FINISHED 10-12-76 DEPTH OF OVERBURDEN 94.0' TOTAL DEPTH 94.0' BEARING
DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.

DRILL EQUIPMENT
Becker, Model No. 180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3½" I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM
Air medium throughout the hole.

CASING & BACKFILL
Placed 5½" O.D. casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-10.0	Moist
10.0-30.0	Wet
30.0-36.0	Moist
36.0-49.0	Water Flow
49.0-75.0	Wet
75.0-94.0	Moist

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
5.5" BD	AS	Not Required By Specifications					4936.86	0.0		
							4933.86	3.0		
							4930.86	6.0		
							4926.86	10.0		
							4911.86	25.0		
							4910.86	26.0		
							4906.86	30.0		
							4900.86	36.0		
							4894.86	42.0		
							4890.86	46.0		
							4877.86	59.0		
							4874.86	62.0		
							4873.86	63.0		
							4866.86	70.0		
5.5" BD	AS	Bottom of Hole					4842.86	94.0		
		Stopped drilling when reached formation.								

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-3.0': SILTY SAND; 60% fine sand, 40% non-plastic fines, subangular, tan to brown, loose consistency on ground surface, strong HCl reaction. (SM)

3.0'-6.0': CLAYEY SAND; 60% fine sand, 40% plastic and non-plastic fines, subangular sand, dark gray-brown, white evaporite coating on dried sample, strong HCl reaction. (SC)

6.0'-10.0': SAND: 5% fine gravel to ½" size, 20% coarse sand, 40% medium sand, 35% fine sand, subrounded to occasionally subangular, tan to brown, occasional twigs, well sorted, strong HCl reaction. (SW)

10.0'-25.0': CLAYEY SAND; 70% fine sand, 30% mostly plastic fines, subangular sand, dark brown, occurred in slurry, strong HCl reaction. (SC)

25.0'-26-0': FAT CLAY; high plasticity, brown with black swirls, high dry strength and toughness, slight HCl reaction. (CH)

26.0'-30.0': GRAVELLY SAND; 25% fine gravel to 1" size, 15% coarse sand, 15% medium sand, 25 % fine sand, 20% non-plastic fines, subangular to occasionally subrounded, brown, well graded, strong HCl reaction, wood fragments. (SW)

30.0'-36.0': SANDY CLAY; low to moderately high plasticity, contains about 20% fine sand and zones of fat clay from 30.0' to 32.0' and contains about 40% fine sand from 32.0' to 36.0', sand is subangular, red, medium dry strength and toughness, moderate HCl reaction. (CL)

36.0'-42.0': SAND; 20% coarse sand, 20% medium sand, 45% fine sand, 15% non-plastic fines, subangular, tan, white evaporite on dried sample, strong HCl reaction. (SW)

42.0'-46.0': SAND; 10% fine gravel to ½" size, 15% coarse sand, 30% medium sand, 30% fine sand, 15% non-plastic fines, subangular to subrounded, tan, white evaporite coating on dried sample, moderate HCl reaction, wood from probable log at 42.0'. (SW)

46.0'-59.0': SANDY GRAVEL; 20% coarse gravel to 1½" size with angular breaks indicating possible cobbles, 30% medium gravel, 20% fine gravel, 30% sand as described from 42.0' to 46.0', subangular

EXPLANATION

CORE LOSS
CORE RECOVERY

BD = Becker Drill
AS = Air (blown) Sample

Type of hole . . . . . D = Diamond, H = Hayzstellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1 29/32", Bx = 2-3/8", Nx = 3"

FEATURE Brine Well Field PROJECT CRBSCP STATE Colorado SHEET 1 OF 2 HOLE NO. PH-7W

7-1337 (9-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado
HOLE NO. PH-7W LOCATION West of Dolores River GROUND ELEV. 4936.86 DIP (ANGLE FROM HORIZ.) 90°
COORDS. N E
BEGUN 10-12-76 FINISHED 10-12-76 DEPTH OF OVERBURDEN 94.0' TOTAL DEPTH 94.0' BEARING
DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

to subrounded, white evaporite coating on dried sample, slight to moderate HCl reaction. (GW)

59.0'-62.0': SANDY CLAY; low plasticity, contains about 40% fine, subangular sand, gray, medium dry strength and toughness, slight to no HCl reaction. (CL)

62.0'-63.0': GRAVELLY SAND; 20% fine gravel to ½" size, 70% coarse sand, 10% medium sand, subrounded to subangular to occasionally angular, poorly graded, gray, no HCl reaction. (SP)

63.0'-70.0': FAT CLAY; high plasticity mostly, with silty zones which grade to medium plasticity lean clay, gray, high dry strength and toughness, no HCl reaction. (CH)

70.0'-94.0': CLAYEY GRAVEL; 30% coarse gravel to 2½" size with angular breaks indicating possible cobbles, 20% medium gravel, 20% fine gravel, 30% clay which occurs as slurry to 75.0' after which it is a moist coating on gravel, coarse gravel decreases as fine gravel increases (some of which is sandstone & sandy shale fragments) with depth until fine gravel to ½" size is about 75% of sample near bottom of hole, subangular with angular breaks and occasionally sub-rounded, individual grains are hard, only occasional slight reaction to HCl. (GC)

94.0': GYPSIFEROUS BRECCIA; shale, soft gray. (Hermosa Formation)

EXPLANATION

CORE LOSS
CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 864-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-8W LOCATION West of Dolores River GROUND ELEV. 4937.53 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E. TOTAL DEPTH 70.0'

BEGUN 10-13-76 FINISHED 10-13-76 DEPTH OF OVERBURDEN 68.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.

DRILL EQUIPMENT

Becker, Model No. 180 truck-mounted, air-hammer drive, 5½" O. D. double wall casing of 3¼"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM

Air medium throughout the hole.

CASING & BACKFILL

Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-12.0	Moist
12.0-27.0	Water Flow
27.0-40.0	Moist
40.0-53.0	Wet
53.0-54.0	Water Flow
54.0-62.0	Moist
62.0-68.0	Water Flow
68.0-70.0	Moist

PIEZOMETER

Installed 5.0' slotted piezometer screen and standpipe with screen located from 61.0' to 66.0'. Then backfilled as described above.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Ca or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
5.5" BD	AS						4937.53	0.0		
							4922.53	15.0		
							4912.53	25.0		
							4912.03	25.5		
							4910.53	27.0		
							4892.53	45.0		
							4885.53	52.0		
							4884.53	53.0		
							4883.53	54.0		
							4877.53	60.0		
							4875.53	62.0		
5.5" BD	AS	Bottom of Hole					4869.53	68.0		
							4867.53	70.0		

Stopped drilling because in formation.

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-15.0': SILTY SAND; 70% fine sand, 30% non-plastic fines from 0.0' to 5.0', beyond 5.0' there is 20% coarse to medium sand, 50% fine sand, 30% non-plastic fines, subangular to subrounded, tan to brown, loose consistency on ground surface, strong HCl reaction. (SM)

15.0'-25.0': SAND; 10% fine gravel to 1½" size, 15% coarse sand, 55% medium sand, 20% fine sand, subrounded to subangular, gray, moderately strong HCl reaction. (SW)

25.0'-25.5': FAT CLAY; high plasticity, gray, high dry strength and toughness, strong HCl reaction. (CH)

25.5'-27.0': SAND; 10% fine gravel to ½" size, 10% coarse to medium sand, 80% fine sand, subangular, gray, evaporite coating on dried sample, poorly graded, strong HCl reaction. (SP).

27.0'-45.0': CLAYEY GRAVEL; 30% coarse gravel to 2" size, 20% medium gravel, 20% fine gravel and coarse sand, 30% plastic fines and thin clay seams, gravel and sand is subrounded to subangular and hard, clay is gray and red to 30' depth, beyond 30' it is red, some white evaporite coating on dried sample, moderate reaction to HCl. (GC)

45.0'-52.0': CLAYEY SAND; 15% coarse to medium sand, 45% fine sand, 40% plastic fines, subrounded to subangular, reddish brown, some white evaporite on dried sample, strong reaction to HCl. (SC)

52.0'-53.0': FAT CLAY; high plasticity, gray, high dry strength and toughness, strong reaction to HCl. (CH)

53.0'-54.0': SILTY SAND; 60% fine sand, 40% non-plastic fines, subangular to subrounded, brown occurred in slurry, strong HCl reaction. (SM)

54.0'-60.0': GRAVEL ; 30% coarse gravel to 1½" size with angular breaks indicating some possible cobbles, 50% medium gravel, 20% fine gravel to coarse sand, mostly subrounded with angular breaks, individual grains are very hard, some evaporite coating on dried sample, moderate reaction to HCl. (GW)

60.0'-62.0': SAND; 10% fine gravel to 1" size, 15% coarse sand, 35% medium sand, 40% fine sand, subangular to subrounded, gray, strong reaction to HCl. (SW)

62.0'-68.0': SILTY SAND; 5% fine gravel 59 1" size, 10% coarse sand, 15% medium sand, 30% fine sand, 40% non-plastic fines, subangular to subrounded, gray, moderate to strong HCl reaction. (SM)

68.0'-70.0': GYPSIFEROUS BRECCIA; shale, soft, gray. (Hermosa Formation)

Sheet 11 of 66

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole	D = Diamond, H = Hayestellite, S = Shot, C = Churn		
Hole sealed	P = Packer, Cm = Cemented, Cs = Bottom of casing		
Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series)	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8", Nx = 3"

7-1337 (9-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado
HOLE NO PH-9W LOCATION West of Dolores River GROUND ELEV. 4936.50 DIP (ANGLE FROM HORIZ.) 90°
COORDS. N. E.
BEGUN 10-13-76 FINISHED 10-13-76 DEPTH OF OVERBURDEN 20.0' TOTAL DEPTH 22.0' BEARING
DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

Drilled by Becker Drill, Inc.

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.

DRILL EQUIPMENT
Becker, Model No.180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3½"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM
Air medium throughout the hole.

CASING & BACKFILL
Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-7.0	Dry
7.0-15.0	Moist
15.0-17.0	Water Flow
17.0-20.0	Moist
20.0-22.0	Dry

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
5.5" BD		Not Required		By Specifications			4936.50	0.0		
							4929.50	7.0		
							4921.50	15.0		
							4919.50	17.0		
5.5" BD	AS	Bottom of Hole					4916.50	20.0		
							4914.50	22.0		

Stopped drilling because in formation.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-7.0': SILTY SAND; 60% fine sand,40% non-plastic fines, subangular, tan to brown, loose consistency on ground surface, strong reaction to HCl. (SM)

7.0'-15.0': SAND; 25% coarse sand with occasional fine gravel to ¼" size, 50% medium sand, 25% fine sand, subrounded to subangular, tan, moderate reaction to HCl. (SW)

15.0'-17.0': SILTY SAND; 5% coarse sand, 20% medium sand, 35% fine sand, 40% non-plastic fines, subrounded to subangular, gray-brown, occurred as slurry, evaporite coating, strong reaction to HCl.(SM)

17.0'-20.0': GRAVEL; 30% coarse gravel to 2" size with angular breaks indicating possible cobbles, 40% medium gravel,15% fine gravel, 15% sand, subangular to subrounded, material of individual grains is quite hard, some evaporite coating on dried samples, reactive to HCl. (GW)

20.0'-22.0': GYPSIFEROUS BRECCIA; soft, buff, fine grained sandstone and soft gray sandy shale, gypsiferous shale. (Hermosa Formation)

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . . Ex = 7/8", Ax = 1 1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . . . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE Brine Well Field PROJECT CRBSCP STATE Colorado SHEET 1 OF 1 HOLE NO PH-9W

7-1337 (9-69) Bureau of Reclamation — GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE: Brine Well Field — PROJECT: Paradox Unit, CRBSCP — STATE: Colorado

HOLE NO.: PH-10W — LOCATION: West of Dolores River — GROUND ELEV.: 4936.16 — DIP (ANGLE FROM HORIZ.): 90°

BEGUN: 10-15-76 — FINISHED: 10-15-76 — COORDS. N: ... E: ... — DEPTH OF OVERBURDEN: 81.0' — TOTAL DEPTH: 82.0' — BEARING: ...

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes — LOGGED BY: R. L. Crutchfield — LOG REVIEWED BY: ...

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.

DRILL EQUIPMENT

Becker, Model No. 180 truck-mounted, air-hammer drive, 5½" O. D. double wall casing of 3¼"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM

Air medium throughout the hole.

CASING & BACKFILL

Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0-0'-14.0	Moist
14.0-58.0	Water Flow
58.0-81.0	Moist
81.0-82.0	Dry

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
5.5" BD	AS	Not Required		By Specifications			4936.16	0.0		
							4928.16	8.0		
							4908.16	20.0		
							4906.16	30.0		
							4898.16	38.0		
							4880.16	56.0		
							4878.16	58.0		
5.5" BD	AS	Bottom of Hole					4855.16	81.0		
		Stopped drilling because in formation.					4854.16	82.0		

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: percentages given in the following descriptions are visual estimates.

0.0'-8.0': SILTY SAND;5% coarse sand,20% medium sand, 40% fine sand, 35% non-plastic fines, subangular to subrounded, tan to brown, loose consistency on ground surface, strong reaction to HCl. (SM)

8.0'-20.0': SAND; 5% fine gravel to ½" size, 15% coarse sand, 30% medium sand, 25% fine sand, 25% non-plastic fines, subangular to subrounded, well graded, tan to brown, occurred in slurry from 14.0' to 20.0', slight to moderate reaction to HCl. (SW)

20.0'-30.0': GRAVELLY SAND;25% fine gravel to 1" size, 15% coarse sand, 20% medium sand, 20% fine sand, 20% non-plastic fines, subangular to subrounded, well graded, gray, moderate to strong HCl reaction. (SW)

30.0'-38.0': SAND;5% fine gravel to ¼" size, 10% coarse sand, 25% medium sand, 35% fine sand, 25% non-plastic fines, subrounded to subangular, well graded, dark gray, strong reaction to HCl. (SW)

38.0'-56.0': GRAVELLY SAND;35% fine gravel to 1" size, 15% coarse sand, 15% medium sand, 20% fine sand, 15% non-plastic fines, subrounded to subangular, well graded, gray, strong reaction to HCl, contains about a 2" gray, fat clay seam at about 46.0', clay is also strong reactive to HCl, slight evaporite coating on dried samples. (SW)

56.0'-58.0': SILTY SAND; 60% fine sand, 40% non-plastic fines, subangular, gray-brown, dried sample is light gray with white evaporite coating and crust, strong reaction to HCl. (SM)

58.0'-81.0': GRAVEL;20% coarse gravel to 2½" with angular breaks indicating possible cobbles, 30% medium gravel, 30% fine gravel, 20% coarse sand, (from 64.0 to 70.0 is mostly angular fragments from coarse sand to fine gravel size) subrounded to subangular with angular breaks and fragments, gray, evaporite coating on dried sample, individual grains of material is very hard, coating reacts strongly to HCl. (GW)

81.0'-82.0': GYPSIFEROUS BRECCIA;siltstone and shale. (Hermosa Formation)

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole ..... D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"
Approx. size of core (X-series)	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"

7-1337 (9-69)
Bureau of Reclamation

GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-1E LOCATION East of Dolores River GROUND ELEV. 4939.51 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-15-76 FINISHED 10-15-76 DEPTH OF OVERBURDEN 111.5' TOTAL DEPTH 112.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

Drilled by Becker Drills, Inc.

Spec. No. 400C-610

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill. DRILL EQUIPMENT Becker, Model No.180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3¼"I.D.,with 600 C.F.M. air compressor and cyclone assembly with sample tube. DRILLING MEDIUM Air medium throughout the hole. CASING & BACKFILL Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled. GROUNDWATER Interval Condition 0.0-14.0 Dry-Moist 14.0-35.0 Water Flow 35.0-36.0 Wet 36.0-38.0 Water Flow 38.0-42.0 Wet 42.0-64.0 Water Flow 64.0-88.0 Wet 88.0-106.0 Moist 106.0-109.0 Wet 109.0-112.0 Moist	5.5" BD	AS	Not Required By Specification					4939.51 4930.51 4925.51 4918.51 4917.51 4912.51 4911.51 4904.51 4903.51 4901.51 4899.51 4889.51 4885.51 4877.51	0.0 9.0 14.0 21.0 22.0 27.0 28.0 35.0 36.0 38.0 40.0 50.0 54.0 62.0			NOTE: Percentages given in the following descriptions are visual estimates. 0.0'-9.0': SILTY SAND;10% medium sand, 60% fine sand, 30% non-plastic fines, subrounded to occ. subangular, loose consistency on surface, brown, strong reaction to HCl, some salt from 6.0' to 9.0'. (SM) 9.0'-14.0': SAND;15% coarse sand, 60% medium sand, 25% fine sand, subangular to subrounded, well graded, tan to brown, moderate to slight HCl reaction, salt (cementing sand & white crust)becoming more prominent. (SW) 14.0'-21.0': SANDY GRAVEL;30% medium gravel, (1" maximum size), 30% fine gravel, 40% sand, subangular to occ. subrounded, sand and gravel mixed with water to form slurry, dried sample became hard and cemented with clear to white evaporite minerals, moderate to slight reaction to HCl. (GW) 21.0'-22.0': SANDY CLAY; low plasticity, contains about 35% fine sand, dark brown to black, contains traces of organic material, medium dry strength and toughness, strong to moderate HCl reaction. (CL) 27.0'-28.0': FAT CLAY;moderately high to high plasticity, brown, high dry strength and toughness, some white evaporite coating on dry sample, moderate reaction to HCl. (CH) 28.0'-35.0': SAND; as 22.0-27.0 above, well graded. 35.0'-36.0': FAT CLAY; as 27.0-28.0 above, but traces of organic gray to black clay in brown clay. 36.0'-38.0': GRAVELLY SAND; 30% fine to medium gravel to 1" size, 20% coarse sand, 35% medium sand, 15% fine sand, subrounded to subangular, coarse grains are very hard, some white evaporite coating on dry sample, strong reaction to HCl. (SW) 38.0'-40.0': FAT CLAY; as 27.0-28.0. 40.0'-50.0': SAND; 10% fine gravel, 20% coarse sand, 50% medium sand, 20% fine sand, tan, subrounded to subangular, dries with white evaporite crust, strong HCl reaction. (SW) 50.0'-54.0': SILTY SAND;5% coarse sand, 30% medium sand, 35% fine sand, 30% non-plastic fines, mostly subangular
	5.5" BD	AS						4839.51	100.0			

22.0'-27.0': SAND; 10% fine to medium gravel (1" maximum) 10% coarse sand, 50% medium sand, 30% fine sand, subangular to subrounded, tan, dryer with hard, evaporite crust cementation, strong HCl reaction (SW)

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . . . D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2 1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series). . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

7-1537 (9-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado
HOLE NO. PH-1E LOCATION East of Dolores River GROUND ELEV. 4939.51 DIP (ANGLE FROM HORIZ.) 90°
COORDS. N. E.
BEGUN 10-15-76 FINISHED 10-15-76 DEPTH OF OVERBURDEN 111.5' TOTAL DEPTH 112.0' BEARING
DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
	5.5" BD	AS		Bottom of Hole				4839.51 4828.01 4827.51	100.0 111.5 112.0		

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

with some subrounded, occurred as sand-water slurry, dries with white evaporite crust, strong HCl reaction, gray. (SM)

54.0'-62.0': GRAVELLY SAND;25% to 35% gravel up to 1" size, 35% coarse sand, 30% medium sand, 10% fine sand (gravel becomes more concentrated with depth), subrounded to subangular, white evaporite coating, strong reaction to HCl. (SW) (Heavy brine slurry from 50' to 64')

62.0'-111.5': GRAVEL; 25% coarse gravel up to 1½" size and with broken, angular fragments which indicate some cobbles, 30% fine gravel, 30% medium gravel, 15% to 25% fine to coarse sand (percentage of sand in relation to gravel varies w/ depth), subrounded to subangular with some angular breaks from percussion drill, white evaporite coatings throughout, coating reacts to HCl from slightly strong to strongly. (GW)

111.5'-112.0': GYPSIFEROUS BRECCIA; soft, gray, shale. (Hermosa Formation)

Stopped drilling because in formation.

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-2E LOCATION East of Dolores River GROUND ELEV. 4939.50 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-14-76 FINISHED 10-14-76 DEPTH OF OVERBURDEN 103.0' TOTAL DEPTH 106.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.	5.5" BD	AS	Not Required		By Specification			4939.50	0.0		
DRILL EQUIPMENT Becker, Model No. 180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3½"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.								4933.50	6.0		
DRILLING MEDIUM Air medium throughout the hole.								4929.50	10.0		
CASING & BACKFILL Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.								4925.50	14.0		
GROUNDWATER Interval — Condition 0.0–14.0 Moist 14.0–25.0 Wet 25.0–29.0 Moist 29.0–44.0 Wet 44.0–54.0 Water Flow 54.0–70.0 Moist 70.0–86.0 Dry 86.0–91.0 Wet 91.0–102.0 Water Flow 102.0–103.0 Wet 103.0–106.0 Moist								4919.50	20.0		
								4914.50	25.0		
								4909.50	30.0		
NOTE: Dry zone may have lost some moisture in blowing air medium.								4901.50	38.0		
								4896.50	43.0		
								4894.50	45.0		
								4889.50	50.0		
								4889.00	50.5		
								4887.50	52.0		
								4887.00	52.5		
								4883.50	56.0		
								4849.50	90.0		
								4848.50	91.0		
								4846.50	93.0		
								4844.50	95.0		
	5.5" BD	AS						4839.50	100.0		

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-6.0': SILTY SAND; 70% fine sand, 30% non-plastic fines, subangular to occ. subrounded, loose consistency on ground surface, brown to tan, strong HCl reaction. (SM)

6.0'-10.0': SAND; 20% medium, 80% fine sand, subangular to subrounded, poorly graded, brown to tan, strong reaction to HCl. (SP)

10.0'-14.0': SAND; 10% fine gravel, 30% coarse sand, 40% medium sand, 20% fine sand, subrounded to occasionally subangular, well graded, traces of wood, tan, strong reaction to HCl. (SW)

14.0'-20.0': SILTY SAND; 70% fine sand, 30% non-plastic fines, subrounded to occ. subangular, tan, occurred as slurry, strong HCl reaction. (SM)

20.0'-25.0': FAT CLAY; high plasticity, brown, high dry strength and toughness, moderate HCl reaction. (CH).

25.0'-30.0': CLAYEY SAND; 10% coarse sand, 30% medium sand, 30% fine sand, 30% plastic fines, plastic fines are brown to red-brown, occurred as a slurry, strong reaction to HCl. (SC)

30.0'-38.0': SAND; 10% fine gravel to ½" size, 20% coarse sand, 40% medium sand, 30% fine sand, subrounded to subangular, some white evaporite crystallization on sample, tan, strong HCl reaction. (SW)

38.0'-43.0': FAT CLAY; as 20.0' to 25.0' above. (CH)

43.0'-45.0': SAND; 10% gravel to 1" size, 20% coarse sand, 40% medium sand, 30% fine sand, subangular to subrounded, strong reaction to HCl, well graded. (SW)

45.0'-50.0': SAND; 10% fine gravel, 25% coarse sand, 35% medium sand, 30% fine sand, subrounded to subangular, well graded, moderate reaction to HCl. (SW)

50.0'-50.5': FAT CLAY; high plasticity, gray-brown, high dry strength and toughness, strong reaction to HCl. (CH)

50.5'-52.0': SAND; as 45.0' to 50.0' above. (SW)

52.0'-52.5': FAT CLAY; as 50.0' to 50.5' above. (CH)

52.5'-56.0': SAND; 10% gravel up to 1" size, 25% coarse sand, 40% medium sand,

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . D = Diamond, H = Hayesterlite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . . Ex = 1-1 2", Ax = 1-7 8", Bx = 2-3 8", Nx = 3"
Approx. size of core (X-series) . . . Ex = 7/8", Ax = 1-1 8", Bx = 1-5/8", Nx = 2-1 8"
Outside dia. of casing (X-series) . . . Ex = 1-13 16", Ax = 2-1 4", Bx = 2-7 8", Nx = 3-1 2"
Inside dia. of casing (X-series) . . . Ex = 1-1 2", Ax = 1-29/32", Bx = 2-3 8", Nx = 3"

7-1337 (9-69)
Bureau of Reclamation

GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-2E LOCATION East of Dolores River GROUND ELEV. 4939.50 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E. TOTAL DEPTH 106.0' BEARING

BEGUN 10-14-76 FINISHED 10-14-76 DEPTH OF OVERBURDEN 103.0'

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (F, C, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
	5.5" BD	AS		Bottom of Hole				4839.50	100.0		
								4836.50	103.0		
								4833.50	106.0		

Stopped drilling because in formation.

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400c-610

25% fine sand, subrounded to subangular, well graded, moderate reaction to HCl. (SW)

56.0'-90.0': GRAVEL; 35% coarse gravel, with some angular breaks indicating possible cobble fragments, 40% medium gravel, 25% fine gravel, beyond 70.0' contains 15% sand and less coarse gravel, subrounded to subangular with some angular breaks, extreme hardness indicated in coarse grains. (GW)

90.0'-91.0': FAT CLAY; high plasticity, gray, high dry strength and toughness, moderate HCl reaction. (CH)

91.0'-93.0': GRAVEL; as 56.0'-90.0' above. (GW)

93.0'-95.0': GRAVEL; as 91.0'-93.0' above with fine clayey sand slurry, and occ. 1" to 2" clay layers. (GW)

95.0'-103.0': GRAVELLY SAND; 20% gravel to 2" size, 30% coarse sand, 30% medium sand, 20% fine sand, subangular to subrounded, strong HCl reaction. (SW)

103.0'-106.0': GYPSIFEROUS BRECCIA; soft, gray, shale. (Hermosa Formation)

CORE LOSS

CORE RECOVERY

EXPLANATION

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . . . D = Diamond, H = Hayrstellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-3E LOCATION East of Dolores River GROUND ELEV. 4938.58 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-14-76 FINISHED 10-14-76 DEPTH OF OVERBURDEN 65.0' TOTAL DEPTH 75.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.

DRILL EQUIPMENT
Becker, Model No.180 truck-mounted, air-hammer drive, 5½" O. D. double wall casing of 3½"I.D. with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM
Air medium thoughout hole.

CASING & BACKFILL
Placed 5½"O. D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-14.0	Moist
14.0-20.0	Wet
20.0-54.0	Water Flow
54.0-75.0	Moist

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cm, & Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
5.5" BD	AS	Not Required		By Specification			4938.58	0.0		
							4932.58	6.0		
							4929.58	9.0		
							4924.58	14.0		
							4918.58	20.0		
							4911.58	27.0		
							4911.08	27.5		
							4894.58	44.0		
							4893.58	45.0		
							4892.58	46.0		
							4884.58	54.0		
							4873.58	65.0		
5.5" BD	AS	Bottom of Hole					4863.58	75.0		

Stopped drilling because in formation.

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: percentages given in the following descriptions are visual estimates.

0.0'-6.0': SILTY SAND;60% fine sand,40% non-plastic fines, subangular to subrounded, tan to brown, loose consistency on ground surface, strong reaction to HCl. (SW)

6.0'-9.0': SAND;70% medium sand, 30% fine sand, subangular to subrounded, tan, strong reaction to HCl. (SP)

9.0'-14.0': SAND; 20% coarse sand to ¼" gravel, 50% medium sand, 30% fine sand, subrounded to subangular, well graded, tan, strong reaction to HCl. (SW)

14.0'-20.0': SILTY SAND;20% medium sand, 50% fine sand, 30% non-plastic fines, subrounded to subangular occurred as slurry with about 2" clay layers at 15.0 and 18.0', gray, strong reaction to HCl. (SM)

20.0'-27.0': SAND; 15% fine gravel to 1" size, 10% coarse sand, 25% medium sand, 50% fine sand, subrounded to subangular, well graded, gray, strong reaction to HCl.(SW)

27.0'-27.5': FAT CLAY;high plasticity, gray-brown high dry strength and toughness, moderately strong reaction to HCl. (CH)

27.5'-44.0': SAND;10% fine gravel to 1" size, 20% coarse sand, 40% medium sand, 30% fine sand, subangular to occasionally subrounded, well graded, gray, some white evaporite coating on dried samples, strong reaction to HCl. (SW)

44.0'-45.0': FAT CLAY; as 27.0-27.5' above. (CH)

45.0'-46.0': SAND; 5% fine gravel up to ½" size, 10% coarse sand, 40% medium sand, 45% fine sand, occ. trace of clay, subangular, well graded, dark gray, strong reaction to HCl. (SW)

46.0'-54.0': GRAVELLY SAND; 20% gravel up to 2" size with angular breaks indicating possible cobbles, 30% coarse sand, 30% medium sand, 20% fine sand, subangular to occasionally subrounded, well sorted, gray, strong reaction to HCl. (SW)

54.0'-65.0': GRAVEL;40% coarse gravel up to 1½" size with angular breaks indicating possible cobble, 25% medium gravel, 35% fine gravel to coarse sand, subrounded to subangular with angular breaks, grains are very hard, considerable evaporite coating and cementation on dried sample, moderate to strong reaction to HCl. (GW)

65.0'-75.0': GYPSIFEROUS BRECCIA; soft, gray, shale (Hermosa Formation)

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . D = Diamond, H = Hayssellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2"	Ax = 1-7/8"	Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series)	Ex = 7/8"	Ax = 1-1/8"	Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16"	Ax = 2-1/4"	Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2"	Ax = 1-29/32"	Bx = 2-3/8", Nx = 3"

Sheet 18 of 66

7-1337 (9-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE: Brine Well Field | PROJECT: Paradox Unit, CRBSCP | STATE: Colorado

HOLE NO.: PH-4E | LOCATION: East of Dolores River | GROUND ELEV.: 4939.66 | DIP (ANGLE FROM HORIZ.): 90°

COORDS. N: E:

BEGUN: 10-14-76 | FINISHED: 10-14-76 | DEPTH OF OVERBURDEN: 53.0' | TOTAL DEPTH: 56.0' | BEARING:

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes | LOGGED BY: R. L. Crutchfield | LOG REVIEWED BY:

Drilled by Becker Drill, Inc.

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (F, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill. DRILL EQUIPMENT Becker, Model No.180 truck-mounted air-hammer drive, 5½" O.D. double wall casing of 3½"I.D.,with 600 C.F.M. air compressor and cyclone assembly with sample tube. DRILLING MEDIUM Air medium throughout the hole. CASING & BACKFILL Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled. GROUNDWATER Interval / Condition 0.0-6.0 Dry-Moist 6.0-14.0 Moist 14.0-40.0 Water Flow 40.0-46.0 Wet 46.0-47.0 Water Flow 47.0-49.0 Moist 49.0-56.0 Dry	5.5"OD BD	AS	Not Required		By Specifications			4939.66	0.0			Spec. No. 400C-610
								4933.66	6.0			NOTE: Percentages given in the following descriptions are visual estimates. 0.0'-6.0': SILTY SAND:60% fine sand, 40% non-plastic fines, subangular, tan, loose consistency on ground surface, strong reaction to HCl. (SM)
								4925.66	14.0			6.0'-14.0': SAND;15% coarse sand with occ. gravel up to ¼", 45% medium sand, 40% fine sand, subrounded to subangular, tan, strong reaction to HCl. (SW)
								4914.66	25.0			14.0'-25.0': SAND; 10% fine gravel to ¼" size, 30% coarse sand, 30% medium sand, 30% fine sand, subrounded to subangular, occurred in slurry, gray, strong reaction to HCl. (SW)
								4913.66	26.0			25.0'-26.0': FAT CLAY; high plasticity, gray, high dry strength and toughness, strong reaction to HCl.
								4909.66	30.0			26.0'-30.0': SAND; as 14.0' to 25.0' above. (SW)
								4899.66	40.0			30.0'-40.0': GRAVELLY SAND; 30% gravel up to 1" size, 20% coarse sand, 30% medium sand, 20% fine sand, subangular to subrounded, gray, some evaporite coating on dried sample, strong reaction to HCl. (SW)
								4886.66	53.0			40.0'-53.0': SANDY GRAVEL; 20% coarse gravel to 2" size with angular breaks indicating possible cobbles, 20% medium gravel, 20% fine gravel, 40% fine to coarse sand, trace of red clay, subrounded to subangular, gray, evaporite coating on dried sample, moderately to strong reaction to HCl. (GW)
	5.5"OD BD	AS	Bottom of Hole					4883.66	56.0			53.0'-56.0': GYPSIFEROUS BRECCIA; soft, gray shale (Hermosa Formation)
			Stopped drilling because in formation.									

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1 2"	Ax = 1-7/8"	Bx = 2-3/8"	Nx = 3"
Approx. size of core (X series)	Ex = 7/8"	Ax = 1-1/8"	Bx = 1-5/8"	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1 13/16"	Ax = 2-1/4"	Bx = 2-7/8"	Nx = 3 1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2"	Ax = 1-29/32"	Bx = 2-3/8"	Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-5E LOCATION East of Dolores River GROUND ELEV. 4938.85 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 10-14-76 FINISHED 10-14-76 DEPTH OF OVERBURDEN 73.0' TOTAL DEPTH 74.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.	6.5" BD	AS	Not Required		By Specification			4938.85	0.0		
DRILL EQUIPMENT Becker, Model No.180 truck-mounted air-hammer drive, 5½" O.D. double wall casing of 3¼"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.								4930.85	8.0		
DRILLING MEDIUM Air medium throughout the hole.								4927.85	11.0		
CASING & BACKFILL Placed 5½"O.D.casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.								4925.35	13.5		
								4924.85	14.0		
								4920.85	18.0		
								4920.35	18.5		
								4908.85	30.0		
								4892.85	46.0		
								4888.85	50.0		
								4884.85	54.0		
								4865.95	73.0		
	6.5" BD	AS	Bottom of Hole					4864.85	74.0		
			Stopped drilling because in formation.								

GROUNDWATER

Interval	Condition
0.0-5.0	Moist
5.0-9.0	Dry-Moist
9.0-12.0	Moist
12.0-48.0	Water Flow
48.0-54.0	Wet
54.0-67.0	Wet-Moist
67.0-74.0	Dry

NOTE: The lower dry zone may have lost some moisture in blowing air medium.

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-8.0': SILTY SAND; 70% fine sand, 30% non-plastic fines, subrounded to subangular, tan to brown, loose consistency at ground surface, strong HCl reaction. (SM)

8.0'-11.0': SAND; 5% coarse sand, 85% medium sand, 10% fine sand, subangular to occasionally subrounded, tan, poorly graded, strong reaction to HCl. (SP)

11.0'-13.5': SAND; 10% fine gravel to ½" size, 30% coarse sand, 40% medium sand, 20% fine sand, subrounded to subangular with occasional angular coarse grains, tan, well graded, occurred in slurry beyond 12.0', strong HCl reaction. (SW)

13.5'-14.0': LEAN CLAY; Medium plasticity, contains about 20% fine sand and non-plastic fines, brown with traces of black organic material, medium to moderately high dry strength, medium toughness, strong HCl reaction. (CL)

14.0'-18.0': SAND; 5% coarse sand, 50% medium sand, 45% fine sand, subangular to subrounded, gray, occurred in slurry, moderately strong HCl reaction. (SW)

18.0'-18.5': FAT CLAY; high plasticity, gray-brown, high dry strength and toughness, strong reaction to HCl. (CH)

18.5'-30.0': SAND; 5% gravel to 1", 15% coarse sand, 60% medium sand, 20% fine sand, subrounded to subangular, gray, occurred in slurry, moderate reaction to HCl. (SP)

30.0'-46.0': GRAVELLY SAND; 25% fine gravel to 1" size, 20% coarse sand, 35% medium sand, 20% fine sand, subangular to subrounded, gray, some evaporite coating on dried sample, strong reaction to HCl, encountered wood fragments at 46.0' (probably a log). (SW)

46.0'-50.0': CLAYEY GRAVEL; 70% fine gravel to ½" size, subrounded to subangular, 30% plastic fines and chunks of fat clay, gray, strong HCl reaction. (GC)

50.0'-54.0': FAT CLAY; high plasticity for most part with some silty zones which grade to lean clay, gray to gray-brown, high dry strength, moderately high to high toughness, moderate reaction to HCl. (CH)

54.0'-73.0': GRAVEL; 20% coarse gravel to 1½", 40% medium gravel, 30% fine gravel, 10% coarse sand, sand becomes more fine beyond 68.0', subrounded to subangular, individual grains are quite hard, some evaporite coating on dried sample, strong HCl reaction (GW)

73.0'-74.0': GYPSIFEROUS BRECCIA; shale, soft, gray. (Hermosa Formation)

Sheet 20 of 66

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole . . . . . D = Diamond, H = Hayssellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series) . . Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"
Inside dia. of casing (X-series). . Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"

7-1337 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-6E LOCATION East of Dolores River GROUND ELEV. 4937.11 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E. BEARING

BEGUN 10-13-76 FINISHED 10-13-76 DEPTH OF OVERBURDEN 74.0' TOTAL DEPTH 78.0'

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

Drilled by Becker Drills, Inc.

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.

DRILL EQUIPMENT

Becker, Model No.180 truck-mounted, air-hammer drive, 5½"O.D. double wall casing of 3½"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM

Air medium throughout the hole.

CASING & BACKFILL

Placed 5½"O.D. casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-10.0	Dry-Moist
10.0-14.0	Moist
14.0-16.0	Wet
16.0-30.0	Water Flow
30.0-51.0	Wet
51.0-55.0	Wet-Moist
55.0-66.0	Dry
66.0-74.0	Water Flow
74.0-78.0	Moist

NOTE: Lower dry zones may have lost moisture in blowing air medium

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, & Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)
5.5" BD	AS	Not Required By Specifications					4937.11	0.0
							4927.11	10.0
							4923.11	14.0
							4917.11	20.0
							4907.11	30.0
							4903.11	34.0
							4899.11	38.0
								40
							4892.11	45.0
							4886.11	51.0
							4881.11	56.0
								60
							4875.11	62.0
							4871.11	66.0
							4869.11	68.0
								70
							4863.11	74.0
5.5" BD	AS	Bottom of Hole					4859.11	78.0
		Stopped drilling because in formation.						80
								90

SAMPLES FOR TESTING

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-10.0': SILTY SAND; 60% fine sand, 40% non-plastic fines, subangular, tan to brown, loose consistency on ground surface, strong reaction to HCl. (SM)

10.0'-14.0': SAND; 10% coarse sand, 40% medium sand, 30% fine sand, 20% non-plastic fines, subrounded to subangular, tan to brown, strong HCl reaction. (SW)

14.0'-20.0': SAND; 10% fine gravel to 1" size, 20% coarse sand, 40% medium sand, 30% fine sand, subangular to subrounded, tan, occurred in slurry, moderate reaction to HCl. (SW)

20.0'-30.0': SILTY SAND; 5% fine gravel to 1" size, 5% coarse sand, 60% fine sand, 30% non-plastic fines, subrounded to subangular, gray, evaporite coating on dried sample, occurred as slurry, strong HCl reaction. (SM)

30.0'-34.0': FAT CLAY; Moderately high to high plasticity, gray to brown to to black, contains some organic black material and may grade to OH in places, high dry strength, moderately high to high toughness, moderate HCl reaction. (CH)

34.0'-38.0': SANDY CLAY; medium to moderately high plasticity and may grade to fat clay in places, contains about 35% fine sand, red-brown, moderately high dry strength, medium toughness, strong reaction to HCl. (CL)

38.0'-45.0': FAT CLAY; high plasticity, brown, high dry strength and toughness, moderately strong HCl reaction. (CH)

45.0'-51.0': SANDY CLAY; low to medium plasticity, contains about 40% fine subrounded to subangular sand, red-brown, medium dry strength and toughness, strong HCl reaction. (CL)

51.0'-56.0': CLAYEY GRAVEL; 60% gravel to 1", 40% sandy clay as above, gravel is mostly subrounded, moderate to strong HCl reaction. (GC)

56.0'-62.0': GRAVELLY SAND; 20% fine gravel to 1" size, 20% coarse sand, 20% medium sand and 40% fine sand to 60.0' depth, beyond 60.0' becomes 20% fine gravel to ¼' size, 60% coarse sand, 10% medium sand and 10% fine sand, subrounded to subangular, gray, strong HCl reaction. (SW)

CORE LOSS

CORE RECOVERY

EXPLANATION

BD = Becker Drill
AS = Air (blown) Sample

Type of hole . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"
Approx. size of core (X-series)	Ex = 1",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"

FEATURE Brine Well Field PROJECT CRBSCP STATE Colorado SHEET 1 OF 2 HOLE NO PH-6E

7-1337 (8-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Brine Well Field PROJECT Paradox Unit, CRBSCP STATE Colorado

HOLE NO. PH-6E LOCATION East of Dolores River GROUND ELEV. 4937.11 DIP (ANGLE FROM HORIZ.) 90°

BEGUN 10-13-76 FINISHED 10-13-76 DEPTH OF OVERBURDEN 74.0' TOTAL DEPTH 78.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R. L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								4937.11	0.0			Drilled by Becker Drills, Inc. Spec. No. 400C-610

62.0'-66.0': FAT CLAY; High plasticity, gray, high dry strength and toughness, moderate HCl reaction. (CH)

66.0'-68-0': GRAVELLY CLAY;low plasticity clay with about 30% fine sand and 10% 1" to 2" gravel, gray, medium dry strength and toughness, moderate HCl reaction, gravel occurred in sandy clay slurry. (CL)

68.0'-74.0': GRAVEL; 30% coarse gravel to 1½" with angular breaks indicating possible cobbles 30% medium gravel, 20% fine gravel, 20% sand slurry, subrounded, hard grains.

74.0'-78.0': GYPSIFEROUS BRECCIA; shale and sandstone. (Hermosa Formation)

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole	D = Diamond, H = Hoystellite, S = Shot, C = Churn				
Hole sealed	P = Packer, Cm = Cemented, Cs = Bottom of casing				
Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"	
Approx. size of core (X-series)	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"	
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"	
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"	

7-1887 (8-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE: Brine Well Field | PROJECT: Paradox Unit, CRBSCP | STATE: Colorado

HOLE NO.: PH-7E | LOCATION: East of Dolores River | GROUND ELEV.: 4936.63 | DIP (ANGLE FROM HORIZ.): 90°

COORDS. N. ..... E. .....

BEGUN: 10-13-76 | FINISHED: 10-13-76 | DEPTH OF OVERBURDEN: 77.0' | TOTAL DEPTH: 80.0' | BEARING:

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes | LOGGED BY: R. L. Crutchfield | LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill.	5.5" BD	AS	Not Required		By Specifications			4936.63	0.0		
								4929.63	7.0		
								4922.63	14.0		
								4916.63	20.0		
								4902.63	34.0		
								4901.63	35.0		
								4896.63	40.0		
								4895.63	41.0		
								4890.63	46.0		
								4883.63	53.0		
								4882.63	54.0		
								4881.63	55.0		
								4876.63	60.0		
								4874.63	62.0		
								4870.63	66.0		
								4861.63	75.0		
								4859.63	77.0		
	5.5" BD	AS	Bottom of Hole					4856.63	80.0		

Drilled by Becker Drill, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-7.0': SILTY SAND; 60% fine sand, 40% non-plastic fines, subangular, tan to brown, loose consistency on ground surface, strong HCl reaction. (SM)

7.0'-14.0': SAND; 5% coarse sand, 30% medium sand, 40% fine sand, 25% non-plastic fines, subangular, tan to brown, strong reaction to HCl. (SW)

14.0'-20.0': SILTY SAND; 5% coarse sand, 20% medium sand, 35% fine sand, 40% non-plastic fines, subrounded to subangular, brown, occurred in slurry, moderate HCl reaction. (SM)

20.0'-34.0': SAND; 10% fine gravel to 1" size, 15% coarse sand, 60% medium sand, 15% fine sand, subrounded to subangular, gray, occurred in slurry, strong HCl reaction. (SW)

34.0'-35.0': FAT CLAY; high plasticity, gray to brown, high dry strength and tougness, moderate to strong HCl reaction.

35.0'-40.0': SAND; as 20.0 to 34.0' above.

40.0'-41.0': FAT CLAY; as 34.0 to 35.0 above.

41.0'-46.0': SILTY SAND; 65% fine sand, 35% non-plastic fines, subangular, gray, occurred as slurry, white evaporite coating on dried sample, strong reaction to HCl. (SM)

46.0'-53.0': GRAVELLY SAND; silty sand, as above with 25% coarse sand to 1" gravel.

53.0'-54.0': FAT CLAY; high plasticity, gray-brown, high dry strength and toughness, moderately strong HCl reaction (CH).

54.0'-55.0': CLAYEY GRAVEL; 60% fine gravel to 1" size with 40% fat, gray-brown clay as above, moderate reaction to HCl, subrounded to subangular. (GC)

55.0'-60.0': GRAVEL; 30% coarse gravel to 2" size, 40% medium gravel, 30% fine gravel to coarse sand, subrounded to subangular with angular breaks, hard individual grains, some evaporite coating, slight HCl reaction. (GW)

60.0'-62.0': CLAYEY GRAVEL; as in 54.0' to 55.0' above.

DRILL EQUIPMENT

Becker, Model No. 180 truck-mounted, air-hammer drive, 5½" O.D. double wall casing of 3¼ I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube.

DRILLING MEDIUM

Air medium throughout the hole.

CASING & BACKFILL

Placed 5½" O.D. casing as hole was drilled. Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled.

GROUNDWATER

Interval	Condition
0.0-6.0	Dry-Mois
6.0-10.0	Moist
10.0-14.0	Moist-Wet
14.0-50.0	Water Flow
50.0-77.0	Wet
77.0-80.0	Moist-Dry

EXPLANATION

CORE LOSS / CORE RECOVERY

BD = Becker Drill

AS = Air (blown) Sample

Type of hole ..... D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) .. Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) .. Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series). Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

Sheet 23 of 66

FEATURE: Brine Well Field | PROJECT: CRBSCP | STATE: Colorado | SHEET 1 OF 2 | HOLE NO. PH-7E

☆GPO 679-482

7-1887 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE: Brine Well Field — PROJECT: Paradox Unit, CRBSCP — STATE: Colorado

HOLE NO.: PH-7E — LOCATION: East of Dolores River — GROUND ELEV.: 4936.63 — DIP (ANGLE FROM HORIZ.): 90°

COORDS. N: E:

BEGUN: 10-13-76 — FINISHED: 10-13-76 — DEPTH OF OVERBURDEN: 77.0' — TOTAL DEPTH: 80.0' — BEARING:

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes — LOGGED BY: R. L. Crutchfield — LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	Drilled by Becker Drills, Inc. CLASSIFICATION AND PHYSICAL CONDITION Spec. No. 400C-610
												62.0'-66.0': FAT CLAY; high plasticity, gray, high dry strength and toughness, some evaporite coating on dried sample, moderate to strong HCl reaction. (CH) 66.0'-75.0': GRAVEL; 30% coarse to 1½" size, 40% medium gravel, 30% fine gravel, subrounded to subangular with angular breaks, some evaporite coating, slight to moderate HCl reaction. (GW) 75.0'-77.0': CLAYEY GRAVEL; gravel as above with sticky, gray clay coating and occasional pieces of gypsiferous shale breccia. Transition zone into formation. 77.0'-80.0': GYPSIFEROUS BRECCIA; shale, soft, gray, (Hermosa Formation).

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series)	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8", Nx = 3"

☆GPO 679-462

7-1887 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE: Brine Well Field | PROJECT: Paradox Unit, CRBSCP | STATE: Colorado

HOLE NO.: PH-8E | LOCATION: East of Dolores River | GROUND ELEV.: 4935.46 | DIP (ANGLE FROM HORIZ.): 90°

COORDS. N. ..... E. .....

BEGUN: 10-13-76 | FINISHED: 10-13-76 | DEPTH OF OVERBURDEN: 47.0' | TOTAL DEPTH: 54.0' | BEARING:

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes | LOGGED BY: R. L. Crutchfield | LOG REVIEWED BY:

Drilled by Becker Drills, Inc.

CLASSIFICATION AND PHYSICAL CONDITION

Spec. No. 400C-610

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, C, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
All depths are taken from ground surface; some subsidence at hole due to impact of percussion drill. DRILL EQUIPMENT Becker, Model No.180 truck-mounted, air-hammer drive, 5½" O. D. double wall casing of 3¼"I.D., with 600 C.F.M. air compressor and cyclone assembly with sample tube. DRILLING MEDIUM Air medium throughout the hole. CASING & BACKFILL Placed 5½"O.D.casing as hole was drilled Casing was removed on completion of drilling and hole was backfilled with sand as casing was pulled. GROUNDWATER Interval — Condition 0.0-14.0 — Moist 14.0-17.0 — Wet 17.0-39.0 — Water Flow 39.0-47.0 — Wet 47.0-54.0 — Moist-Dry	5.5"QD BD 5.5"QD BD 5.5"QD BD							4935.46 4925.46 4921.46 4909.46 4905.46 4892.46 4891.96 4888.46 4881.46	0.0 10.0 14.0 20 26.0 30.0 40 43.0 43.5 47.0 50 54.0 60 70 80 90		
	AS			Bottom of Hole Stopped drilling because in formation.							

NOTE: Percentages given in the following descriptions are visual estimates.

0.0'-10.0': SILTY SAND; 60% fine sand to 75% fine sand beyond 6.0' depth, 40% to 25% non-plastic fines, subangular, tan to brown to light reddish brown, loose consistancy on ground surface, strong reaction to HCl. (SM)

10.0'-14.0': SAND; 15% coarse sand, 40% medium sand, 45% fine sand, subangular, tan, strong reaction to HCl. (SW)

14.0'-26.0': SANDY SILT;40% fine sand, 60% non-plastic fines, subangular sand, dark gray brown, occurred as slurry, strong reaction to HCl. (ML)

26.0'-30.0': GRAVELLY SAND;25% fine gravel to ½" size, 15% coarse sand, 15% medium sand, 20% fine sand, 25% non-plastic fines, subangular to subrounded, dark gray, some evaporite coating on dried sample, strong reaction to HCl.(SW)

30.0'-43.0': CLAYEY SAND;10% fine gravel to ½" size, 10% coarse sand, 15% medium sand, 25% fine sand, 40% mostly plastic fines, subangular to subrounded visible grains, dark gray to black, moderate reaction to HCl. (SC)

43.0'-43.5': SANDY CLAY;low plasticity, contains about 40% fine sand which is subangular, dark gray, medium dry strength and toughness, strong HCl reaction. (CL)

43.5'-47.0': SAND;5% coarse sand, 25% medium sand, 50% fine sand, 20% non-plastic fines, subangular to occasionally subrounded, gray to dark gray, some white evaporite coating on dried sample, strong reaction to HCl. (SW)

47.0'-54.0': GYPSIFEROUS BRECCIA; shale, and sandy shale with some sandstone. (Hermosa Formation)

EXPLANATION

CORE LOSS

CORE RECOVERY

BD = Becker Drill

AS - Air (blown) Sample

Type of hole ..... D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) .. Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) .. Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx – 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series).. Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE: Brine Well Field | PROJECT: CRBSCP | STATE: Colorado | SHEET 1 OF 1 | HOLE NO. PH-8E

☆GPO 679-482

7-1887 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET. 1 OF. 2

FEATURE Paradox Unit. Brine Wellfield PROJECT. Colorado River Basin Salinity Control STATE. Colorado

HOLE NO. OH-2C1 LOCATION COORDS. N. E. GROUND ELEV. DIP (ANGLE FROM HORIZ.)

BEGUN 9-29-75 FINISHED. 12-6-75 DEPTH OF OVERBURDEN 120.0' TOTAL DEPTH. 225.0' BEARING.

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED. LOGGED BY. D. Burgoyne from *.reports LOG REVIEWED BY.

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspector's drill report.
All depths are taken from ground surface. Hole approx. vertical though not surveyed. DRILL EQUIPMENT 28' hole for piezometer pipe #3 drilled with Portadrill Mod 503, truck-mounted, rotary type on 9-29-75 225' hole drilled 0'-111' with Becker patented, truck-mounted, air-hammer drive, air drill medium drill on 10-20-75. Depths 111'-225' drilled with Portadrill 503. CASING RECORD 10-20-75: Backer Cs driven to 111'. 11-5-75: drove 5" Cs to 112.8'. 12-9-75 Cs pulled to 72'. 12-10-75 remaining Cs pulled. DRILLING MEDIUM 28' hole: NaCl brine 225' hole 0'-111': Air. 111'-164': NaCl brine with "Zeogel" & "Impermex". 164'-225': NaCl brine.	BD	AS	Not required by specifications						0.0 12.0 26.0 42.0 63.0 92.0			0.0'-26.0': SILTY SAND; * some clay lenses above 12.0'; low-medium plasticity; (SM) 12.0'-26.0': some gravel 26.0'-27.0': CLAY; * gray; medium plasticity; (CL-CH) 27.0'-42.0': SILTY SAND & GRAVEL;* (SM-GM) 42.0'-63.0': SILTY GRAVEL; * some cobbles 5"-8"; (GM) 63.0'-92.0': SILTY SAND; * some clay; low plasticity; (SM) 92.0'-110.0': GRAVEL; * 3"

CORE LOSS
CORE RECOVERY

EXPLANATION

BD = Becker drill 9"od-6"id double walled Cs with crowd-out bit shoe

AS = Air-blown samples

Type of hole . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series)	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8", Nx = 3"

Sheet 26 of 66

FEATURE . . . Brine Wellfield . . . PROJECT . . CRBSCP . . . STATE . Colorado . SHEET . 1 . . OF . 2 . HOLE NO. OH-2C1

☆GPO 679-482

7-1887 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Paradox Unit Brine Wellfield PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. OH-2C1 LOCATION COORDS. N. E. GROUND ELEV. DIP (ANGLE FROM HORIZ.)

BEGUN 9-29-75 FINISHED 12-6-75 DEPTH OF OVERBURDEN 120.0' TOTAL DEPTH 225.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED LOGGED BY D. Burgoyne from * Reports LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspector's drill report.
DRILL FLUID LOSSES 100% fluid loss 133'-225' on 11-5-75 to 12-6-75. PIPE INSTALLATIONS On 9-29-75, 28' hole filled with Filter sand & piezometer tip #3 centered at 25'. On 12-10-75 piezometer pipes #1&2 installed as follows: Uncleanable 225'-150'. Grout 150'-143'. Void 143'-120'. Piezometer tip #1 centered at 140' Packer @120' Backfill sand 120'-110'. Grout 110'-88'. Backfill sand 88'-66'. Filter sand 66'-53' Backfill sand 73'-69'. Grout 69'-0'.	BD 4½" TC	AS WS							110.0 120.0 133.0 151.0 166.0 225.0			110.0'-120.0': GYPSUM BRECCIA; * 120.0'-151.0': SHALE BRECCIA; * soft 133.0'-151.0': some fractured sandstone large void 133.0'-140.0'. 151.0'-166.0': SANDSTONE BRECCIA; * 166.0'-225.0': GYPSUM BRECCIA; * apparent: no cuttings returned. End of graphic log: no change in method or lithology

BD = Becker drill 9"od-6"id double walled Cs with crowd-out bit shoe

EXPLANATION

TC = Tri-cone bit 4½" dia.
WS = Washed samples
AS = Air-blown samples

CORE LOSS
CORE RECOVERY

Type of hole . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

Sheet 27 of 66

FEATURE Brine Wellfield PROJECT CRSCP STATE Colo. SHEET 2 OF 2 HOLE NO. OH-2C1

★GPO 679-482

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 of 3

FEATURE: Paradox Valley-Dolores River — PROJECT: Colorado River Water Quality Improvement Program — STATE: Colorado

HOLE NO.: DH-23CX — LOCATION: Near C½, S16, T40N, R19W, 140' W of river bank — GROUND ELEV.: 4937.87 feet datum — DIP (ANGLE FROM HORIZ.): 90°

COORDS.: N. 622,963.8 ..... E. 1,035,967.9

BEGUN: 9-11-73 — FINISHED: 12-20-73 — DEPTH OF OVERBURDEN: 99.0 — TOTAL DEPTH: 300.75 — BEARING: ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: Water table 5.8'±, 999 meters — LOGGED BY: C. Parrish — LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	Type of Casing	SALINITY OF WELL FLUID: DEPTH (FEET) From	DEPTH (FEET) To	Date 1973	Kind of sample and EC @ 25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITIONS
Depths are from original ground level, 1.00' below reference level at top of 16" Cs (el. 4938.87) before final 1.01' (top el. 4939.88) cap section was welded on. **DRILL EQUIPMENT** **Bucyrus Erie 24-W 1920 swing arm cable tool rig, truck mounted, owned by Exploration Drilling, Inc., Durango, Colo.** **DRILLING FLUID** **Used turbid river water from 0.0-13.0 saline formation water to depth 53.0 then to base of overburden using Loloss compound stirred into a thick slurry with formation brine and pumped to bottom of hole as follows:** Depth 1973 / Loloss in brine (lbs/gal) / Hole Depth 9-19 6/75 53.0' 9-20 5/75 57.0' 9-21 4/75 70.0' 9-27 2/50 96.0' **End of shift on 9-27 at depth 101.0', 1 lb of Breaker-D enzyme stirred into well by surging action of bit to degrade any residual Loloss mixture. From 10-13-73 at depth 99.0' til 11-15 at depth 300.75' drilled using formation brine with heavy suspended load of black, oily silt.** **Salinity samples** Tested fluid caught with material samples from bottom of bailer. Tests made with Beckman Solu-Bridge, Ser. #82013 on site. Bottle samples also sent to USBR lab in Salt Lake City for analysis. Samples not retained after testing	16" Min. & 14½" CT 16" Min. & 14½" CT	Cs Concrete collar Perforated in alternate rows 6" long with 8 evenly spaced vertical slots/row Unperforated Perforated in alternate rows 6" long with 8 evenly spaced vertical slots/row; for 24 hr pump test; reperforated with Mills knife each 1½' with 6 cuts/row. Cs	Cs 30.0 CS 34.0 8.64 (Top of perfs) Cs 70.0 8.64 (Top of perfs)	32.5 46.0 97± (Grout plug) 74.0 99.66 (Base of perfs)	9-17 9-18 10-9 to 10-11 9-22 12-17 to 12-19	Lab #2718 and Bailed begin of shift 128.3x10³ Lab #2719 and Bailed begin of shift 109.5x10³ First pump test samples: Lab #2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115 Lab #2720 and Bailed begin of shift 79.6x10³ Third pump test samples: Lab #2679, 2680	4937.87 4924.9 4920.9 4917.9 4917.9 4913.9 4912.9 4910.9 4907.9 4904.9 4903.9 4902.9 4892.9 4887.9 4884.9 4883.9 4882.9 4881.9 4880.9 4878.9 4877.4 4875.15 4870.9 4870.4 4865.9 4852.9 4839.9 4837.9	0 10 13 17 18 19 20 26 28 27 30 33 34 36 40 45 46 50 53 54 55 56 57 59 60 62.25 67 67.5 70 72 80 85 90 100			0.0-13.0: SILTY SAND; maximum size fine sand with non-plastic fines; abundant tamarisk roots to depth 6.0'. no roots below depth 6.0'; brown; slightly brackish below depth 6.0'; highly reactive to HCl; (SM). 13.0-17.0: SILTY SAND: fine sand with non-plastic fines and scattered coarse sand and very fine gravel and old wood fragments: gray; brackish; highly reactive to HCl; (SM). 17.0-18.0: GRAVEL; fine; subrounded; igneous types; dark gray stained; (GP). 18.0-19.0: FAT CLAY; red and black globs recovered on bit; high plasticity; highly reactive to HCl; (CH). 19.0-24.0: SILTY SAND; fine to medium sand with non-plastic fines and scattered coarse sand; highly reactive to HCL; gray; (SM). 24.0-25.0: FAT CLAY; high plasticity, highly reactive to HCl; black; (CH). 25.0-27.0: SILTY SAND; fine to medium sand with non-plastic fines; gray; faint H_2S odor; saline; highly reactive to HCl; (SM). 27.0-30.0: CLAY, SAND AND GRAVEL; admixture of fat clay gobs, fine to coarse sand and subrounded, igneous gravel; maximum size 2½", gray, saline; reactive to HCl. 30.0-33.0: SILTY SAND; fine sand with non-plastic fines; gray; saline; highly reactive to HCl; (SM) 33.0-34.0: SILTY SAND; fine to medium sand with non-plastic fines and scattered fine gravel; gray; very salty, highly reactive to HCl; (SM). 34.0-35.0: SAND; medium; little to no fines; gray; salty; (SP). 35.0-45.0: SILTY SAND; maximum size very fine sand with non-plastic fines; gray; highly reactive to HCl; (SM). 45.0-46.0: FAT CLAY; high plasticity, gray; highly reactive to HCl; (CH). 46.0-50.0: SILTY SAND; fine sand with non-plastic fines; gray; salty; highly reactive to HCl; (SM). 50.0-53.0: SAND; medium to coarse with very fine, subrounded gravel; strong sewer odor; salty; highly reactive to HCl; (SP). 53.0-54.0: GRAVEL; fine, subrounded; igneous types; some old pine bark; (GP) 54.0-55.0: SAND; fine to coarse; gray; salty; highly reactive to HCl; (SP). 55.0-56.0: SILTY SAND; fine sand with non-plastic fines; gray; salty; highly reactive to HCl; (SM)

CORE LOSS / CORE RECOVERY

EXPLANATION

Min=Minimum diameter of hole.
CT=Cable tool, single blade bit, 5'0" long, with 5" dia stem 22½' long.
EC=Electrochemical units expressed in micromhos of specific conductance.
°C=Centigrade
od=Outside diameter

Sheet 28 of 66

FEATURE: Paradox Valley, Dolores River — CRWQIP: — Colorado — SHEET 1 of 3 — DH-23CX

GPO 884-441

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 3

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO DH-23CX LOCATION Near C¼, 816, 140' W of river bank GROUND ELEV. 4937.87 see notes HOLE INCLINATION (FROM HORIZ.) 90°

COORDS. N. 621,963.8 E. 1,035,967.9 TOTAL DEPTH 300.75 BEARING —

BEGUN 9-11-73 FINISHED 12-24-73 DEPTH OF OVERBURDEN 98.0

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Water table 5.8'± see notes LOGGED BY C. Norvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	TYPE OF Casing	SALINITY OF WELL FLUID: DEPTH (FEET) From	DEPTH (FEET) To	Date 1973	Kind of Sample and EC @ 25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
Bailed drill fluid An 8¼" id, 9' long 34.2 gal capacity bailer was used from depth 0.0'-24.0' but was too heavy for the rig. A 5" id, 18' long, 18 gal bailer was used from 24.0'-62.0' but was too light to draw cutting. The 8¼" id bailer was shortened to 6'1", with capacity of 24 gal and was satisfactory to completion of well. Approx 5,250 gal. of brine and overburden cuttings was bailed from interval 0.0'-100.5'; and approx. ⅔ this amount was bailed from the breccia in interval 100.5-300.75. Volume of 16" dia hole between 98.0'-100.5' is approx 1,070 gal, not including caved areas. Volume of 12" dia hole in breccia 100.5-300.75 is approx 1,175 gallons. Bailed fluid and cuttings were diverted to an open wash 30' W. of the well.	12¼" Min & 10" CT	16" Cs	No tests between depths 99.66' and 193.5				4837.9	100			56.0-57.0: SAND AND GRAVEL; medium to coarse sand and fine, subrounded gravel; gray; highly reactive to HCl; salty.
							4829.9	108			57.0-59.0: SILTY SAND; fine to medium sand with non-plastic fines; strong sewer odor; dark gray; salty; (SM).
								110			59.0-60.5: SAND AND GRAVEL; fine to coarse sand and fine, subrounded gravel; gray; highly reactive to HCl; salty.
								120			60.5-62.25: SILTY SAND; fine to medium sand with non-plastic fines and trace of coarse sand; dark gray; highly reactive to HCl; salty; (SM).
								130			62.25-67.0: SAND AND GRAVEL; fine to coarse sand and mostly fine, subrounded igneous type gravel with a few scattered 1¼" maximum gravel; dark gray; salty.
											67.0-67.5; SILT OR FINE SAND; not recovered; loose; soft; bit dropped through easily.
											67.5-72.0: SAND AND GRAVEL; mostly fine sand with fine to coarse, subrounded, igneous type gravel; dark gray; salty.
								140			72.0-85.0: SILTY GRAVEL; rounded to subrounded, igneous type gravel 2¼"-5" maximum size, mostly less than 3/4" with non-plastic fines; dark gray; salty (GM).
							4792.9	145			85.0-98.0: SILTY SAND AND GRAVEL; fine to coarse angular sand with non-plastic fines and subrounded igneous type gravel; mostly fine gravel with a few 1" maximum size; % of gravel increased with depth as follows: 5%, 85'-88'; 10%, 88'-90'; 20%, 90'-91'; 30%, 91'-92'; 40%, 92'-98'; dark gray; silty sand highly reactive to HCl; salty.
								150			98.0-108.0: DECOMPOSED GYPSUM BRECCIA: soft; sticky, clay-like, dark gray, gypsiferous material; moderately reactive to HCl; salty; HS and sewer odor noticeable 98'-100', strong 100'-108'; oily film and residue throughout; somewhat sandy texture 98'-105', and hard fine grained chips intermixed 105'-108'; trace of salt crust on dried samples.
								160			108.0-145.0: CLAY-SHALE GYPSUM BRECCIA: soft, sticky-clay-like, dark gray gypsiferous material and highly fragmented shale particles recovered; moderately reactive to HCl 108.0'-113.0', little or no reaction below depth 113.0'; slight HS odor 108'-130', no odor 130'-135', slight HS 135'-137', no odor 137'145'; oily film and residue throughout; heavy white salt crust on samples when dry 108'-118' trace of crust 118'-136', and dense fine crystalline white salt growths 136'-145'.
								170			145.0-210.0: SANDSTONE-GYPSUM BRECCIA: irregular zones of soft, sticky, clay-like gypsiferous material and fairly hard fine grained sandstone; recovered as a clay-like matrix with intermixed sandstone chips and one larger lump of hard very fine grained sandstone at depths →
								180			
								190			
	12¼" Min. & 10" CT	10" & 12" id Cs	12" CS 193.5	200.0	10-2	Sample is ½ black marl, salty, oily slight HS	4737.9	200			

EXPLANATION

Min= Minimum diameter of hole.
CT=Cable tool, single blade bit, 5'2½" long, with 5" dia. stem, 22½' long.
od= Outside diameter.
id= Inside diameter.

WATER LEVEL DATA (Begin of shift)			
Date 1973	Hole Depth	Depth to water	
9-15	30.0'	16"Cs	6.5'
9-17	32.5'		6.25'
9-24	75.0'		6.4'
9-28	102.0'		6.2'
10-8	99.0'		5.74'
(before pump surging)			
10-9	97.0'		5.80'
(before pump test)		12"Cs	16"Cs
10-15	104.0'	7.5'	5.9'
10-16	118.0'	115.0'	5.8'
10-17	134.0'	107.0'	5.8'
10-18	148.0'	19.9'	5.8'
10-19	151.0'	10.3'	5.9'
10-23	161.0'	9.8'	5.9'
10-25	179.0'	8.5'	5.6'
10-26	196.0'	15.6'	5.8'
10-29	203.9'	0.3'	5.8'
10-30	203.9'	6.0'	5.8'
10-31	203.9'	3.9'	5.9'
11-2	203.9'	5.2'	5.8'
11-6	207.0'	8.0'	5.8'
11-7	214.0'	15.1'	5.9'
11-8	236.0'	14.7'	5.9'
11-9	251.0	13.5'	5.9'
11-13	268.0	11.5'	5.8'
11-15	298.0	10.9'	5.7'

Sheet 29 of 66

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colorado SHEET 2 OF 3 HOLE DH-23CX

GEOLOGIC LOG OF DRILL HOLE

SHEET 3 OF 3

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program Colorado

HOLE NO. DH-23CX LOCATION Near C¼, S16, 140' W of river bank DIP 90°
COORDS. N 621,963.8 E 1,035,967.9 GROUND ELEV. 493'.87 see notes

BEGUN 9-11-73 FINISHED 12-24-73 DEPTH OF OVERBURDEN 98.0 TOTAL DEPTH 300.75 BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Water table 5.8'±, see notes LOGGED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

CASED INTERVAL

Date 1973	Hole Depth	Depth of Cs
9-13	16.0'	16'Cs 13.0'
9-14	30.0'	28.0'
9-15	32.5'	30.0'
9-17	46.0'	47.0'
9-18	52.0'	51.5'
9-19	57.0'	54.0'
9-20	62.3'	62.3'
9-21	94.0'	90.0'
9-22	95.0'	90.0'
9-24	85.0'	75.9'
9-25	91.0'	90.9'
9-26	96.0'	93.0'
9-27	102.0'	101.66'
10-13	104.0'	12"Cs 104.0'
10-15	118.0'	116.0'
10-16	136.0'	136.0'
10-17	148.0'	136.1'
10-18	151.0'	143.±
10-19	161.0'	155.±
10-23	176.0'	161.±
10-24	179.0'	174.±
10-25	196.0'	187.±
10-26	203.9'	203.87'
11-5	207.0'	10"Cs 0.0'
11-15	300.75'	0.0'
11-21 to 11-28		10"Cs was installed to depth 300.75'

Casing description

From 2.01' above ground to depth 101.66', 16" od (15¼" id), 3/8" wall, new seamless steel Cs, pre-perforated at depths 8.64'-33.52' and 45.94'-99.66'. The same type 12" id non-perforated Cs with an 0.55' top end coupling set between depths 101.53' and 203.87'. The same type 10" id Cs with an 0.54' top end gasket and coupling set between depths 101.33'-300.75', pre-perforated at depths 229.17'-279.60'. On 12-10 a 13" dia. ½" thick steel plate with a ¼" neoprene gasket and a handline was placed on top of the 10" coupling. On 12-11 the 16" Cs was reperforated with a Mills knife 6 cuts each 1½' between depths 63'± and 98'±.

TYPE AND SIZE OF HOLE: 16" Min; 12" Nom & 10" CT; 210

TYPE OF CASING: 16" id Cs; 12" id Cs; 10" id Cs

Unperforated; Perforated in alternate rows of 8 evenly spaced ¼" vertical slots 4" long with 6" between rows of slots.; Unperforated with 2½' concrete plug

SALINITY OF WELL FLUID

Depth (Feet) From	Depth (Feet) To	Date 1973	Kind of Sample and EC @ 25°C
12"Cs 203.87	225.0	11-7	Bailed during drilling: sample is ½ black marl, salty, oily, strong H_2S x 10^3
229.17	279.60	12-3	Discharge from pump during raw-hiding: Lab # 2515, # 2516
		12-4 to 12-6	Second pump test samples: Lab # 2517, # 2518, # 2519, # 2520
Begin shift 236.0	250.0	11-8	Bailed during drilling: sample is ½ black marl, salty, oily, slight H_2S, x 10^3
Begin shift 268.0	275.0	11-13	Bailed during drilling: sample is ½ black marl, salty, oily, strong H_2S foamy. x 10^3
Begin shift 298.0	300.75	11-15	Bailed at end of drilling: sample is ½ black marl, salty, oily, strong H_2S & foamy. x 10^3

ELEVATION (FEET): 4737.9; 4727.9; 4637.2

DEPTH (FEET): 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300.75

GRAPHIC LOG

SAMPLES FOR TESTING

176± and 193.5±; dark gray; no reaction to HCl; little to no H_2S odor 145'-176', strong H_2S odor 176'-179', mild H_2S odor 179'-210'; oily film and residue throughout; bailed fluid black and foamy below depth 183'; heavy white crystalline salt crust on dried samples entire interval; very small, fresh iron pyrite crystals noted at depth 157' to 158'.

210.0-300.75: GYPSUM BRECCIA AND SALT; irregular zones of soft, black, clay-like shaly and fine to medium sandy breccia with black crystalline salt throughout; recovered as a black, sooty clay-like matrix with some hard sandstone and clayey chips mixed throughout; intervals 217'-219' and 286'-288' very soft, soupy, poorly recovered samples; below depth 260' black crystalline salt abundant in both wet and dried samples; H_2S odor mild but varied to depth 265' and generally strong below 265'; oily film and residue throughout entire interval.

Notes continued:

PUMP TESTS

Power unit was a GMC V6 gasoline engine, attached through an angle head drive to a Franklin Morris centrifugal pump having an 8" discharge outlet and 6" od, 9-stage bowls rated at 1,000 gpm at 200' lift. The first test was from 10-9-73, 1:32 PM to 10-11-73, 7:30 AM, 42 hours long in the 16" Cs between depths 0.0'-97' with base of bowls set at depth 85.2'; the second test 12-4-73, 10:00 AM to 12-6-73, 10:00 AM, 48 hrs, in 10" Cs 229.17-279.60' in gypsum, base of bowls at depth 201.2'; the third test, 12-17-73, 10:00 AM to 12-19-73, 10:00 AM, 48 hrs, in 16" Cs, reperforated between 63'±-98'±.

GEOPHYSICAL TEST

On 12-10-73, the Go-International firm made one run to depth 299' and logged gamma ray-neutron through the casings.

DRILL SITE

Fairly level ground between two shallow meander scars; tamarisk growth chopped and bladed away; half way between (173'± from each) DH-6PX and DH-7PX; and 155' NW of the river.

Min=Minimum diameter of hole.
Nom=Nominal diameter of open hole.
CT=Cable tool, single bit blade, 5'2½" long, with 5" dia. stem 22½' long.
od=outside diameter.
gpm=gallons per minute.

7-1827 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 3

FEATURE Paradox Unit - brine well field PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. DH-1 W 1 LOCATION GROUND ELEV. DIP (ANGLE FROM HORIZ.)

COORDS. N. E.

BEGUN 4-22-75 FINISHED 10-26-75 DEPTH OF OVERBURDEN 119.3' TOTAL DEPTH 300' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Not taken LOGGED BY D Burgayne from*reports LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspectors drill report.
All depths are taken from ground surface. Hole not surveyed for deviation from verticle. DRILL EQUIPMENT Portadrill Mod. 503 truck-mounted, rotary type from depth 0'-103' on 4-24-75. Because of flooding the hole was moved 50' to the northwest 4-23-75 and the first 71' was redrilled with no samples taken. Longyear 44 used to complete well to 300'. CASING RECORD Date / Hole Depth / Depth of Cs 1975 4-24 103' 0 4-25 103' 103' 7-14 115.5' 110' 7-18 130.5' 130.5' 7-23 175' 152' 7-28-75 pulled 4" Cs. 8-25-75 Set 6" Cs to 64.5'. 8-26-75 Set Cs to 71.3' 8-28-75 Set Cs to 76.5' 9-2-75 Pulled 6" Cs DTILLING FLUID 10.0 lbs "Lo-Loss" per gallon natural brine to depth of 95'. Thereafter, only natural brine	DB ST DB 10 ST DB ST DB 20 ST DB ST ST 30 DB ST DB ST 50 DB ST DB ST 60 DB 7-7/8 TC 70 80 4½ TC 90	0 55 0 65 0 90 0 90 0 90 65 0 95 0 80 0 80 0 75 0 80 0 15 0 0 0	Not required by specifications						10 16.9 20 29.0 30 40 43.0 44.0 49.0 50 60 65.0 70 80 90 98.0			0.0'-16.9': SILTY SAND;*(SM). 16.9'-29.0': SAND and GRAVEL;* gravel 3/8"-1/2" size; (S&G) 29.0'-43.0': SILTY SAND;* gravel scour from above; (SM) 43.0'-44-0': COBBLE;* 44.0'-49.0': SAND and GRAVEL:* maximum gravel size 3/8"; (S&G) 49.0'-65.0': CLAYEY, SANDY GRAVEL;* 2-1/2 maximum gravel size, some cobble below 59.5'; black water returns below 54'; (GC) 65.0'-98.0': GRAVEL;* 1-1/2" maximum size; some red clay 70.0'-71.0'; some cobble 71.0'-98.0'; (GP) 98.0'-103.0': SAND;* clean well -

CORE LOSS
CORE RECOVERY

EXPLANATION

DB = Rotary drag bit
ST = Split tube drive sampler, NX
TC = Tricone rock bits 4½" and 7-7/8" diameters

Type of hole . . . . . D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE . . Brine Wellfield . . . . . PROJECT . CRBSCP . . . . . STATE Colorado . . . SHEET . 1 . OF . 3 . . . HOLE NO. 1 W 1 . . . . .

☆GPO 679-482

7-1887 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 3

FEATURE Paradox Unit Brine Wellfield PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. DH-1W1 LOCATION GROUND ELEV. DIP (ANGLE FROM HORIZ.)

COORDS. N. E.

BEGUN 4-22-75 FINISHED 10-26-75 DEPTH OF OVERBURDEN 119.3' TOTAL DEPTH 300.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED LOGGED BY D. Burgoyne from * report LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Ce, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION (* = as recorded on inspector's drill record.)
DRILL FLUID LOSSES Date 1975 — Depth Drilled — %Loss 7-14 — 105.5'-125' — 100 7-25 — 218'-228' — 100 228'-257' — 80-100 257'-267' — 80 7-26 — 257'-300' — 80-100	TC	0							0			graded sand with some gravel; (SW)
	CB	0							103.0			103.0'-119.3': GRAVEL; * (GP)
	CB	10							10			
	CB	0							119.3			119.3'-157.0': SHALE BRECCIA & GRAVEL; * maximum gravel size 1½".
	CB	18							20			
	TC	0										
	CB	0							30			
	CB	74										
	CB	100							40			
	CB	94										
	CB	100							50			
	CB	64										
	CB	92							157.0			157.0'-175.0': GYPSUM BRECCIA;* gray to black water returns.
	CB	100							60			
	CB	96							70			
	CB	62							175.0			175.0'-208.0': SHALE & GYPSUM BRECCIA; * soft shale, shale, & gypsum breccia in layers; gray to black water returns.
	CB	83							80			
	CB	100							90			

EXPLANATION

CORE LOSS

CORE RECOVERY

CB = Core barrel bit, Nx

TC = Tri-cone rock bit, 4½" dia.

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE Brine Wellfield PROJECT CRBSCP STATE Colorado SHEET 2 OF 3 HOLE NO. DH-1W1

☆GPO 679-482

7-1887 (8-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 3 OF 3

FEATURE Paradox Unit Brine Wellfield PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. DH-1W1 LOCATION COORDS. N. E. GROUND ELEV. DIP (ANGLE FROM HORIZ.)

BEGUN 4-22-75 FINISHED 10-26-75 DEPTH OF OVERBURDEN 119.3' TOTAL DEPTH 300.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Not taken LOGGED BY D. Burgoyne from * report LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspector's drill report.
	CB	100							208.0			208.0'-237.5': SHALE BRECCIA;* gray & black colored in layers; black water returns.
	CB	92										
	CB	91							237.5			237.5'-300.0': GYPSUM BRECCIA; * with small layers of pure gypsum; black water returns; 80-100% water loss
	CB	100										
	CB	55										
	CB	70										layer of shale breccia ~ 277'
	CB	92										
	CB	98										
	CB	100										

CB = Core barrel bit, Nx

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

Sheet 33 of 66

FEATURE Brine Wellfield PROJECT CRBSCP STATE Colorado SHEET 3 OF 3 HOLE NO. DH-1W1

★GPO 679-482

7-1807 (8-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE: Paradox Unit Brine Wellfield — PROJECT: Colorado River Basin Salinity Control — STATE: Colorado

HOLE NO. DH-2W — LOCATION — COORDS. N. ..... E. ..... — GROUND ELEV. ..... — DIP (ANGLE FROM HORIZ.) .....

BEGUN 7-10-75 — FINISHED 7-12-76 — DEPTH OF OVERBURDEN 81.0' — TOTAL DEPTH 225.0' — BEARING .....

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED ..... — LOGGED BY D. Burgoyne from * report — LOG REVIEWED BY .....

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspector's drill reports.
All depths are taken from ground surface. Hole approx. vertical, though not surveyed. DRILL EQUIPMENT Portadrill Mod 503 truck-mounted, rotary type. CASING RECORD Date 1975 — Depth drilled — Depth of Cs 7-10 — 75' — 39.3' 7-11 — 166' — 76.7' 7-17 — 225' — 104.0' DRILLING MEDIUM NaCl brine & "Lo-Loss" Fluid was lost at a rate of 15-20 gpm between depths 57'-75'. PIPE INSTALLATIONS On 7-21-75 to 7-24-75 3 piezometer pipes were placed as follows: Cave in 225'-220'. Backfill sand 220'-218'. Filter sand 218'-196'. Piezometer tip #1 centered at 218'. Grout 196'-86'. Backfill sand 86'-80'. Filter sand 80'-69'. Piezometer tip #2 centered at 77'. Backfill sand 69'-64'. Grout 64'-34'. Backfill sand 34'-28'. Filter sand 28'-0'. Piezometer tip #3 centered at 25'.	7 7/8 TC	WS	Not required by specifications						0.0			0.0'-24.0': SILTY SAND; * fine sand; (SM)
									11.0			11.0'-11.5': gravel seam; ¼"-1½"
									24.0			24.0'-31.0': GRAVEL; * clean; ¼"-1" (GP)
									31.0			31.0'-34.0': SILTY SAND; * fine sand; (SM)
									34.0			34.0'-42.0': CLAY; * brown; (CL)
									42.0			42.0'-45.0': SAND AND GRAVEL; * clean; 1" maximum size; (GP-SP)
									45.0			45.0'-46.0': GRAVEL; clean; ¼"-1½" (GP)
												46.0'-54.0': SAND & GRAVEL; gravel pea sized; (GP-SP)
									54.0			54.0'-81.0': GRAVEL; * ¼"-1½"; (GP)
									57.0			55.0'-57.0': gravel to 1"; some signs of breccia; water returns gray-black
												57.0'-81.0': gravel to 1" maximum;
	5 7/8 TC	WS							81.0			81.0'-225.0': SHALE BRECCIA; low to medium plasticity; contains sharp fragments of limestone; water returns colored gray-black; breccia gray-black in color.
	4½" TC	WS										
			End of graphic log: no change in method or lithology						225.0			

TC = Tri-cone bit 7 7/8", 5 7/8", 4½"

EXPLANATION

CORE LOSS / CORE RECOVERY

Type of hole ..... D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) .. Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) .. Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) .. Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

Sheet 34 of 66

FEATURE Brine Wellfield ..... PROJECT CRBSCP ..... STATE Colorado .. SHEET 1 OF 1 HOLE NO. DH-2W .....

☆GPO 879-482

7-1987 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET. 1 OF 3

FEATURE. Paradox Unit Brine Wellfield PROJECT. Colorado River Basin Salinity Control STATE. Colorado

HOLE NO. DH-3W1 LOCATION COORDS. N. E. GROUND ELEV. DIP (ANGLE FROM HORIZ.)

BEGUN 4-25-75 FINISHED 9-11-75 DEPTH OF OVERBURDEN 50.0' TOTAL DEPTH 300.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED LOGGED BY D. Burgoyne from * report LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspector's drill report
All depths are taken from ground surface. Hole approx. vertical though not surveyed. DRILL EQUIPMENT Drilled to 91.5' with Portadrill Mod 503, truck-mounted rotary type on 4-25-75 to 8-7-75. Drilled 91.5'-231.8' with Mobile-drill B61 on 8-8-75 to 9-2-75. Hole re-drilled with 5 5/8" TC bit on 8-20-75 with portadrill 503. Hole redrilled 0'-62' with 7 7/8" TC, 62'-83' with 5 1/8" TC, 83'-106' with 4½ TC on 9-10-75 using Porta-drill. Hole drilled 231.8'-300.0' & enlarged 106'-300.0' with 4½" TC. CASING RECORD 8-8-75 Placed 4" Cs to 83'. 9-10-75 Pulled 4"Cs & placed 6" Cs to 62.3'. 9-15-75 6" Cs pulled from hole.	SS DB SS DB SS DB SS DB SS DB SS TC SS TC SS TC SS TC SS TC SS 4½ TC CB	75 0 70 0 80 0 70 0 75 0 65 0 60 0 70 0 85 0 80 0 45 0 100 0 20 0 100 CS 74	Not required by specifications					0.0 2.0 5.0 10 15.0 17.0 20.0 22.0 30 35.0 40.0 45.0 50.0 60 65.0 66.8 70 80 91.5 90			0.0-2.0': CLAY; * (CL) 2.0'-5.0': SANDY CLAY; * (CL) 5.0'-15.0': SAND; * (SP) 15.0'-17.0': SILTY SAND; * some clean sand; (SM) 17.0'-20.0': SAND & GRAVEL; * gravel small; (SP-GP) 20.0'-22.0': SAND; * (SP) 22.0'-40.0': SAND & GRAVEL; * gray sand; (GW) 22.0'-35.0': well graded gravel to 1½". 35.0'-40.0': gravel to 2" maximum size. 40.0'-45.0': SAND; * fine gray sand; (SP) 45.0'-50.0': SAND & GRAVEL; * gravel to 2" maximum; soft sandstone boulders 46.5'-47.5'; (GP-SP) 50.0'-102.0': SHALE BRECCIA; * gray-black; firm; silty; sandstone fragment at 52.5' 65.0'-65.8': some gravel 66.8'-91.5': some limestone fragments; water returns black 91.5'-91.6': some gravel to 3/4"

CORE LOSS
CORE RECOVERY

EXPLANATION

SS = Split spoon NX
DB = Drag bit
TC = tri-cone bit 4½" dia.
CS = Cutting samples (washed)
CB = Core barrel bit NW

Type of hole . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"
Approx. size of core (X-series)	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"

FEATURE Brine Wellfield PROJECT CRBSCP STATE Colorado SHEET 1 OF 3 HOLE NO. DH-3W1

☆GPO 679-482

7-1937 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET. 2 .... OF. 3 ....

FEATURE . Paradox. Unit. Brine. Wellfield ..... PROJECT. Colorado .River .Basin .Salinity .Control . STATE. . Colorado .....

HOLE NO. . DH-3W1 . . LOCATION ..... COORDS. N. ..... E. ..... GROUND ELEV. ..... DIP (ANGLE FROM HORIZ.) .....

BEGUN . 4-25-75. . . FINISHED. . 9-11-75 . . . DEPTH OF OVERBURDEN . . . . . 50.0' TOTAL DEPTH. . . . . 300.0' . . . . BEARING. .....

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED ..... LOGGED BY. D. Burgoyne from ..... LOG REVIEWED BY. .....

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

DRILLING MEDIUM

NaCl brine & ~ 10# "Lo-Loss"/gal. 0'-65' NaCl & "Drispac" 65'-91.5' NaCl brine 91.5'-231.8'. NaCl & "Drispac" 231.8'-300.0'. Also used when enlarging hole.

DRILL FLUID LOSSES

Date 1975	Depth Drilled	%Loss
8-11	92'-102'	0-10
8-12	102'-112'	50-70
	112'-127'	0-10
8-13	127'-132'	50-60
	132'-137'	0-10
	137'-147'	0-15
8-14	147'-150'	40-50
	150'-164'	10-20
8-15	164'-184'	10-20
8-16	184'-192'	10-20
8-18	192'-200'	20-25
	200'-202'	10-15
8-19	202'-205'	40-50
8-26	205'-208'	0-10
(lost 100% at 215')		
8-27	218'-222'	0-20
(lost 100% at 220.5' for a few minutes)		
8-29	222'-227'	0-20
8-30	227'-232'	0-20

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)
CB	5
CB	26
CB	82
CB	80
CB	84
CB	94
CB	78
CB	70
10" CB	36
5" CB	74
5" CB	64
5" CB	100
CB	74
CB	72
CB	60
CB	36
CB	77
CB	30
CB	24

PERCOLATION TESTS

DEPTH (FEET) FROM (F, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)

ELEVATION (FEET)

DEPTH (FEET)

100.0
102.0
112.0
122.0
127.0
132.0
154.5
164.5
192.5

GRAPHIC LOG

SAMPLES FOR TESTING

CLASSIFICATION AND PHYSICAL CONDITION

* = as recorded on inspector's drill report.

102.0'-112.0': GRAVEL;* to 1½" max.; some clay breccia; water returns black.

112.0'-122.0': SHALE BRECCIA; * some rock & gravel to 1" upper 5'.

122.0'-127.0': SANDSTONE; * some shale breccia.

127.0'-200.5': SHALE BRECCIA;* water returns black

132.0'-154.5': some sandstone; last 5' decomposed.

154.5'-164.5': hard & soft shale breccia.

164.5'-200.5': some sandstone.

192.5'-193.0': some sand.

EXPLANATION

CORE LOSS

CORE RECOVERY

CB = Core barrel bit NW

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series) . .	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"
Approx. size of core (X-series) . .	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"
Outside dia. of casing (X-series) .	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"
Inside dia. of casing (X-series) . .	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"

Sheet 36 of 66

FEATURE . . . Brine Wellfield . . . . . PROJECT CRBSCP . . . . . STATE . Colorado . . SHEET . 2 . . OF . 3 . . HOLE NO. . DH-3W1 . . . . . .

☆GPO 679-482

7-1987 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 3 OF 3

FEATURE: Paradox Unit. Brine Wellfield | PROJECT: Colorado River Basin Salinity Control | STATE: Colorado

HOLE NO. DH-3W1 | LOCATION | GROUND ELEV. | DIP (ANGLE FROM HORIZ.)

COORDS. N. E.

BEGUN 4-25-75 | FINISHED 9-11-75 | DEPTH OF OVERBURDEN 50.0' | TOTAL DEPTH 300.0' | BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED | LOGGED BY D. Burgoyne from * report | LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspector's drill report
PIPE INSTALLATIONS On 9-12-75 to 9-15-75 3 piezometer pipes were installed as follows: Cave in 294'-283'. Backfill sand 283'-281'. Piezometer tip #1 centered at 281'. Filter sand 281'-268'. Backfill sand 268'-264'. Grout 264'-87'. Backfill sand 87'-81'. Filter sand 81'-70' Piezometer tip #2 centered at 80'. Backfill sand 70'-67'. Grout 67'-32'. Backfill sand 32'-27'. Filter sand 27'-0'. Piezometer tip #3 centered at 25'.	CB CB CB CB CB CB CB 4½" TC	40 64 27 100 67 80 18 0 CS							200.5 207.5 217.5 223.1 235.0 275.0 285.0 300.0			200.5'-223.1': SANDSTONE; * some very fine sand top 0.2'; water returns black. 201.5'-222.0': some shale breccia 207.5'-217.5': sandstone decomposed. 217.5'-222.2': sandstone becoming more fragmented; angular fragments grading to subrounded fragments; 3" maximum size. 223.1'-300.0': SHALE BRECCIA; * some gypsum in shale; some sandstone fragments to 1½"; shale decomposed. 235.0'-275.0': some limestone fragments 285.0'-300.0': some limestone fragments

EXPLANATION

CORE LOSS
CORE RECOVERY

CB = Core Barrel bit NW
TC = Tri-cone 4½" dia.
CS = Cutting samples (taken every 5').

Type of hole . . . D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

Sheet 37 of 66

FEATURE Brine Wellfield PROJECT CRBSCP STATE Colorado SHEET 3 OF 3 HOLE NO. DH-3W1

★GPO 679-482

7-1537 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 3

FEATURE: Paradox Unit Brine Wellfield | PROJECT: Colorado River Basin Salinity Control | STATE: Colorado

HOLE NO.: DH-4W1 | LOCATION: | GROUND ELEV.: | DIP (ANGLE FROM HORIZ.):

COORDS. N.: E.: | TOTAL DEPTH: 300.0' | BEARING:

BEGUN: 7-22-75 | FINISHED: 8-7-75 | DEPTH OF OVERBURDEN: 111.0' | D. Burgoyne from

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: | LOGGED BY: *. report | LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

All depths are taken from ground surface. Hole approx. vertical though not surveyed.

DRILL EQUIPMENT

Portadrill Mod 503, truck-mounted, rotary type from depth 0' to 116'. Long vear 44 core drilling rig from 116.0'-300.0'.

CASING RECORD

Date 1975	Hole Depth	Depth of Cs
7-26	106.0'	92.0' (6" Cs)
7-28	116.0'	107.0' (4" Cs)
7-29	137.7'	116.5'
7-31	165.8'	147.0'
8-1	171.0'	166.8'
8-4	225.4'	174.0'
8-5	238.0'	179.0'

8-8-75 pulled 4" Cs out except for 70' which fell back in & was covered with sloughed-off matl.
8-16-75 drove 6" Cs to 113' in attempt to retrieve 4" Cs.
8-21-75 drilled past bottom of 4" Cs (205') to 300' with objective of leaving it in the hole.
8-28-75 while attempting to pull 6" Cs out, 75' of it broke off in the hole (depths 38' to 113'). It was left in.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION (* = as recorded on inspector's drill report.)
								0.0			
TC	0	Not required by specifications									0.0'-9.5': SANDY LOAM; * (SM)
DS	10										
TC	0										
DS	10							9.5			9.5'- : SAND; * (SP)
TC	0							10			9.5'-23.0': clean fine sand
DS	10							14.2			14.2'-19.0': some pea gravel
TC	0							19.0			
DS	10							20			23.0'-28.0': clean fine to medium sand
TC	0										
DS	10										
TC	0							27.5			27.5'-29.0': with some gravel; 3/4" maximum size
DS	10							30			28.0'-53.5': clean medium sand
TC	0										
DS	10										
TC	0							38.0			38.0'-43.0': some gravel; 3/4" maximum size.
DS	10							40			
TC	0							43.0			
DS	10							45.0			45.0'-53.5': some gravel; 3/4" maximum size.
TC	0										
DS	75							50			
TC	0							53.5			53.5'-80.0': GRAVEL; * 1½" maximum size; (GP)
DS	40										
TC	0										
DS	0										
4½" TC	CS							60			
								70			
								75.0			75.0'-80.0': a trace of breccia
								80.0			80.0'-111.0': SHALE BRECCIA;
								90			

EXPLANATION

TC = Tri-cone bit, 4½" dia.
DV = Drive sampler
CS = cutting sample (washed)

CORE LOSS
CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE: Brine Wellfield | PROJECT: CRBSCP | STATE: Colorado | SHEET 1 OF 3 | HOLE NO. DH-4W1

★GPO 679-482

7-1387 (8-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

FEATURE: Paradox Unit Brine Wellfield — PROJECT: Colorado River Basin Salinity Control — STATE: Colorado
HOLE NO.: DH-4W1 — LOCATION: — GROUND ELEV.: — DIP (ANGLE FROM HORIZ.):
BEGUN: 7-22-75 — FINISHED: 8-7-75 — COORDS. N: E: — DEPTH OF OVERBURDEN: 111.0' — TOTAL DEPTH: 300.0' — BEARING:
DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: — LOGGED BY: D. Burgoyne from * report — LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

DRILLING MEDIUM
NaCl brine with "Drispac". 0'-165.8' NaCl brine 165.8'-300.0'.

DRILL FLUID LOSSES

Date 1975	Depth drilled	%Loss
7-27	0'-116'	0
7-29	116'-138'	10
7-30	138'-142'	20-30
	142'-161'	20
7-31	161'-166'	NR
8-1	166'-171'	15
8-2	171'-184'	0
	171'-210'	10
8-4	210'-214'	25
	214'-225'	10
8-5	225'-238'	5
8-6	238'-270'	0-5
8-7	270'-300'	0-10

no losses redrilling.

PIPE INSTALLATIONS
Piezometer pipe #2 not installed due to broken 6" Cs.
Piezometer pipes #1 & 3 installed on 8-23-75 to 8-28-75 as follows:
Backfill sand 300'-292'.
Filter sand 292'-280'.
Piezometer tip #2 centered at 289'.
Backfill sand 280'-271'.
Grout 271'-27'.
Backfill sand 27'-25'.
Filter sand 25'-0'.
Piezometer tip #3 centered at 25'.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION (* = as recorded on inspector's drill report)
4½" TC	CS							0			
								10			
								111.0			111.0'-121.5': SHALE BRECCIA; * water returns colored black.
CB (NX)	29							120			
								121.5			121.5'-131.5': intermittent layers of sandstone breccia
CB (NX)	17							130			
								131.5			131.5'-171.0': SANDSTONE BRECCIA
CB (NX)	19							140			
CB	0										
CB	55										
CB	100										
CB (NX)	60							150			
CB (NX)	22										
CB (NX)	37							160			
CB	0										
CB (NQ)	31							170			
								171.0			171.0'-214.4': GYPSUM BRECCIA; * water returns black
CB (NQ)	83										
CB (NQ)	98										
CB (NQ)	94							180			
CB (NQ)	100										
								190			
CB (NQ)	100										

EXPLANATION

TC = Tri-cone bit 4½" dia.
CB = Core barrel bit NX, NQ

CORE LOSS
CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2",	Ax = 1-7/8",	Bx = 2-3/8",	Nx = 3"
Approx. size of core (X-series)	Ex = 7/8",	Ax = 1-1/8",	Bx = 1-5/8",	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16",	Ax = 2-1/4",	Bx = 2-7/8",	Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2",	Ax = 1-29/32",	Bx = 2-3/8",	Nx = 3"

FEATURE: Brine Wellfield — PROJECT: CRBSCP — STATE: Colorado — SHEET: 2 OF 3 — HOLE NO.: DH-4W1

☆GPO 679-482

7-1587 (6-74)
Bureau of Reclamation

GEOLOGIC LOG OF DRILL HOLE

SHEET 3 OF 3

FEATURE Paradox Unit Brine Wellfield PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. DH-4W1 LOCATION COORDS. N. E. GROUND ELEV. DIP (ANGLE FROM HORIZ.)

BEGUN 7-27-75 FINISHED 8-7-75 DEPTH OF OVERBURDEN 111.0' TOTAL DEPTH 300.0' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED LOGGED BY D. Burgoyne from *. report LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION * = as recorded on inspector's drill report.
	CB (NQ)	100							210.0			210.0'-214.4': some shale breccia
	CB (NQ)	100							214.4			214.4'-252.0': SHALE BRECCIA; * very fragmented; water returns black
	CB (NQ)	56										
	CB (NQ)	55										
	CB (NQ)	94							230.0			230.4'-233.4': layers of gypsum breccia
	CB (NQ)	98							233.4			
	CB (NQ)	86										246.0'-252.0': some gypsum breccia
	CB (NQ)	95							246.0			252.0'-280.0': GYPSUM BRECCIA; * with fractures; water returns black-gray
	CB (NQ)	97							252.0			
	CB (NQ)	96										
	CB (NQ)	56							270.0			270.0'-280.0': some shale & sandstone breccia; water returns black
	CB (NQ)	64							280.0			280.0'-300.0': SHALE BRECCIA; * water returns black
	CB (NQ)	47							290.0			280'-290.0': some sandstone breccia
	CB (NQ)	100										

EXPLANATION

CB = Core barrel bit, NQ

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series). . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE Brine Wellfield PROJECT CRBSCP STATE Colorado SHEET 3 OF 3 HOLE NO. CH-4W1

☆GPO 679-482

7-1337 (Web)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-1PX LOCATION SW¼ S. 16, 1/8 mi. E of river, on W side of Co.Rd. GROUND ELEV. DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 7-2-72 FINISHED 7-11-72 DEPTH OF OVERBURDEN 47.4' TOTAL DEPTH 131.5' BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below LOGGED BY C. Norvik, J.Keller LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are corrected to ground level from driller's measuring point 0.3' above ground. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT

Sprague & Henwood NW-Hyd. No. 212, hydraulic feed rotary drill, skid mounted.

DRILLING FLUID

Dolores River water, salinity increased as river level dropped color remained clear.

River samples at pump

Date	Salinity EC @ 25°C
1972	
7-3	12.1×10^3
7-11	88.0×10^3

Baled water samples (Begin of shift)

Date	Depth	Salinity EC @ 25°C
1972		
7- 4	48'-58'	9.5×10^3
7- 5	49'-91'	59.6×10^3
7-11	18'	25.3×10^3
7-11	116'-126'	131.4×10^3

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (Ft. Ca. or Cm.)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
4" WB	WB		No tests					0			0.0-34.7: SILTY SAND; as recorded on driller's report; recovered as reddish brown, fine grained sand with about 25% non-plastic fines; slightly crusty with salt when dry and highly reactive to HCl
	WS							10			
	WS							20			34.7-37.7: SAND AND GRAVEL; as recorded on driller's report; recovered as coarse to fine grained sand sized particles; angular to sub-angular shaped; mixed color and composition including igneous types; highly reactive to HCl.
	WS							30			
	WS							34.7			37.7-47.4: GRAVEL AND COBBLES; as recorded on driller's report; recovered in interval 37.7-41.7 as highly fragmented 0.2' maximum length core segments having naturally rounded ends; fresh to slightly stained mixed composition porphyritic types; and recovered in interval 41.7-47.4 as medium grained sand with clay lumps and some chips of shale, grayish, heavily crusted with salt and highly reactive to HCl.
	WS							37.7			
NxD ST	85							40			
4" WB	WS							47.4			47.4-49.3: DECOMPOSED SHALE; as recorded on driller's report; recovered mixed with interval 41.7-47.4 above.
	WS							49.3			
NxD ST	100	50						50			49.3-131.5: GYPSUM BRECCIA; entirely randomly mixed structure of light gray irregular shaped inclusions of shale, sand-stone, limestone and gypsum in dark gray to black salty, gypsiferous matrix; inclusions moderately to very hard and matrix generally softer; core varied from compact to coarsely crumbly; core segments entirely rough surfaced and deeply pitted; highly fragmented; minute black salt crystals common and well developed in matrix; white salt coating on core when dry; inclusions generally reactive to HCl, matrix slightly though variably reactive to HCl.
	100	60						60			
	100										
	100	70						70			
	100	80						80			
	100	90						90			
NxD ST	99										

EXPLANATION

WB=Wash bored
WS=Wash sample
ST= 5' Split tube core barrel

CORE LOSS
CORE RECOVERY

Type of hole (D = Diamond, H = Haverslite, S = Shot, C = Calyx, P = Packer, Cm = Cemented, Cs = Rotary cuttings)
Approx. size of hole (X-series: Ex = 1-1 2", Ax = 1-7 8", Cx = 2-1 2", Bx = 3-1 2", Nx = 3-3 4")
Approx. size of core (X-series: Ex = 1 13 16", Ax = 1 1 8", Bx = 2 1 8", Nx = 3 1 32")
Outside dia. of casing (X-series: Ex = 1-1 2", Ax = 1-25 32", Bx = 2-1 2", Nx = 3-1 2")

7-1337 (5-69) Bureau of Reclamation — GPO 884-441

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Paradox Valley-Dolores River — PROJECT Colorado River Water Quality Improvement Program — STATE Colorado

HOLE NO. DH-1PX — LOCATION NW¼ S. 16, 1/8 mi. E. of river, on W side of Co. Rd. — GROUND ELEV. — DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. — E. — TOTAL DEPTH 131.5' — BEARING ---

BEGUN 7-2-72 — FINISHED 7-11-72 — DEPTH OF OVERBURDEN 47.4'

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below — LOGGED BY C. Norvik, J. Keller — LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

DRILLING FLUID LOSS

BS

Interval	% Loss
0-101.1	0
101.1-131.5	100

WATER LEVEL DATA (Begin of Shift)

Date 1972	Hole Depth	Depth to Water
7- 3	34.7'	14.7'
7- 4	58.1'	14.7'
7- 5	101.1'	14.2'
7-11	131.5'	14.7'

CASED INTERVAL

Date 1972	Hole Depth	Depth of Cs
7- 2	34.7'	34.7'
7- 3	49.3'	49.3'

No Cs 49.3'-131.5'
Cs removed upon completion of hole.

WATER LEVEL PIPE
132.2' of 1¼" SCH 80 psi black plastic pipe with plug top installed from 0.7' above ground to depth 131.5'. One 1-9/32" nominal ID white coupling at 85.8'-86.2'. Lower 46.0' section perforated each 2' with two ¼"± holes.

CHARACTER OF DRILLING
Chopped with no problems to depth 35'±. Blasted cobbles at 37.7' and 45.7'. The 10' core barrel was blocking off so put in 5' split tube sampler at 121.6'.

DRILL SITE
Level sandy ground beside county road.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P. Cs. or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
BxD ST	100							100			
	96							110			
	100							120			
	91										
	88										
	100							130			
								131.5			

EXPLANATION

CORE LOSS / CORE RECOVERY

ST=5' Split tube core barrel

Type of hole ..... D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cs = Bottom of casing

	Ex	Ax	Bx	Nx
Approx. size of hole (X-series)	E = 1-1.2"	A = 1-7 8"	B = 2-3 8"	N = 3"
Approx. size of core (X-series)	E = 7 8"	A = 1-1 8"	B = 1-5/8"	N = 2-1 8"
Outside dia. of casing (X-series)	E = 1-11 (4")	A = 2-1 4"	B = 2-7 8"	N = 3-1 2"
Inside dia. of casing (X-series)	E = 1-1.2"	A = 1 29 32"	B = 2-3/8"	N = 3"

FEATURE Paradox Valley-Dolores River — PROJECT C.R.W.Q.I.P. — STATE Colorado — SHEET 2 OF 2 — HOLE NO. DH-1PX

7-1337 (9-70)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement STATE Colorado

HOLE NO DH-2PX LOCATION W¼ Cor, Sec.15, 40'W of old 4'x4' cribbed 23' shaft. GROUND ELEV. Program DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 7-12-72 FINISHED 7-15-72 DEPTH OF OVERBURDEN 50.5 TOTAL DEPTH 74.1 BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below LOGGED BY C.Horvik, J. Keller LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (F, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
Depths are corrected to ground level from driller's measuring point 0.4' above ground. Hole not surveyed for deviation, if any, from vertical.	4" WB	WB		No tests					0			0.0-14.6: SILTY SAND; as recorded on driller's report; recovered as reddish brown very fine sand with about 25% non-plastic fines, highly reactive to HCl; (SM).
		WB							10			
		WB										
DRILL EQUIPMENT		WB							14.6			14.6-24.6: GRAVELLY CLAY
Sprague & Henwood NW-Hyd, No. 212, hydraulic feed rotary drill, skid mounted.		WB							20			24.6-29.6: SAND
	NxD	1.0										29.6-39.6: GRAVELLY CLAY
	ST	0							24.6			39.6-50.5: CLAY AND GRAVEL
	RxDs	100										Intervals 14.7-50.6 as recorded on driller's report; recovered as coarse to medium grained sand and varied non-plastic fines and small sandstone fragments; angular to subangular; very small to minute salt crystals throughout; all materials slightly salty; highly reactive to HCl; variably colored.
	4" WB	WB							29.6			
DRILLING FLUID		WB							30			
Dolores River water Salinity increased as river level dropped, color remained clear.		WB										
		WB							39.6			50.5-52.1: DECOMPOSED SHALE; recorded as drive sampled shale on driller's report; recovered mixed with interval above.
Baled water samples (Begin of shift)		WB							40			
Date Depth Salinity 1972 EC@25°C		WB										
7-13 28'-35' 111.2ml		WB										
7-14 27'-50' 141.5x10³		WB										
7-15 26'-41' 180.2x10³		WB										
7-15 41'-46' 201.4x10³		WB							50.5			
	RxDs	34							52.1			52.1-74.1: GYPSUM BRECCIA; entirely randomly mixed structure of light gray irregularly shaped inclusions of shale, sandstone, limestone and gypsum in dark gray to black salty, gypsiferous matrix; inclusions moderately to very hard and matrix generally softer; core varied from compact to coarsely crumbly; core segments entirely rough surfaced and deeply pitted; highly fragmented; minute black salt crystals very common and well developed in matrix; white salt coating on core when dry, inclusions somewhat reactive to HCl, matrix slightly though variably reactive to HCl.
DRILL FLUID LOSSES	NxD											
Interval % Loss	ST	15										
0-14.6 0												
14.6-24.6 100		29							60			
24.6-57.7 0												
57.7-65.6 100		19										
65.6-69.6 0		75										
69.6-74.1 100		100										
		100										
WATER LEVEL DATA (Begin of shift)		44							70			
Date Hole Depth 1972 Depth to water												
7-13 39.6' 27.6'									74.1			
7-14 No drilling												
7-15 65.6' 26.1'												
				Notes Continued:								
CASED INTERVAL				to depth 74.1. One section of pipe only, perforated 52'-74'.					80			
Date Hole Depth 1972 Depth of Cs												
7-12 39.6' 39.6'				CHARACTER OF DRILLING								
7-13 65.6' 58.1'				Chopped easy except kept loosing water at bottom of Cs. Drilling fluids recovered for short period each time Cs was driven to bottom of hole. Hole caved continuously on last day (15th) with Cs at depth 65.6'								
7-15 74.1' 65.6'												
Cs removed upon completion of hole									90			
				DRILLING SITE								
WATER LEVEL PIPE				Nearly level alluvial fan at base of gypsum hill.								
74.5' of 1" 80 psi ~~black plastic~~ pipe with plug top installed from 0.4 above ground												

CORE LOSS
CORE RECOVERY

EXPLANATION

Ds=Drive sample
ST=5' Split tube core barrel
WB=Wash bored
WS=Wash sample

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1 2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . . Ex = 1 13 16", Ax = 2-1 4", Bx = 2-7/8", Nx = 3 1 2"
Inside dia. of casing (X-series) . . Ex = 1-1 2", Ax = 1-29 32", Bx = 2-3/8", Nx = 3"

Sheet 43 of 66

FEATURE Paradox Valley-Dolores River PROJECT C.R.W.Q.I.P. STATE Colorado SHEET 1 OF 1 HOLE NO. DH-2PX

7-1357 (9-69) Bureau of Reclamation GPO 684-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-3PX LOCATION By Cor. Common to Sec. 15, 16, 21 & 22 GROUND ELEV. DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

BEGUN 7-17-72 FINISHED 7-29-72 DEPTH OF OVERBURDEN 33.8' TOTAL DEPTH 200.6' BEARING -

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below LOGGED BY C. Norvik, D. Pillmore LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are corrected to ground level from drillers measuring point 0.4' above ground. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT
Sprague & Henwood NW Hyd. No. 212, hydraulic feed rotary drill, skid mounted.

DRILLING FLUID
Hauled in tank from Dolores River 1/4 mi. u/s of bridge near Bedrock; slightly turbid.

Salinity Samples
Bottled by drillers at site, taken from baler at begin of shift. Samples not retained after testing. Other tests as follows:
Turbid Drilling fluid in sump before bailing:
7-25,7AM 33.7x10³
7-28,7AM 12.5x10³
Variation due to unscheduled additions of water from tank.
River water in tank
Slightly turbid
0.7x10³

DRILLING FLUID LOSSES

Interval	% Loss
0-23.1	0
23.1-27.9	100
27.9-200.6	0

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)
WB	
WS	
WB	
NxD ST	46
	40
NxWB	WB
NxD ST	76
	100
	100
	71
	100
	100
	98
	48
	92
	83
	53
	70
	57
	73
	64
	81
	62
NxD ST	

SALINITY OF DRILL FLUID

DEPTH (FEET) FROM	TO	DATE	Kind of Sample and EC@ 25°C
			(Probe on water surface),
		At 34.2	7-28 14.6 x 10³
			All samples shown below are taken from baler:
35	45	7-29	15.6x10³
40	50	7-26	50 x10³
40	50	7-27	4.0x10³
45	55	7-30	19.2x10³
55	60	7-25	119.6x10³
65	75	7-26	5.6x10³
80	90	7-28	15.3x10³
85	95	7-27	30.5x10³

ELEVATION (FEET)

DEPTH (FEET): 0.0, 10, 19.6, 20, 27.6, 27.9, 30.4, 30.8, 40, 41.6, 50, 60, 70, 80, 90

GRAPHIC LOG

SAMPLES FOR TESTING

CLASSIFICATION AND PHYSICAL CONDITION

0.0-19.6: SAND AND GRAVEL; as recorded on drillers report; recovered as medium to fine grained, reddish sand with about 40% non-plastic fines and a few scattered red sandstone fine gravels, highly reactive to HCl.

19.6-27.6±: GRAVEL AND COBBLES; as recorded on drillers report; recovered as 0.4' max. Core segments of fine-grained, variably color banded red and yellow sandstone graded to an easily crumbled conglomerate having yellowish fine sandstone inclusions in a very porous coarse reddish sand matrix, poorly cemented with thick soft, red coating; scattered small free gypsum crystals throughout interval; core segments highly fractured, mixed with subangular sand and gravel size particles; highly reactive to HCl.

27.6±-27.9: SILT; 0.2' length core segment of gritty, buff tan, low plasticity fines; slow reaction to HCl.

27.9-30.1: SAND, GRAVEL AND CLAY; as recorded on drillers report; recovered as coarse to fine, reddish and gray sand, crusty when dry, trace of salty coating, highly reactive to HCl.

30.1-30.4: SILTSTONE; 0.3' length core segment; moderately hard; irregularly highly fractured with iron oxide stained surfaces; highly reactive to HCl.

30.4-33.8±: SILT; gritty; buff tan; compact core segments but easily crumbled; low plasticity fines; highly reactive to HCl; lower contact highly fragmented and gradational with interval below.

33.8±-41.6±: BRECCIA; entirely randomly mixed structure of brownish to varied gray, irregular inclusions of sandstone, shale and gypsum in porous matrix; inclusions moderately hard and matrix compact but crumbles easily and has many irregular small vugs and partially interconnecting channels; highly fragmented; core segments entirely rough surfaced; highly reactive to HCl; slightly salty; both contacts are gradational with adjacent intervals.

EXPLANATION

CORE LOSS / CORE RECOVERY

WB = Wash bored
WS = Wash Sample
ST = 5' split tube core barrel

Type of hole ..... D = Diamond, H = Hayward-Tits, S = Shot, C = Churn
Hole sealed ..... P = Packer, Cm = Cemented, Cr = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2"	Ax = 1-7/8"	Bx = 2-3/8"	Nx = 3"
Approx. size of core (X-series)	Ex = 7/8"	Ax = 1-1/8"	Bx = 1 5/8"	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16"	Ax = 2-1/4"	Bx = 2-7/8"	Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2"	Ax = 1-29/32"	Bx = 2-3/8"	Nx = 3"

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colorado SHEET 1 OF 2 HOLE NO DH-3PX

GEOLOGIC LOG OF DRILL HOLE

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-3PX LOCATION By Cor. Common to Sec. 15, 16, 21, & 22 GROUND ELEV. DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E.

SPUDDED 7-17-72 FINISHED 7-29-72 DEPTH OF OVERBURDEN 33.8' TOTAL DEPTH 200.6' BEARING -

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below LOGGED BY C. Norvik, D. Pillmore LOG REVIEWED B

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

WATER LEVEL DATA
(Begin of shift)

Date 1972	Hole Depth	Depth to Water
7-18	38.4'	29.6'
7-25	71.6'	37.4'
7-26	81.4'	35.8'
7-27	102.1'	35.6'
7-28	130.4'	34.2'
7-29	161.8'	33.9'

CASED INTERVAL

Date 1972	Hole Depth	Depth of Cs
7-17	38.4'	30.1'
7-18	71.6'	30.1'
7-25	81.4'	74.6'

No Cs 74.6'-200.6' Cs removed upon completion of hole.

WATER LEVEL PIPE
199.4' of 1 1/2" 80 psi black plastic pipe with plug top installed from 0.4' above ground to depth 199.4'. One 1 9/32" nominal ID white coupling at 99.1'-99.5'. Lower 60' section perforated each 2' with two 1/4"± holes.

CHARACTER OF DRILLING
7-18-72 String blasted depth 18.6'-21.6' to straighten CS. 7-25-72 Hole caving, drove Cs to 71.6'; next run very broken and blocking top of core barrel, drove Cs to 74.6'. Formation "very rotten" depth 71.6'-102.1', some caving. 7-28-72 3.0' of black caved material 127.4'-130.4' begin of shift. Core barrel catches going down at depths 104.6'and 119.6'. 7-29-72 1 1/2' of black caved material 160.3'-161.8' begin of shift. Some caving continued to completion of hole.

TYPE AND SIZE OF HOLE: NXD ST

CORE RECOVERY (%): 67, 100, 100, 87, 100, 94, 100, 100, 97, 96, 90, 100, 98, 96, 100, 97, 93, 100, 92, 100, 90, 96, 95

SALINITY OF DRILL FLUID

DEPTH (FEET) FROM	TO	DATE	(Kind of Sample) and EC@ 25°C
95	105	7-29	22.1x10³
95	105	7-30	20.6x10³
115	125	7-28	142.2x10³
150	160	7-29	43.5x10³
185	195	7-30	93.3x10³

ELEVATION (FEET)

DEPTH (FEET): 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200.6

GRAPHIC LOG

SAMPLES FOR TESTING

CLASSIFICATION AND GENERAL REMARKS

41.6±-200.6: GYPSUM BRECCIA; entirely randomly mixed structure of dark gray to black irregular shaped inclusions of shale sandstone, gypsum and limestone in a black salty and gypsiferous matrix; inclusions moderately to very hard and matrix generally softer; core varied from compact to coarsely crumbly to claylike; core segments varied from entirely rough surfaced and pitted near top of interval to increasingly smooth and clay like at bottom of interval; highly fragmented; minute black salt crystals common and well developed in upper portion of interval, lower portion is as salty with few to no crystals developed; white salt coating on core when dry; inclusions generally reactive to HCl, matrix slightly though variable reactive to HCl.

Notes continued -

DRILL SITE
Small sandy nose at base of gypsum hill.

PERCOLATION TESTS
None made.

EXPLANATION

ST = 5' split tube core barrel

CORE LOSS

CORE RECOVERY

Type of hole: D = Diamond, H = Hoystellite, S = Shot, C = Chip
Hole sealed: P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series): Ex = 1 1/2", Ax = 1 7/8", Bx = 2 3/8", Nx = 3"
Approx. size of core (X-series): Ex = 7/8", Ax = 1 1/8", Bx = 1 5/8", Nx = 2 1/8"
Outside dia. of casing, X-series: Ex = 1 13/16", Ax = 2 1/4", Bx = 2 7/8", Nx = 3 1/2"
Inside dia. of casing, X-series: Ex = 1 1/2", Ax = 1 29/32", Bx = 2 3/8", Nx = 3"

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colorado SHEET 2 OF 2 HOLE NO. DH-3PX

Bureau of Reclamation — GPO 884-481

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-4PX LOCATION NE ¼ Sec. 21, 150' North of East Paradox Creek GROUND ELEV. DIP (VERTICAL FROM HORIZ.) 90°

COORDS. N E BEARING —

BEGUN 7-30-72 FINISHED 8-2-72 DEPTH OF OVERBURDEN 90.6 TOTAL DEPTH 118.5

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below LOGGED BY C. Rorvik & J. Keller LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	Salinity of Drill Fluid: DEPTH (FEET) From	DEPTH (FEET) To	Date	(Kind of sample) and EC@ 25.°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
Depths are from ground level, the measuring point used by the drillers. Hole not surveyed for deviation, if any, from vertical.	WB 4"Cs	WS						0			0.0-20.0: SILTY SAND; as recorded on drillers report; recovered as fine to very fine grained, reddish sand with about 40% non-plastic fines; slightly crusted lumps crumble easily; highly reactive to HCl; (SM).
DRILL EQUIPMENT: Sprague & Henwood NW Hyd. No. 212, hydraulic feed, rotary drill, skid mounted.		WS						10			20.0-25.0: FAT CLAY; as recorded on drillers report; recovered as lumps of highly plastic clay with high toughness and dry strength; dried lumps very difficult to crumble; highly reactive to HCl; (CH).
DRILLING FLUID: Hauled in tank from Dolores River ¼ mi U/S of bridge near bedrock; slightly turbid.		WS		At 25.5	8-2	(Probe on water surface) 10.8x10³		20			25.0-40.0: CLAYEY SAND; recorded on drillers report as sand; recovered as fine grained, reddish sand with moderate to low plasticity; dried lumps crumble fairly easy; highly reactive to HCl; (SC).
SALINITY SAMPLES: Baled samples bottled by drillers at begin of shift. Drilling fluid tested at collar by C. Rorvik. Samples not retained after testing. Other tests as follows: Difference noted in condition of a sample; fluid 100'-105' when clear & settled tested 202.1x10³ and when stirred was murky, black and tested 232.0x10³.		WS						30			40.0-80.0: SANDY LEAN AND FAT CLAY; recorded on drillers report as sandy clay; recovered as low plasticity clay with moderately high plasticity clay zones at 40.0-43.0', 50.0-55.0' and 70.0-76.0' in which lumps have moderately high toughness and dry strength; fine sand throughout entire interval; highly reactive to HCl; (CL).
8-1: River water in water truck tanks 0.7x10³ (murky brown)		WS	35	45	8-1	(Baled) 2.3x10³		40			
		WS						50			
		WS						60			
		WS						70			
		WS	70	80	8-2	(Baled) 11.1x10³		80			80.0-88±: SAND; as recorded on drillers report; recovered as medium grained, angular to subangular, igneous and metamorphic rock type, varigated color from white to black, highly reactive to HCl; (SP).
DRILLING FLUID LOSSES: Interval 0-70, %Loss 0; 70-91, 50; 91-96, 100; 96-118.5, 50		WS									88±-90.0: MARL; small sample retained with sand interval above; dark black; fairly high dry strength and toughness; difficult to crumble by hand; very low to plasticity; soapy to feel when wet or dry; highly reactive to HCl.
	WB 4"Cs		80	90	8-1	(Baled) 2.1x10³	88.0	90			90.0-94.7: GYPSUM BRECCIA; as recorded on drillers report; recovered as fragments of dark gray to black limestone in darker and softer matrix; highly reactive to HCl; hairline cracks filled with white salt crystals.
	NxD ST	85					94.7				
		100					100				

EXPLANATION

CORE LOSS / CORE RECOVERY

WB=Wash bored
WS=Wash sample
ST=5' split tube core barrel

Type of hole: D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed: P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X series): Ex = 1-1 2", Ax = 1-7 8", Bx = 2-3 8", Nx = 3-3 4"
Approx. size of core (X series): Ex = 7 8", Ax = 1-1 8", Bx = 1-5 8", Nx = 2-3 4"
Outside dia. of casing (X series): Ex = 1-13 16", Ax = 2-1 4", Bx = 2-7 8", Nx = 4"
Inside dia. of casing (X series): Ex = 1-1 2", Ax = 1-5 8", Bx = 2-3 8", Nx = 3-7 8"

7-1737 (9-69) Bureau of Reclamation GPO 684-461

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO DH-4PX LOCATION NW¼ Sec. 21 150' North of East Paradox Creek GROUND ELEV. DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. E. TOTAL DEPTH 118.5 BEARING —

BEGUN 7-30-72 FINISHED 8-2-72 DEPTH OF OVERBURDEN 90.6

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below LOGGED BY C. Rorvik & J. Keller LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

WATER LEVEL DATA
(Begin of shift)

Date 1972	Hole Depth	Depth to Water
7-31	30.0'	Dry
8-1	80.0'	15'
8-2	118.5'	25.5'

CASED INTERVAL

Date 1972	Hole Depth	Depth of Cs
7-30	30.0'	30.0'
7-31	80.0'	80.0'
8-1	118.5'	90.0'
8-2	118.5'	90.0'

No Cs 90.0-118.5'

Cs removed upon completion of hole

WATER LEVEL PIPE
118.9' of 1½" 80 psi black plastic pipe with plug top installed from 0.4' above ground to depth 118.5' One 1-9/32" nominal ID white coupling at 100.2' lower 27.5' section perforated each 2' with two ¼"± holes. Soft mud level at depth 105'±.

CHARACTER OF DRILLING
Overburden bored easily.
In gypsum zone, core was very sticky and swelled (due to settling) into split tube core barrel and wouldn't slide out.

DRILL SITE
Level sandy ground in area cleared of greasewood brush in East Paradox flood channel.

PERCOLATION TESTS
None made.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	Salinity of Drill Fluid: DEPTH (FEET) From	TO	Date	(Kind of sample) and EC@ 25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
NWD 87	94	*At	101.0	8-1	2.1x10³				
		100	105	8-2	Bale 4 [illegible] 2.1x10³				
	100	*At	106.5	8-1	3.3x10³				
	68						110		
		*At	113.5	8-1	5.1x10³				
	92								
NWD 87	100	*=Drilling return flow at collar.					118.5		

94.7-118.5: GYPSUM BRECCIA AND MARL; randomly mixed clay-like zones and dark gray to black irregularly shaped inclusions of shale, gypsum and limestone in a black salty and gypsiferous matrix; inclusions moderately hard with matrix generally softer; core varied from compact to coarsely crumbly with clay like zones in lower part of interval; dried surface covered with white salt; minute black salt crystals formed in upper part of interval; generally highly reactive to HCl with lesser reaction on areas of heavy salt encrustations; waxed samples of core from 103.2 to 112.0 yield very strong odor of H_2S gas; waxed samples above and below this interval yield very little to no H_2S odor.

EXPLANATION

CORE LOSS
CORE RECOVERY

Type of hole . . . D = Diamond H = Hoystellite S = Shot C = Churn
Hole sealed . . . P = Packer Cm = Cemented Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1 2" Ax = 1-7 8" Bx = 2-3/8" Nx = 3"
Approx. size of core (X-series) . . Ex = 7 8" Ax = 1-5 8" Bx = 1-5/8" Nx = 2-1/8"
Outside dia. of casing (X-series) Ex = 1-13/16" Ax = 2-3/4" Bx = 2-7/8" Nx = 4"
Inside dia. of casing (X-series) Ex = 1-1 2" Ax = 1-29/32" Bx = 2-3 3" Nx = 3"

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colorado SHEET 2 OF 2 HOLE NO DH-4PX

7-1337 (9-69) Bureau of Reclamation — SPO 684-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE: Paradox Valley-Dolores River — PROJECT: Colorado River Water Quality Improvement Program — STATE: Colorado

HOLE NO.: DH-5PX — LOCATION: SE1/4 Sec. 9, 100' SE of County Road — GROUND ELEV.: — DIP (ANGLE FROM HORIZ.): 90°

COORDS. N: — E:

BEGUN: 8-10-72 — FINISHED: 8-14-72 — DEPTH OF OVERBURDEN: 80.0 — TOTAL DEPTH: 136.5 — BEARING: —

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See notes below — LOGGED BY: J.L. Keller — LOG REVIEWED BY: C.M. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILL FLUID: DEPTH (FEET) FROM	TO	DATE	(KIND OF SAMPLE) AND EC@25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
Depths are corrected to ground level from driller's measuring point 0.5' above ground. Hole not surveyed for deviation if any, from vertical. DRILL EQUIPMENT Failing 1500, hydraulic feed rotary drill, truck mounted. DRILLING FLUID Hauled in tank from Dolores River, 1/4 mi. u/s of bridge near Bedrock; slightly turbid. SALINITY SAMPLES Bottled by Drillers at site, taken from baler at begin of shift. Samples not retained after testing. Other tests as follows: 8-12: River water in water truck tank 0.5x10³ 8-15: Baler samples 45'-55' yellowish. 65'-75' greenish. 90'-100' black, trace H_2S. 125'-136' (first bale from bottom) black, strong H_2S odor. 125'-136' (Second bale from bottom) black, moderate H_2S odor.	RB 4"Ca	WB						0			0.0-9.5: SAND AND GRAVEL; as recorded on drillers report; recovered as medium to fine grained sand; multi-colored reddish to light gray color; slightly crusted lumps crumble easily by hand; moderately reactive to HCl; surface of ground at drillsite is medium to fine grained red silty sand with a few scattered red sandstone gravel-sized fragments.
								9.5			
	WB 4"Ca	WS						10			
								19.5			9.5-19.5: SAND; as recorded on drillers report; recovered as medium to fine grained sand; multi-colored reddish; slightly crusted lumps crumble easily by hand; moderately high reaction to HCl. (SP)
								20			
		WS		At25.0	8-15	(Probe on water surface) 9.7x10³					19.5-69.5: SANDY CLAY; as recorded on drillers report; recovered as medium to fine grained; low plasticity; variegated reddish color to grayish-white in lower 10' of interval; highly reactive to HCl; interval 39.5-42.0' moderately high plasticity; dried lumps crumble with difficulty by hand; (SC)
								30			
		WS		At35+	8-11	(Sump fluid) 0.6x10³					
			25	40	8-14	(1st baler) 0.8x10³					
						(1st & 2nd baler)					
	AxDs	20	28	43	8-12	3.2x10³		40			
			28	43	8-12	3.9x10³					
	WB 4"Ca	WS		At50	8-11	(Drilling fluid) 2.0x10³					
			35	50	8-12	(3d baler) 3.2x10³					
								50			
		WS	45	55	8-15	(1st baler) 7.5x10³					
			45	60	8-12	(4th baler) 4.1x10³					
								60			
		WS									
		WS									
								69.5			
								70			69.5-75.5: SAND, GRAVEL AND COBBLES; recorded on drillers report as gravelly clay; recovered as well rounded, fine gravel in interval 69.5'-71.5', composed of medium grained, multi-colored igneous types with no reaction to HCl; interval 71.5'-75.5' is medium to fine grained sand; large amount of pyrite throughout; dark green to black color; non plastic; no reaction to HCl.
	WB NxCs	WS	56	72	8-12	(5th baler) 4.2x10³					
		WS	65	75	8-15	(2d baler) 35.8x10³					
								75.5			
	NxD-ST NxCs							80			75.5-90.3: SANDSTONE; medium grained; grayish-green color between 75.5'-84.5' black between 84.5'-90.3'; moderately high porosity, indistinct grain size planes at angle of 55° to core axis; no reaction to HCl; variably fractured and crumbly throughout interval; core fragments less than 0.1' to 1.5' long, average about 0.3'; slightly salty to taste.
		39									
DRILLING FLUID LOSSES INTERVAL — % LOSS 0-39.5 — 0 39.5-49.5 — 75 49.5-69.5 — 50 69.5-84.5 — 0 84.5-136.5 — 100	NxD-ST		75	90	8-13	(Baled) 151.6x10³					
		87	75	90	8-14	177.9x10³		90.3			
		95									90.3-96.0: MUDSTONE; dark gray to black; crumbly to compact, with hard irregular fragments; no reaction to HCl; very strong salty taste.
		100	90	100	8-15	(Baled) 159.5x10³		96.0			
								100			

EXPLANATION

WB= Wash Bored — DS= Drive Sample

WS= Wash Sample — RB= 3-1/4" Rock Bit

ST= 5' Split tube core barrel

CORE LOSS / CORE RECOVERY

Type of hole: D = Diamond, H = Hayesteline, S = Shot, C = Churn

Hole sealed: P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1 2"	Ax = 1-7 8"	Bx = 2-3 8"	Nx = 3"	
Approx. size of core (X-series)	Ex = 7/8"	Ax = 1-1 8"	Bx = 1-5 8"	Nx = 2-1 8"	
Outside dia. of casing (X-series)	Ex = 1-13/16"	Ax = 2 4"	Bx = 2-7 8"	Nx = 3-1 2"	
Inside dia. of casing (X-series)	Ex = 1-1 2"	Ax = 1-29 32"	Bx = 2-3 8"	Nx = 3"	

Sheet 48 of 66

FEATURE Paradox Valley-Dolores River — PROJECT CRWQIP — STATE Colorado — SHEET 1 OF 2 — DH-5PX

7-1312 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO DH-5PX LOCATION SE1/4 Sec. 9, 100' SE of County Road GROUND ELEV. DIP (ANGLE FROM HORIZ.) 90°

COORDS. N E BEARING -

BEGUN 8-10-72 FINISHED 8-14-72 DEPTH OF OVERBURDEN 80.0 TOTAL DEPTH 136.5

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See notes below LOGGED BY J.L. Keller LOG REVIEWED BY C.N. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

WATER LEVEL DATA
(Begin of Shift)

DATE 1972	HOLE Depth	DEPTH Water
8-11	19.5'	Dry
8-12	49.5'	28'
8-13	75.5'	?
8-14	107.8'	25'
8-15	136.5'	25'

CASED INTERVAL

Date 1972	Hole Depth	Depth of Cs.
8-10	19.5'	20'
8-11	49.5'	40'
8-12	75.5'	76'
8-13	107.8'	80'
8-14	136.5'	80'

WATER LEVEL PIPE
136.2' of 1-1/2" 80 psi black plastic pipe with plug top installed from 0.5' above ground to depth 135.7'. Two 1-9/32" nominal ID white couplings at 96.4'-96.8' and 123.1'-123.5'. 85.6'-135.7' perforated each 2' with two 1/4" ± holes.

CHARACTER OF DRILLING
Overburden drilled fairly easy. Drilled with 3-1/4" rock bit, for ease of Cs driving. Ran out of 4" Cs and had to drive NxCs 70'-80'.

DRILL SITE
Gently sloping side hill near base of low ridge, 20' North of county road.

PERCOLATION TESTS
No packer tests made. Hole making water from bottom of Cs at depth 80.0 on 8-15 while bailing.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILL FLUID: DEPTH (FEET) FROM	TO	DATE	(Kind of Sample) and EC@ 25°C	ELEVATION (FEET)	DEPTH (FEET)
NxD	100				(Baled)		
ST		93	108	8-14	180.0x10³		
	100	93	108	8-14	222.4x10³		107.5
	98						110.5
	79						
	100						
	100						
	89						
					(Baled)		131.9
NxD	90	130	136.5	8-15	182.8x10³		
ST		130	136.5	8-15	161.8x10³		136.5

GRAPHIC LOG

SAMPLES FOR TESTING

CLASSIFICATION AND PHYSICAL CONDITION

96.0-107.5: SANDSTONE; medium to fine grained; hard; black; interval 100'± - 104'± indistinct grain size planes at angle of 55° to core axis; abundant pyrite crystals; variably fractured and crumbly fragments less than 0.1' to 1.5' long, average about 0.3'.

107.5-110.5: MUDSTONE; dark gray to black; non-plastic; soapy feeling when wet or dry; difficult to crumble by hand; no reaction to HCl; indistinct grain size planes at angle of 55° to core axis.

110.5-131.9: SANDSTONE; medium grained; moderately hard; moderate to highly porous; dark gray to black color; no reaction to HCl; 8 1"± open fractures in interval 116.9-131.9' filled with large clear tabular gypsum crystals having many minute, interconnecting worm-like water passages; fracture fillings are inclined 25° from core axis at 116.9-118.3, 118.3-118.7, 119.0-120.7, 122.0-122.5, 123.0-123.1, and 125.7-126.6; 1-1/2" fracture filling about parallel to core axis 131.7-131.9.

131.9-136.5: SILTSTONE; dark gray to black; moderately hard; no reaction to HCl; chalky and very salty taste.

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Hayssellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, C = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . . . Ex = 1-13/16", Ax = 2-1/2", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . . Ex = 1-1/2", Ax = 1-25/32", Bx = 2-3/8", Nx = 3"

7-1337 (9-69) Rev. Bureau of Reclamation GPO 884-461

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Paradox Valley-Dolores River PROJECT Colo. River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-6PX LOCATION C¼, 810' W of riverbank GROUND ELEV. 4939.7 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 622,128.5 E. 1,035,964.3 TOTAL DEPTH 192.0 BEARING

BEGUN 1-26-73 FINISHED 2-23-73 DEPTH OF OVERBURDEN 81.0

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Artesian-see notes below LOGGED BY C. Borwick LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are from ground level, the measuring point used by the drillers. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT

Failing 1500, hydraulic feed rotary drill, truck mounted

DRILLING FLUID

Pumped from river SE of drill site, slightly but variably turbid. Tested for salinity with conductivity meter 1-31-73, 0.5×10^3, temp 76° F.

Below depth 175' used near-saturated formation salt brine recirculated from a pit to lessen erosion of hole. Below depth 185' mixed varied, but thick amounts of Loloss compound in the brine pit to lessen collapse in the drillhole.

Salinity Samples. Bottled by drillers at site, taken at Cs collar during drilling. Samples not retained after testing.

DRILL FLUID LOSSES

Interval	% Loss
0-10.0	0
10.0-20.0	50
20.0-58.0	Artesian 50
58.0-60.0	50
60.0-120±	Artesian 0
120-192	0

Note: artesian effect increased with depth to a max. flow of 1½ gpm at collar from depth 104'±. Below 104'± effect remained level with the Cs collar.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILL FLUID: DEPTH (FEET) FROM	TO	Date 1973	kind of sample and EC @ 25° C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
4" RB		No tests				4939.7			
WB	WS								
	WS					4919.7			
4" WB	WS								
	WS								
	WS					Sand fill			
	WS								
	WS					4881.7			
	WB								
NxD	27								
4" WB	WS					4871.7			
NxD	100					4869.7			
4" WB	WS								
	WS					4858.7			
NxD WL	75								
	17					Grout plug			
NxWB	WS	93	94	1-31	98×10^3				
NxD WL	55	94	103	2-6	166×10^3	4839.7			

Pipe

CLASSIFICATION AND PHYSICAL CONDITION

0.0-20.0: SAND; as recorded on drillers report; recovered as fine to very fine quartzose, light tan sand; (SP).

20.0-58.0: SAND AND GRAVEL; as recorded on drillers report; recovered as follows: 20.0-25± as fine to very fine quartzose, light tan sand; 25±-30.0 as medium to fine quartzose, gray sand; 30.0-40.0 as medium to fine quartzose, light gray to whitish sand with 3/4" maximum size rounded gravel and fragments of wood roots near depth 40; 40.0-58.0 as fine, gray sand with brown clay lumps. All samples moderately to highly reactive to HCl.

58.0-68.0: POORLY GRADED GRAVEL; recorded on drillers report as hard packed 58.0 to 60.0 and very hard packed 60.0 to 68.0; (GP); recovered as follows: 58.0-60.6: Coarse sand-sized, angular black and white rock chips. 60.6-63.0: sub-rounded to sub-angular fine to coarse sized, max. size 0.2' core segment, entirely hard, igneous rock type composition; gray to black stained. 63.0-68.0: Mostly fine to medium natural sand with a few gravel-sized shaly fragments; stained gray. All gravel samples low to moderately reactive to HCl.

68.0-70.0: COBBLES; as recorded on the drillers report; recovered as 2 core segments, a 0.3' length of hard sandstone and 0.15' of a hard igneous type with remainder of recovery as freshly worn rounded, gravel-sized fragments in interval 68.0-69.5; and medium to fine, gray sand and angular rock fragments and thin chips 69.5-70.0; low to moderately reactive to HCl.

70.0-81.0: GRAVEL; as recorded on drillers report; recovered as medium to coarse sand-sized, angular fragments and thin chips of rock in interval 70.0-80.0; and fine gray sand with fine gravel 80.0-81.0; low to moderately reactive to HCl; (GP).

EXPLANATION

RB=3⅞" Rock bit
WB=Wash cored
WS=Wash sample
WL=Wire line method

gpm=gallons per minute
EC=Electrochemical units expressed in micromhos of specific conductance.
°C=Centigrade

CORE LOSS
CORE RECOVERY

Type of hole . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2"	Ax = 1-7/8"	Bx = 2-3/8"	Nx = 3"
Approx. size of core (X-series)	Ex = 7/8"	Ax = 1-1/8"	Bx = 1-5/8"	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16"	Ax = 2-1/4"	Bx = 2-7/8"	Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1/2"	Ax = 1-29/32"	Bx = 2-3/8"	Nx = 3"

Sheet 50 of 66

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colo. SHEET 1 OF 2 HOLE NO DH-6PX

7-1437 (9-69) Rev. Bureau of Reclamation GPO 884-481

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Paradox Valley-Dolores River PROJECT Colo. River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-6PX LOCATION. Ck. 816, 310'W of riverbank

COORDS. N. 622,128.5 E. 1,035,964.3 GROUND ELEV. 4939.7 DIP (ANGLE FROM HORIZ.) 90°

BEGUN 1-26-73 FINISHED. 2-23-73 DEPTH OF OVERBURDEN 81.0 TOTAL DEPTH 192.0 BEARING --

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED. Artesian-see notes below. LOGGED BY C. Norvik LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

WATER LEVEL DATA
(Begin of shift)

Date 1973	Hole Depth	Depth to Water
1-27	20.0'	Feeble
1-28	40.0'	flow at
1-29	60.0'	Cs collar
1-30	70.0'	"
1-31	83.0'	"
2-6	93.0'	"
2-7	103.0'	"
2-7	104.0'	1½ gpm at Cs collar
2-8	120.0'	Constant level at Cs collar
2-9	140.0'	-3.0' Hole caved in.
2-10	147'	Constant level at Cs collar
2-12	153.7'	"
2-13	165.2'	"
2-14	176.1'	"
2-15	185.4'	-3.0' Hole caved in.
2-21	191.0'	-3.0'

CASED INTERVAL

Date 1973	Hole Depth	Depth of Cs
1-26	20.0'	20.0(4"
1-27	40.0'	40.0(4"
1-28	60.0'	60.0(4"
1-29	70.0'	70.0(4"
1-30	83.0'	81.0(Nx
1-31	93.0'	93.0(Nx
2-6	103.0'	100.0(Nx
2-7	120.0'	104.0(Nx
2-8	140.0'	126.0(Nx
2-9	147.0'	147.0(Bx
2-11	147.0	(Removed Bx) 131.0(Nx
2-12	165.2	155.0(Nx
2-13	176.1	168.0(Nx
2-14	185.4	175.0(Nx

Nx & Bx Cs drove hard all the way. Cs removed upon completion of hole.

WATER LEVEL PIPES
3-1" id 80 psi black plastic pipes with plug top installed as follows: Pipe #1 from 3.35' above ground to depth 190.0' with 3.0' of 1/16" slots from depth 186.5-189.5' with

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILLING FLUID: DEPTH (FEET) FROM	TO	Date 1973	Kind of sample and EC @ 25°C
NxD ST	100	103	104	2-6	Artesian 1½ gpm 23.5 X 10^3
	100				
1 10	100				
	95				
	100				Gray silty drilling return
	100				
	53	118.5	120	2-7	62 X 10^3
1 30	50				Reddish & black silty drilling returns
	84	126	131	2-8	85 X 10^3
		131	132	2-8	65 X 10^3
	100				
	77				Red, brown & black silty drilling returns
1 40	90				
	100	143	146	2-9	50.5 X 10^3
NxWB	WS	146	148	2-10	23.2 X 10^3
NxD ST	30				
1 50	69				H_2S odor greenish black drilling return
	44				
	100				
1 60	100	162	164	2-12	56 X 10^3
	91				Black H_2S silty drilling return
	100	Cs 165	171	2-13	56.6 X 10^3
1 70	87				
	84				
	85				Black silty drilling return
1 80		Cs 175	185	2-14	92.3 X 10^3
	63				
	97				
1 90	70	185	192		No test
	100				

ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
Pipes #1 & #2 4839.7			
Grout plug	110		
	120		
	130		
Pea gravel & sand			
Slotted tip of Pipe #2	140		
	150		
Grout plug	160		
	170		
Pea Gravel	180		
Slotted tip of Pipe #1 4747.7	190 192		

CLASSIFICATION AND PHYSICAL CONDITION

81.0-192.0: GYPSUM BRECCIA; entirely pulverized and fragmented, crumbly to soft, clay-like material with much shaly character and scattered, moderately hard inclusions of sandstone; gray to black; sewer odor; no semblance of core shape above depth 164.0, and maximum core length 0.4' between 164.0 and 192.0; 3 notable zones as follows: soft, black, uniform, fine-grained sandstone fragments in interval 107.0-108.0; black, shaly fine-grained sandstone thin-bedding inclined 0°-30° to the core axis in interval 131.0-137±; and 50% sandstone-30% shale interbedded in interval 167.0-192.0; salt content increases with depth from a trace at 81.0 to saturated with brine at 120± and encrusted from 186± to 192.0; no reaction to HCl.

Notes Continued:

an 0.5' pointed end; Pipe #2 from 3.55' above ground to depth 145.0' with 3.0' of 1/16" slots from depth 141.5-144.5 with an 0.5' pointed end; and Pipe #3 from 3.75' above ground to depth 74.0'. perforated each 2' with two 1/4"± holes.

CHARACTER OF DRILLING
Chopped and rock bitted easily to 60.6'. Blasted hard pack gravel at 60.6' and cobbles at 68'. Tight on 4"Cs at 70.0. Caved at 93'±, 103'±, 120'±, 126'±, 140' to 146', 147' to 153.7' then replaced Cs, caved back up to 131.0'. String shot 131'-141'. Caved again 131' to 155' Caved 155' to 192' each time drill string was pulled out, stuck rods several times. String shot 168'-171' to open up for Cs.

DRILL SITE
Level sandy ground between old river meanders, covered with small tamarisk brush and some ice.

CORE LOSS
CORE RECOVERY

EXPLANATION

WB= Wash bored
WS= Wash sample
ST= 5' Split tube core barrel

gpm= Gallons per minute
id= inside diameter
psi=pounds per square inch

Type of hole . . . . . D = Diamond, H = Hayesellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1/2"	Ax = 1-7/8"	Bx = 2-3/8"	Nx = 3"
Approx. size of core (X-series)	Ex = 7/8"	Ax = 1-1/8"	Bx = 1-5/8"	Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-11/16"	Ax = 2-1/4"	Bx = 2-7/8"	Nx = 3-1/2
Inside dia. of casing (X-series)	Ex = 1-1/2"	Ax = 1-29/32"	Bx = 2-3/8"	Nx = 3"

EC=Electrochemical units expressed in micromhos of specific conductance.
°C= Centigrade

Sheet 51 of 66

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colorado SHEET 2 OF 2 HOLE NO. DH-6PX

Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 5

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-7PX LOCATION Near Cs.816.21'. N of riverbank see note* GROUND ELEV. 4938.4 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N.621,789.22 E. 1,035,967.91 TOTAL DEPTH 469.7 BEARING ---

BEGUN 2-24-74 FINISHED 4-22-74 DEPTH OF OVERBURDEN 107.3

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Artesian-see notes below LOGGED BY C. Norvik LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILL FLUID: DEPTH (FEET) From	DEPTH (FEET) To	Date 1973	Kind of sample and EC @ 25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
* Depths are from 0.7' above ground level when drilled; on 4-27-73 a flood added 1.0' of sand and level when surveyed 10-26-73 was 4939.37. Hole not surveyed for deviation, if any, from vertical.	4" WB	WS	No tests in overburden				4938.4 Pipes 1 2 3				
DRILL EQUIPMENT Failing 1500, hydraulic feed rotary drill, truck mounted							Sand fill				0.0-9.3: SAND; as recorded on drillers report; recovered as fine quartzose, light tan silty sand; highly reactive to HCl; (SP).
DRILL FLUID Overburden drilled with slightly turbid river water pumped from 100' downstream, the same site as for DH-6PX On 3-8-73 began drilling rock section with thick amounts of Loless compound mixed in saturated formation salt brine. Salinity Samples Bottled by drillers at site, taken at Cs collar during drilling. Samples not retained after testing.							4929.1	9.3			9.3-19.3: SAND AND GRAVEL; as recorded on drillers report; recovered same as interval above.
		WS					4919.1	19.3			19.3-24.3: SAND; as recorded on drillers report; recovered same as interval 0.0-9.3.
		WS					4914.1	24.3			24.3-29.3: SAND AND GRAVEL; as recorded on drillers report; recovered same as interval 0.0-9.3.
		WS					4909.1	29.3			29.3-39.3: POORLY GRADED GRAVEL; recorded on drillers report as gravel and sand; recovered as coarse, sub-rounded to sub-angular, brown, red and white sand particles; highly reactive to HCl; (GP).
		WS					4899.1	39.3			39.3-44.3: SAND; as recorded on drillers report; recovered as fine, light tan sand; (SP).
		WS					4894.1	44.3			44.3-59.3: SAND AND GRAVEL; as recorded on drillers report; recovered as fine, light tan sand in interval 44.3-49.3 and as 70% fine sand and 30% medium, gray sand; highly reactive to HCl.
		WS					4879.1	59.3			59.3-64.3: GRAVEL; recorded on drillers report as river gravel; recovered as 70% fine and 30% medium, gray sand; (GP).
DRILL FLUID LOSSES (%) AND GAINS (gpm)	4" WB	WS					4874.1	64.3			64.3-82.3: GRAVEL AND COBBLES; as recorded on drillers report, also described as hard packed in interval 64.3-72.3; recovered as medium to coarse, angular, gray sand with an 0.3' core of generally fresh granitic rock in interval 69.0-69.3.
Interval Fluid: 0.0-24.3 0%; 24.3-49.3 60%; 49.3-244.8 Wastage equal gains; 244.8-247.3 Artesian ½ gpm; 247.3-278.8 Wastage equal gains; 278.8-286.8 Artesian 2 gpm; 286.8-318.3 Wastage equal gains; 318.3-328.0 Artesian 1 gpm; 328.0-339.8 Artesian 1½ gpm; 339.8-469.7 Wastage progressively →								69.3			
	4" WB	WS					4856.1	82.3			82.3-89.3: SAND; as recorded on drillers report; recovered as light gray to buff; fine sand; highly reactive to HCl; (SP).
		WS					4849.1 Sand fill	89.3			89.3-99.3: SAND AND GRAVEL; recorded on drillers report as sand; recovered as sub-rounded to sub-angular, ¼" maximum size very fine gravel with coarse and medium sand mixed in; gray; highly reactive to HCl.
		WS					4839.1	99.3			

EXPLANATION

CORE LOSS / CORE RECOVERY

WB = Wash bored
WS = Wash sample
gpm = gallons per minute

Type of hole . . . D = Diamond, H = Hoystrillite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X series)	Ex = 1-1 2"	Ax = 1-2 8"	Bx = 2 3 8"
Approx. size of case (X series)	Ex = 2 7/8"	Ax = 1-1 1/8"	Bx = 1 5/8"
Outside dia. of casing (X series)	Ex = 1 13 16"	Ax = 2-1 4"	Bx = 2 7 8"
Inside dia. of casing (X series)	Ex = 1-1 2"	Ax = 1 29 32"	Bx = 2 3 8"

Notes Cont'd: exceeded gains as the pull of each core became deeper; at bottom of hole still 0%.

Sheet 52 of 66

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colo. SHEET 1 OF 5 HOLE NO DH-7PX

Rev. Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 5

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-7PX LOCATION Near C¼, 816.21'W of riverbank GROUND ELEV. 4938.4 see Note* DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 621,789.22 E. 1,035,967.91 TOTAL DEPTH 469.7 BEARING ---

BEGUN 2-24-74 FINISHED 4-22-74 DEPTH OF OVERBURDEN 107.3

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Artesian-see notes below LOGGED BY C. Rorvik LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

WATER LEVEL DATA
(Begin of shift)

Date 1973	Hole Depth	Depth to water
2-25	24.3	+0.0
2-26	49.3	+0.0
2-27	62.3	+0.0
2-28	72.3	+0.0
3-1	89.3	+0.0
3-6	99.3	+0.0
3-7	103.3	+0.0
3-9	107.3	+0.0
3-10	121.8	+0.0
3-11	140.6	+0.0
3-12	161.3	+0.0
3-13	186.8	+0.0
3-14	207.7	+0.0
3-21	227.9	+0.0

(+0.0 indicates an artesian head of 6.0' above river level, to top, but not flowing out of, casing collar)

3-22	244.8	½ gpm
3-23	259.7	+0.0
3-24	278.8	2 gpm
3-25	291.3	+0.0
3-26	300.3	+0.0
3-27	313.8	+0.0
3-27	318.3	1 gpm
3-28	328.0	1½ gpm
3-29	339.8	+0.0
4-3	343.7	3.3
4-4	347.3	5.0
4-5	361.7	1.8
4-6	371.4	4.3
4-7	372.9	4.1
4-8	387.3	4.6
4-9	401.5	4.0
4-10	420.7	4.6
4-11	435.1	3.6
4-12	452.3	3.8

CASED INTERVAL

Date 1973	Hole Depth	Depth of Cs
2-24	24.3	24.3
2-25	49.3	29.3
2-26	64.3	59.3
2-27	72.3	72.3
2-28	89.3	89.3

(used all of 4" casing)

3-1	99.3	99.3
3-6	103.3	103.3
3-7	107.3	107.3
3-8	107.3	Pulled

NxCs out, installed NxWL to 76.3, then

TYPE AND SIZE OF HOLE

8"WB-NxD 4" WB

NxD 1 | NxD ST | NxD ST

CORE RECOVERY (%)

WS 100

82 | 100 | 98 | 98 | 100 | 100 | 100 | 100 | 100 | 89 | 100 | 94 | 100 | 91 | 100 | 89 | 100

SALINITY OF DRILL FLUID

DEPTH (FEET) From	DEPTH (FEET) To	Date 1973	Kind of sample and EC @ 25°C
	At begin of drilling		
	at bottom of casing,		
Cs	red-brown, oily, silty.		
107.3	107.3	3-8	102x10³
			Gray, silty drilling returns 87x10³
131.3	134.3	3-10	
			Gray, silty drilling return 98.5x10³
171.6	174.3	3-12	

ELEVATION (FEET)

4838.4 | 4834.1 | 4831.1 | 4780.1 | 4775.1 | 4738.4

DEPTH (FEET)

Pipes 2¾" 2⅜"

0 | 50 | 63 | 100 | 110 | 120 | 130 | 140 | 150 | 158.3 | 160 | 163.3 | 170 | 180 | 190 | 200

Sand fill

Grout plug

GRAPHIC LOG

SAMPLES FOR TESTING

CLASSIFICATION AND PHYSICAL CONDITION

99.3-104.3: SAND, GRAVEL AND COBBLES; recorded on drillers report as hard packed gravel with cobbles at 99.3 and 102.3; recovered same as interval 89.3-99.3 with an 0.1' and 0.3' core of fine-grained igneous type rock at interval 102.3-102.6 and sub-rounded, hard, granitic gravel in interval 102.6-104.3; all materials stained gray.

104.3-107.3: SAND, GRAVEL AND CLAY; recorded on drillers report as hard-packed gravel; recovered as coarse to medium, dark gray sand, sub-rounded, dark gray, fine gravel and sandy, black, fat clay; highly reactive to HCl.

107.3-158.3: GYPSUM BRECCIA; about 90% black, compact, clay-like material; sticky when wet, powdery when dry; with 10% generally soft, gray sandstone fragment inclusions throughout; 5.0' maximum length core segments between mechanical breaks; interval 112.3-158.3 has many punky zones and shaly and sandstone angular fragments 0.1'-0.3' long; entirely saturated with NaCl salt; heavily encrusted with white salt when dry; strong reaction to HCl to depth 127.3, little to no reaction below.

158.3-166.3: SANDSTONE; fine-grained; massive; gray; only partings are mechanical breaks; saturated with NaCl salt; little to no reaction to HCl.

166.3-209.3: SANDSTONE-SHALE BRECCIA; irregular zones of soft and crumbly to moderately hard sandstone inclusions, shale and sandy shattered material; entirely air slaked and shrinkage cracked when dry; saturated with NaCl; thin white salt crust when dry; gray; little to no reaction to HCl.

EXPLANATION

CORE LOSS / CORE RECOVERY

WB=Wash bored
WS=Wash sample
ST=5' Split tube core barrel

gpm= gallons per minute
EC= Electrochemical units expressed in micromhos of specific conductance.
°C=Centigrade

Type of hole . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . . Ex = 1-1 2", Ax = 1-7 8", Bx = 2-3 8", Nx = 3" 8"
Approx. size of core (X-series) . . . Ex = 1 8", Ax = 1-1 8", Bx = 1-5/8", Nx = 2" 8"
Outside dia. of casing (X-series) . . . Ex = 1-1 16", Ax = 1-7 8", Bx = 2-3 8", Nx = 3" 2"
Inside dia. of casing (X-series) . . . Ex = 1-1 2", Ax = 1-29 32", Bx = 2-1 8", Nx = 3" 8"

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colo. SHEET 2 OF 5 HOLE NO. DH-7PX

GEOLOGIC LOG OF DRILL HOLE

FEATURE Paradox Valley-Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO. DH-7PX LOCATION Near. C¼,S16,.21'W. of riverbank GROUND ELEV. 4938.4 see note* DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 621,789.22 E. 1,035,967.91 TOTAL DEPTH 469.7 BEARING

BEGUN 2-24-74 FINISHED 4-22-74 DEPTH OF OVERBURDEN 107.3

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Artesian-see notes below LOGGED BY C. Rorvik LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILL FLUID: DEPTH (FEET) From	DEPTH (FEET) To	Date 1973	Kind of sample and EC @ 25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
CASED INTERVAL Continued - pulled NxWL out and reinstalled NxCs to depth 107.3. Last 6.0' drove very hard. WATER LEVEL PIPES 3-1" id 80psi black plastic pipes with plug top installed as follows: 4-17-73 Pipe #1 from original ground level to depth 390.3 with 3.0' of 1/16" slots from depth 386.8 to 389.8 with an 0.5' tapered end and 1" id couplings centered at depths 28.8, 95.8, 193.3 and 292.7; 4-21-73 Pipe #2 from original ground level to depth 271.3 with 3.0' of 1/16" slots from depth 267.8 to 270.8 with an 0.5' tapered end and 1" id couplings at depths 71.3 and 98.3; 4-21-73 Pipe #3 from original ground level to depth 121.3 perforated each 2' with two ¼"± holes and a 1" id coupling at depth 19.3. On 9-12-73 added 1" id couplings and 4.08' of 1¼" id sections to the pipes (3.08' above new ground level) before being surveyed. CHARACTER OF DRILLING 0.0 - 60± chopped easy. 60±-70± hard chopping through tight gravel. 70±-107.3 chopped slowly (except NxD on cobble at 69.0-69.3). Cobbles blasted at 99.3 and 102.3.	NxD ST	100					4738.4	200			209.3-343.3: SANDSTONE BRECCIA; generally fine, sandy textured material compact to punky; weak to soft with a few moderately hard zones in upper portion of interval; mostly fragmented with a few core segments to 1.0' long in interval 259.3-313.8; fragments mostly broken at 30 and 60 to core axis in interval 209.3-259.3, many angular fragments at 30 and 60 with many platy fragments at 80 to core axis in interval 259.3-313.8; and fewer fragments and more distinct small core segments in interval 313.8-343.3; entirely saturated with NaCl salt; many dark colored salt crystals formed in the rock material in interval 313.8-343.3; trace of salt crust when dry in interval 209.3-259.3, spotty to even white salt crust 259.3-313.8, and heavily crusted with salt crystals 313.8-343.3; dark gray; little to no reaction to HCl.
		96									
	210	100									
		100				Artesian head after 5 days of no drilling activity, static level at 5.0' above ground level, 48°F, 101X10³ oily.					
		100									
	220	84									
		92	Cs 107.3	227.9	3-19						
	230	96									
		100					Grout plug				
		100				Gray silty drilling returns 104X10³					
	240	84	237.3	239.3	3-21						
		100									
		100									
	250	100									
		96									
		100					Pea gravel				
	260	94									
		100					Slotted tip of Pipe #2				
	270	100									
		100									
	280	100									
		100									
		82				Gray silty drilling returns 105X10³					
	290		291.3	294.3	3-25		Grout plug				
		100									
	NxD ST	100					4638.4	300			

EXPLANATION

CORE LOSS / CORE RECOVERY

WL=Wire line method
ST=5' Split tube core barrel
psi= pounds per square inch
id=inside diameter
EC=Electrochemical units expressed in micromhos of specific conductance.
°C=Centigrade

Type of hole ... D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed ... P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) Ex = 1-1 2", Ax = 1-7 8", Bx = 2-3 8", Nx = 3-
Approx. size of core (X-series) Ex = 7 8", Ax = 1-1 8", Bx = 1-5 8", Nx = 2-
Outside dia. of casing (X-series) Ex = 1-13 16", Ax = 2-1 4", Bx = 2 7 8", Nx = 4-
Inside dia. of casing (X-series) Ex = 1-1 2", Ax = 1-29/32", Bx = 2 3 8", Nx = 4"

7-1432 (10-69) Rev
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 4 OF 5

Colorado River Water Quality Improvement Program

FEATURE Paradox Valley-Dolores River PROJECT STATE Colorado

HOLE NO. DH-7PX LOCATION Near C¼,S16, 21'W of riverbank see note* GROUND ELEV. 4938.4 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 621,789.22 E. 1,035,967.91

BEGUN 2-24-74 FINISHED 4-22-74 DEPTH OF OVERBURDEN 107.3 TOTAL DEPTH 469.7 BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Artesian-see notes below LOGGED BY C. Norvik LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILL FLUID: DEPTH (FEET) From	TO	Date 1973	Kind of sample and EC @ 25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
CHARACTER OF DRILLING- Cont'd 107.3-469.7 hole tended to collapse and squeeze in upper zones but lessened with depth Had a constant problem with clayey core compressing and oozing between the split tube liner and blocking against the outer barrel, resulting in many extra short runs. DRILL SITE Fairley level edge of river bank densely covered with burned stalks and green mature tamarisk brush, snow covered at time of drilling. The river was 6.0' below top of bank at begin of drilling and rose to 1½'-2' below the bank on 4-18-73 then held steady until after hole was completed. Drill site was a low island during the latter part of drilling. The approach through the swamp to the west became too soft for 4-wheel drive trucks and a snow cat was tried and then an ATV Coot was used.	NxD ST	100	Test samples lost in flood at site				Pipe #2 4638.4	300			
		98									
	310	100						310			
		100									
	320	96						320			
		94									
	330	100						330			
		95					Sand grout				
		35									
	340	75					4595.1	343.3			343.3-400.5: GYPSUM BRECCIA AND SALT; variegated zones of marbled, banded and spotty textures; micaceous throughout; moderately hard to compact; mostly in mechanically broken core lengths, maximum 2.5' long, with few fragment zones; light to dark gray; entirely saturated with NaCl salt; interval 345.5-346.8 is natural petroleum impregnated and has free NaCl salt and gypsum crystals; interval 371.4-372.9 has a reddish clayey stain and free salt crystals; the oil was evident on the core at the time of drilling as only 2 small dots but within a week had oozed out of many small vugs and cracks and covered the entire core segment.
	350	100						350			
		100									
	360	90						360			
		52									
	370	31					Pea gravel	370			
	380	100						380			
		100					Slotted tip of Pipe #1				
	390	100						390			
		100									
	NxD ST	100					4538.4	400			

EXPLANATION

CORE LOSS / CORE RECOVERY

ST = 5' Split tube core barrel

Type of hole . . . . . D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1 2", Ax = 1-7/8", Bx = 2-3 8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1 8"
Outside dia. of casing (X-series) . Ex = 1 13 16", Ax = 2-1 4", Bx = 2-7 8", Nx = 3-1 2"
Inside dia. of casing (X series) . . Ex = 1-1/2", Ax = 1 29 32", Bx = 2-3/8", Nx = 3"

7-1517 (9-69) Rev. Bureau of Reclamation GPO 854-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 5 OF 5

Colorado River Water Quality Improvement Program

FEATURE Paradox Valley-Dolores River PROJECT STATE Colorado

HOLE NO. DH-7PX LOCATION. Near Ck. 816, 21' W. of riverbank GROUND ELEV. 4938.4 see note" DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 621,789.22 E. 1,035,967.91

BEGUN 2-24-74 FINISHED. 4-22-74 DEPTH OF OVERBURDEN 107.3 TOTAL DEPTH. 469.7 BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED. Artesian-see notes below. LOGGED BY. C. Rorvik LOG REVIEWED BY.

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILL FLUID: DEPTH (FEET) From	DEPTH (FEET) To	Date 1973	Kind of sample and EC @ 25°C	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
	NxD ST		Test samples lost in flood at site.				4527.9	400.5			400.5-469.7: GYPSUM BRECCIA, SALT AND OIL; 95% crystalline gypsum and NaCl salt in marbled white, gray and black colored textures; very small fresh pyrite crystals are common throughout; core mostly broken mechanically, driller commented that bottom 20' of hole had no jointing, maximum core length in box 2.5' with 50% of interval above 449.7 less than 0.5' core lengths and a few scattered zones of crumbly black decomposed gypsiferous materials; at 412.5-412.7 is an 0.2' seam of clear crystalline gypsum; at 468.3-469.7 is a 1.4' zone of soft, whitish, compact material; some white salt crust on core when dry; most of core stained with natural petroleum oil and more abundantly exhibited the same oozing effect as described above for interval 345.5-346.8, and excluding the surface stains, the most prominent intervals impregnated with oil are as follows: 401.8-402.8, 412.7-413.6, 419.4-420.5, 421.3-421.9, 425.2-425.5, 434.1-434.9, 442.8-443.3, 444.7-445.5, 451.3-451.9, 452.3-454.0, 459.4-460.8 then evenly-spaced pattern of smaller spots between 460.8 and 469.7.
		100									
		100									
410		100						410			
		100									
420		100						420			
		100									
430		100					Pea Gravel fill in hole	430			
		97									
440								440			
		100									
450								450			
		100									
460								460			
		100									
	NxD ST	100					4468.7	469.7			

EXPLANATION

CORE LOSS

CORE RECOVERY

ST = 5' Split tube core barrel

Type of hole . . . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, C = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . Ex = 1 1 2" Ax = 1-7 8", Bx = 2-3 8", Nx = 3"
Approx. size of core (X-series) . Ex = 7-8", Ax = 1-1 8", Bx = 1-5/8", Nx = 2-1 8"
Outside dia. of casing (X-series) . Ex = 1-13 16", Ax = 2 1-4", Bx = 2-7/8", Nx = 3-1 2"
Inside dia. of casing (X-series) . Ex = 1 1 2" Ax = 1-29 32", Bx = 2-3/8", Nx = 2"

Sheet 56 of 66

FEATURE Paradox Valley-Dolores River PROJECT CRWQIP STATE Colo SHEET 5 OF 5 HOLE DH-7PX

Rev. Bureau of Reclamation GPO 684-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE Paradox Valley - Dolores River PROJECT Colorado River Water Quality Improvement Program STATE Colorado

HOLE NO DH-8PX LOCATION Near C¼ S16, 40' W of river GROUND ELEV. 4939.5 DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 621,988.2 E. 1,036,248.4 TOTAL DEPTH 85.0

BEGUN 4-23-73 FINISHED 5-6-73* DEPTH OF OVERBURDEN Unknown BEARING —

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED Artesian-see notes below. LOGGED BY C. Servik LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are from ground level, the measuring point used by the drillers. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT
Failing 1500, hydraulic feed rotary drill, truck mounted

DRILL FLUID
Pumped into sump from river 250' upstream, the same site as for DH-6PX and -7PX. River water was very turbid and was mixed with thick amounts of Loloss compound in the sump. The mixture gained in salinity as drilling returns recirculated through the sump.

Salinity Samples
Bottled by drillers at site, taken at Cs collar during drilling. Samples not retained after testing.

DRILL FLUID LOSSES (-) AND GAINS (Gpm)

Interval	Fluid
0.0-20.0	0
20.0-60.0	Wastage equal gains.
At 60.0	3/4 gpm
60.0-85.0	Artesian effect diminishing.

WATER LEVEL DATA (Begin of shift)

Date 1973	Hole Depth	Depth to water
4-24	20.0	0.0
4-25	40.0	0.0
4-26	75.0	0.0

CASED INTERVAL

Date 1973	Hole Depth	Depth of Cs
4-23	20.0	20.0
4-24	40.0	40.0
4-25	75.0	75.0
4-26	85.0	85.0
8-22	85.0	70.0

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	SALINITY OF DRILLING FLUID: DEPTH (FEET) From	DEPTH (FEET) To	Date 1973	Kind of sample and EC @ 25°C	ELEVATION (FEET)	DEPTH (FEET) NxCs Pipe +1.6	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
Nx WB						4939.5				
WS		0	Cs 10	4-23	Sample Lost	4929.5	10			0.0-10.0: SAND; tan; as recorded on drillers report; sample lost in flood of site on 4-27-73
WS		10	Cs 20	4-23	Fine sandy drill returns 0.4x10³		20			10.0-60.0: SAND AND GRAVEL; gray; as recorded on drillers report; sample lost
WS		20	Cs 30	4-24	Fine sandy drill returns 0.2x10³		30			
WS		30	Cs 40	4-24	Fine sandy drill returns 0.2x10³		40			
WS		40	Cs 50	4-25	Fine sandy drill returns 0.3x10³		50			
WS		50	Cs 60	4-25	Fine sandy drill returns 0.1x10³	4879.5	60			
		60	Cs 63	4-25	Red silty artesian 0.5x10³					60.0-75.0: SAND, GRAVEL AND COBBLES; gray; as recorded on drillers report; sample lost.
WS		63	Cs 70	4-25	Dark brown silty drill returns 1.6x10³		70			
WS		70	Cs 75	4-25	Black silty drill returns 2.0x10³	4864.5	75			75.0-85.0: SAND AND GRAVEL; gray; as recorded on drillers report; sample lost
WS		75	Cs 80	4-26	Black silty drill returns 4.0x10³		80			
Nx WB		80	Cs 85	4-26	No test	4854.5	85			

Notes Continued-
NxCs left in place 68.4' below ground and 1.6' stick up; to serve as water level pipe.

CHARACTER OF DRILLING - Chopped easy to depth 60.0. Used 2 sticks of dynamite at 63.0 to blast cobble. No problems indicated below depth 63.0

DRILL SITE - Shallow, meander scarred, fairly level, sandy surface thickly covered with burned stalks and green tamarisk brush. The ATV Coot was used with increasing difficulty to reach the site. On 4-27-73 the river rose to about 1½' over its bank and flooded the site; burying the spare casing, rods, pumps, sample boxes, etc. under soft mucky silt. The site was abandoned until 8-22-73 when the rig was removed with no further drilling.

EXPLANATION

CORE LOSS / CORE RECOVERY

WB=Wash bored
WS=Wash sample

EC=Electrochemical units expressed in micromhos of specific conductance.
°C=Centigrade

Type of hole: D = Diamond, H = Haystellite, S = Shot, C = Churn
Hole sealed: P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series): Ex = 1 1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series): Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series): Ex = 1-13/16", Ax = 2 1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series): Ex = 1 1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control Project STATE Colorado

HOLE NO. DH-13RA LOCATION southeastern reservoir GROUND ELEV. 6325± DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 526,800 E. 1,098,700 TOTAL DEPTH 200.0' BEARING ---

BEGUN 7-8-75 FINISHED 7-17-75 DEPTH OF OVERBURDEN 12.0'

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are from ground level. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT
Sullivan 22 hydraulic feed rotary drill.

DRILLING FLUID
Clear water.

DRILL FLUID LOSSES
No fluid loss throughout drilling.

WATER LEVEL DATA
(Begin of Shift)

Date 1975	Hole Depth	Depth to Water
7-9	45.0	17.0
7-10	64.0	17.0
7-11	83.0	17.0
7-12	100.0	16.7
7-13	116.8	16.0
7-14	137.6	17.0
7-15	159.6	19.0
7-16	178.0	19.6
7-17	191.9	20.6

CASED INTERVAL
0.0'-30.5' Cs removed upon completion of hole.

BACKFILL OF HOLE
Upon completion the hole was washed with clear water and a cement mix was pumped into the hole before final fill of soil.

CHARACTER OF DRILLING
Easy drilling through entire hole, no problems.

DRILL SITE
On gently sloping, sagebrush terrain.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
Nx	DS	0.00	30.5Cs	No	Test		6325±	0.0		
DS							6322±	2.7		
NxD	77									
	90						6313±	12.0		
	56									
	86									
		30.5Cs	45.0	No	Test					
	62									
	35									
	100									
	97	45.0P	54.4	0.10	55	5				
	100									
	89	54.4P	64.0	0.00	65	5				
	100									
	95	64.0P	75.0	0.00	75	5				
	100									
	64									
	100	75.0P	86.0	0.00	85	5				
	87									
	100	86.0P	94.8	0.00	95	5				
	91									
	100	94.8P	104.7	0.00	100	5				
NxD							6225±	100.0		

Drilled by USBR crew

CLASSIFICATION AND PHYSICAL CONDITION

0.0-2.7: SANDY CLAY; medium plasticity, about 20% fine sand, medium dry strength and toughness, red-brown to brown, moderately reactive to HCl; (CL).

2.7-12.0: WEATHERED SHALE; thick bedded, moderately poor fissility, crumbly throughout, slight air slake, soft, brittle, medium compaction, gray-brown to gray, decomposed to nearly clay in places, no reaction to HCl.

12.0-200.0: SHALE; thick bedded with bedding plane perpendicular to core axis, good to moderate fissility, strong air slaking from 43,9' to 44.2' and 60.7' to 62.7', well compacted, moderately soft to hard, gray to black, no reaction to HCl to 98.5' but moderate to strong reaction from 98.5' to 200', occasionally slightly sandy, 112.1' to 112.5' is light gray mudstone layer which does not react to HCl. Chalky white zone occurs at 188.8' to 189.3'.

12.0-75.0 is somewhat weathered and moderately soft in zones, segments range from crumbled fragments to 0.9' and average about 0.1'.

75.0-150.0 is segmented from 0.3' to 0.5' and averages about 0.4'.

150.0 to 200.0 is segmented from 0.3' to 1.5' and averages about 0.5'.

A fracture 45° to core axis occurs from 163.6' to 163.8'.

Vertical fractures occur from 122.2' to 123.0', from 125.2' to 125.9', from 126.8' to 130.3', from 133.1' to 134.1'.

DS = Drive Sample

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole: D = Diamond, H = Hoystellite, S = Shot, C = Churn
Holes sealed: P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1 2"	Ax = 1-7 8"	Bx = 2-3/8"	Nx = 3"
Approx. size of core (X-series)	Ex = 7 8"	Ax = 1-1/8"	Bx = 1-5/8"	Nx = 2-1 8
Outside dia. of casing (X-series)	Ex = 1-13 16"	Ax = 2-1 4"	Bx = 2-7/8"	Nx = 3-1 2
Inside dia. of casing (X-series)	Ex = 1-1 2"	Ax = 1-29 32"	Bx = 2-3 8"	Nx = 3"

FEATURE Radium Evaporation Pond PROJECT CRBSCP STATE Colorado SHEET 1 OF 2 HOLE NO. DH-13RA

7-1317 (9-69)
Bureau of Reclamation GPO 884-491

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. DH-13RA LOCATION southeastern reservoir Project GROUND ELEV. 6325± DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 526,800 E. 1,098,700

BEGUN 7-8-75 FINISHED 7-17-75 DEPTH OF OVERBURDEN 12.0' TOTAL DEPTH 200.0' BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								6225±	100.0			Drilled by USBR crew
	NxD	94										12.0-200.0: SHALE; thick bedded with bedding plane perpendicular to core axis, good to moderate fissility, strong air slaking from 43.9' to 44.2' and 60.7' to 62.7', well compacted, moderately soft to hard, gray to black, no reaction to HCl to 98.5' but moderate to strong reaction from 98.5' to 200', occasionally slightly sandy, 112.1' to 112.5' is light gray mudstone layer which does not react to HCl. Chalky white zone occurs at 188.8' to 189.3'.
		100										
		94	104.7P	116.8	0.00	115	5					
		95										12.0-75.0 is somewhat weathered and moderately soft in zones, segments range from crumbled fragments to 0.9' and average about 0.1'.
			116.8P	128.1	0.00	125	5					
			128.1P	137.6	0.00	135	5					75.0-150.0 is segmented from 0.3' to 0.5' and averages about 0.4'.
		100										
			137.6P	145.6	0.00	140	5					150.0-200.0 is segmented from 0.3' to 1.5' and averages about 0.5'.
			145.6P	152.0	0.00	150	5					
		93	152.0P	159.6	0.00	150	5					A fracture 45° to core axis occurs from 163.6' to 163.8'.
		95	159.6P	169.0	0.00	160	5					
		100										Vertical fractures occur from 122.2' to 123.0', from 125.2' to 125.9', from 126.8' to 130.3', from 133.1' to 134.1'.
		98	169.0P	178.0	0.00	170	5					
		93										
		100	178.0P	188.4	0.00	180	5					
		65	188.4P	200.0	0.00	190	5					
		100										
	NxD		Bottom of hole					6125±	200.0			

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . D = Diamond H = Hayestellite S = Shot C = Climax
Hole sealed . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X series) . . Ex = 1-1 2", Ax = 1-7 8", Bx = 2-3 8", Nx = 3"
Approx. size of core (X-series . . Ex = 7 8", Ax = 1-1 8", Bx = 1-5 8", Nx = 2-1 8"
Outside dia. of casing (X-series) . Ex = 1-13 16", Ax = 2-1 4", Bx = 2 7 8", Nx = 3-1 2"
Inside dia. of casing (X-series) . . Ex = 1-1 2", Ax = 1 29 32", Bx = 2-3 8", Nx = 3"

7-1317 (9-69) Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. DH-14RA LOCATION Southwestern reservoir Project GROUND ELEV. 6330± DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 532,600 E. 1,085,300

BEGUN 7-30-75 FINISHED 8-8-75 DEPTH OF OVERBURDEN 2.2' TOTAL DEPTH 106.2' BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY C. Rorvik

Drilled by USBR crew

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING AND OTHER DRILLING CONDITIONS

Depths are from ground level. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT
Sullivan 22 hydraulic feed rotary drill.

DRILLING FLUID
Clear water.

DRILL FLUID LOSSES
No fluid loss throughout drilling.

WATER LEVEL DATA
(Begin of Shift)

Date 1975	Hole Depth	Depth to Water
7-31	20.5	7.0
8-6	41.5	22.0
8-7	57.6	11.0
8-8	86.7	20.8

CASED INTERVAL
0.0'-51.1' Cs removed upon completion of hole.

BACKFILL OF HOLE
Upon completion, the hole was washed with clear water and cement mix pumped into the hole before final fill of soil.

CHARACTER OF DRILLING
Broke core bit in hole at 57.6'. Otherwise, no problems.

DRILL SITE
On gently sloping sagebrush terrain.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
4"RB	WS	0.0	9.8Cs	8.00	G	5	6330±	0.0			
							6329±	1.0			
							6328±	2.2			
							6325±	5.0			
NxD	100	9.8Cs	20.5	No Test							
	0										
	98	20.5Cs	31.8	0.00	30	5					
	95										
	100	31.8Cs	43.5	11.00	40	5					
		43.5Cs	51.1	0.00	50	5					
		51.1Cs	52.0	No Test							
		52.0P	57.3	0.50	60	5	6276±	53.8			
	97										
	100	67.3P	77.0	0.60	70	5					
		77.0P	86.7	0.64	80	5					
	95										
	100	86.7P	106.2	No Test							
NxD							6230±	100.0			

0.0-1.0: SANDY CLAY; low plasticity, about 25% fine sand, medium dry strength and toughness, red-brown, slightly reactive to HCl (CL).

1.0-2.2: WEATHERED SHALE; entirely fragmented, poor fissility, moderately hard to soft, brittle. Slightly reactive to HCl.

2.2-5.0: Rock Bit - No Sample.

5.0-53.8: SHALE; thick bedded at 90° to axis, poor to fair fissility, slight air slake at 43.6' to 43.8', 48.2' to 48.3', and 48.9' 5o 49.2', well compacted for the most part, moderately hard to hard, soft chalky-white zone 30.6'-el.6', gray to dark gray, slightly to moderately reactive to HCl. Vertical fractures occur from 13.1' to 13.7'. Core varies from ¼" fragments to 0.9' segments and average 0.5'.

53.8-103.7: SANDY SHALE; thick bedded at 90° to axis, poor fissility, no air slaking, hard, well compacted and cemented, soft chalky-white zone 90.6' to 92.6', dark gray to mottled light gray due to sand, some zones have about 50% fine to medium grain sand, moderately reactive to HCl to 62' depth, but not reactive beyond.

103.7-106.2: SANDSTONE; fine to medium grained, subrounded to subangular, somewhat rough texture, moderately soft to moderately hard, well cemented and compacted, light gray with very minute gray layers of shale, slightly reactive to HCl. Segments range from 0.1' to 0.6' and average 0.3'.

EXPLANATION

RB = Rock Bit
WS = Wash Sample
G = Gravity

CORE LOSS
CORE RECOVERY

Type of hole D = Diamond, H = Hayesteelite, S = Shot, C = Churn
Hole sealed P = Packer, Cm = Cemented, C = Bottom of casing
Approx. size of hole (X-series) Ex = 1-1 2" Ax = 1-7/8" Bx = 2-3 8", Nx = 3"
Approx. size of core (X series) Ex = 7 8" Ax = 1 1 8", Bx = 1-5-8", Nx = 2 1 8"
Outside dia. of casing (X-series) Ex = 1-13/16" Ax = 1 1 4", Bx = 2-7/8", Nx = 3 1 2"
Inside dia. of casing (X-series) Ex = 1-1 2" Ax = 1-29/32" Bx = 2-3 8" Nx = 3"

7-1337 (5-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control Project STATE Colorado

HOLE NO. DH-14RA LOCATION Southwestern reservoir COORDS. N. 532,600 E. 1,085,300 GROUND ELEV. 6330± DIP (ANGLE FROM HORIZ.)

BEGUN 7-30-75 FINISHED 8-8-75 DEPTH OF OVERBURDEN 2.2' TOTAL DEPTH 106.2' BEARING

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
	NxD	96			No	Test		6226±	103.7			
				Bottom of		hole		6224±	106.2			

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Hoystellite, S = Shot C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE Radium Evaporation Pond PROJECT CRBSCP STATE Colorado SHEET 2 OF 2 HOLE NO. DH-14RA

7-1337 (9-69)
Bureau of Reclamation GPO 854-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control Project STATE Colorado

HOLE NO. DH-15RA LOCATION northwestern reservoir GROUND ELEV. 6287± DIP (ANGLE FROM HORIZ.) 90°

COORDS. N. 536,900 E. 1,086,400 TOTAL DEPTH 76.9' BEARING ---

BEGUN 7-26-75 FINISHED 7-29-75 DEPTH OF OVERBURDEN 10.5'

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are from ground level. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT
Sullivan 22 hydraulic feed rotary drill.

DRILLING FLUID
Clear water.

DRILL FLUID LOSSES
No fluid loss throughout drilling.

WATER LEVEL DATA
(Begin of Shift)

Date 1975	Hole Depth	Depth to Water
7-27	25.4	3.0
7-28	48.8	2.6
7-29	67.2	5.0

CASED INTERVAL
0.0'-58.0' Cs removed upon completion of hole.

BACKFILL OF HOLE
Upon completion, the hole was washed with clear water and cement mix pumped into the hole before final fill of soil.

CHARACTER OF DRILLING
Easy drilling throughout entire hole - no problems.

DRILL SITE
On gently sloping sagebrush terrain.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)
Nx DS	DS	0.0Cs	10.5	0.00	G	5	6286+	1.0
							6281+	5.5
							6276+	10.5
NxD	97	10.5Cs	20.6	0.00	25	5		
	92							
	98	20.6Cs	30.2	0.00	30	5		
	96						6262+	25.0
	100	30.2Cs	39.8	0.00	40	5		
	85							
	100	39.8Cs	48.8	0.00	45	5		
	50						6240+	47.4
	86	48.8Cs	57.5	0.20	50	5		
							6231+	55.8
							6230+	57.2
	94	57.5P	67.2	0.00	60	5		
							6222+	64.5
							6220+	67.2
	100	67.2P	76.9	0.00	70	5	6219+	68.3
							6215+	72.1
							6212+	75.0
NxD			Bottom of hole				6210+	76.9

GRAPHIC LOG

SAMPLES FOR TESTING

Drilled by USBR crew

CLASSIFICATION AND PHYSICAL CONDITION

0.0-1.0: LEAN CLAY; medium to moderately high plasticity, 20% fine sand, medium dry strength and toughness, red-brown, moderately reactive to HCl (CL).

1.0-5.5: SANDY CLAY; slight to low plasticity, about 40% fine sand (grades occasionally clayey sand), moderately high dry strength, contains traces of gypsum, moderately reactive to HCl. (CL).

5.5-10.5: SANDY CLAY; low plasticity, about 30% fine sand, moderately high dry strength, traces of gypsum, slightly reactive to HCl. (CL).

10.5-25.0: WEATHERED SANDY SHALE; moderately thick bedded at 90° to core axis, poor to fair fissility, no air slaking but crumbled and heavily fragmented along bedding planes, well cemented and compacted where less deterioration from weathering has occurred, soft to moderately hard, tan to gray first 17.6' but then becomes mottled gray, traces of gypsum, is occasionally very sandy to moderately sandy, only slightly reactive to HCl in places. Fragmented throughout, largest segments .5', average .1'.

25.0-47.4: SANDY SHALE; thick bedded at 90° to axis, poor to fair fissility, no air slake, weathered zone of decomposed light gray shale from 34.9' to 35.6', well compacted and cemented, moderately soft to hard, gray to dark gray and sometimes mottled, traces of gypsum, some trace of pyrite, slightly sandy to very sandy and may grade to shaley sandstone in places, occasionally slightly reactive to HCl. Core segments range from .1' to 1.6', averaging .5', except in fragmented zone from 34.9' to 35.6'.

47.4-55.8: SANDSTONE; fine to medium grained, subangular to subround, even grain texture, moderately hard to hard, tight, dense, well cemented, light gray, slight reaction to HCl. Segments range from 3.2' to .1', averaging 2.0'.

55.8-57.2: COAL; low specific gravity, somewhat blocky, black, some trace of shale and thin layers of light gray sandstone as above - bony, size range from .5' to ½". (See sheet 2 for further descriptions)

EXPLANATION

CORE LOSS / CORE RECOVERY

DS = Drive Sample
G = Gravity

Type of hole: D = Diamond, H = Hoystellite, S = Shot, C = Churn
Hole sealed: P = Packer, Cm = Cemented, Cs = Bottom of casing

Approx. size of hole (X-series)	Ex = 1-1 2"	Ax = 1-7/8"	Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series)	Ex = 7/8"	Ax = 1-1/8"	Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series)	Ex = 1-13/16"	Ax = 2-1/4"	Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series)	Ex = 1-1 2"	Ax = 1-29/32"	Bx = 2-3/8", Nx = 3"

7-1332 (N-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO. DH-15RA LOCATION. northwestern reservoir Project
COORDS. N. 536,900 E. 1,086,400 GROUND ELEV. 6287± DIP (ANGLE FROM HORIZ.) 90°

BEGUN 7-26-75 FINISHED 7-29-75 DEPTH OF OVERBURDEN 10.5' TOTAL DEPTH 76.9' BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	PERCOLATION TESTS: DEPTH (FEET) TO	PERCOLATION TESTS: LOSS (G.P.M.)	PERCOLATION TESTS: PRESSURE (P.S.I.)	PERCOLATION TESTS: LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
									10			Drilled by USBR crew
									20			57.2-64.5: SILTSTONE; fine smooth texture, light gray; occasionally shaley to sandy, carbonaceous shale at 60.2' to 61.0', grades into shale at 62.8' - poor fissility, moderately soft to moderately hard, gray, well compacted, slightly reactive to HCl, segments ¼" to .7', averaging .2'.
									30			64.5-67.2: SANDSTONE; fine to medium grained, subangular to subround, even grain texture, moderately hard to hard, tight, dense, well cemented, light gray, slightly reactive to HCl. Segments from .9' to .5'.
									40			67.2-68.3: SHALE; poor fissility, well compacted, moderately soft to moderately hard, slightly reactive to HCl, ¼" to .7' averaging .2'.
									50			68.3-72.1: SANDSTONE; fine to medium grained, subangular to subround, even grain texture, moderately hard to hard, tight, dense, well cemented, light gray, slightly reactive to HCl. Segments from .5' to 1.4'.
									60			72.1-75.0: CARBONACEOUS SHALE AND COAL; low specific gravity, somewhat blocky, black, some trace of shale and thin layers of light gray sandstone - bony, fragments to .3'.
									70			75.0-76.9: SANDSTONE; fine to medium grained, subangular to subround, even grain texture, moderately hard to hard, tight, dense, well cemented, light gray, with very numerous thin layers of carbonaceous shale, slightly reactive to HCl. Average segments .5'.
									80			
									90			

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Hayestellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . Ex = 1-1 2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . Ex = 1-1 2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

FEATURE Radium Evaporation Pond PROJECT CRBSCP STATE Colorado SHEET 2 OF 2 HOLE NO. DH-15RA

7 1337 (9-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control STATE Colorado

HOLE NO DH-16RA LOCATION central reservoir Project COORDS. N. 532,500 E. 1,093,100. GROUND ELEV. 6310± DIP (ANGLE FROM HORIZ.) 90°

BEGUN 8-9-75 FINISHED 8-14-75 DEPTH OF OVERBURDEN 5.6' TOTAL DEPTH 114.6' BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are from ground level. Hole not surveyed for deviation, if any, from vertical.

DRILL EQUIPMENT
Sullivan 22 hydraulic feed rotary drill.

DRILLING FLUID
Clear water

DRILL FLUID LOSSES

Cs	Interval	%Loss
10.0	14.8-19.6	80
10.0	19.6-20.0	60
20.0	20.0-25.3	75
20.0	25.3-30.1	75
20.0	30.1-39.7	50
20.0	39.7-49.3	50
20.0	49.3-59.0	60

WATER LEVEL DATA
(Begin of Shift)

Date 1975	Hole Depth	Depth to Water
8-10	9.9	7.0
8-11	30.1	24.6
8-12	59.0	24.0
8-13	78.4	25.5
8-14	114.6	25.0

CASED INTERVAL
0.0'-59.0 Cs removed upon completion of hole.

BACKFILL OF HOLE
Upon completion, the hole was washed with clear water and a cement mix was pumped into the hole before final fill of soil.

CHARACTER OF DRILLING
Easy drilling through entire hole - no problems

DRILL SITE
On generally level, sagebrush terrain.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING
							6310±	0.0		
Nx		0.0	10.0	0.50	G	5	6309±	1.0		
DS	DS						6304±	5.6		
NxD	34									
	94	10.0Cs	20.0	16.00	G	5				
	100									
	0									
	88	20.0P	30.1	15.00	25	5				
	92									
	98	30.1P	39.7	0.60	40	5				
	100									
		39.7P	49.3	0.70	50	5				
	93	49.3P	59.0	0.60	55	5				
	94	59.0P	68.7	0.00	60	5				
	100	68.7P	78.4	0.00	70	5				
		78.4P	88.1	0.00	80	5				
		88.1P	97.7	0.00	90	5				
NxD		97.7P	107.4	0.00	100	5	6210±	100.0		

Drilled by USBR crew

CLASSIFICATION AND PHYSICAL CONDITION

0.0-1.0: LEAN CLAY; medium plasticity, about 15% fine sand, medium dry strength and toughness, reddish brown, highly reactive to HCl; (CL).

1.0-5.6: LEAN CLAY; medium to high plasticity, 5-10% fine sand, may grade to CH in places, medium dry strength and toughness, tan to gray, traces of gypsum, displays slight fissility in places, indicating decomposed shale, reactive to HCl. (CL)

5.6-114.6: SHALE; thick bedded at 90° to axis, poor to good (generally fair) fissility, no air slaking, medium soft to hard, well compacted, gray to dark gray to occasional black carbonaceous layers, slight to moderate reaction to HCl, frequent fragmented weathered zones to 20' depth with tannish-gray color, 46.8' to 48.2' and 103.4' to 107' are soft weathered zones of light gray to chalky white, smooth texture to 78.8' then becomes moderately rough, somewhat mottled and sandy. Segments vary from fragments to 2.2' and average about 1.0'.

EXPLANATION

CORE LOSS / CORE RECOVERY

DS = Drive Sample
G = Gravity

Type of hole . . . . . D = Diamond, H = Hayatellite, S = Shot, C = Churn
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X series) . . Ex = 1-7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series) . Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X series) . . Ex = 1-1/2", Ax = 1-29.32", Bx = 2-3/8", Nx = 3"

FEATURE Radium Evaporation Pond PROJECT CRBSCP STATE Colorado SHEET 1 OF 2 HOLE NO DH-16RA

7-1337 (9-69)
Bureau of Reclamation GPO 884-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 2 OF 2

FEATURE Radium Evaporation Pond PROJECT Colorado River Basin Salinity Control Project STATE Colorado

HOLE NO. DH-16RA LOCATION central reservoir COORDS. N. 532,500 E. 1,093,100 GROUND ELEV. 6310± DIP (ANGLE FROM HORIZ.) 90°

BEGUN 8-9-75 FINISHED 8-14-75 DEPTH OF OVERBURDEN 5.6' TOTAL DEPTH 114.6' BEARING ---

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED See Notes LOGGED BY R.L. Crutchfield LOG REVIEWED BY C. Rorvik

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS	TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								6210±	100.0			Drilled by USBR crew
		96										
			107.4	114.6	0.00	100	5					
	110	98							110			
	NxD			Bottom of hole				6195+	114.6			

EXPLANATION

CORE LOSS

CORE RECOVERY

Type of hole . . . . . D = Diamond, H = Haystellite, S = Shot, C = Chum
Hole sealed . . . . . P = Packer, Cm = Cemented, Cs = Bottom of casing
Approx. size of hole (X-series) . . Ex = 1-1/2", Ax = 1-7/8", Bx = 2-3/8", Nx = 3"
Approx. size of core (X-series) . . Ex = 7/8", Ax = 1-1/8", Bx = 1-5/8", Nx = 2-1/8"
Outside dia. of casing (X-series). Ex = 1-13/16", Ax = 2-1/4", Bx = 2-7/8", Nx = 3-1/2"
Inside dia. of casing (X-series) . . Ex = 1-1/2", Ax = 1-29/32", Bx = 2-3/8", Nx = 3"

Bureau of Reclamation GPO 854-401

GEOLOGIC LOG OF DRILL HOLE

SHEET 1 OF 1

FEATURE: Radium Evaporation Pond | PROJECT: Colorado River Basin Salinity Control Project | STATE: Colorado

HOLE NO: DH17RA | LOCATION: eastern reservoir | COORDS: N. 531,600 E. 1,099,800 | GROUND ELEV.: 6304± | DIP (ANGLE FROM HORIZ.):

BEGUN: 7-22-75 | FINISHED: 7-25-75 | DEPTH OF OVERBURDEN: 13' | TOTAL DEPTH: 47.2' | BEARING:

DEPTH AND ELEV. OF WATER LEVEL AND DATE MEASURED: See Notes | LOGGED BY: R.L. Crutchfield | LOG REVIEWED BY:

NOTES ON WATER LOSSES AND LEVELS, CASING, CEMENTING, CAVING, AND OTHER DRILLING CONDITIONS

Depths are from ground level. Hole not surveyed for deviation, if any from vertical

DRILL EQUIPMENT
Sullivan 22 hydraulic feed rotary drill.

DRILLING FLUID
Clear water

DRILL FLUID LOSSES

Cs	Interval	%Loss
20.2	20.2-25.0	95
20.2	25.0-29.7	95
20.2	29.7-38.5	95
20.2	38.5-47.2	95

WATER LEVEL DATA
(Begin of Shift)

Date Hole 1975	Depth	Depth to water
7.24	20.2	7.0
7.25	47.2	11.0

CASED INTERVAL
0.0'-20.2' Cs removed upon completion of hole

BACKFILL OF HOLE
Upon completion the hole was washed with clear water and a cement mix was pumped into the hole before the final fill of soil

CHARACTER OF DRILLING
Easy drilling through entire hole-no problems.

DRILL SITE
On generally level, sagebrush terrain.

TYPE AND SIZE OF HOLE	CORE RECOVERY (%)	PERCOLATION TESTS: DEPTH (FEET) FROM (P, Cs, or Cm)	DEPTH (FEET) TO	LOSS (G.P.M.)	PRESSURE (P.S.I.)	LENGTH OF TEST (MIN.)	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
N x DS 10	DS	0.0	5.0Cs	0.00	G	5					
		5.0Cs	13.0	0.00	G	5	6298+	6.0			0.0-6.0: LEAN CLAY; medium plasticity, about 20% fine sand, medium to high dry strength and toughness, reddish brown, occasional trace of gypsum, highly reactive to HCl. (CL)
	95	13.0Cs	25.0	4.50	G	5	6291+	13.0			6.0-13.0: LEAN CLAY; medium plasticity, about 10% fine sand, may grade to CH in places, medium to high dry strength, medium toughness, tan to gray to gray-brown, contains high amount of gypsum with some crystals 1/4", highly reactive to HCl. (CL)
	100						6283+	20.6			13.0-20.6: WEATHERED SANDY SHALE; mostly thick bedded at 90° to axis, poor to fair fissility, no air slaking but crumbly and soft in zones, fairly well compacted and cemented where not deteriorated badly, moderately sandy to very sandy, soft to moderately soft, tan to becoming gray, occasional slight reactively to HCl, only slightly sandy at 19.2', traces of fragmented gypsum throughout with an average size of 0.2'.
	85	21.0P	29.7	9.00	25	5					
	100	29.7P	38.5	0.20	35	5					
		38.5P	47.2	0.00	50	5	6263+	40.9			20.6-40.9: SANDSTONE; fine to medium grained, subangular to subrounded, even-grained texture, thin 1/16" layers of gray shale and frequent interbedded shale layers of 0.1' to 0.5' past 30' depth, moderately hard to hard, tight, dense, well cemented, light gray, no to slight HCl reaction, segments from 1' to 1.6' averaging 0.5'
							6257+	46.6			40.9-46.6: COAL; blocky, interbedded carbonaceous shale and light gray sandstone layers of 1/4" to 2", black, low specific gravity, fragments to 0.5' averaging 0.2'.
							6257+	47.2			46.6-47.2: SANDSTONE; fine to medium grained, subangular to subrounded, even grained texture, thin 1/16" layers of gray shale, moderately hard to hard, tight, dense, well cemented, light gray, no to slight HCl reaction, segments from 0.1' to 1.6' averaging 0.5'.

DS = Drive Sample
G = Gravity

EXPLANATION

CORE LOSS
CORE RECOVERY

Type of bore: D = Diamond, R = Rockwellite, S = Shot, C = Calyx
Hole drilled: P = Percussion, C = Cable, R = Rotary, T = Bottom of core
Approx. size of hole (X series): Ex = 1.7 8", Ax = 2.3 8", Bx = 2.9 8", Nx = 3.7 8"
Approx. size of core (X series): Ex = 1.0 8", Ax = 1.8 8", Bx = 1.5 8", Nx = 2.1 8"
Outside dia. of casing (X series): Ex = 1.6 8", Ax = 2.4 8", Bx = 2.7 8", Nx = 3.5 8"
Inside dia. of casing (X series): Ex = 1.29 42", Ax = 1.91 8", Bx = 2.3 8", Nx = 3.0 8"

Sheet 66 of 66

FEATURE: Radium Evaporation Pond | CRBSCP | Colorado | SHEET 1 OF 1 | DH-17RA

1975 summary of evaporation and climatological observations
Dry Creek Basin, San Miguel County, Colorado

Month	Air temperature (°F)					Total precipitation (inches)	Total wind (N. miles)	Average langleys	Evaporation pan #1 fresh			Evaporation pan #2 brine			Evaporation pan #3 brine		
									Water temperature (°F)		Total evaporation (inches)	Water temperature (°F)		Total evaporation (inches)	Water temperature (°F)		Total evaporation (inches)
	Average maximum	Average minimum	Average dry bulb	Average wet bulb	Average dew point				Average maximum	Average minimum		Average maximum	Average minimum		Average maximum	Average minimum	
January	41.	17.	37.	34.	27.3	0.08	0.	0.	0.	0.	0.	60.	25.	0.23	45.	24.	0.37
February	40.	19.	32.	33.	28.6	.49	0.	0.	0.	0.	0.	10.	-3.	1.15	9.	-3.	1.47
March	47.	29.	46.	37.	25.0	2.61	1,321.	0.	47.	34.	1.31	14.	0.	2.35	14.	0.	2.44
April	51.	29.	46.	39.	31.2	1.27	3,553.	0.	59.	36.	5.64	19.	1.	4.40	18.	0.	4.86
May	64.	34.	56.	45.	34.7	1.23	2,912.	0.	68.	38.	6.80	25.	4.	5.16	23.	4.	5.61
June	76.	40.	69.	53.	41.0	.26	2,667.	0.	76.	43.	11.23	31.	8.	12.56	33.	8.	8.89
July	84.	51.	76.	62.	54.3	.61	1,613.	0.	83.	52.	11.62	37.	13.	7.31	36.	13.	8.35
August	83.	47.	80.	57.	39.0	.52	1,835.	0.	81.	48.	10.60	34.	11.	8.51	33.	11.	8.65
September	74.	37.	67.	49.	29.6	.75	1,188.	0.	73.	41.	6.81	30.	6.	5.54	29.	7.	6.14
October	71.	32.	51.	36.	18.1	.20	2,211.	0.	67.	31.	5.61	23.	1.	4.28	24.	1.	4.83
November	51.	24.	41.	36.	24.5	.38	2,197.	89.1	0.	0.	0.	14.	0.	2.77	13.	1.	3.36
December	41.	7.	31.	29.	23.3	.61	1,310.	174.7	0.	0.	0.	7.	-2.	.41	7.	-2.	.81
Yearly	60.	31.	53.	42.	31.4	9.01	20,806.	131.9	69.	40.	59.62	25.30	5.41	54.67	23.75	5.46	55.78

Note: Brine in Evaporation Pan #2 = 260,000 mg/l.
Brine in Evaporation Pan #3 = 170,000 mg/l.
No snow fall measurements taken at Dry Creek Basin Station. Solar meter installed November 1975.

1976 summary of evaporation and climatological observations
Dry Creek Basin, San Miguel County, Colorado

Month	Air temperature (°F)					Total precipitation (inches)	Total wind (miles)	Average langleys	Evaporation pan #1 fresh			Evaporation pan #2 brine			Evaporation pan #3 brine		
									Water temperature (°F)		Total evaporation (inches)	Water temperature (°F)		Total evaporation (inches)	Water temperature (°F)		Total evaporation (inches)
	Average maximum	Average minimum	Average dry bulb	Average wet bulb	Average dew point				Average maximum	Average minimum		Average maximum	Average minimum		Average maximum	Average minimum	
January	36.	-2.	24.	28.	25.8	0.51	819.	210.0	0.	0.	0.	5.	-7.	0.67	5.	-6.	0.83
February	46.	20.	39.	36.	30.2	.83	2,607.	198.4	0.	0.	0.	11.	-2.	1.53	12.	-0.	1.64
March	47.	15.	42.	36.	158.1	.16	2,868.	374.3	0.	0.	0.	12.	-4.	3.16	12.	-4.	11.48
April	58.	28.	51.	46.	41.9	.43	3,164.	406.2	62.	35.	5.17	20.	1.	5.52	20.	1.	7.16
May	72.	37.	64.	54.	44.9	.36	1,956.	536.6	74.	41.	8.09	33.	8.	4.97	33.	8.	4.55
June[1/]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
July[1/]	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
August	82.	51.	75.	55.	38.8	1.48	[2/] 6,399.	436.6	79.	47.	9.52	37.	12.	7.28	0.	0.	0.
September	70.	42.	59.	51.	43.7	2.11	1,295.	363.3	78.	43.	7.88	38.	10.	6.47	0.	0.	0.
October	63.	24.	38.	37.	35.3	.14	1,250.	333.7	63.	36.	4.27	20.	1.	6.82	0.	0.	0.
November	54.	16.	0.	0.	0.	.10	970.	251.4	0.	0.	0.	11.	-4.	4.06	0.	0.	0.
December	46.	10.	0.	0.	0.	0.	907.	34.1	0.	0.	0.	5.	-10.	1.93	0.	0.	0.
Yearly	57.	27.	49.	43.	52.3	6.12	22,234.	314.5	71.	40.	34.93	19.23	.41	42.41	16.65	-.11	25.66

Note: Brine in Evaporation Pan #2 = 260,000 mg/l.
Brine in Evaporation Pan #3 = 170,000 mg/l.
Evaporation Pan #3 removed May 1976.

1/ There are no data for June and July.
2/ Wind mileage (nautical miles) for August is actually the sum total for June, July, and August.

1977 summary of evaporation and climatological observations
Dry Creek Basin, San Miguel County, Colorado

Month	Air temperature (°F)					Total precipitation (inches)	Total wind (miles)	Average langleys	Evaporation pan #1 fresh			Evaporation pan #2 brine			Evaporation pan #3 brine		
									Water temperature (°F)		Total evaporation (inches)	Water temperature (°F)		Total evaporation (inches)	Water temperature (°F)		Total evapotation (inches)
	Average maximum	Average minimum	Average dry bulb	Average wet bulb	Average dew point				Average maximum	Average minimum		Average maximum	Average minimum		Average maximum	Average minimum	
January	38.	5.	0.	0.	0.	0.73	741.	0.	0.	0.	0.	4.	-9.	1.89	0.	0.	0.
February	47.	13.	0.	0.	0.	.16	1,003.	0.	0.	0.	0.	11.	-5.	1.70	0.	0.	0.
March	48.	17.	0.	0.	0.	.20	2,673.	387.7	0.	0.	0.	13.	-4.	3.98	0.	0.	0.
April	63.	29.	0.	0.	0.	.20	1,866.	481.8	71.	38.	2.68	23.	3.	5.21	0.	0.	0.
May	67.	37.	52.	41.	41.3	.70	3,332.	589.5	69.	39.	9.64	25.	5.	7.93	0.	0.	0.
June	88.	44.	77.	50.	15.8	.20	2,362.	705.6	86.	48.	6.91	39.	11.	5.77	0.	0.	0.
July	79.	54.	69.	58.	55.4	0.	1,628.	536.8	88.	52.	9.70	0.	0.	0.	0.	0.	0.
August	75.	49.	70.	58.	61.2	3.71	1,587.	536.6	88.	49.	11.38	0.	0.	0.	0.	0.	0.
September	68.	41.	64.	49.	38.7	2.22	1,743.	482.6	76.	47.	9.03	0.	0.	0.	0.	0.	0.
October	58.	27.	49.	42.	62.9	1.58	636.	350.3	65.	40.	6.01	0.	0.	0.	0.	0.	0.
November	43.	23.	49.	39.	66.7	.85	1/100.	227.4	62.	42.	1.14	0.	0.	0.	0.	0.	0.
Yearly	61.	31.	61.	48.	48.9	10.55	17,672.	477.6	75.	44.	56.49	19.43	.61	26.48	0.	0.	0.

Note: Brine in Evaporation Pan #2 = 260,000 mg/1.
Brine in Evaporation Pan #3 = 170,000 mg/1.

1/ Not complete month of wind data.

Summary of evaporation and climatological observations
Bedrock, Montrose County, Colorado

Month	Air temperature (°F) Average maximum	Average minimum	Average dry bulb	Average wet bulb	Average dew point	Total precipitation (inches)	Total wind (miles)	Total langleys	Evaporation pan #1 fresh Water temperature (°F) Average maximum	Average minimum	Total evaporation (inches)
					1975						
January	47.	20.	0.	0.	0.	0.	0.	0.	0.	0.	0.
February	47.	20.	0.	0.	0.	0.	0.	0.	0.	0.	0.
March	54.	25.	35.	35.	48.8	.20	825.	0.	55.	35.	1.11
April	60.	29.	43.	37.	49.8	1.24	2,058.	0.	63.	38.	6.34
May	72.	36.	54.	44.	43.9	.52	1,983.	0.	72.	43.	8.71
June	83.	42.	62.	49.	38.4	.42	1,755.	0.	79.	48.	11.01
July	92.	55.	70.	59.	49.9	2.06	1,252.	0.	89.	58.	10.61
August	89.	47.	65.	54.	46.8	.84	1,097.	0.	84.	53.	10.29
September	83.	42.	57.	48.	52.2	.52	1,036.	0.	78.	48.	7.45
October	72.	27.	43.	35.	47.1	.58	1,162.	0.	65.	36.	5.55
November	56.	16.	39.	33.	52.1	.74	1,218.	0.	53.	33.	1.90
December	45.	15.	0.	0.	0.	~~8.97~~ 8.47	772.	0.	0.	0.	0.
Yearly	66.	31.	39.	33.	35.8	~~16.09~~ 7.59	13,158.	0.	53.	33.	62.97
						Paradox 13.62					
					1976						
January	40.	2.	0.	0.	0.	5.93 .23	526.	0.	0.	0.	0.
February	52.	23.	0.	0.	0.	.41	1,281.	0.	0.	0.	0.
March	56.	21.	41.	34.	50.0	~~3.31~~ .81	1,971.	0.	58.	34.	4.35
April	67.	30.	51.	40.	38.2	.40	1,859.	0.	66.	38.	7.26
May	77.	40.	58.	48.	47.6	1.22	1,525.	0.	76.	46.	9.08
June	87.	43.	65.	50.	29.9	.38	1,715.	0.	82.	48.	12.85
July	95.	54.	72.	59.	44.0	.81	1,197.	0.	90.	57.	12.28
August	88.	49.	67.	56.	52.3	1.52	1,053.	0.	85.	54.	9.65
September	81.	44.	57.	52.	71.3	1.57	762.	0.	78.	51.	6.36
October	70.	26.	41.	36.	61.1	.14	853.	0.	64.	37.	4.57
November	59.	16.	38.	34.	64.6	.23	702.	0.	56.	35.	1.83
December	48.	4.	0.	0.	0.	0.	614.	0.	0.	0.	0.
Yearly	68.	29.	41.	34.	38.2	~~15.92~~ 7.12	14,058.	0.	55.	33.	68.23
						Paradox 8.68					

1977 summary of evaporation and climatological observations
Bedrock, Montrose County, Colorado

Month	Air temperature (°F) Average maximum	Average minimum	Average dry bulb	Average wet bulb	Average dew point	Total precipitation (inches)	Total wind (miles)	Total langleys	Evaporation pan #1 fresh Water temperature (°F) Average maximum	Average minimum	Total evaporation (inches)	Evaporation pan #2 brine Water temperature (°F) Average maximum	Average minimum	Total evaporation (inches)	Evaporation pan #3 brine Water temperature (°F) Average maximum	Average minimum	Total evaporation (inches)
January	38.	3.	0.	0.	0.	~~10.63~~ .82	460.	0.	0.	0.	0.00	0.	0.	0.00	0.	0.	0.
February	53.	17.	0.	0.	0.	.15	926.	0.	0.	0.	0.00	53.	25.	.98	0.	0.	0.
March	54.	20.	41.	34.	51.0	.43	1,948.	0.	56.	35.	3.96	61.	27.	3.44	0.	0.	0.
April	71.	31.	53.	42.	43.4	.16	1,625.	0.	67.	41.	7.38	77.	41.	5.59	0.	0.	0.
May	75.	39.	58.	46.	37.7	.57	2,397.	0.	71.	44.	10.82	83.	46.	7.49	0.	0.	0.
June	91.	49.	70.	53.	32.9	.17	1,462.	0.	84.	53.	12.24	95.	53.	8.73	0.	0.	0.
July	90.	57.	70.	60.	57.9	3.75	1,088.	0.	87.	59.	10.48	100.	62.	7.56	0.	0.	0.
August	90.	53.	68.	59.	58.6	1.38	860.	0.	87.	59.	8.35	97.	60.	6.17	0.	0.	0.
September	84.	44.	60.	50.	53.5	.85	1,101.	0.	78.	50.	7.54	86.	51.	5.77	0.	0.	0.
October	74.	29.	44.	38.	60.6	.35	924.	0.	65.	40.	4.87	71.	38.	3.38	0.	0.	0.
November	57.	23.	41.	37.	67.9	1.17	879.	0.	51.	36.	1.06	51.	29.	1.66	0.	0.	0.
Yearly	71.	33.	46.	38.	42.1	~~19.61~~ 9.74	13,670.	0.	59.	38.	66.70	70.	39.	50.77	0.	0.	0.

Note: Brine in evaporation pan #2 = 260,000 mg/l.
No evaporation pan #3 at Bedrock Station.