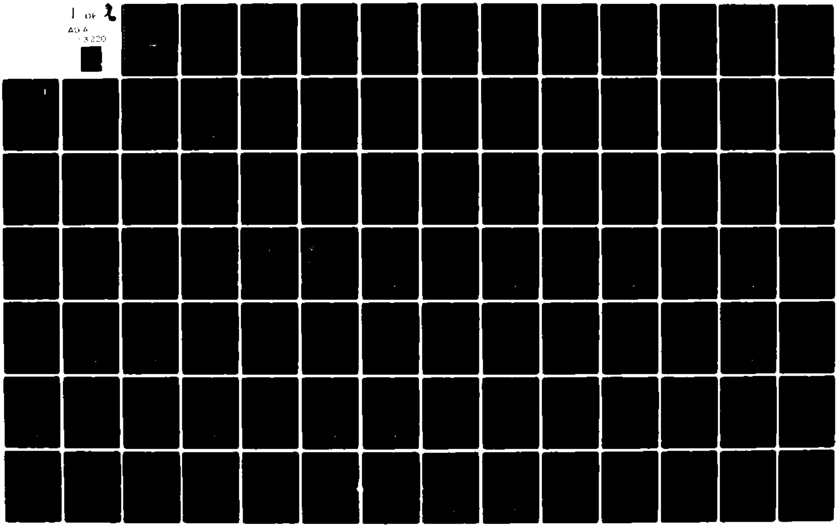
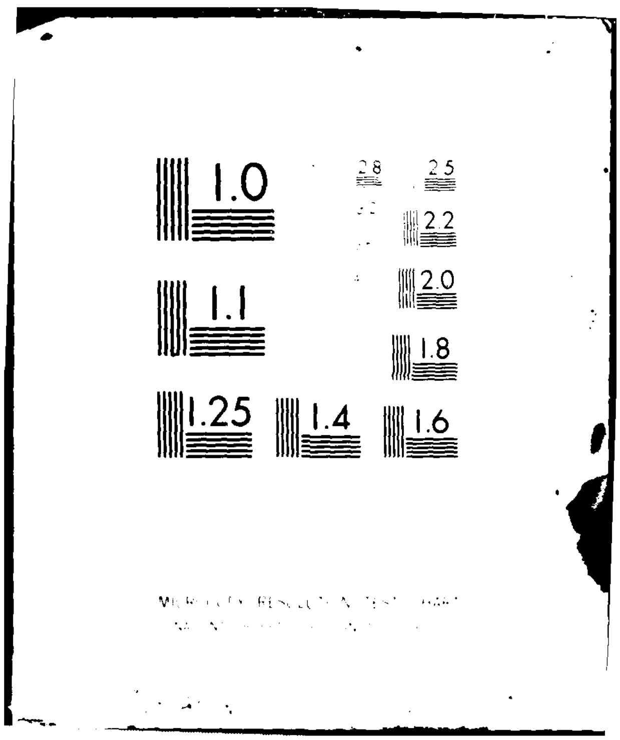
AD-A113 220   ERTEC WESTERN INC. LONG BEACH CA   F/G 8/8
MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME I. COY--ETC(U)
MAY 81   F04704-80-C-0006
UNCLASSIFIED   E-TR-51-I   NL

1 OF 2
AD A
113220




1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

Ertec

The Earth Technology Corporation

E-TR-51-I

MX SITING INVESTIGATION
WATER RESOURCES PROGRAM
OPERATIONAL BASE STUDIES REPORT

VOLUME I

COYOTE SPRING OPERATIONAL BASE
NEVADA

Prepared for:

U. S. Department of the Air Force
Ballistic Missile Office
Norton Air Force Base, California 92409

Prepared by:

Ertec Western, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

28 May 1981

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER ~~E-TR-51-I~~ E-TR-51-I 2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (*and Subtitle*) MX Siting Invest. W.R.P. O.B. Studies Rpt Vol. I Coyote Spring O.B. Nev.	5. TYPE OF REPORT & PERIOD COVERED Final
	6. PERFORMING ORG. REPORT NUMBER E-TR-51-I
7. AUTHOR(s) Ertec Western, Inc	8. CONTRACT OR GRANT NUMBER(s) F04704-80-C-0006
9. PERFORMING ORGANIZATION NAME AND ADDRESS Ertec Western Inc. (formerly Fugro National) P.O. Box 7765 Long Beach Ca 90807	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 64312 F
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Department of the Air Force Space and Missile Systems Organization Norton AFB Ca 92409 (SAMSO)	12. REPORT DATE 28 May 81
	13. NUMBER OF PAGES 53
14. MONITORING AGENCY NAME & ADDRESS (*if different from Controlling Office*)	15. SECURITY CLASS. (*of this report*)
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (*of this Report*)

Distribution Unlimited

17. DISTRIBUTION STATEMENT (*of the abstract entered in Block 20, if different from Report*)

Distribution Unlimited

18. SUPPLEMENTARY NOTES

Two volume report, volume II is for Escalante Valley of southwestern U[illegible]

19. KEY WORDS (*Continue on reverse side if necessary and identify by block number*)

surface water, ~~Hydrology~~, Ground water, water quality, ~~[illegible]~~, geology, Faults, Drainage basins, Test drilling, Aquifer testing, water development, springs, water rights.

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

Results of an investigation for [illegible] water [illegible] [illegible] during [illegible] operation [illegible] study area of [illegible] [illegible] indicate that the possibility is excellent to obtain large quantities of good quality water from the carbonate aquifer. An aquifer test using a [illegible] [illegible] produced 585 gallons per minute with [illegible] [illegible] [illegible]

DD FORM 1 JAN 73 1473   EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

FOREWORD

This report was prepared for the U.S. Department of the Air Force, Ballistic Missile Office (BMO), in compliance with Contract No. F04704-80-C-0006, CDRL Item 004A2. It represents the results of Ertec Western, Inc.'s (formerly Fugro National, Inc.) investigations of the water resources at three of the candidate Operational Base (OB) sites in the Utah and Nevada MX deployment area.

The report has been divided into two discrete volumes. Each volume discusses the hydrologic information which is pertinent to the valley in which the candidate OB sites are located and is summarized below.

- Volume I - Includes the results of Ertec's investigations of the water resources at the Coyote Spring OB site study area as of March 1981, the text providing evaluation of the water resources of the study area, and supporting data. Currently, additional studies are being conducted in the area of the Coyote Spring OB site and will be presented in FY 82.

- Volume II - Includes the results of Ertec's investigations of the water resources in the Escalante Valley where both the Beryl and Milford candidate sites are located, the text providing evaluation of the water resources of the valley, and supporting data. No further investigations of the water resources in the valley are presently planned.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

LIST OF APPENDICES

LIST OF FIGURES

TABLE OF CONTENTS (Cont.)

Page

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF INVESTIGATION

Coyote Spring Valley has been identified as a candidate location for the main Operational Base for the MX missile system in Nevada (Figure 1). There is essentially no available surface water, and there has been very little development of ground water in the area and little is known about the ground-water resources. Withdrawals of ground water from possible aquifers in the area would place increased demand on the ground-water system and could result in a lowering of ground-water levels. The magnitude of any such effect and its impact on regional springs are a major concern to the Air Force as well as to existing water users.

The purpose of this investigation is to identify and assess possible water supply sources and to evaluate the effects ground-water withdrawals could have on existing water users in the area of Coyote Spring Valley, Kane Springs Valley, and the Muddy River Springs area.

This investigation was initiated in October 1980. The major elements of the program are discussed below.

Existing Data Collection and Review

- Existing pertinent publications and data contained in agency files relating to water availability, local water use, regional ground-water flow systems, and aquifer characteristics were collected and reviewed.
- State and federal officials and individuals knowledgeable about ground-water conditions in Nevada were contacted.

FIGURE 1

@@ @@ A113220 (U) FIELD/GROUP @@@@@@

UNCLASSIFIED TITLE

WATER RESOURCES PROGRAM. VOLUME I. COYOTE SPRING OPERATIONAL BASE, NEV

ABSTRACT

(U) RESULTS OF AN INVESTIGATION TO EVALUATE THE WATER RESOURCES IN TH
HERN NEVADA SHOWS THAT THE POSSIBILITY IS EXCELLENT TO OBTAIN LARGE QU
AQUIFER. AN AQUIFER TEST USING A LOW CAPACITY PUMP PRODUCED 595 GALLO

POSTING TERMS ASSIGN

AREA OF SOUTHERN NEVADA
USE NEVADA
SOUTH(DIRECTION)

LARGE QUAN
USE QUAN

NEVADA
USE NEVADA

QUALITY WA
USE QUAL
WATE

WATER RESOURCES
USE WATER RESOURCES

WATER RESO
USE WATE

PHRASES NOT FOUND DURING LEXICAL DICT

4.2 FEET

000

SPRING OPERATIONAL BASE, NEVADA.

ATE THE WATER RESOURCES IN THE COYOTE VALLEY OPERATION BASE STUDY AREA OF SOUT
EXCELLENT TO OBTAIN LARGE QUANTITIES OF GOOD QUALITY WATER FROM THE CARBONATE
ACITY PUMP PRODUCED 595 GALLONS PER MINUTE WITH 4.2 FEET OF DRAWDOWN. (AUTHOR)

POSTING TERMS ASSIGNED

LARGE QUANTITIES
USE QUANTITY

QUALITY WATER
USE QUALITY
WATER

WATER RESOURCES PROGRAM
USE WATER RESOURCES

NOT FOUND DURING LEXICAL DICTIONARY MATCH PROCESS

PHOTOGRAPH THIS SHEET

LEVEL

INVENTORY

DTIC ACCESSION NUMBER

E-TR-51-I

DOCUMENT IDENTIFICATION

Final
28 May 81

Contract F04704-80-C-0006

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR
NTIS GRA&I ☒
DTIC TAB ☐
UNANNOUNCED ☐
JUSTIFICATION

BY
DISTRIBUTION /
AVAILABILITY CODES

DIST	AVAIL AND/OR SPECIAL
A	

DISTRIBUTION STAMP

DTIC
SELECTED
APR 9 1982
D

DATE ACCESSIONED

"Original contains color plates: All DTIC reproductions will be in black and white"

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

DTIC FORM OCT 79 70A

DOCUMENT PROCESSING SHEET

Shallow Aquifer Reconnaissance

- Field studies were performed to identify water users, measure ground-water levels, collect ground-water samples for chemical analysis, measure spring and stream discharges, conduct aquifer tests of existing wells, and examine general hydrogeologic conditions. Specifically:

  - Ground-water levels were measured in seven wells in order to construct potentiometric maps for identifying ground-water migration patterns and areas of recharge or discharge;

  - Ground-water samples were collected from 10 wells or springs for field and laboratory analyses to characterize the water quality and to assess its suitability for use in construction and for drinking purposes and as an aid in identifying ground-water migration patterns and recharge areas;

  - Spring and stream discharge measurements were made at seven locations to aid in surface-water studies and to provide input to computer model simulations of the ground-water systems in the area; and

  - Although planned, no existing wells were available or found suitable for conducting aquifer tests to determine potential well yields and the aquifer's ability to store and transmit water.

Valley-fill and Carbonate Aquifer Studies

- An observation and test well were drilled into valley-fill deposits, and a test well was drilled in carbonate rocks and tested. The drilling and testing programs were designed to gather information about aquifer characteristics (i.e., the ability of the aquifers to store and transmit water) and to collect water samples for analyses about the regional ground-water flow systems.

- Regional and basin geologic units and structures were assessed to better understand the regional ground-water flow systems.

Surface-Water Overview

- The surface-water regime was investigated to provide data on the availability of surface water and determine the rates and amounts of potential recharge to the ground-water systems.

Water Appropriations

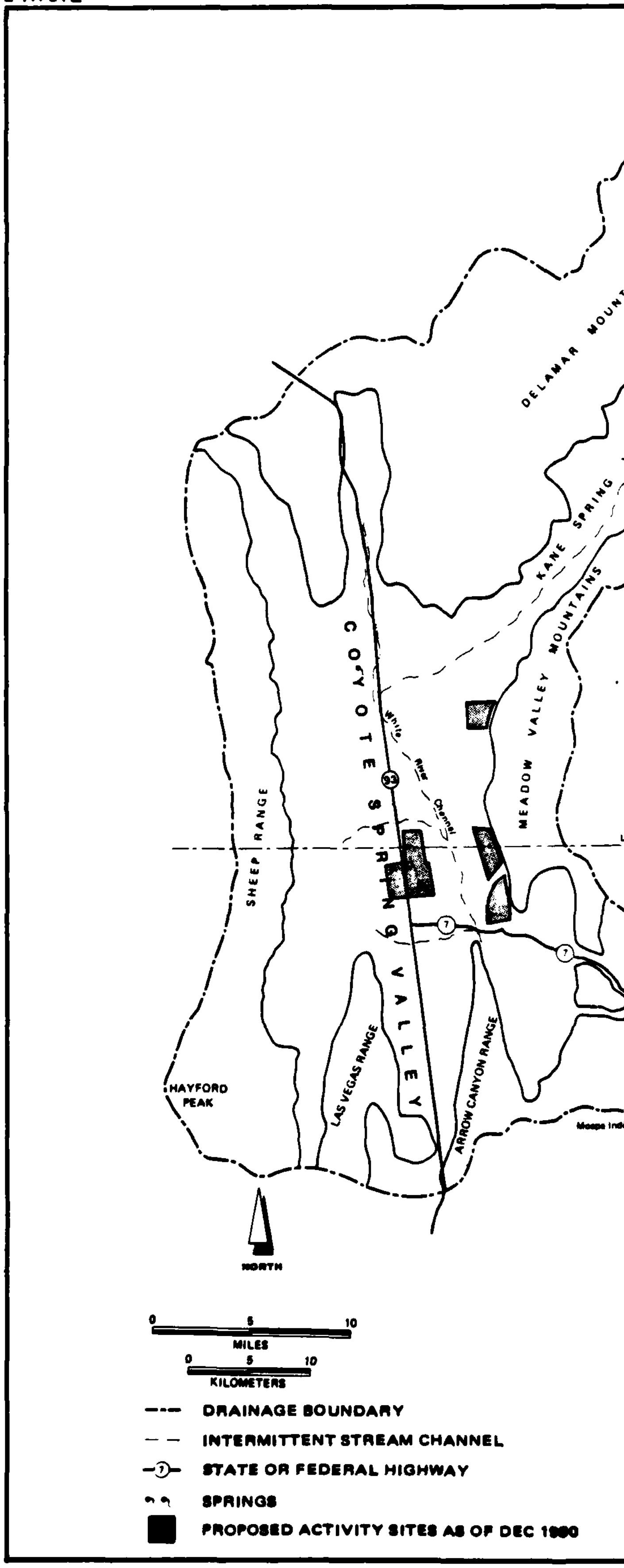
- The quantity of water required for the OB was identified from information provided by others. An application for appropriation was submitted to the Nevada State Engineer's Office. The points of diversions for ground-water withdrawals were defined, and the diversion sites were surveyed in the field.

Investigation of the water resources at the Coyote Spring OB site is presently ongoing. Additional drilling and testing in the carbonates underlying the valley and monitoring of discharge at Muddy River Springs is in progress. This future work will supplement the results presented in this interim report and is planned to be released in early FY 82.

1.2 LOCATION

The area of investigation is in southeastern Nevada and includes Coyote Spring Valley, Kane Springs Valley, and Muddy River Springs (Figure 2). This area is located in parts of Lincoln and Clark counties.

Coyote Spring Valley is traversed from north to south by U.S. Highway 93 and State Highway 7 (now Highway 168). There are only a few inhabitants in Coyote Spring Valley. Kane Springs Valley is northeast of Coyote Spring Valley and is accessed only by a single dirt road traversing its length from southwest to northeast. There are no inhabitants in Kane Springs Valley. The Muddy River Springs area is located at the southeast end of the study area and is reached by State Highway 7. There is substantial agricultural development and habitation in the Muddy River Springs area.



Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

LOCATION MAP—COYOTE SPRING OB STUDY AREA, NEVADA

28 MAY 81

FIGURE 2

1.3 PREVIOUS INVESTIGATIONS

There have been a limited number of hydrologic investigations of the study area. In 1964, a study was conducted by Thomas Eakin as part of a U.S. Geological Survey (USGS) series of reconnaissance ground-water studies in the State of Nevada. In that report, Coyote Spring and Kane Springs valleys as well as the Muddy River were assessed for their potential as water-supply resources. In a report prepared by Eakin (1966), Coyote Spring Valley was identified as one of 13 valleys hydraulically interconnected by a regional ground-water system. In his report, Eakin also identified Muddy River and its related springs as the discharge area for the regional system. In 1966, a report prepared by the Desert Research Institute (DRI) for the Nevada Power Company concentrated on problems in the area above the headwater springs of the Muddy River and in the Meadow Valley Wash. In this investigation, DRI concluded that the water supply for the valley-fill material in the Upper Muddy River Basin was local in origin and withdrawals from these water-yielding sediments would not materially affect the flow of the Muddy River.

2.0 RESULTS AND CONCLUSIONS

Coyote Spring Valley is currently under consideration for siting of the MX primary main Operational Base (OB) in Nevada. A dependable water supply is needed for construction and operation of the OB. Because little water-supply development has occurred in the area and few data are available, a water resources investigation is being performed. This investigation was initiated in October 1980 to identify water supply sources and alternatives, assess the sources, and evaluate the effects future ground-water withdrawals could have on existing water users in the vicinity of the Coyote Spring Valley OB. The study area includes Coyote Spring Valley, adjacent Kane Springs Valley, and along Muddy River to Muddy River Springs. The following is a summary of the results and conclusions obtained from this investigation to date. An additional report is scheduled for early FY 82 which will more fully discuss the potential of the carbonate aquifer system in the area and the potential impacts of withdrawals from that system to meet the OB water requirements.

Field activities have included aquifer tests, water-sample collection and quality analyses, ground-water level measurements, spring- and stream-discharge measurements, and drilling and testing programs in both the valley-fill materials and carbonate rocks of the area. This work is currently continuing at and near the Coyote Spring OB candidate site.

Except for Muddy River Springs in the southeast portion of the study area, surface-water sources are very limited. Records of the Nevada State Engineer show that all available surface water is beneficially used and entirely appropriated. If surface water is to be used as a source of water to meet MX requirements for the OB, lease or purchase of existing surface-water rights would be necessary. Due to the inadequate supply of surface water available in Coyote Spring Valley, any surface water for the OB would have to be leased or purchased and piped from the Muddy River Springs area or from the Overton Arm of Lake Mead (Colorado River).

The valley-fill material in Coyote Spring Valley will only provide for limited development of ground water. Tests conducted by Ertec in the central part of the valley indicate low hydraulic conductivity, and consequently, low anticipated well yields for these deposits. In addition, the long term operational water requirement for the OB of approximately 4200 acre-feet (5.2 hm^3) exceeds the estimated annual recharge to the valley-fill material of 2600 acre-feet (3.2 hm^3). Because of these factors, the valley-fill material in Coyote Spring Valley is not considered to be an adequate source of water for OB construction and operational use.

The regional carbonate aquifer system that underlies much of the study area is considered to have the highest potential for development as a water-supply source. Depth to water in this system is not excessive. The static water level in south Coyote

Spring Valley is about 350 feet (107 m) below land surface. Movement of ground water in the regional system appears to be concentrated in zones of increased fracture density related to faulting. A test well in southern Coyote Spring Valley that penetrated fractured carbonate rock was pumped at a rate in excess of 500 gallons per minute with only about 3 feet (1 m) of drawdown. The transmissivity for the carbonate system at this location is estimated to be about 40,000 ft^2/day (3717 m^2/day). These results suggest a potential yield of water from the carbonate system more than adequate to meet OB water-supply requirements for construction and operational use. What is unclear however, is the possible effect these withdrawals would have on other water sers and the environment.

The impacts of withdrawing water from the regional carbonate system cannot be defined with available data. Natural discharge from this system is presumed to occur at the Muddy River Springs. A program of discharge measurements has been initiated to monitor short-term impacts of pumping from a high-capacity carbonate test well presently being drilled in Coyote Spring Valley on the Muddy River Springs. Numerical simulation will also be applied to evaluate long-term effects of MX withdrawals on the springs.

Pending applications and permits for ground-water withdrawals in Coyote Spring Valley total slightly more than the perennial yield, as defined by the Nevada State Engineer's Office (1971) of 18,000 acre-ft/yr (22.2 hm^3/yr).

There have been no specific applications to withdraw water from the regional carbonate aquifer system. How such an application will be viewed by the State Engineer, if different than for applications for withdrawals from valley-fill materials is not defined at this time.

All but three of the 19 water samples analyzed for water quality meet federal and state drinking water standards and are therefore suitable for domestic consumption. The three water samples that did not meet the standards are from wells located in an area of high domestic and agricultural use in the Moapa area. All water samples analyzed meet the criteria established by the Portland Cement Association for the mixing of cement. The quality of water is expected to remain good and suitable for domestic, construction, and operating purposes; however, the controls on water quality will be further evaluated to assess if there is a potential for deterioration in response to long-term withdrawals.

3.0 GEOGRAPHY

3.1 PHYSIOGRAPHY

The area of investigation consists of irregularly shaped, south-to-southwest trending valleys of the Basin and Range Physiographic Province (Fenneman, 1931).

Coyote Spring Valley trends in a southerly direction and is approximately 40 miles (64 km) long and has a maximum width of about 8 miles (13 km). The elevation of the valley floor ranges from about 2000 to 2500 feet (610 to 762 m). The valley is bounded by steep fronts on the west, from south to north, by the Las Vegas and Sheep ranges and on the east by the northern Arrow Canyon Range, southern Meadow Valley Mountains, and the southwesterly tip of the Delamar Range. These mountains reach average elevations of 4000 to 5000 feet (1219 to 1524 m). The Sheep Range, located along the western edge of the valley, contains the highest point in the area, Hayford Peak, which has an elevation 9920 feet (3024 m). Kane Springs Valley extends northeast of Coyote Spring Valley for approximately 24 miles (39 km) and has a maximum width of 4 miles (6 km). The elevation of the valley floor ranges from 2000 to 4000 feet (610 to 1219 m). The Muddy River Springs area is located to the east-southeast of Coyote Spring Valley. It is separated from Coyote Spring Valley by a topographic high consisting primarily of lake sediments of Tertiary age.

The floor of Coyote Spring Valley is dominated by two landscape features, coalescing alluvial fans and the channel of White

River. These features have significance to the hydrologic budget of the valley. Broad coalescing alluvial fans, characteristic of the intermontane desert basins of Nevada, extend from the mountain ranges toward the valley axis. Runoff from thunderstorm events and snowmelt in the mountains is rapidly lost to infiltration on these fans and serves to recharge the ground-water reservoir. The channel of White River (also known as Pahranagat Wash) forms the axis of Coyote Spring Valley (Figure 2). The ancestral White River maintained a perennial flow through this trough and was a tributary to the Virgin and Colorado rivers until some 10,000 years ago (Eakin, 1964). Streamflow in most of the White River and its tributary channels is ephemeral, flowing only in direct response to high intensity storms. It is quite likely that recharge to the ground-water from precipitation was considerably higher in late Pleistocene times than at present.

3.2 CLIMATE

The climate in the area is arid to semiarid. Precipitation ranges from 4 to 6 inches (10 to 15 cm) per year on the valley floor and from 8 to 10 inches (20 to 25 cm) per year in the surrounding mountains. Snow commonly occurs during the winter in the higher parts of the Sheep and Delamar ranges but rarely elsewhere in the area (Eakin, 1964). During the months of July and August, severe thunderstorms may occur. These thunderstorms are generally localized and are too short in duration and too infrequent to be a dependable supply of water in the valley. The mean monthly temperatures on the valley floor range from about 37° (3°C) in January to approximately 90°F (32°C) in July (Eakin, 1964). Such high temperatures, combined with frequent winds and low humidity values, result in high potential evaporation rates during the summer months. As a consequence, much of the runoff from summer storm events is lost to evaporation and little is available to recharge the ground-water reservoir. Recharge from snowmelt runoff onto the alluvial fans is probably more effective because of the lower average temperatures during the spring months and the more sustained nature of these flows.

3.3 VEGETATION

There is insufficient year-round rainfall in the study area to support agriculture, other than grazing, without irrigation. The normal precipitation supports only native brush and short hardy grasses. Perennial vegetative cover is approximately five to 10 percent. The area is populated mainly by creosote bush, sagebrush, and Joshua trees. In isolated areas of shallow perched water, some phreatophytes, such as saltbush, saltgrass, and mesquite, are present.

4.0 GENERAL GEOLOGY

4.1 GEOLOGIC SETTING

The geology of the area is dominated by faulting along the valley margins, by carbonate rocks cropping out along the edges and underlying the valley, and by thick accumulations of sediments in the valley. The structural features which are present in the surrounding mountains along with the stratigraphic characteristics of the carbonate rocks and the valley-fill materials make this a complex hydrogeologic area.

The floor of Coyote Spring Valley is underlain by sedimentary units ranging from lake sediments of late Pliocene age to unconsolidated alluvial fan and stream-channel deposits of Holocene age. Coyote Spring Valley is located between thick sections of rocks of Paleozoic age in the Sheep, Pahranagat, and Arrow Canyon ranges. This condition suggests that the valley is also underlain by a similarly thick section of rocks of Paleozoic age.

4.1.1 Regional Geology

Coyote Spring Valley is largely a typical block-faulted valley of the Basin and Range Province with down-thrown blocks forming the valleys and up-thrown blocks forming the mountains. The regional geology of the area is characterized by north-south trending mountains separated by broad desert valleys which generally contain thick accumulations of sediments. Most of the valleys are closed basins with no external surface drainage, however, those in the study area are open topographically. Relief between valleys and adjoining mountains is generally less than 5000 feet (1524 m).

4.1.2 Stratigraphy

The rocks, exposed within the surrounding mountains, are of Paleozoic, Mesozoic, and Cenozoic ages. The valley-fill deposits are of Tertiary and Quaternary age. In areas adjacent to Coyote Spring Valley, the stratigraphic thickness of the Paleozoic rocks exceeds 30,000 feet (9144 m) (Kellogg, 1960). The mountain ranges are composed primarily of limestone and dolomite (both carbonates) of Paleozoic age with minor strata of quartzite and shale. In the Delamar Mountains and in the Meadow Valley Mountains (northeast of Coyote Spring Valley), carbonate rocks of Paleozoic age are capped by volcanic rocks of Tertiary age. Some of the carbonate rocks exhibit considerable secondary hydraulic conductivity from fracturing and solution openings. Hence, some of the carbonate rocks are productive aquifers. The quartzites, shales, and volcanic rocks typically yield little water to wells.

Lake sediments of probable Pliocene age are exposed mainly in the central and southeastern portions of Coyote Spring Valley and the Muddy River Springs area. Exposures consist of interbedded, poorly sorted mudstone, siltstone, sandstone, pebbly sandstone, conglomerate, fresh-water limestone, and water-laid tuff. The lake sediments in the area were probably much thicker than the few hundred feet currently exposed in Coyote Spring

Valley. An Ertec Western, Inc. (formerly Fugro National, Inc.) boring (12S/63E-29db) (see Appendix A for well and spring numbering system) indicates that the maximum thickness of the lake sediments of Tertiary age exceeds 650 feet (198 m). These lake sediments can generally be considered as being poor aquifers.

Intermediate and older age alluvial fan deposits are thickest near the valley margin where they are estimated to be about 100 feet (30 m) thick. Their thickness decreases toward the axis of the valley. The alluvial fan deposits consist predominantly of poorly graded to moderately well-graded sand and gravels. The detritus of these fan deposits is locally derived from the mountain ranges bordering the valley and reflects the lithology of these mountains. Where saturated, the intermediate to older age alluvial fan deposits are poor to fair aquifers and are likely to yield moderate quantities of water to wells.

The younger age alluvial fan deposits generally consist of a relatively thin cover a few feet thick overlying the older basin-fill units. The younger age alluvial fan deposits are predominantly composed of gravel and sand. Many of the channels in the area contain cobbles and boulders. The near-surface gravels in the channels appear to be slightly cemented with calcium carbonate. Exposures in some of the deeper incisions indicate that the degree of cementation within the alluvial sediments probably increases with depth. The younger alluvial fan deposits are not known to be saturated and as such, are not considered a potential aquifer.

In Coyote Spring Valley, the depth to bedrock below ground surface varies. In the southern part of the valley near the valley margin at a carbonate test well site (13S/63E-23dd) drilled by Ertec, bedrock was intersected 30 feet (9 m) below the surface. At a valley-fill test well site (12S/63E-29db2) located in the center of the valley, bedrock was found by Ertec at 850 feet (259 m) below the surface.

A deep seismic refraction survey, conducted by Ertec along State Route 7 between the channel of the White River (Pahranagat Wash) and U. S. Highway 93, indicated bedrock at depths no less than 250 feet (76 m) below the surface. According to the survey, the depth to bedrock is greatest near the axis of Coyote Spring Valley.

4.2 STRUCTURAL GEOLOGY

The structural geology of the area is dominated by predominantly north-south fault scarps and lineaments that trend through the alluvium. Bedrock and valley-fill materials have been faulted, fractured, and displaced in a complex way and in varying degrees within the region during several periods of structural activity. These structural features are important as they appear to influence the direction and rate of movement of ground water through the area.

4.2.1 Regional Structures

The typical structural features of the Basin and Range Province are characterized by uplifted block-faulted mountain ranges surrounding down-faulted valleys occurring along north and northeast trending normal faults. Additionally, the regional structural geology of the study area contains two other major features, the Gass Peak Thrust Fault and the Pahranagat Shear System. The Gass Peak Thrust Fault has surface exposure only in the Las Vegas Range to the southwest of the study area. The general topography of the Sheep Range and Coyote Spring Valley is the result of movement along this fault.

The Pahranagat Shear System is evident in areas north of Coyote Spring Valley and consists of a northeast striking system of shear faults. Tschanz and Pampeyan (1970) had estimated 6 to 10 miles (10 to 16 km) of lateral displacement along this shear system.

4.2.2 Recent Faulting

In the study area, faulting is evident from field observations and aerial photography. These structural features appear to cut sediments and alluvial fan deposits of intermediate and older Tertiary age. Faulting in the northern portion of Coyote Spring Valley may be acting as a partial hydrologic barrier to ground-water flow in valley-fill deposits resulting in the occurrence of springs and a shallow, perched body of ground water. There are very few data in the area, however, an alternate explanation of stratigraphic control of the perched ground water may also be feasible.

Faulting is evident along the southeastern side of Kane Springs Valley and along the eastern flank of Coyote Spring Valley.

Alluvium in both Kane Springs Valley and Coyote Spring Valley is cut by minor normal faults of late Quaternary to Holocene age.

4.3 GEOMORPHOLOGY

Terrain conditions in the study area range from deeply incised "badland" topography to areas of relatively smooth surfaces. Incision depths range throughout the area from less than 1 foot (0.3 m) to greater than 130 feet (40 m). The deeper incisions allow for the channeling of surface flow, but the shallower or flatter surfaces permit flooding or sheet wash during intense storms. Terrain characteristics are generally controlled by the underlying basin-fill sediments.

4.3.1 Land Forms

The study area is dominated by alluvial fans. Areas underlain by younger age alluvial fans are characterized by numerous, closely spaced shallow channels which range in depth from less than 1 foot (0.3 m) to a maximum of about 10 feet (3.0 m) with an average depth of about 3 feet (0.9 m). The fan surfaces are very uneven due to concentrations of cobbles and boulders.

Most of the areas where sediments of late Tertiary age are exposed have developed a "badland" topography characterized by fine drainage networks with high density. In these areas, the maximum drainage depth is about 200 feet (61 m) with an average depth of about 20 feet (6 m). Divides between incisions are relatively smooth, nearly flat surfaces which have a slope of about two to three degrees. The infrequent runoff in such areas would be rapidly channalized.

The terrain, in areas where intermediate and older age alluvial fan deposits occur, ranges from relatively smooth planar surfaces with widely spaced incisions to areas of "rolling" topography. The maximum drainage depth in these areas is about 30 feet (9 m) with an average of about 10 feet (3 m). Except in the areas of "rolling" terrain, divides between incisions are generally flat and have an average slope of about one degree. Runoff from such areas would be as numerous rivulets or as sheet flow.

4.3.2 Drainage Basin Characteristics

The study area is characterized by two major axial drainages, White River Channel (Pahranagat Wash) and Kane Springs Wash. These axial washes are flanked by numerous tributaries which partially dissect the valley-fill sediments. Kane Springs Wash drains southwesterly and joins White River Channel just east of U.S. Highway 93. White River Channel drains south to the vicinity of State Route 7 where it turns southeast and exits Coyote Spring Valley between the Arrow Canyon Range and the Meadow Valley Mountains. It eventually joins the Muddy River to the south. Both the White River Channel and Kane Springs Wash are ephemeral and flow only after periods of heavy rainfall.

5.0 SURFACE-WATER HYDROLOGY

5.1 SURFACE-WATER REGIME

A relatively small portion of the rainfall in the study area is drained from the land on which it falls as is typical of arid climates. Direct evaporation, shallow infiltration, and delayed transpiration return a large portion of the precipitation back to the atmosphere before it can find its way into the stream channels in the area. A small quantity of perennial surface flow in the study area (excluding Muddy River) is the result of flow from local springs emanating from shallow perched aquifers or from shallow fractured rock along the mountain fronts. This flow is too small and too localized and sporatically distributed to be considered as a water source for the OB.

The dominant surface-water supply occurs as spring discharge southeast of Coyote Spring Valley in the Muddy River Springs area. These springs are considered the outlet for the White River regional ground-water flow system that originates from the north and includes the underflow from 13 valleys (Eakin, 1966).

The normal precipitation in the area is not of sufficient quantity to result in perennial streamflows through Coyote Spring or Kane Springs valleys. Surface water in the study area occurs as ephemeral streams in response to intensive precipitation events such as thunderstorms or locally from springs. The springs are the result of: 1) discharge from locally recharged perched aquifers in the valley-fill materials in

Coyote Spring and Kane Springs valleys; 2) discharge from locally recharged carbonate rocks in the mountains; or 3) discharge from the regional carbonate flow system in the Muddy River Springs area. All surface-water supplies have been fully appropriated by local ranchers or by other downstream users.

5.1.1 Streams

The Muddy River is the only perennial stream in the study area. The head of the Muddy River is about 8 miles (13 km) above the town of Moapa where ground water flowing through the regional ground-water flow system (carbonate) surfaces as springs. The average surface-water discharge measured at the U.S. Geological Survey (USGS) gauging station near Moapa for the period between 1944 and 1979 was 32,670 acre-ft/yr (40.3 hm^3/yr) (USGS, 1980).

Eakin (1964) estimated that the mean annual discharge of the springs supplying the Muddy River is 36,000 acre-feet (44.4 hm^3). The difference between the gauging station measurements and the estimated discharge is due to some of the discharging springs being located below the gauging station and possibly to some evapotranspiration losses between the springs and the USGS gauging station near Moapa.

5.2 SURFACE-WATER DEVELOPMENT

5.2.1 Present Development

In the study area, the Muddy River Springs are the only major developed surface-water source. Water is diverted for irrigation and other uses from the Muddy River between the springs and

Lake Mead. In Coyote Spring Valley, limited surface-water development occurs at the north end of the valley where water from local springs is used for domestic and stock watering purposes.

5.2.2 Appropriations

Appropriations for surface water in Coyote Spring Valley filed with the Nevada Division of Water Resources total 42 acre-ft/yr (0.05 hm^3/yr) (DRI, 1980). Of these appropriations, 36 acre-ft/yr (0.04 hm^3/yr) are identified as certificates and proofs by DRI (1980). The remainder of the identified water rights is in the permit or application phase of the appropriation process (DRI, 1980). A list of these water rights is provided in Appendix F.

6.0 GROUND-WATER HYDROLOGY

6.1 GROUND-WATER REGIME

The study area includes two distinct ground-water systems: 1) the regional carbonate flow system, and 2) the local valley-fill system. Coyote Spring and Kane Springs valleys are among 13 valleys encompassed by the White River regional ground-water flow system (Eakin, 1966). This regional flow system is suspected to have subsurface flow southward to the Muddy River Springs area.

6.1.1 Occurrence and Movement

Ground-water flow in the regional system occurs mainly through fractures and solution openings in carbonate rocks. The existence of this regional flow system is largely supported by the imbalance between recharge and discharge estimates for the area. Recharge due to precipitation in Coyote Spring and Kane Springs valleys has been estimated to be 2600 acre-ft/yr (3.2 hm^3/yr); discharge from Muddy River Springs, located about 10 miles (16 km) southeast of these valleys, is approximately 36,000 acre-feet annually (44.4 hm^3/yr) (Eakin, 1964). This imbalance indicates that another source of water must contribute to the Muddy River Springs. The most plausible source is underflow from northern portions of the regional flow system through Coyote Spring Valley.

A test well drilled by Ertec in southern Coyote Spring Valley (13S/64E-23dd) tapping carbonate rocks has a static water level at about 350 feet (107 m) below land surface. This corresponds to an approximate elevation of 1810 feet (552 m) which is 50 feet (15 m) higher than the 1760-foot (536-m) elevation of discharge at the Muddy River Springs (approximately 10 miles [16 km] southeast). This gradient further substantiates ground-water movement within the regional flow system through Coyote Spring Valley to the Muddy River Springs.

The test well in southern Coyote Spring Valley (13S/64E-23dd) was sited to intersect faulting within the carbonate rock units. Testing of this well, described in detail in Section 6.2.2, provided an estimated transmissivity for the carbonates of 40,000 ft^2/day (3717 m^2/day). This is a relatively high transmissivity value and suggests a significant potential for production of water from the carbonates in structurally altered areas. Where the carbonate rocks are not extensively fractured, ground-water movement and production potential from the regional flow system is speculative. A valley-fill test well installed by Ertec in the central portion of Coyote Spring Valley (12S/63E-29db2) was subsequently deepened into underlying carbonate rock. Carbonate rock was penetrated from a depth of 850 to 1221 feet (259 to 372 m). Faulting or other structural deformation was not anticipated nor evident in the carbonate rocks. Although no aquifer test was performed on the deepened well, the transmissivity of the carbonate rock at that site is believed to be very low. This is based on : 1) the observation during drilling that the hole was not losing significant quantities of drilling fluids; and 2) the apparent lack of fractures as interpreted from examination of well cuttings and geophysical logs.

Depth to ground water in the valley fill in central Coyote Spring Valley varies from 300 feet (91 m)(Eakin, 1966) to at least 545 feet (166 m) as measured in well 12S/63E-29db1 by Ertec in late 1980. There are several small areas (such as near well 11S/62E-13bd) where shallow perched water occurs in the near-surface, valley-fill deposits. This perched water is probably due to the presence of shallow, relatively impervious deposits in the valley fill or faulting within the alluvium. Ground water in the valley-fill deposits flow toward the axis of the valley and then to the south. This flow direction is likely largely unchanged by the small amount of pumping that occurs.

Analysis of water-level response data during the falling-head tests in valley-fill observation well 12S/63E-29db1 indicate transmissivities of only about 100 ft^2/day ($7.7 m^2$/day). This is a very low value for transmissivity and suggests that wells in the valley fill would not yield more than a few 10s of gallons per minute (gpm). Considering also the limited recharge to the system, 2600 acre-ft/yr (3.2 hm^3/yr) (Eakin, 1966), the valley-fill deposits in Coyote Spring Valley are not considered to be a viable source of water for the OB.

5.1.2 Springs

Several small local springs occur in northern Coyote Spring Valley and in Kane Springs Valley. However, the regional springs occurring at the head of the Muddy River are the dominant hydrologic feature of that area. These springs were discussed in the surface-water section of this report. Appendix C gives a record of spring data.

6.2 EXPLORATORY DRILLING AND TESTING

An exploratory drilling and testing program was initiated in Coyote Spring Valley by Ertec to evaluate the availability of ground water as a supply for OB construction and operation requirements. The program was divided into two phases: 1) valley-fill exploration to depths of approximately 1000 feet (305 m); and 2) exploration of the regional carbonate system.

6.2.1 Drilling Program

Situated on a relatively flat surface at about 2460 feet (750 m) elevation, the valley-fill well site is located approximately one-half mile (0.8 km) east of U.S. Highway 93 and approximately 5 miles (8 km) north of State Highway 7. Mud rotary drilling of the observation well (12S/63E-29db1) began in mid-November 1980 and was completed to a total depth of 714 feet (218 m). Geophysical logs indicated the possible existence of two water-bearing zones. The first zone was indicated between 510 and 560 feet (155 to 171 m), and the second zone between 610 and 714 feet (186 to 218 m). Accordingly, two piezometers were installed to monitor ground-water levels. The static water level in each piezometer was measured at 545 feet (166 m) below land surface.

Drilling of a test well (12S/63E-29db2) located 500 feet (152 m) south of the observation well was completed in January 1981 to a total depth of 1221 feet (372 m). Carbonate rocks were penetrated from 850 feet (259 m) to total depth. This valley-fill test well was extended into carbonate rock because of the lack of productive water-bearing zones in the valley-fill deposits. The carbonate rock is also believed to be nonproductive at this site because of the lack of significant fracturing or solution openings. A static water level of 627 feet (191 m) has been measured in the well. Because the carbonate rock exhibits a low hydraulic conductivity here, this water level may be suspect because the water levels in the well may not have equilibrated at the time the measurement was made.

A carbonate test well (13S/63E-23dd) was installed by Ertec about 3 miles (5 km) east of the intersection of U.S. Highway 93 and State Highway 7 and 5 to 6 miles (8 to 10 km) southeast of the valley-fill observation well (12S/63E-29db1). It was completed to a total depth of 669 feet (204 m) in early December 1980 in a highly fractured and productive water-bearing zone. The static water level was measured at 353 feet (108 m) below land surface. Currently, additional carbonate wells are being drilled and tested to assist in the evaluation of the regional flow system in the area.

A more complete description of drilling, well construction, and aquifer testing data for the completed wells is presented in Appendix E.

6.2.2 Aquifer Testing

To determine the hydraulic conductivity of the valley-fill deposits monitored by the piezometers in the observation well (12S/63E-29db1), two falling head or slug permeability tests were conducted in December 1980. Results from these tests indicated a very low hydraulic conductivity of about 1.3 ft/day (0.4 m/day) and a calculated transmissivity of about 120 ft^2/day (11.1 m^2/day) for the intervals tested. The low calculated transmissivity indicates that the valley fill in the central portion of Coyote Spring Valley will yield very little water to wells. Data recorded during the test are included in Appendix E.

An aquifer test was performed at the carbonate well site to determine the characteristics of the regional flow system and to attempt to assess the impacts of withdrawals from the system. The pumping rate achieved (about 538 gpm [34 l/s]) during the test proved to be too small to adequately stress the carbonate system. Currently, additional testing is being conducted adjacent to this site. It is anticipated that this will allow for a better assessment of potential impacts.

A step-drawdown test was conducted in the carbonate well site in December 1980. The test consisted of three variable discharge rates measured by an in-line totalizer flow meter. These rates varied between 150 and 595 gpm (10 to 38 l/s). After a recovery period of 24 hours following the step-drawdown test, a constant discharge test was run. The well was pumped for a total of

77 hours at rate of an average 538 gpm (34 l/s). Maximum drawdown in the well was 3.3 feet (1.0 m). Selected springs located approximately 10 miles (16 km) southeast of the well were monitored during the test and no measurable effects were noted. Based on the results of the tests, the transmissivity of the carbonate system was estimated to be approximately 40,000 ft^2/day (3717 m^2/day). This is a high value for transmissivity and indicative of excellent water-production potential.

6.3 GROUND-WATER DEVELOPMENT

6.3.1 Ground-Water Availability

The perennial yield of the ground-water reservoir in Coyote Spring and Kane Springs valleys is estimated to be 2600 acre-ft/yr (3.2 hm^3/yr) which is equivalent to the estimated average annual recharge derived from precipitation within the area (Eakin, 1964). The Nevada State Engineer's Office (1971) estimated a perennial yield of 18,000 acre-ft/yr (22.2 hm^3/yr) for Coyote Spring Valley and an additional 500 acre-ft/yr (0.6 hm^3 yr) for Kane Springs Valley. The reason for the substantial difference between the perennial yield estimated by Eakin (1964) and the State Engineer (1971) is uncertain. Consideration of potential yield from the regional flow system would increase Eakins' (1964) estimate of perennial yield and may be the basis for the State Engineer's estimate.

6.3.2 Present Development

Present (1981) development of ground water in the study area is concentrated in the Muddy River Springs area. Development of ground water in this area includes wells for irrigation purposes, domestic consumption, and stock use. The annual ground-water withdrawal by wells is estimated to be between 2000 and 3000 acre-feet (2.5 to 3.7 hm^3). There is very little use of ground water in Coyote Spring and Kane Springs valleys since only a few low yield wells have been drilled for domestic or stock watering purposes.

6.3.3 Allocations

The Nevada State Engineer's abstracts of water filings show a total of 18,859 acre-ft/yr (23.3 hm^3/yr) in permits and pending applications for ground-water in Coyote Spring Valley (DRI, 1980). The filings are listed in Appendix F.

7.0 WATER QUALITY

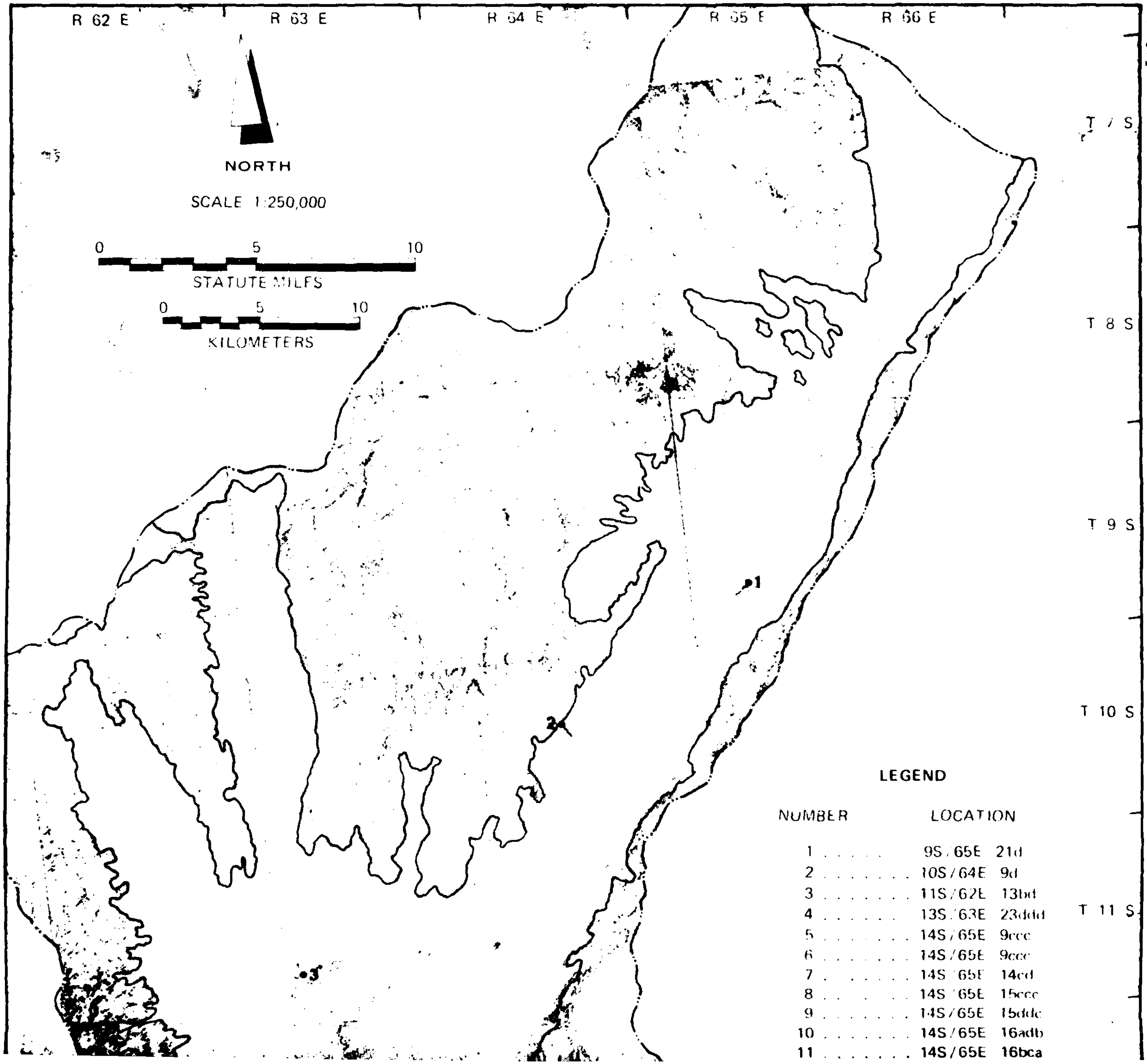
7.1 CHEMICAL CONSTITUENTS

Results of chemical analyses of water samples collected by Ertec supplemented by published chemical data and information on present-use patterns of irrigation were used to interpret the water quality in the study area. Trilinear diagrams (Piper, 1944) were used as an aid in the classification of water types. Water quality was evaluated in terms of concentration and type of ionic constituents. Chemical data from seven wells, ten springs, and two streams were used in the evaluation of the water quality. The locations of the points of collection for these water samples are shown in Figure 3.

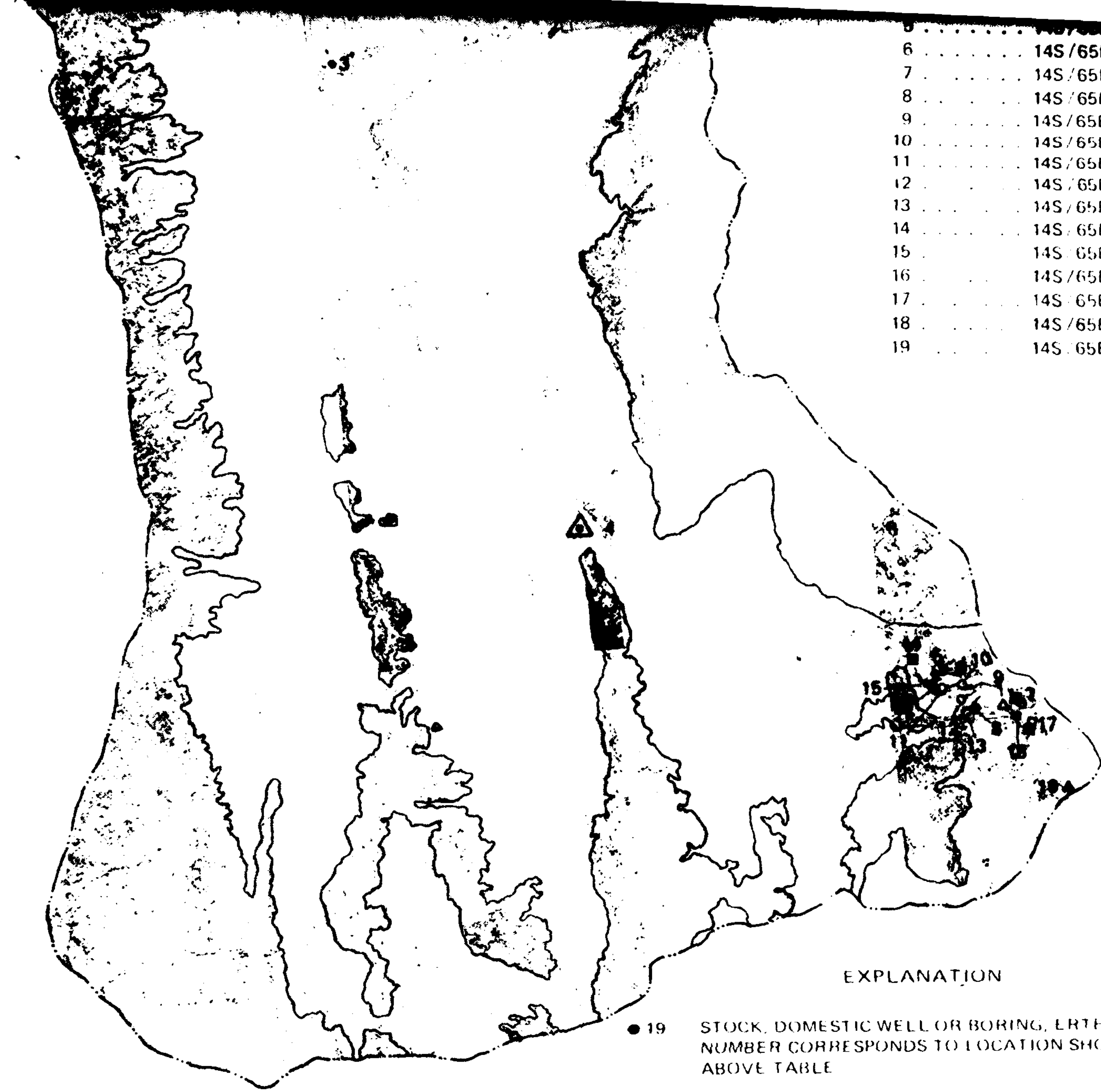
Six water samples were collected by Ertec during a field reconnaissance in November 1980. One water sample was collected from a carbonate well drilled by Ertec in December 1980. Chemical analyses used in this water-quality evaluation are listed in Appendix D.

Additional chemical data were available for six wells, one spring, and two streams but were not used in the water-quality evaluation due to either date of sampling (pre-1970), repetition in sampling, or incomplete analyses. These data are also listed in Appendix D.

The results of two chemical analyses are available for ground water from Kane Springs Valley. These water samples are from an unnamed spring, located in 9S/65E-21d, and Willow Spring, located in 10S/64E-9d. A trilinear diagram, Figure 4, shows


R 62 E
R 63 E
R 64 E
R 65 E
R 66 E
T 7 S
T 8 S
T 9 S
T 10 S
T 11 S
NORTH
SCALE 1:250,000
0 5 10
STATUTE MILES
0 5 10
KILOMETERS
1
2
3
LEGEND
NUMBER LOCATION
1 . . . . . . 9S/65E 21d
2 . . . . . . 10S/64E 9d
3 . . . . . . 11S/62E 13bd
4 . . . . . . 13S/63E 23ddd
5 . . . . . . 14S/65E 9ccc
6 . . . . . . 14S/65E 9ccc
7 . . . . . . 14S/65E 14cd
8 . . . . . . 14S/65E 15ccc
9 . . . . . . 14S/65E 15ddc
10 . . . . . . 14S/65E 16adb
11 . . . . . . 14S/65E 16bca

6	14S/65E-9ccc
7	14S/65E 14cd
8	14S/65E 15ccc
9	14S/65E 15ddc
10	14S/65E 16adb
11	14S/65E 16bca
12	14S/65E 16db
13	14S/65E 16ddc
14	14S/65E 17aa 1
15	14S/65E 17aa 2
16	14S/65E 17aa 3
17	14S/65E 23ac
18	14S/65E 23bbb
19	14S/65E 36b



EXPLANATION

- ● 19 STOCK, DOMESTIC WELL OR BORING, ERTEC DATA NUMBER CORRESPONDS TO LOCATION SHOWN IN ABOVE TABLE
- △ 4 ERTEC WESTERN EXPLORATION DRILLING SITE
- ○ STOCK, DOMESTIC WELL OR BORING, OTHER DATA
- MUNICIPAL OR IRRIGATION WELL, ERTEC DATA
- SPRING, ERTEC DATA
- SPRING, OTHER DATA
- △ STREAM, OTHER DATA

Ertec

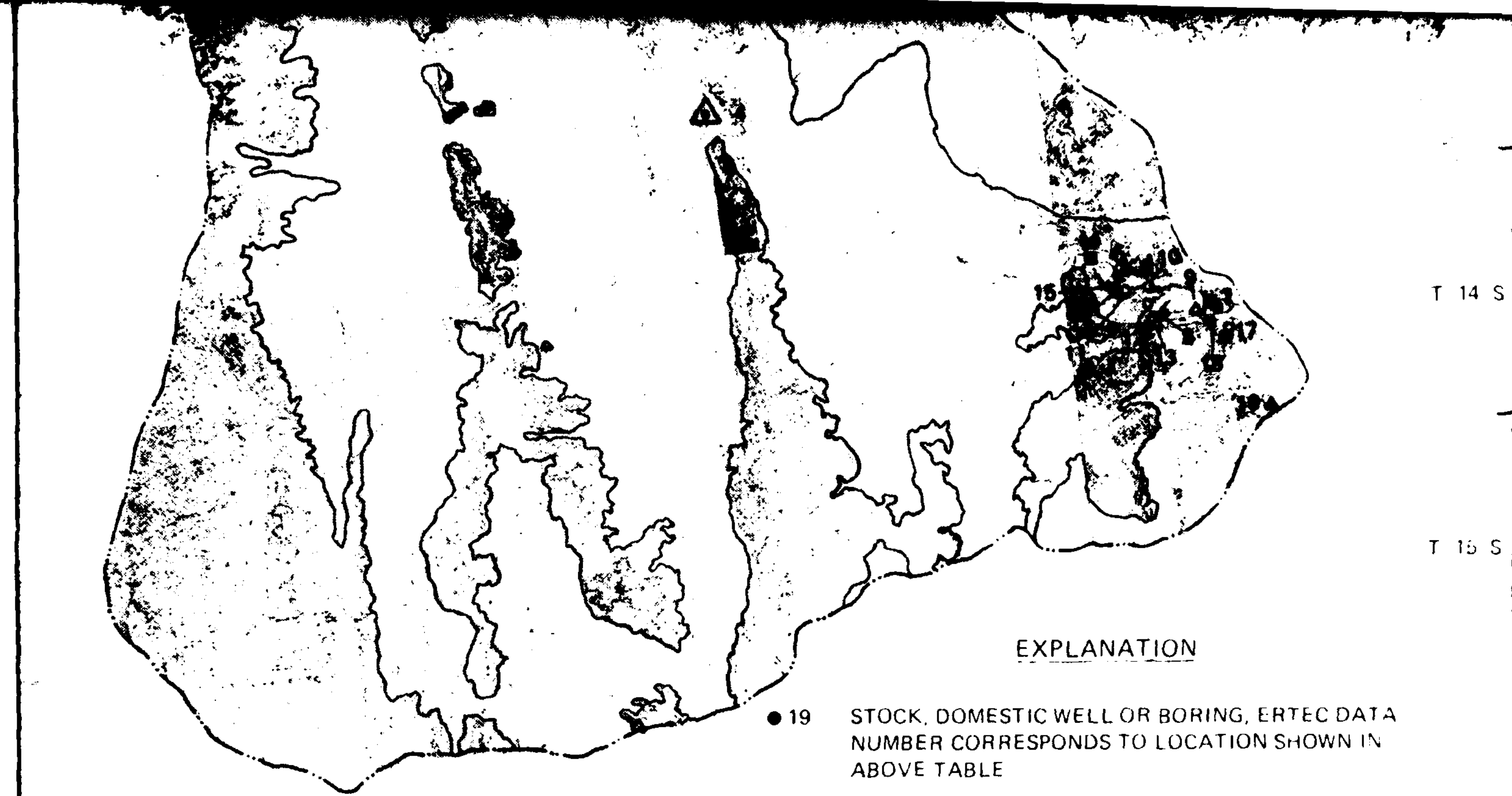
The Earth Technology Corporation

WATER (

COYOT

STUDY A

28 MAY 81



EXPLANATION

- ● 19 STOCK, DOMESTIC WELL OR BORING, ERTEC DATA NUMBER CORRESPONDS TO LOCATION SHOWN IN ABOVE TABLE
- △ 4 ERTEC WESTERN EXPLORATION DRILLING SITE
- ○ STOCK, DOMESTIC WELL OR BORING, OTHER DATA
- ◉ MUNICIPAL OR IRRIGATION WELL, ERTEC DATA
- SPRING, ERTEC DATA
- SPRING, OTHER DATA
- △ STREAM, OTHER DATA
- ■ EXCEEDS SECONDARY STATE STANDARDS FOR DRINKING WATER SUPPLIES IN AT LEAST ONE INORGANIC CONSTITUENT
- ROCK/NON ROCK BOUNDARY,
- DRAINAGE BOUNDARY
- SUITABLE AREA BASED ON WATER QUALITY

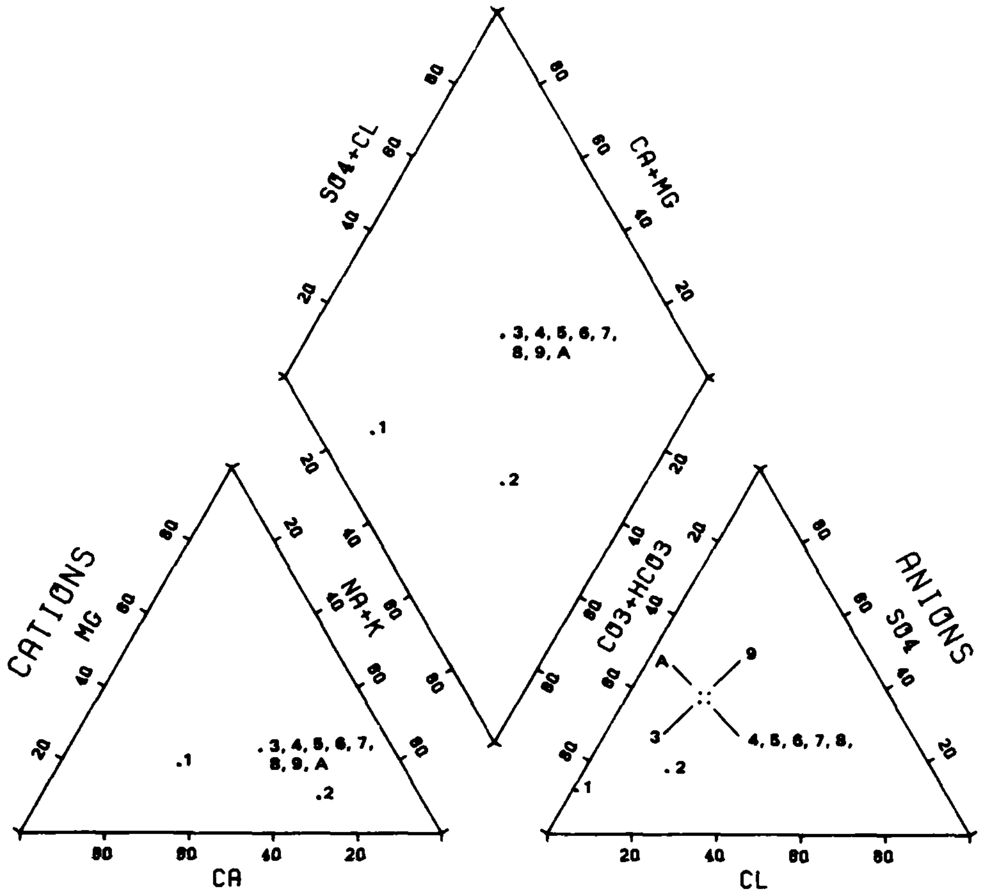
Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WATER QUALITY MAP
COYOTE SPRING OB
STUDY AREA, NEVADA

28 MAY 81

FIGURE 3



PERCENTAGE REACTING VALUES

COYOTE SPRING O.B. STUDY AREA-SPRINGS

KEY	STATION NAME OR NUMBER	TOTAL DISSOLVED SOLIDS	MG	CA	NA+K	CO3+ HCO3	SO4	CL	ION BALANCE
			MILLIGRAMS PER LITER / MILLI-EQUIVALENTS PER LITER						
1	9S-65E-21D	70.00	4.00 0.33	19.00 0.95	12.00 0.50	87.00 1.39	9.00 0.19	0.50 0.01	5.43*
2	10S-64E-9D	265.00	4.00 0.33	17.00 0.85	52.50 2.28	130.00 2.08	27.00 0.57	23.00 0.64	2.41
3	14S-65E-17AA2	591.00	27.00 2.21	65.00 3.24	109.00 4.64	278.00 4.45	172.00 3.61	61.00 1.71	1.85
4	14S-65E-9CCC	600.00	27.00 2.21	62.00 3.09	103.00 4.41	262.00 4.19	177.00 3.72	66.00 1.85	-0.22
5	14S-65E-9CCC	600.00	27.00 2.21	62.00 3.09	103.00 4.43	262.00 4.19	179.00 3.78	66.00 1.85	-0.33
6	14S-65E-15CCC	610.00	26.00 2.13	64.00 3.19	108.00 4.65	270.00 4.32	182.00 3.82	68.00 1.90	-0.35
7	14S-65E-16DB	610.00	27.00 2.21	62.00 3.09	106.00 4.54	267.00 4.27	181.00 3.80	66.00 1.85	-0.38
8	14S-65E-16BCA	620.00	28.00 2.30	63.00 3.14	107.00 4.61	269.00 4.30	186.00 3.86	66.00 1.85	0.15
9	14S-65E-16ADB	635.00	28.00 2.30	65.00 3.24	110.00 4.72	270.00 4.32	198.00 4.12	69.00 1.93	-0.52
A	14S-65E-16DDC	720.00	29.00 2.38	65.00 3.24	111.00 4.80	277.00 4.43	193.00 4.05	61.00 1.71	1.13

* = Ion balance differs by more than 2.5%.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

COYOTE SPRING OB STUDY AREA
SPRINGS – WATER CHEMISTRY

28 MAY 81 FIGURE 4

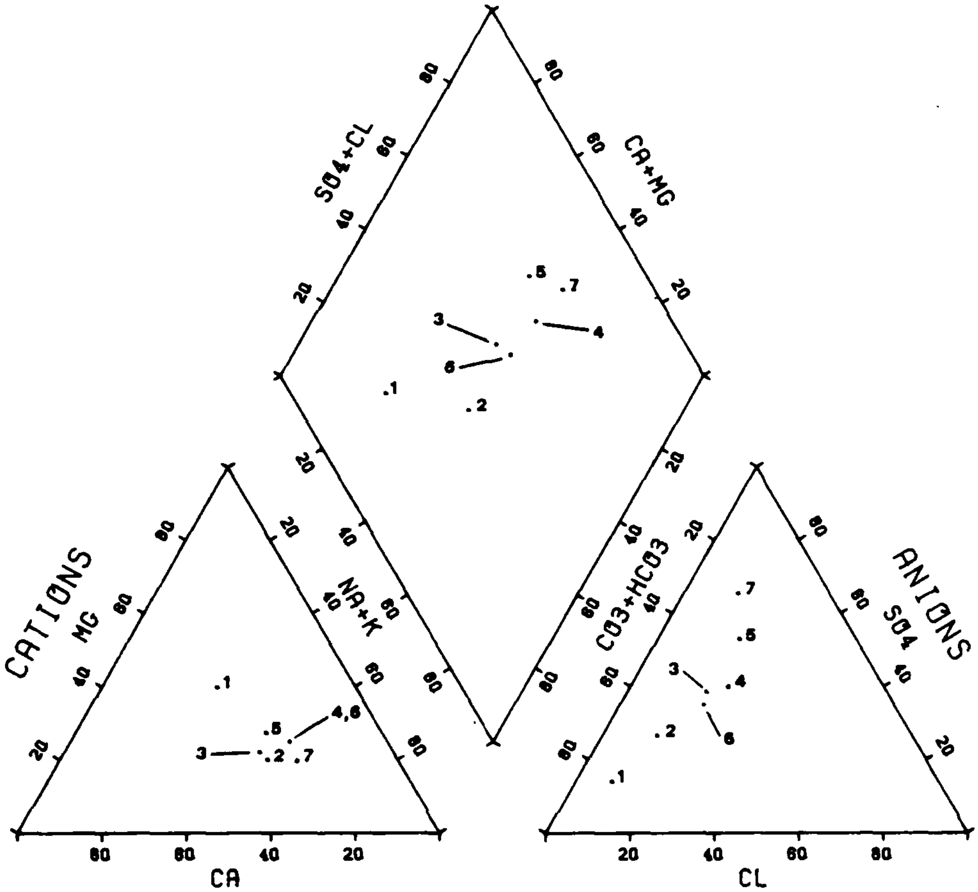
that the water from these springs is calcium and sodium bicarbonate in type and is significantly different from the water of all other springs considered in this study. The two springs in Kane Springs Valley are believed to be discharging from a zone of locally perched water.

The remaining springs in the study area are located in the vicinity of Muddy River Springs. Figure 4 shows that these ground water have identical chemical compositions which are mixed magnesium-calcium-sodium bicarbonate-sulfate.

Figure 5 is a trilinear diagram which shows the chemical composition of ground water sampled from wells in the Coyote Spring OB study area. The results of chemical analyses are available for two wells located in Coyote Spring Valley and five wells in the Muddy River Springs area. All wells are tapping aquifers in valley-fill deposits with the exception of the well located in 13S/63E-23dd which is the Ertec carbonate well drilled in November and December 1980.

The depth to water in the well located at 11S/62E-13bd was measured to be 14.4 feet (4.4 m), and the ground water is believed to be perched. Figure 5 shows the water type to be calcium-magnesium bicarbonate.

Figure 5 also shows that the ground water from the Ertec carbonate exploration well is sodium bicarbonate in type. This composition is slightly different from, but approaches that of, the ground water in the Muddy River Springs area which are



PERCENTAGE REACTING VALUES

COYOTE SPRING O.B. STUDY AREA-WELLS

KEY	STATION NAME OR NUMBER	TOTAL DISSOLVED SOLIDS	MG	CA	NA+K	CO3+ HCO3	SO4	CL	ION BALANCE
			MILLIGRAMS PER LITER / MILLI-EQUIVALENTS PER LITER						
1	11S-62E-13BD	299.00	27.00 2.21	37.00 1.85	34.90 1.52	258.00 4.13	35.00 0.73	16.00 0.45	2.43
2	13S-63E-23DDD	491.00	20.00 1.64	51.00 2.54	94.00 4.02	306.00 4.90	102.00 2.14	37.00 1.04	0.81
3	14S-65E-17AA3	583.00	27.00 2.21	65.00 3.24	110.00 4.66	274.00 4.38	172.00 3.61	66.00 1.90	1.11
4	14S-65E-23BBB	915.00	40.00 3.28	76.00 3.79	168.00 7.35	318.00 5.08	318.00 6.68	104.0[illegible] 2.91	-0.77
5	14S-65E-14CD	1070.00	54.00 4.43	90.00 4.49	168.00 7.27	297.00 4.75	429.00 9.01	117.00 3.28	-2.54*
6	14S-65E-17AA1	1200.00	60.00 4.92	115.00 5.74	250.00 10.77	579.00 9.28	3[illegible]00 [illegible]27	143.00 4.00	-0.25
7	14S-65E-23AC	1800.00	69.00 5.66	136.00 6.79	345.00 14.95	360.00 5.76	81[illegible]00 17.20	120.00 3.38	2.01

* = Ion balance differs by more than 2.5%.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

COYOTE SPRING OB STUDY AREA
WELLS – WATER CHEMISTRY

28 MAY 81

FIGURE 5

higher in total dissolved solids (TDS) and sulfate concentrations and which are mixed sodium bicarbonate-sulfate in type. The water from the wells in the Muddy River Springs area is basically similar in type to that of the springs in this region. As the TDS concentrations in the well water increase, the water type gradually changes from sodium bicarbonate to sodium sulfate.

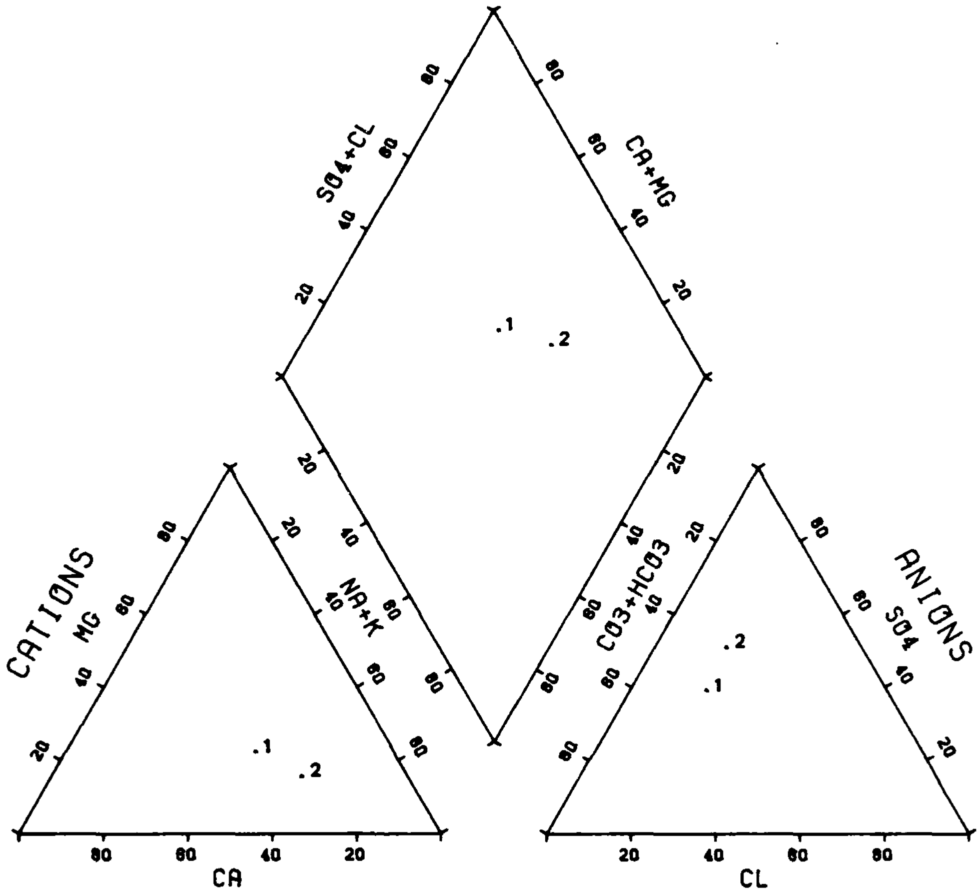
Figure 6 shows the water quality of surface-water samples obtained from the Muddy River. The water samples from the Muddy River are also mixed sodium bicarbonate-sulfate similar to the Muddy River Springs which are the source of discharge.

An increase in TDS concentrations in well water occurs in a few very localized areas throughout the Muddy River Springs area. This increase is probably due to concentration of dissolved constituents through evaporation and transpiration of infiltrated irrigation waters in this agricultural area.

7.2 SUITABILITY OF WATER FOR PUBLIC SUPPLY

Generally, most of the waters analyzed are suitable for drinking. Table 1 lists Primary Drinking Water Standards recommended by the U.S. Environmental Protection Agency and Tables 2 and 3 list Primary and Secondary Drinking Water Standards adopted by the State of Nevada.

None of the water sampled in this study exceeded primary federal or state drinking water standards. Water from three wells, all located in the Moapa Valley-Muddy River Springs area,



PERCENTAGE REACTING VALUES

COYOTE SPRING O.B. STUDY AREA-STREAMS

KEY	STATION NAME OR NUMBER	TOTAL DISSOLVED SOLIDS	MG	CA	NA+K	CO3+ HCO3	SO4	CL	ION BALANCE
			MILLIGRAMS PER LITER / MILLI-EQUIVALENTS PER LITER						
1	14S-65E-15ODC	690.00	29.00 2.38	71.00 3.54	112.00 4.79	292.00 4.67	202.00 4.24	70.00 1.98	-0.74
2	14S-65E-36B	1000.00	30.00 2.48	82.00 4.09	223.00 9.48	328.00 5.25	393.00 8.25	98.00 2.74	-0.65

* = Ion balance differs by more than 2.5%.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

COYOTE SPRING OB STUDY AREA
STREAMS—WATER CHEMISTRY

28 MAY 81

FIGURE 6

MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS

CONTAMINANT	LEVEL, mg/l
ARSENIC	0.05
BARIUM	1.
CADMIUM	0.010
CHROMIUM	0.05
LEAD	0.05
MERCURY	0.002
NITRATE (AS N)	10.
SELENIUM	0.01
SILVER	0.05

NOTE: The maximum contaminant level for nitrate is applicable to both community water systems and non-community water systems. The other inorganic chemicals apply only to community water systems.

MAXIMUM CONTAMINANT LEVELS FOR FLUORIDE

When the annual average of the maximum daily air temperatures for the location in which the community water system is situated is:

TEMPERATURE, °F	TEMPERATURE, °C	LEVEL, mg/l
53.7 and below	12.0 and below	2.4
53.8 to 58.3	12.1 to 14.6	2.2
58.4 to 63.8	14.7 to 17.6	2.0
63.9 to 70.6	17.7 to 21.4	1.8
70.7 to 79.2	21.5 to 26.2	1.6
79.3 to 90.5	26.3 to 32.5	1.4

Reference: U.S. Environmental Protection Agency, 1976, National Interim Primary Drinking Water Regulations, EPA - 570/9-76-003

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS

28 MAY 81

TABLE 1

CONTAMINANT	LEVEL, mg/l
ARSENIC	0.05
BARIUM	1.
CADMIUM	0.010
CHROMIUM	0.05
LEAD	0.05
MERCURY	0.002
NITRATE (AS N)	10.
SELENIUM	0.01
SILVER	0.05
FLUORIDE	*

* - TEMPERATURE DEPENDENT
INDENTICAL TO U.S. ENVIRONMENTAL
PROTECTION AGENCY

Reference: Nevada State Board of Health, 1977

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

NEVADA PRIMARY DRINKING WATER STANDARDS MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS

28 MAY 81 TABLE 2

CONTAMINANT	LEVEL, mg/l *	MAXIMUM LEVEL, mg/l * *
CHLORIDE	250	400
COLOR	15 COLOR UNITS	N/A
COPPER	1	N/A
FOAMING AGENTS	0.5	N/A
IRON	0.3	0.6
MAGNESIUM	125	150
MANGANESE	0.05	0.1
ODOR	3 THRESHOLD ODOR NUMBER	N/A
pH	6.5 - 8.5	N/A
SULFATE	250	500
TDS (Total Residue dried at 103 - 105° C)	500	1000
ZINC	5	N/A

N/A—not applicable

* These chemical substances should not be present in a public water supply in excess of the listed levels where, in the judgement of the health authority, other more suitable supplies are or can be made available. Such alternate supplies must be economically feasible, available under law in sufficient quantities and of a significant higher quality.

** These chemical substances shall not be present in a public water supply in excess of the listed levels.

Reference: Nevada State Board of Health, 1977.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

NEVADA SECONDARY DRINKING WATER STANDARDS MAXIMUM CONTAMINANT LEVELS FOR INORGANIC CHEMICALS

28 MAY 81 TABLE 3

have TDS concentrations which exceed 1000 milligrams per liter (mg/1), the maximum Nevada secondary standard. One of these wells, located at 14S/65E-23ac, also has water which exceeds the Nevada secondary standard for sulfate. In this well, and also in the well at 14S/65E-17aa1, the depth to water is less than 20 feet (6 m). These three wells are located in an area of high domestic and agricultural use in the Moapa area. The high TDS concentrations are probably due to concentration of salts from agricultural usage and rapid infiltration of irrigation water to the shallow water table.

Future development of water resources should be feasible from a water quality standpoint in the entire study area. Ground-water samples in the area meet federal and state drinking water standards for all inorganic constituents tested.

7.3 SUITABILITY OF WATER FOR CONSTRUCTION

Construction water uses are summarized in Table 4. The only uses where water quality poses a potential problem are in the mixing of cement. Water suitable for cement mixing is unlikely to cause problems in soil compaction for road and rail construction or in dust suppression.

The recommended limits on the quality of mixing water for cement are summarized in Table 5. All water samples from the study area meet these criteria.

ACTIVITY	WATER USE
Roads	Soil Compaction Dust Palliative Mix
Railroads	Compaction
Shelters	Compaction Concrete Soil Cement
Construction Camps	Potable Water
Miscellaneous	Dust Control Equipment Washing Revegetation

Reference: Table 13: MX Verifiable Horizontal MPS Facility Subsystem (Vol. I) Ralph M. Parsons Company (1979).

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

SUMMARY OF CONSTRUCTION WATER USE

28 MAY 81

TABLE 4

CONSTITUENT		mg/l
Total Dissolved Solids	<	2000
Suspected Solids	<	2000
Iron	<	20
Sodium Sulphide	<	100
Sodium-Potassium Carbonates and Bicarbonates	<	1000
Sodium Chloride	<	20,000
Sodium Sulphate	<	10,000
Magnesium Sulphate	<	40,000
Magnesium Chloride	<	40,000

Reference: Portland Cement Association (1966)

NOTE: Waters with HCO_3 concentrations of 550 mg/l are listed as suitable for concrete manufacture. No upper limit was established by Portland Cement Association research (Mr. Frank Randall – Portland Cement Assoc. (1981) Per. Comm.).

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WATER-QUALITY CRITERIA
FOR MIXING CEMENT

28 MAY 81 TABLE 5

8.0 IMPACTS OF WATER DEVELOPMENT

The U.S. Air Force estimates that the MX Operational Base will use approximately 4200 acre-feet of water per year (5.2 hm^3/yr). Water requirements during the construction phase are expected to reach a peak demand of 9685 acre-feet (11.9 hm^3) in 1986. Both of these estimates are considerably greater than the perennial yield of 2600 acre-ft/yr (3 hm^3/yr) for Coyote Spring Valley estimated by Eakin (1964). When compared to the perennial yield of 18,000 acre-ft/yr (22.2 hm^3/yr) estimated by the Nevada State Engineer, they represent only 23 percent of the perennial yield for operational use and 54 percent of it for peak year construction requirements.

Data obtained from the drilling and testing program in Coyote Spring Valley conducted by Ertec indicate that the valley-fill materials may not be capable of supplying sufficient quantities of water to meet either the peak construction or the estimated operational water requirements of MX. Therefore, the carbonate aquifer is currently being considered as the most probable source of water for MX requirements.

Long-term withdrawals from the regional carbonate flow system would probably have very little impact in Coyote Spring Valley but could possibly impact the area of the Muddy River Springs. This potential impact and its magnitude are currently being investigated. Withdrawals from the carbonates in Coyote Spring Valley could concurrently lower the hydraulic head in the carbonate-rock aquifer system. If the carbonates in Coyote

Spring Valley are hydraulically connected with the carbonates at Muddy River Springs, some reduction in the discharge at the Muddy River Springs may occur in response to long-term pumping from the carbonate at Coyote Spring Valley. This could also possibly reduce the flow in the Muddy River. Flow records for the Muddy River show that, over a 30-year period, flow of water in the river has not varied significantly even though there has been development of the water resources in the Muddy River Springs area.

A drilling and testing program is in progress to evaluate the characteristics of the carbonate system in the study area and to assess any possible effects on the spring discharge of the Muddy River Springs as the result of MX withdrawals from the regional carbonate aquifer. Initial testing of this system was not of sufficient duration or at high enough rates of yield to provide a reliable basis for assessing the aquifer system.

9.0 FUTURE DEVELOPMENT

9.1 POTENTIAL FOR SURFACE-WATER DEVELOPMENT

Surface water in the study area is used for domestic consumption, stock watering and, in the Muddy River Springs area, for irrigation purposes. However, all surface water is appropriated and diverted for use in those areas that are in close proximity to the springs and downstream along the Muddy River. No further appropriations of surface water can be made. Therefore, no new development of water from this source without lease or purchase can be expected.

9.2 POTENTIAL FOR GROUND-WATER DEVELOPMENT

The occurrence of ground water in the study area is divided into two sources; water from the valley-fill aquifer, and water from the regional carbonate aquifer. The valley-fill system consists of locally recharged ground water occurring in the valley-fill material, whereas the regional carbonate system consists of ground-water flowing through carbonate rocks within the White River regional ground-water flow system.

Information gathered from Ertec's exploratory drilling and testing program suggests that the valley-fill materials in Coyote Spring Valley will yield very little water. Development of valley-fill ground water in the area of Muddy River Springs is possible but would be limited to lease or purchase of existing water rights because ground water is fully appropriated. Should this option be selected, it would be necessary to pump the water through a pipeline for a a distance of almost 20 miles (32 km).

In the area of this study, water from the regional carbonate system may be the only long-term, ground-water supply source available for the MX requirements. The quantity of ground water that could be pumped from the regional system without impacting regional spring discharge cannot presently be defined. Information obtained from Ertec's carbonate exploration and testing program suggests a high probability of being able to develop large quantities of ground water from the system. Further drilling and testing is currently in progress to better define the capabilities of the regional ground-water system in this area and the impacts of its development. This work is anticipated to be completed in 1982.

It was suggested in the Draft Environmental Impact Statement (DEIS) (USAF, 1981) that water from a source outside the regional system such as the Colorado River could be obtained, transported, and used as a water-supply source for the Coyote Spring Valley OB. This, however, may not be a possible alternative source for water supply due to the legal, political, and possible environmental problems that could be associated with developing a water supply from the Colorado River.

10.0 REFERENCES

Bateman, R. L., 1976, Inventory and chemical quality of ground water in the White River, Muddy River, Meadow Valley Wash areas, southeastern Nevada: Project Report 40.

Bowyer, G., Pampeyan, E. H. and Longwell, C.R., 1958, Geologic map of Clark County, Nevada: U. S. Geological Survey Mineral Inventory Map MF-138.

Desert Research Institute (DRI), 1980, (Rev. 1981) Water rights in Nevada and Utah: An inventory within the MX area.

Eakin, T. E., 1963, Ground-water appraisal of Pahranagat and Pahroc valleys, Lincoln and Nye counties, Nevada: State of Nevada, Ground-Water Resources Reconnaissance Series, Report 21.

__________, 1964, Ground-water appraisal of Coyote Spring and Kane Springs Valley and Muddy River Spring area, Lincoln and Clark counties, Nevada: State of Nevada, Ground-Water Resources Reconnaissance Series, Report 25.

__________, 1966, A regional interbasin groundwater system in the White River area, southeastern Nevada, State of Nevada, Water Resources Bulletin 30.

Eakin, T. E., and Moore, D. L., 1964, Uniformity of discharge of Muddy River Springs, southeastern Nevada, and relation to interbasin movement of ground water: U.S. Geological Survey Professional Paper, pp. 501-D.

Ertec Western, Inc., 1980, Proposed operational base site Coyote Spring and Kane Springs Valleys, Nevada, Technical Report, February 1980.

__________, 1980, MX water resources program plans Nevada-Utah Siting Area, August 1980.

__________, 1980, Preliminary geotechnical investigation proposed operational base site Coyote Spring Valley, Nevada, v. I, Technical Report, December 1980.

Ertec Northwest, Inc., 1980, Environmental assessment for aquifer studies at five locations in Coyote Spring Valley.

Fenneman, N. M., 1931, Physiography of the western United States: New York, McGraw-Hill Book Co.

Kellogg, E., 1960, Geology of the southern Egan Range, Nevada: Intermountain Association of Petroleum Geologists, Guidebook to the Geology of east-central Nevada.

Liggett, M. A., and Ehrenspeck, H.E., 1974, Pahranagat shear system, Lincoln County, Nevada, Argus Exploration Company Report of Investigation for Goddard Space Flight Center.

Maxey, G. B., Mindling, A.L., and Domenico, P. A. 1966, Ground water in upper Muddy River Basin, Desert Research Institute, University of Nevada.

Nevada State Engineer, 1971, Water for Nevada, Nevada Water Resources Report No. 3.

__________, 1980, Division of Water Resources Abstract of Water Filings.

Nevada State Division of Health, 1977 (amended 1980), Water supply regulations, Part I.

Phoenix, D. A., 1948, Geology and ground water in the Meadow Valley Wash drainage area, Nevada, above the vicinity of Caliente: State of Nevada, Water Resources Bulletin 7.

Piper, A. M., 1944, A graphic procedure in the geochemical interpretation of water analysis: American Geophysical Union Transactions 25th Annual Meeting, Part 6.

Portland Cement Association, 1966, "Mixing Water for Concrete," Portland Cement Association Pamphlet.

Ralph M. Parsons Company, 1979. MX verifiable horizontal MPS facility subsystem, v. 1.

Randall, F., 1981, Personal communication about waters suitable for concrete manufacture, Portland Cement Association.

Rush, F. E., 1968, Water-resources appraisal of the lower Moapa-Lake Mead area, Clark County, Nevada, State of Nevada Water Resources Reconnaissance Series, Report 50.

Tschanz, C. M., and Pampeyan, E.H., 1961, Preliminary geologic map of Lincoln County, Nevada, U. S. Geological Survey Mineral Inventory Field Studies Map MF-206.

Tschanz, C. M., and Pampeyan, E. H. 1970, Geology and mineral deposits of Lincoln County, Nevada, Nevada Bureau of Mines Bulletin 73.

Tschanz, C. M., Orkild, P. P., and Poole, F.G., 1979, Road log from Las Vegas to Ely, Nevada, via Caliente and Pioche, Utah Geological Association Basin and Range Symposium.

U.S. Department of the Air Force, 1981, Deployment area selection and land withdrawal/acquisition, Draft Environmental Impact Statement, v. IV, Part 1, Environmental Consequences to the Study Regions and Operating Base Vicinities.

U.S. Environmental Protection Agency, 1976a, National interim primary drinking water regulations, EPA-570/9-76-003.

__________, 1976b, Quality criteria for water.

U.S. Army Corps of Engineers, 1974, Flood plain information Muddy River, vicinity of Overton, Clark County, Nevada, Prepared for Clark County by Los Angeles District, California.

U.S. Geological Survey, 1978, Nevada stream flow characteristics, U.S. Geological Survey, Water Resources Series, Report No. 28.

____________________, 1980, Water resources data for Nevada, Water Year 1979, U.S. Geological Survey Water Data Report, NV-79-1.

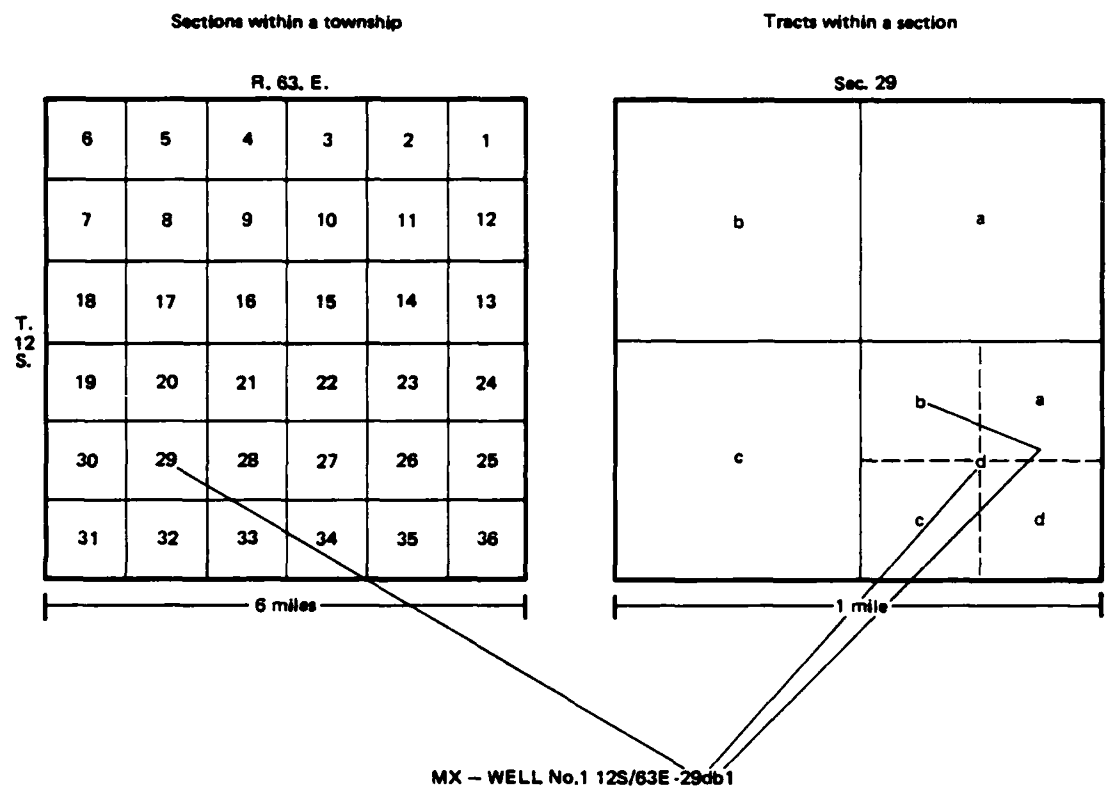
Winograd, I. J., and Friedman, I., 1972, Deuterium as a tracer of regional ground-water flow, southern Great Basin, Nevada and California, U.S. Geological Survey Bulletin V-83.

APPENDIX A

WELL AND SPRING NUMBERING SYSTEM

WELL AND SPRING NUMBERING SYSTEM

The numbering system for wells and springs in this report is based on the rectangular subdivision of the public lands referenced to the Mount Diablo base line and meridian. This location number consists of three units: the first is the township south of the base line; the second unit, separated from the first by a slant line, is the range east of the meridian; the third unit, separated from the second by a dash, designates the section number. The section number is followed by letters that indicate the quarter, and quarter-quarter section. The letters a, b, c, and d designate, respectively, the northeast, northwest, southwest, and southeast quarters. The letters may be followed by a number which denotes the number of the well drilled in a particular quarter-quarter section. For example well *12S/63E-29db1* is the first well recorded in the NW1/4, SE1/4 Sec. 29, T12S, R63E, Mount Diablo base line and meridian. The numbering system is illustrated in Figure A-1.



Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WELL AND SPRING NUMBERING SYSTEM USED IN THIS REPORT

28 MAY 81

FIGURE A-1

APPENDIX B

RECORDS OF WELLS

WELL LOCATION	OWNER OR WATER USER	YEAR OF COMPLETION	DEPTH OF WELL (feet)	DIAMETER OF CASING (inches)	ELEVATION OF LAND SURFACE (feet above m.s.l.)	DATE OF MEASUREMENT (mo. – yr.)	DEPTH TO WATER (feet)	WATER LEVEL ELEVATION (feet above m.s.l.)	REFERENCES	REMARKS
					COYOTE SPRING VALLEY					
10S/62E-14a1	Van Horn	—	510	10	—	-58	416	—	2	Abandoned
11S/62E-13bd	Judy's Ranch	—	—	—	2540	11-80	14	2526	1	Spring area
12S/63E-29db1	U.S. Air Force	1980	714	26 @40' 10 @475' 2 @714'	2465	12-80	545	1920	1	714 ft. valley-fill low specific yield
12S/63E-29db2	U.S. Air Force	1980 1981	1240	10 @860'	2465	12-80	545	1920	1	Well located 500 ft. south of 0-1. Bed rock at 850 ft.
13S/63E-23dd	U.S. Air Force	1980	669	26 @50'	2180	12-80	353	1827	1	Well located 6 miles south of 0-1. Bed rock at 30 ft; high sp, capacity and est. transmissivity
13S/63E-25a1	L.W. Perkins	1944	353	6	—	4-44	332		2	Abandoned
					MUDDY RIVER SPRING AREA					
14S/65E-8ba	Nev. Power Co.	1964	70	8	—	—	28	—	3	N.P.-064 No 2
14S/65E-8ab	C. Lewis	1949	58	12	1830	3-63	29	1801	2	N.P. No 1
14S/65E-8ac1	C. Lewis	—	44	—	1825	6-63	30	1795	2	502 gpm 1952
14S/65E-8ac2	C. Lewis	1962	65	14	—	—	18	—	3	N.P. No 3
14S/65E-8ad	C. Lewis	1959	66	16	—	—	16	—	3	N.P. No 2
14S/65E-8db1	W.O. Perkins	—	—	5+5 Feet	—	9-53	23	—	2	Open Dug-well 285 gpm 1950
14S/65E-8db	C. Lewis	1954	52	14	—	—	21	—	3	N.P. No 5
14S/65E-8dc	W.O. Perkins	1950	52	14	1825	6-63	25	1800	2	4989 gpm 1951

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WELLS MEASURED BY ERTEC WESTERN AND OTHERS, COYOTE SPRING VALLEY OB STUDY AREA, NEVADA
PAGE 1 OF 2

28 MAY 81 TABLE B-1

WELL LOCATION	OWNER OR WATER USER	YEAR OF COMPLETION	DEPTH OF WELL (feet)	DIAMETER OF CASING (inches)	ELEVATION OF LAND SURFACE (feet above m.s.l.)	DATE OF MEASUREMENT (mo. – yr.)	DEPTH TO WATER (feet)	WATER LEVEL ELEVATION (feet above m.s.l.)	REFERENCES	REMARKS
14S/65E-8dd	C. Lewis	1964	65	—	1800	11-80	28	1772	3	Irrigation
14S/65E-9cc1	H. Lewis	1949	75	12	—	3-61	21	—	2	420 gpm 1949
14S/65E-9cc2	F. Taylor	1958	60	12	—	—	145	—	3	Irrigation
14S/65E-9dd1	P.H. Godfrey	1959	65	12	—	7-59	10	—	2	125 gpm
14S/65E-9dd2	F. Taylor	1957	60	12	—	6-57	14	—	2	75 gpm
14S/65E-15bb	F. Taylor	1948	80	20	—	6-63	19	—	2	1400 gpm
14S/65E-16aa	F. Taylor	—	80	14	—	9-63	—	—	2	flowing 75 gpm
14S/65E-17a	L. Perkins	—	43	17	—	11-80	17	—	1	—
14S/65E-22ab	V. Perkins	1948	150	10	—	—	21	—	3	Irrigation
14S/65E-23ab	L. Perkins	—	50	6	—	3-61	2	—	2	OBS-Well
14S/65E-23ac	L. Perkins	1948	82	16	—	6-63	2	—	2	440 gpm
14S/65E-23ac2	Nev. Power Co.	—	—	7	1726	11-80	3	1723	1	—
14S/65E-23bb	D&G Perkins	1948	60	10	—	6-63	14	—	2	270 gpm 1948
14S/65E-23bb2	R. Beamer	1958	80	10	—	—	8	—	3	Irrigation

REFERENCES: 1. Measured by Ertec Western, 1980
2. Eakin, 1964
3. Maxey, 1966

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WELLS MEASURED BY ERTEC WESTERN AND OTHERS, COYOTE SPRING VALLEY OB STUDY AREA, NEVADA
PAGE 2 OF 2

28 MAY 81 TABLE 8-1

APPENDIX C

RECORD OF SPRINGS

LOCATION	SOURCE	DATE OF MEASUREMENT - MO. - YR.	ELEVATION (FEET)	DISCHARGE (gpm)
8S/66E-30b	2	7-75	3674.5	2.4
9S/65E-21d	2	7-75	3346.5	2.4
10S/64E-9d	1	11-80	3876.0	1.0 (e)
11S/62E-13bd	1	11-80	2520.0	< 1.0 (e)
14S/65E-9ccc (S)	2	6-71	1800.0	53.0
14S/65E-9ccc (N)	2	6-71	1800.0	103.0
14S/65E-ccc	2	6-71	1750.0	–
14S/65E-16adb	2	6-71	1760.0	3233.5
14S/65E-16bca	2	6-71	1900.0	242.5
14S/65E-16db	2	6-71	1850.0	852.8
14S/65E-16ddc	2	7-75	1739.0	–
14S/65E-17aa-2	1	11-80	1900.0	–
15S/61E-24d	2	6-75	6693.0	< 1.6

(e) - DISCHARGE ESTIMATED
(S) - SOUTH
(N) - NORTH

NOTE: WHERE PUBLISHED DATA ARE LACKING OR INACCURATE GROUND SURFACE ELEVATIONS ARE TAKEN FROM TOPOGRAPHIC MAPS.

Source: 1. Ertec Western, 1980
2. Bateman, 1976

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

RECORD OF SPRINGS
COYOTE SPRING OB
STUDY AREA, NEVADA

28 MAY 81 TABLE C

APPENDIX D

WATER CHEMISTRY DATA

SAMPLE LOCATION	OWNER OR WATER USER	DATE OF COLLECTION (mo.-yr.)	TEMPERATURE °C*	pH*	SPECIFIC CONDUCTANCE (µmhos/cm @ 25 °C)*	BICARBONATE (HCO_3)*	CARBONATE (CO_3)*	DISSOLVED SOLIDS (see note)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (as N)	SILICA (SiO_2)	TRITIUM (pCi/liter)	REFERENCES	REMARKS
9S/65E-21d		7-75	30.5	7.9	155	87*		70	19	4	10	2	9	0.5	-	-	-		2	Spring-Kane Spring Wash
10S/64E-9d		11-80	19.5	7.8	3300	130	0	265	17.0	4	48	4.5	27	23	0.9	1.3	59		1	Willow Spring
11S/62E-13bd		11-80	17.0	8.5	590	258	0	299	37	27	32	2.9	35	16	0.2	1.2	19		1	
13S/63E-23dd		12-80	-	-	-	306	0	491	51	20	83	11	102	37	2.1	0.2	34		1	
14S/65E-9ccc		6-71	33	8.1	855	262*		600	62	27	91	12	177	66	-	-	32		2	Baldwin House Spring South
14S/65E-9ccc		6-71	33	8.0	850	266*		600	62	27	92	11	179	66	-	-	31		2	Baldwin House Spring-North
14S/65E-14cd		9-74	20	8.4	1575	297*		1070	90	54	153	15	429	117	-	0.5***	65		2	Abbot Well
14S/65E-15ccc		6-71	33	8.1	885	270*		610	64	26	97	11	182	68	-	-	29		2	Iverson Spring
14S/65E-15ddc		6-75	29	7.8	1100	292*		690	71	29	99	13	202	70	-	3.2***	-		2	Muddy River at Gage
14S/65E-16adb		6-71	33	8.1	910	270*		635	65	28	98	12	196	69	-	-	30		2	Muddy (Big) Spring
14S/65E-16bca		6-71	33	8.2	880	269*		620	63	28	96	11	184	66	-	-	32		2	Baldwin Cut Spring
14S/65E-16db		6-71	33	8.2	830	267*		610	62	27	94	12	181	66	-	-	31		2	Jones Spring
14S/65E-16ddc		7-75	32	6.6	1000	277*		720	65	29	101	10	193	61	2.1	0.5***	29		2	Pederson/ Warm Spring
14S/65E-17aa-1		11-80	31	8.1	1100	579	0	1200	115	60	225	25	394	143	1.5	0.0	38		1	
14S/65E-17aa-2		11-80	29.5	8.2	1100	278	0	591	65	27	95	14	172	61	1.3	0.5	25		1	Spring
14S/65E-17aa-3		11-80	26.8	7.9	2100	274	0	583	65	27	95	15	172	68	1.6	0.5	24		1	
14S/65E-23ac		11-80	17	8.1	2600	360	0	1800	136	69	315	30	819	120	2.0	0.0	23		1	Well-Moapa
14S/65E-23bbb		12-74	27	7.6	1460	316*		915	76	40	157	11	318	104	-	1.4***	40		2	Whemer Well
14S/65E-36b		6-75	27	7.2	1050	328*		1000	82	30	194	29	393	98	-	4.4***	-		2	Muddy Riv. at Moapa Ind. Reserv.

References: 1. Ertec Western, 1980
2. Bateman, 1976

* lab determinations as bicarbonate + carbonate

** Na + K
*** Nitrate as NO_3

All measurements in mg/l unless otherwise noted

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WATER CHEMISTRY DATA USED IN ANALYSIS - COYOTE SPRING VALLEY OB STUDY AREA, NEVADA

28 MAY 81 TABLE D-1

SAMPLE LOCATION	OWNER OR WATER USER	DATE OF COLLECTION (mo.-yr.)	TEMPERATURE °C*	pH*	SPECIFIC CONDUCTANCE (μmhos/cm @ 25 °C)*	BICARBONATE (HCO_3)*	CARBONATE (CO_3)*	DISSOLVED SOLIDS (see note)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (as N)	SILICA (SiO_2)	TRITIUM (pCi/liter)	REFERENCES	REMARKS
10S/64E-9d		7-75	25.5	7.7	300	135*		250	19	3	50	3	34	21	1.2	5.0***	69		1	Spring-Kane Spring Wash
14S/65E-8ab		10-69	—	7.7	—	288*		535	69	22	92**		140	58	2.4	1.6***	--		1	Anderson Well
14S/65E-8ac		10-69	—	.6	—	288*		505	67	23	84**		123	58	2.3	1.3***	--		1	Lewis Well # 1
14S/65E-8ad		10-69	—	7.7	—	290*		505	69	21	86**		123	57	2.3	1.8***	--		1	Lewis Well # 2
14S/65E-8ad		10-69	—	7.7	—	317*		595	77	27	98**		165	60	2.3	1.3***	--		1	Lewis Well # 3
14S/65E-15ddc		3-62	22	--	1090	303*		725	71	33	125	14	216	75	2.4	1.5***	32		1	Muddy River at Gage
14S/65E-15ddc		6-71	--	8.3	940	286*		670	66	30	105	13	200	74	—	--	35		1	Muddy River at Gage
14S/65E-16aa		4-69	32	7.8	940	274*		615	62	27	98	10	182	67	—	—	29		1	Willow Flowing Well
14S/65E-23		5-63	--	7.5	—	288*		860	90	29	156**		320	109	2.8	2.0***	--		1	Well-Moapa

References: 1. Bateman, 1976

* lab determinations as bicarbonate + carbonate
**Na + K
***Nitrate as NO_3

All measurements in mg/l unless otherwise noted

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

OTHER WATER CHEMISTRY DATA
COYOTE SPRING VALLEY
OB STUDY AREA, NEVADA

28 MAY 81 TABLE D-2

APPENDIX E

DRILLING AND TESTING ACTIVITIES

SUMMARY OF DRILLING AND TESTING ACTIVITIES

In order to ascertain the aquifer characteristics at the proposed Operational Base location in Coyote Spring Valley, exploratory drilling and testing was conducted by Ertec in November and December of 1980. Field activities were conducted at one valley-fill test site (12S/63E-29db) and one carbonate test site (13S/63E-23dd).

Exploratory Drilling

Exploratory drilling activities began at the valley-fill site (12S/63E-29db1) in mid-November 1980. Field reconnaissance of the area and data reported by Eakin (1966) indicated that the average depth to water at this location could be about 300 feet (91 m).

Exploration at the site was initiated by mud rotary drilling of a pilot hole to 471 feet (144 m). This well encountered a lost circulation zone at approximately 450 feet (137 m). The well was geophysically logged and these logs were correlated with the well cuttings. The geophysical logs were interpreted as indicating potential water-bearing zones at 250 and 275 feet (76 to 84 m) and 350 to 470 feet (107 to 143 m). The well was cased and screened at these intervals. Subsequent air-lifting showed no fluid return indicating that the well was dry and that interpretation of the depth to water and the geophysical logs had been incorrect. Following this, the well was deepened to 714 feet (218 m). Water-bearing horizons were found between 510 to 460 feet and 610 to 714 feet (155 to 171 m and 186 to 218 m). The well was completed as an observation well with two single point piezometers to allow for precise water-level measurements within these deeper water bearing zones. Static water level in both piezometers was subsequently measured at 545 feet (166 m) below land surface.

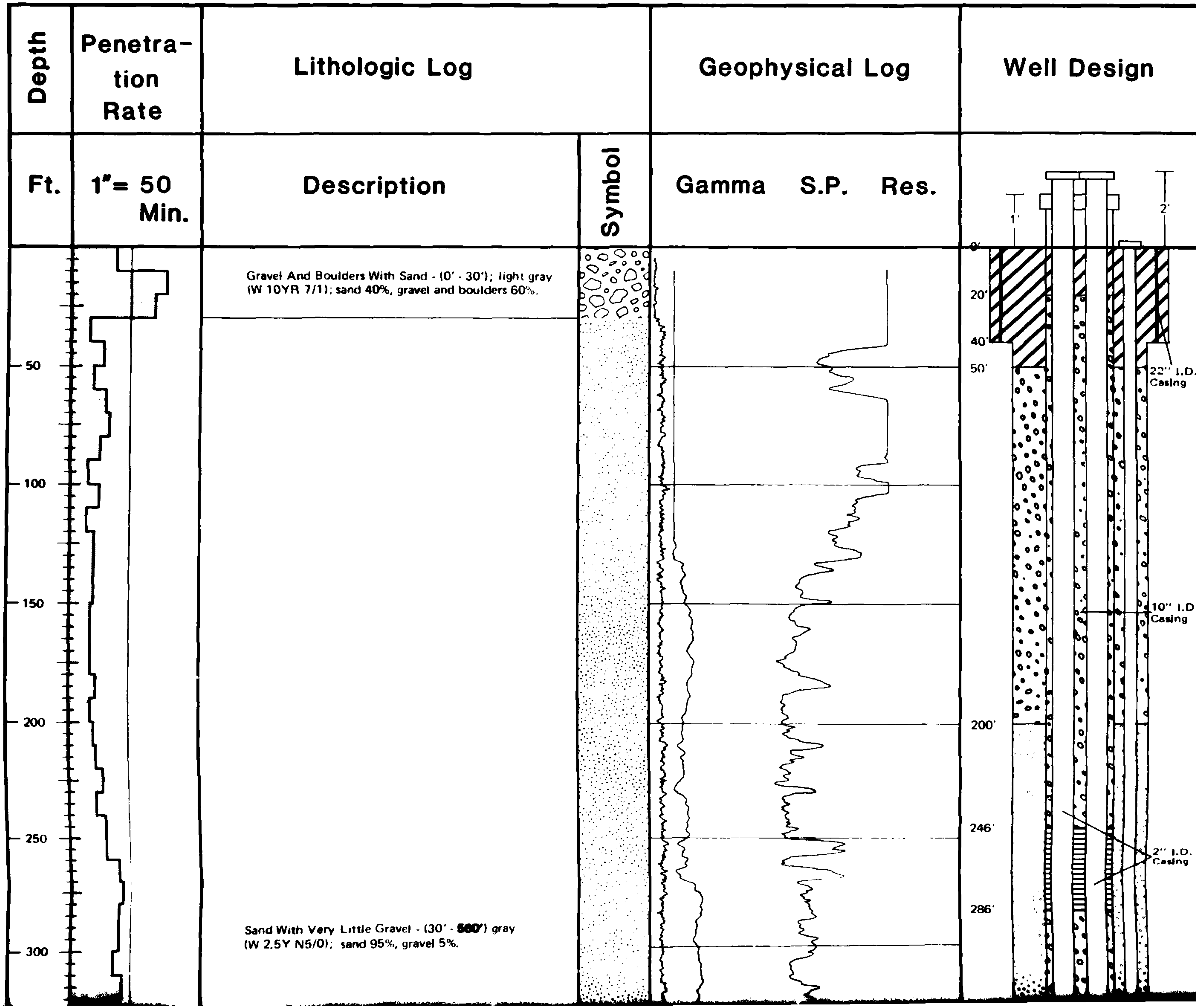
Figure E-1 shows a summary of lithologic units penetrated geophysical logs, and a diagram of the completed well.

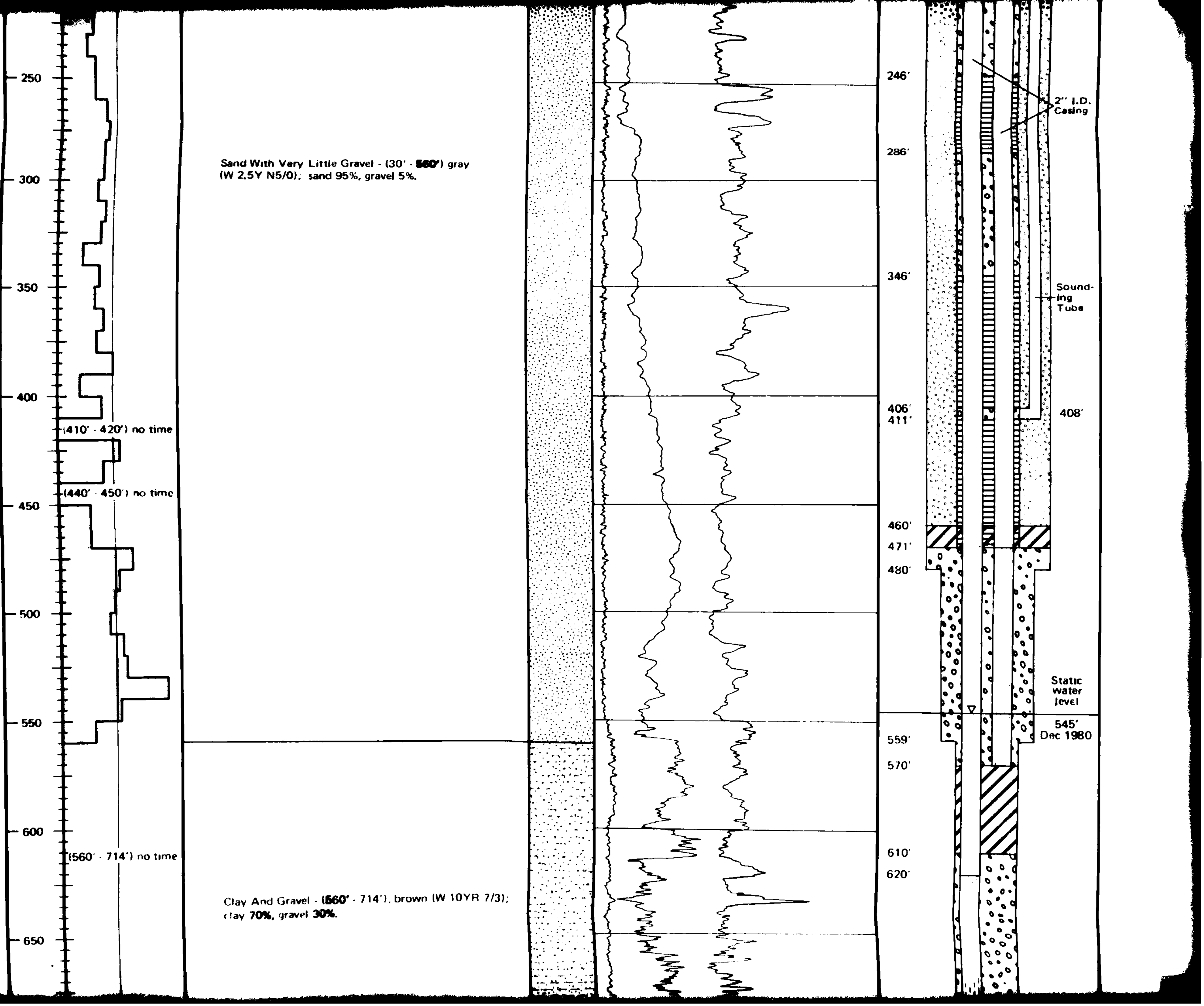
Drilling was then initiated on a projected test well approximately 500 feet (152 m) south of the observation well. This well penetrated valley-fill deposits to a depth of 850 feet (259 m) at which point carbonate bedrock was encountered. No productive water-bearing horizons were penetrated in the valley fill. The valley-fill materials were cased off, and the well was extended into the underlying carbonate rock to a total depth of 1221 feet (372 m). Lack of indicated solution or fracture openings and mud viscosity changes during drilling suggests that the carbonate rock penetrated at this site is relatively impermeable. The well was completed as an open observation well in the carbonate rock. Static water level was measured at 627 feet (191 m) below land surface. The reliability of this measurement is questionable because of the indicated low permeability and the fact that the well was not extensively developed. Figure E-2 shows a summary of lithologic units penetrated, geophysical logs, and a diagram of the completed well.

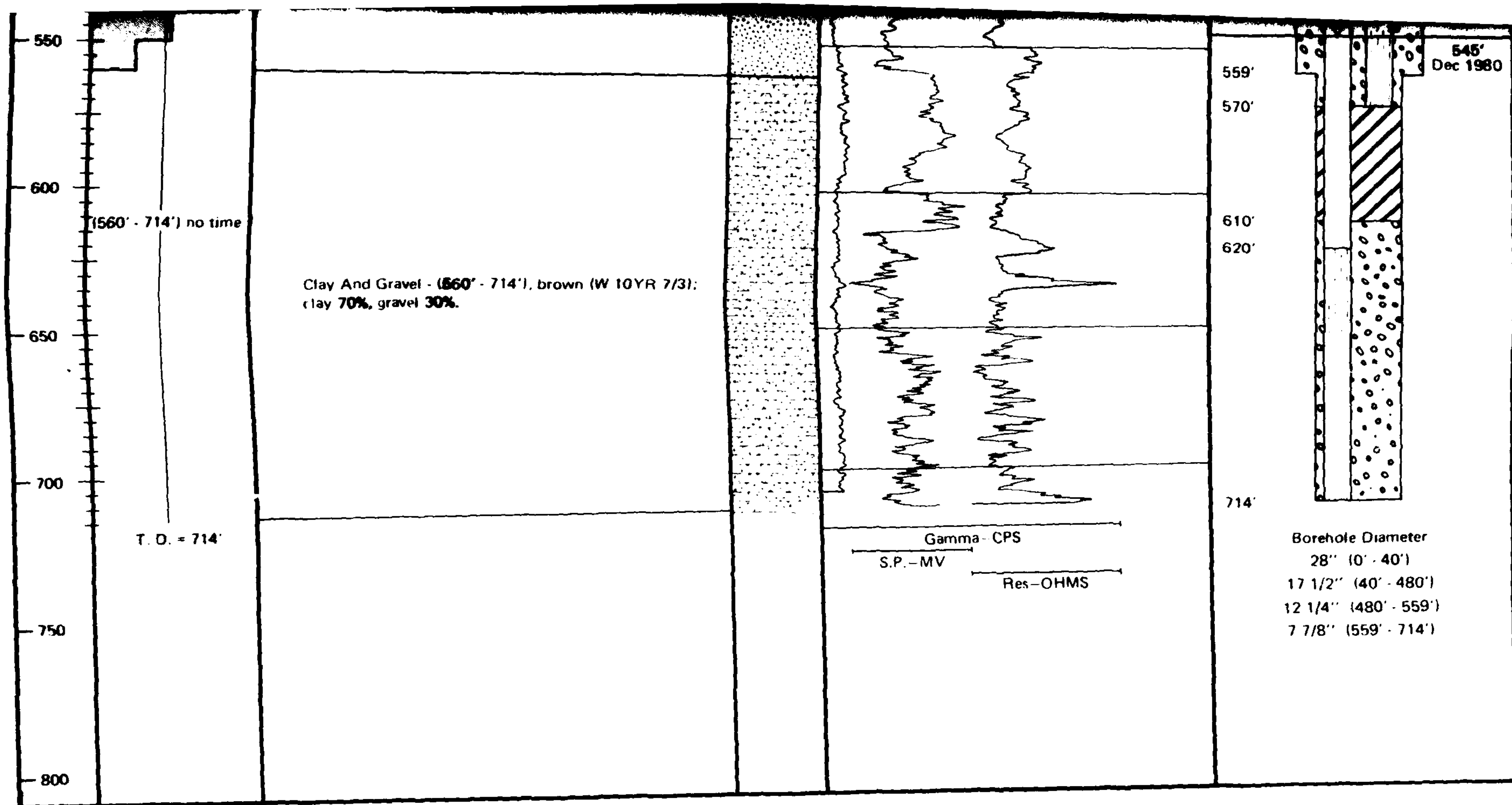
The carbonate exploratory well at 13S/65E-23dd was drilled to a depth of 669 feet (204 m). The well was terminated at 669

COYOTE SPRING VALLEY OBSERVATION WELL 12S/63E-29db1

E-TR-51-I




250
300
350
400
450
500
550
600
650
(410' - 420') no time
(440' - 450') no time
(560' - 714') no time
Sand With Very Little Gravel - (30' - 560') gray (W 2.5Y N5/0); sand 95%, gravel 5%.
Clay And Gravel - (560' - 714'), brown (W 10YR 7/3); clay 70%, gravel 30%.
246'
286'
346'
406'
411'
460'
471'
480'
559'
570'
610'
620'
2" I.D. Casing
Sound-ing Tube
408'
Static water level
545' Dec 1980



LITHOLOGIC SYMBOLS

- Sand
  Silty Sand
  (May also include modifiers of: with some gravel and with very little gravel).
- Clay With Gravel
  Clay Silt With Gravel
  Silt With Gravel
  Silty Clay With Gravel
  (May also include the modifiers and gravel).
- Gravel With Sand
  Gravel With Clay Sand
  Gravel With Silty Clay Sand
  Gravel With Silty Sand
  Gravel With Clay And Sand
  Gravel With Silt And Sand
  (May also include modifiers of with some, and with very little).

WELL DESIGN

- Cement
- 8 - 12 Sand
- Pea Gravel
- Screen
  Johnson Hi-Cap
  .060 inch slot size
- Slotted Pipe

Ertec
The Earth Technology Corporation

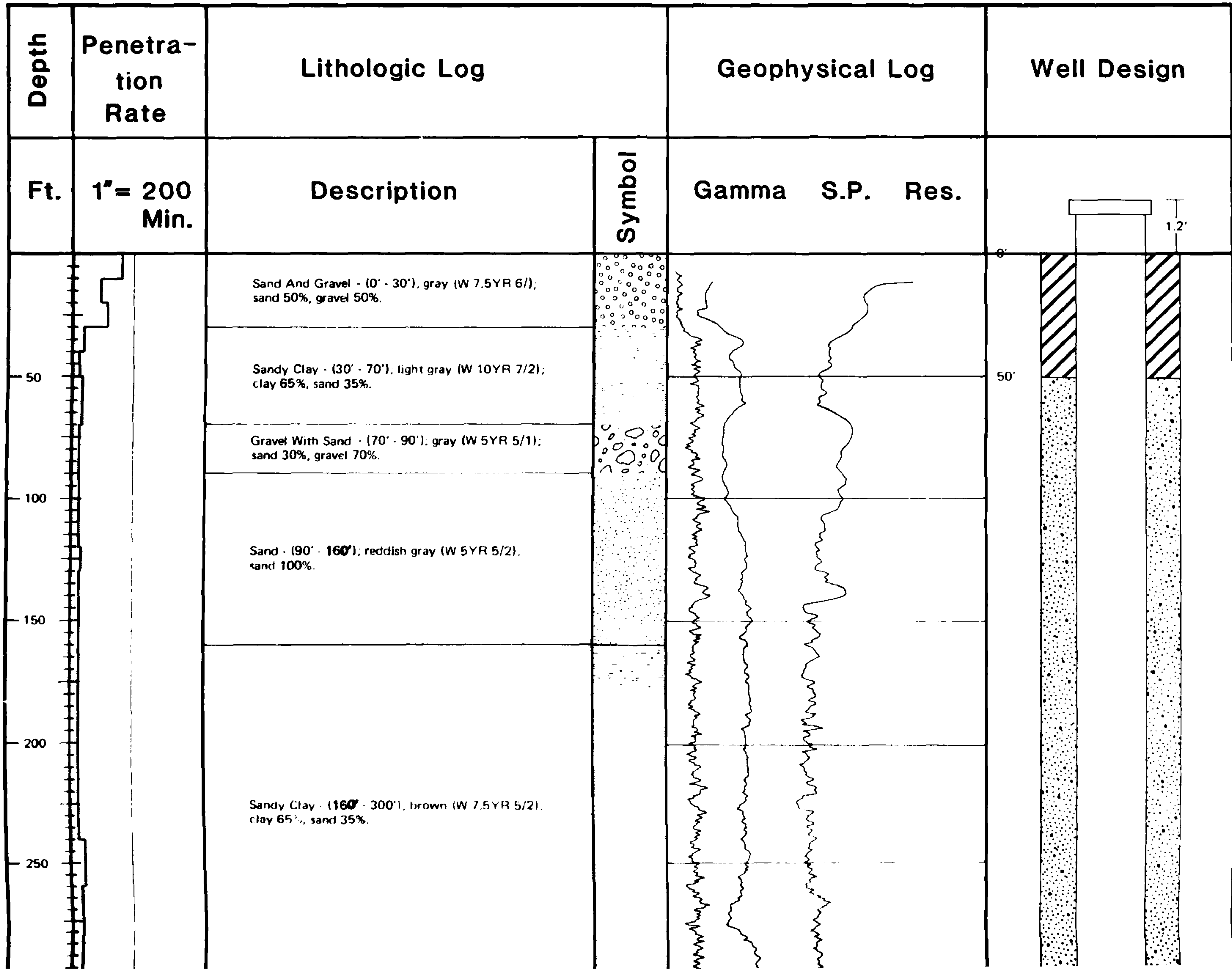
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

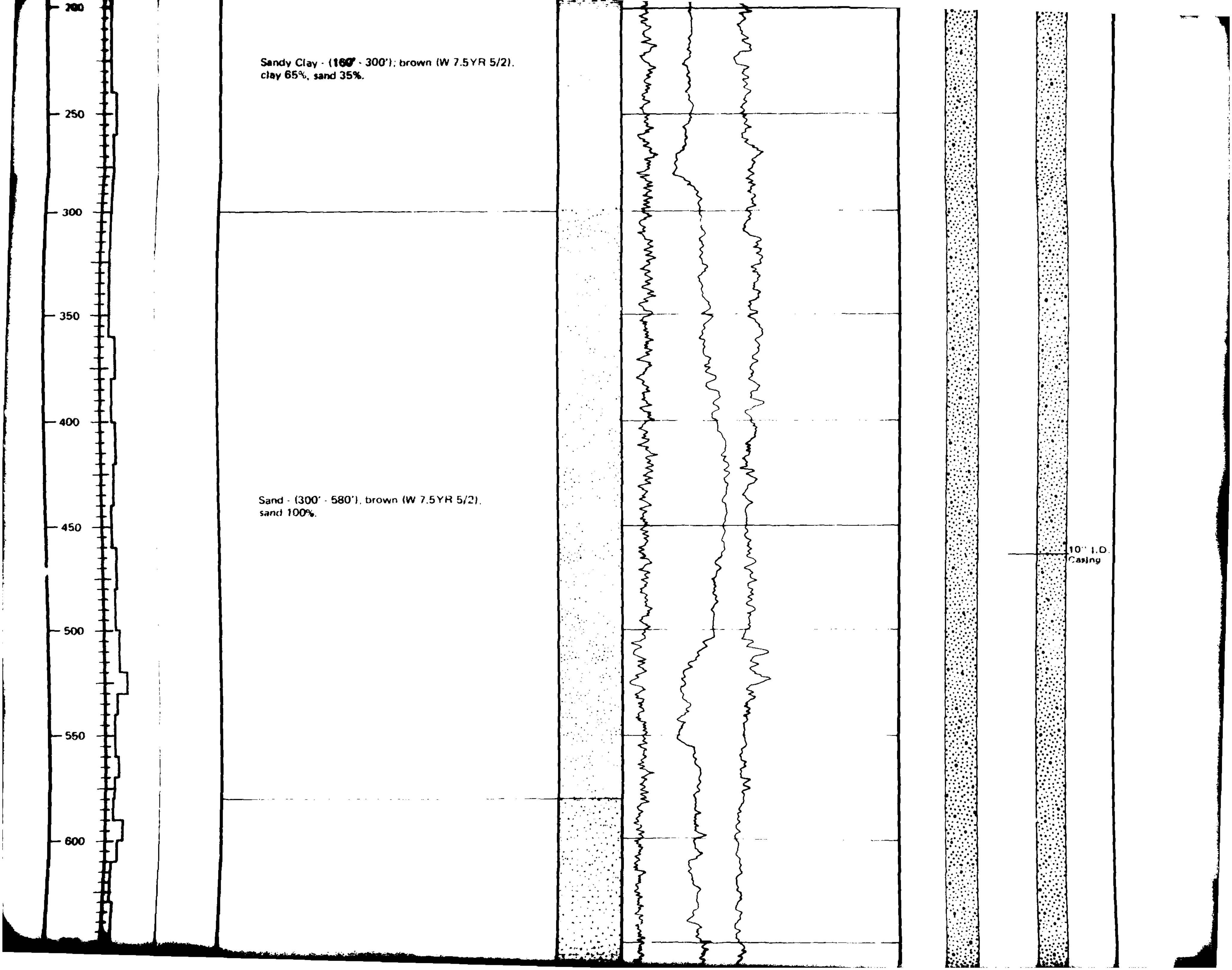
LITHOLOGIC LOG AND WELL COMPLETION SUMMARY–COYOTE SPRING VALLEY–FILL OBSERVATION WELL

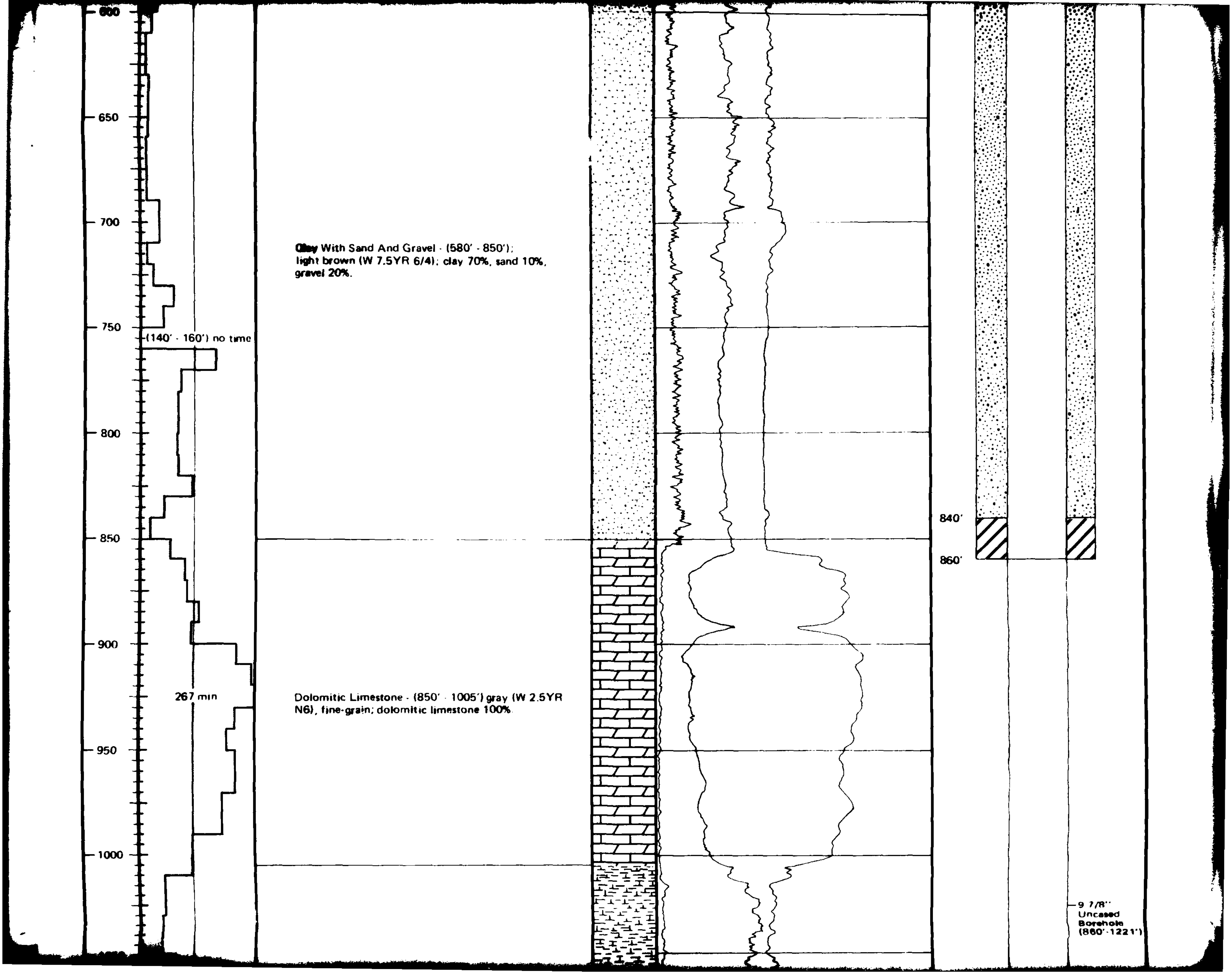
28 MAY 81

FIGURE E-1

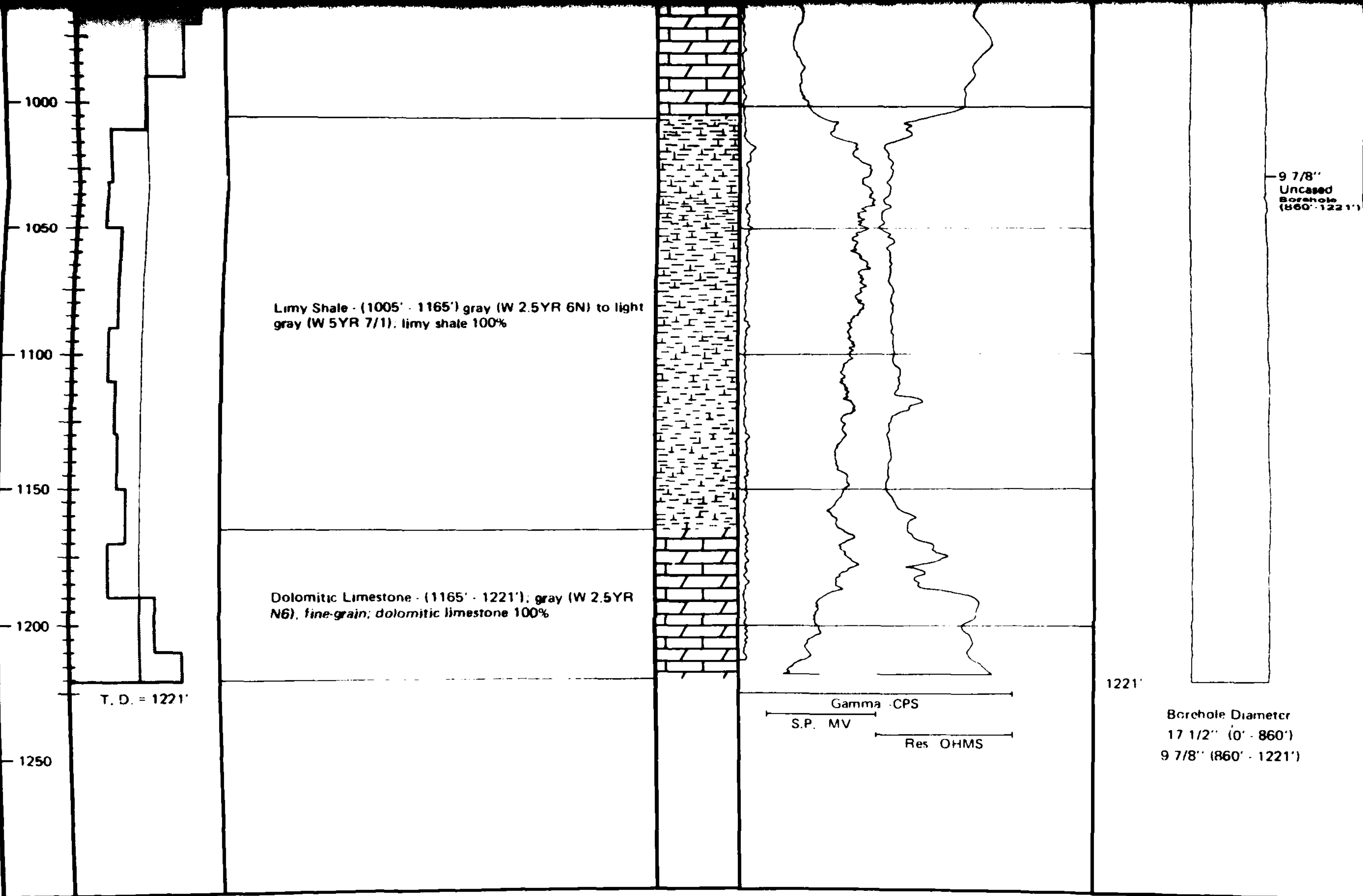
COYOTE SPRING VALLEY TEST WELL 12S/63E 29db 2




200
250
300
350
400
450
500
550
600
Sandy Clay - (160' - 300'); brown (W 7.5YR 5/2).
clay 65%, sand 35%.
Sand - (300' - 580'), brown (W 7.5YR 5/2).
sand 100%.
10" I.D.
Casing



600
650
700
750
800
850
900
950
1000
(140' - 160') no time
267 min
Clay With Sand And Gravel - (580' - 850'); light brown (W 7.5YR 6/4); clay 70%, sand 10%, gravel 20%.
Dolomitic Limestone - (850' - 1005') gray (W 2.5YR N6), fine-grain; dolomitic limestone 100%.
840'
860'
9 7/8'' Uncased Borehole (860'-1221')



LITHOLOGIC SYMBOLS

Clay With Gravel
Clay Silt With Gravel
Silt With Gravel
Silty Clay With Gravel
(May also include the modifier: and gravel)

Sandy Clay
Silty Clay
Sandy Silty Clay
Sandy Silt
Sandy Clay Silt
(May also include modifiers of: with some gravel, and **with very little gravel**).

WELL DESIGN

Cement

Non Graded Gravel Pack

T. D. = 1221'

1250

Gamma–CPS

S.P.–MV

Res–OHMS

Borehole Diameter
17 1/2" (0' - 860')
9 7/8" (860' - 1221')

LITHOLOGIC SYMBOLS

Clay With Gravel
Clay Silt With Gravel
Silt With Gravel
Silty Clay With Gravel
(May also include the modifier: and gravel)

Sandy Clay
Silty Clay
Sandy Silty Clay
Sandy Silt
Sandy Clay Silt
(May also include modifiers of: with some gravel, and with very little gravel).

Sand
Silty Sand
(May also include modifiers of: with some gravel and with very little gravel).

Sand With Gravel
Silt And Sand With Gravel
Silty Sand With Gravel
(May also include the modifier: and gravel).

Gravel With Sand
Gravel With Clay Sand
Gravel With Silty Clay Sand
Gravel With Silty Sand
Gravel With Clay And Sand
Gravel With Silt And Sand
(May also include modifiers of, with some and with very little).

Dolomitic Limestone

Limy Shale

WELL DESIGN

Cement

Non Graded Gravel Pack

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

LITHOLOGIC LOG AND WELL COMPLETION SUMMARY–COYOTE SPRING VALLEY–FILL TEST WELL

28 MAY 81

FIGURE E-2

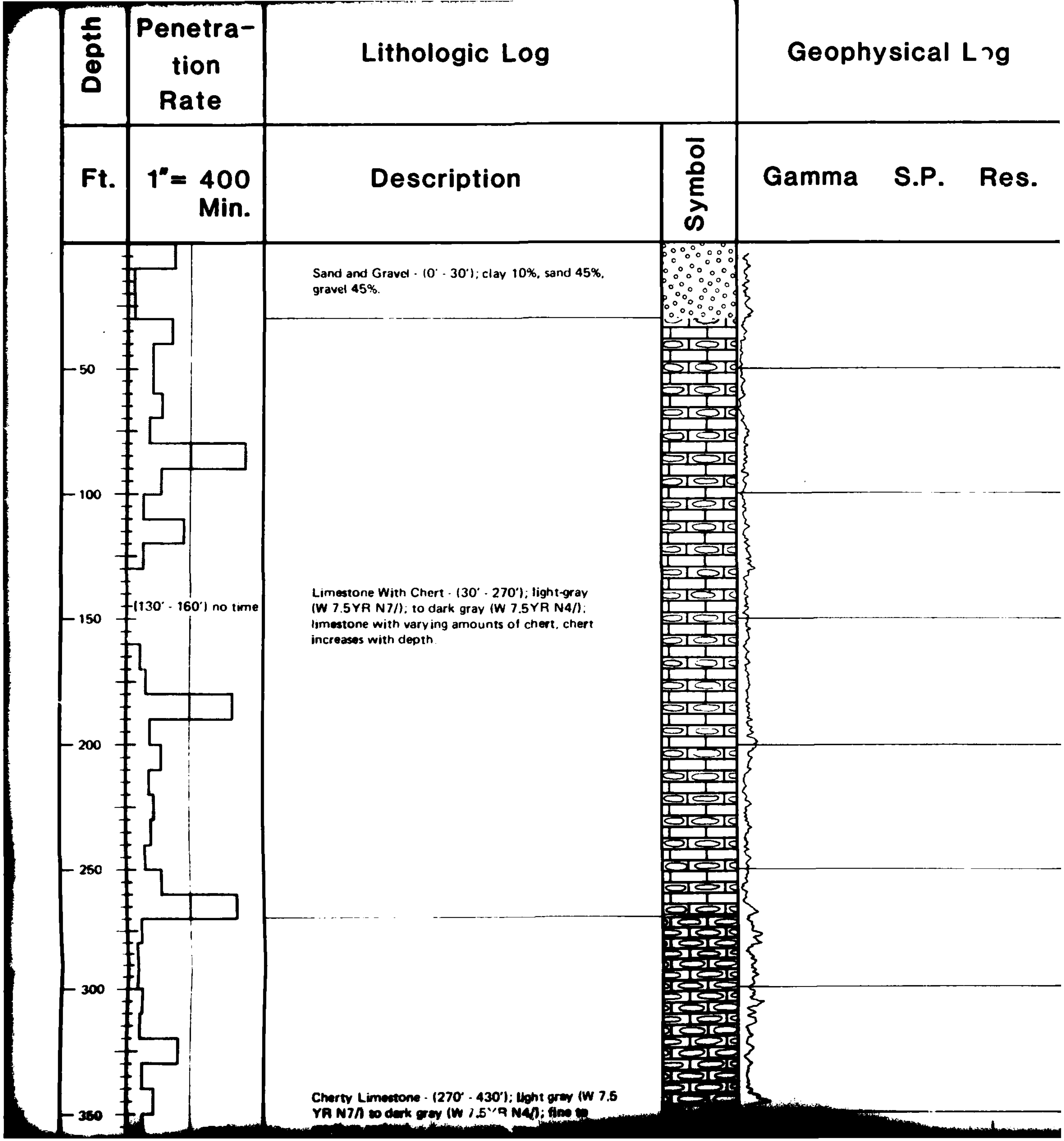
feet (204 m) because of loss of circulation in the well. Lithologic units penetrated, geophysical logs, and well completion are shown in Figure E-3.

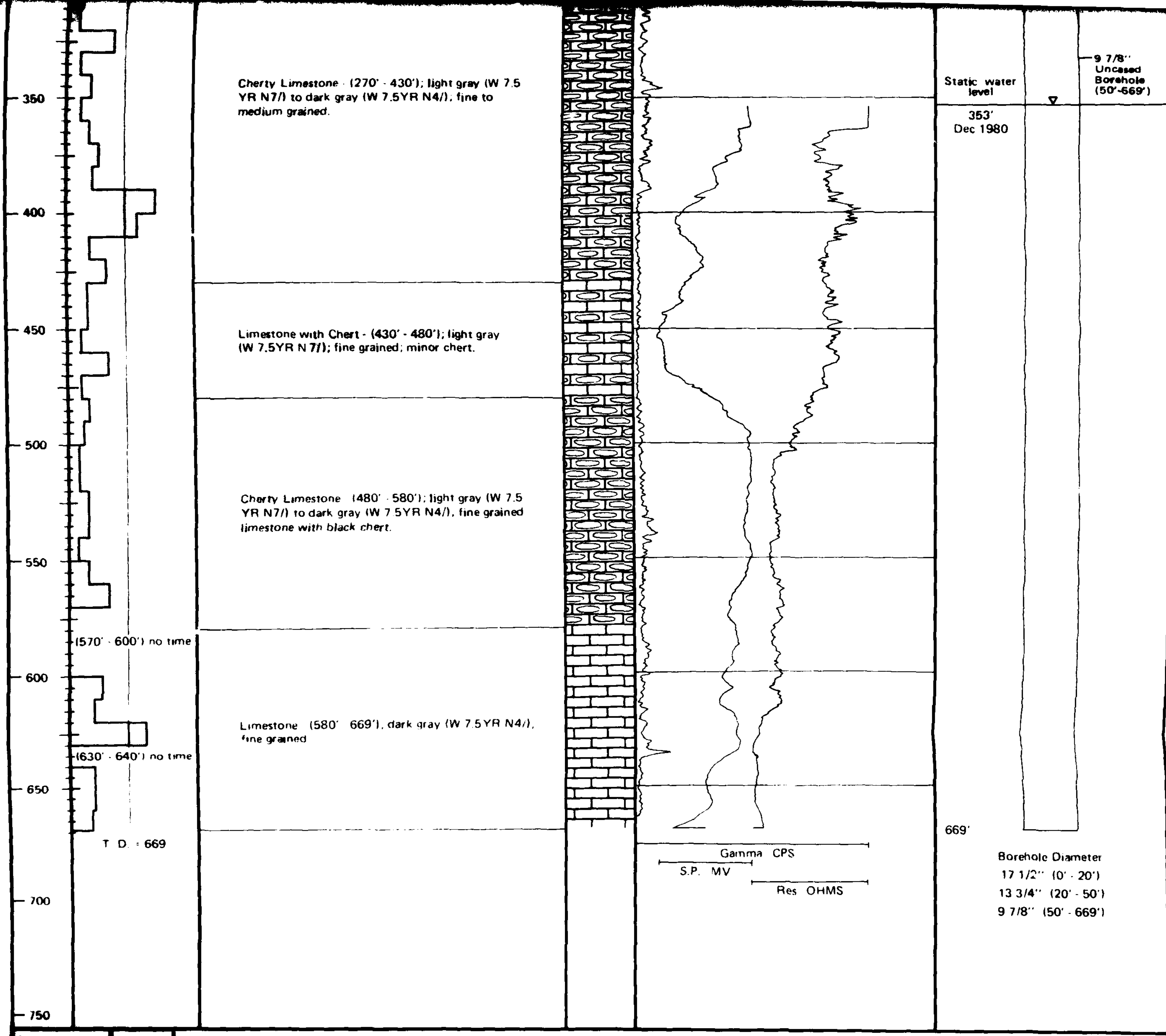
<u>Aquifer Testing</u>

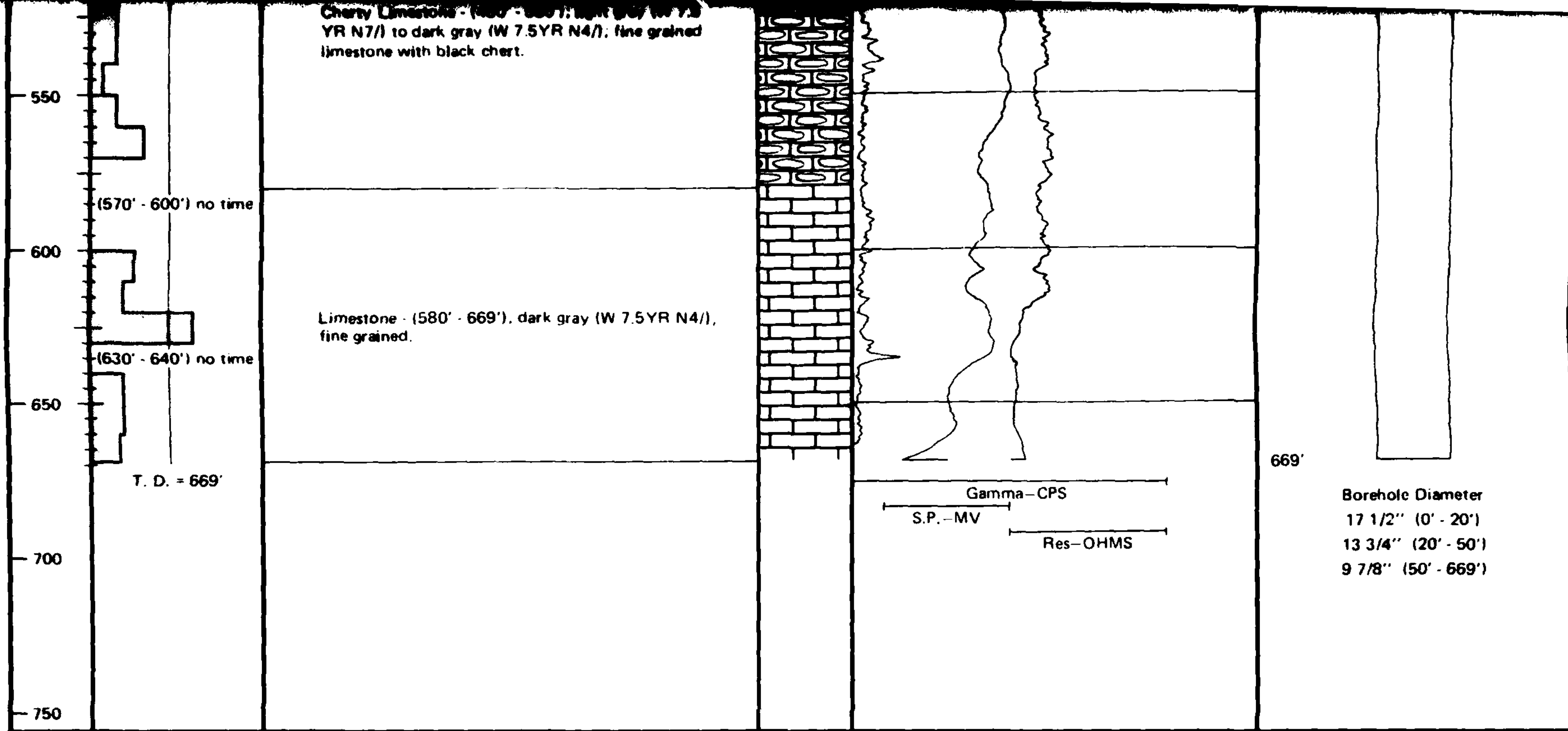
Slug tests to determine the hydraulic characteristics of the valley-fill material were conducted in December 1980 in the first observation well. The tests were conducted for a total of 365 minutes. Maximum decline in water level in the well after 365 minutes was 161.3 feet (49.2 m) in the shallow piezometer and 158.3 feet (48.2 m) in the deep piezometer. Data recorded during the test are listed in Tables E-1 and E-2. Static water level in the piezometers was 545 feet (166 m) below ground surface.

Permeability and transmissivity calculated from the slug tests were 1.3 ft/day (0.4 m/day) and 120 ft^2/d (11.1 m^2/d), respectively. The low permeability and transmissivity are probably related to the predominantly fine-grained sediments that comprise the valley-fill materials at the drilling site.

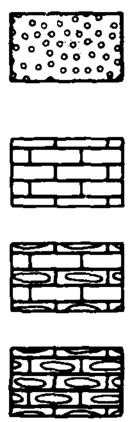
Aquifer testing was conducted at the carbonate well in December 1980. Testing consisted of two stages. The first consisted of a step drawdown test which allowed for initial evaluation of the aquifer and well yield capabilities. The second stage consisted of a constant discharge test. This test provided an analysis of the aquifer characteristics and allowed the monitoring of nearby wells and springs to measure the effect of withdrawals (see Figure E-4).


Depth
Penetration Rate
Lithologic Log
Geophysical Log
Ft.
1" = 400 Min.
Description
Symbol
Gamma
S.P.
Res.
50
100
150
200
250
300
350
(130' - 160') no time
Sand and Gravel - (0' - 30'); clay 10%, sand 45%, gravel 45%.
Limestone With Chert - (30' - 270'); light-gray (W 7.5YR N7/); to dark gray (W 7.5YR N4/); limestone with varying amounts of chert, chert increases with depth.
Cherty Limestone - (270' - 430'); light gray (W 7.5 YR N7/) to dark gray (W 7.5YR N4/); fine to


350
400
450
500
550
600
650
700
750
(570' - 600') no time
(630' - 640') no time
T. D. = 669
Cherty Limestone - (270' - 430'); light gray (W 7.5 YR N7/) to dark gray (W 7.5YR N4/); fine to medium grained.
Limestone with Chert - (430' - 480'); light gray (W 7.5YR N 7/); fine grained; minor chert.
Cherty Limestone (480' - 580'); light gray (W 7.5 YR N7/) to dark gray (W 7.5YR N4/), fine grained limestone with black chert.
Limestone (580' - 669'), dark gray (W 7.5YR N4/), fine grained
Gamma CPS
S.P. MV
Res OHMS
Static water level
353'
Dec 1980
669'
9 7/8'' Uncased Borehole (50'-669')
Borehole Diameter
17 1/2'' (0' - 20')
13 3/4'' (20' - 50')
9 7/8'' (50' - 669')



LITHOLOGIC SYMBOLS



WELL DESIGN

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

LITHOLOGIC LOG AND WELL COMPLETION SUMMARY–COYOTE SPRING CARBONATE TEST WELL

28 MAY 81

FIGURE 8-3

SHALLOW PIEZOMETER		DEEP PIEZOMETER	
Time (min.)	Depth (ft.)	Time (min.)	Depth (ft.)
0	0	0	0
2	11.95	4	7.55
7	19.25	9	14.77
11	25.68	13	20.70
15	33.75	20	29.86
25	44.30	30	31.95
35	55.02	40	57.13
45	63.25	50	66.40
55	72.15	60	74.15
65	77.96	—	—
75	83.85	75	79.15
105	97.43	105	97.88
135	108.30	135	108.74
165	118.25	165	117.96
195	129.50	195	127.23
225	134.65	225	133.43
255	139.50	255	138.70
315	149.95	315	149.90
335	154.56	335	154.60
365	161.35	365	158.30

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

COYOTE SPRING VALLEY – FILL
OBSERVATION WELL 12S/63E-29db1
SLUG PERMEABILITY TEST RECORDS

28 MAY 81

TABLE E-1

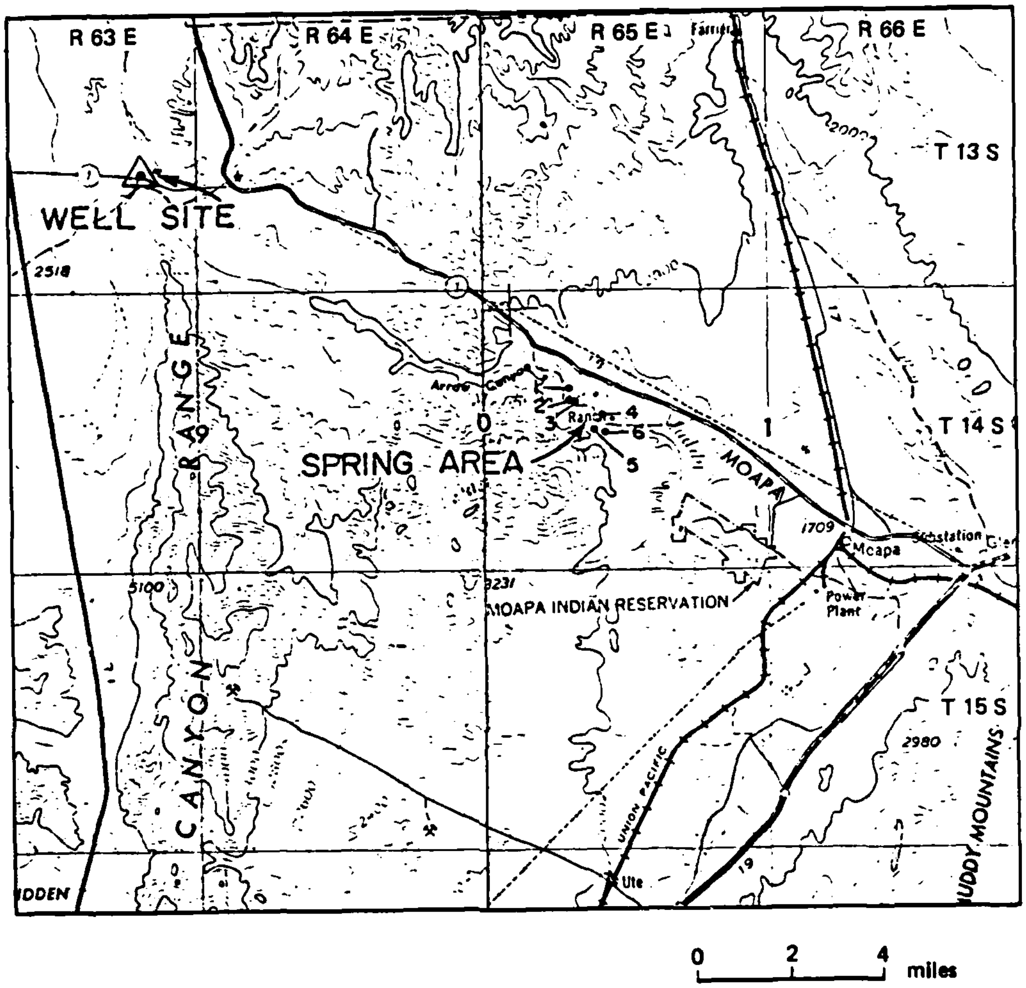
PIEZOMETER	DIAMETER BOREHOLE - in	DIAMETER CASING - in	LENGTH OF SLOTTED INTERVAL ft	TIME OF TEST (min)	ORIGINAL HEAD ft	ELEVATION OF FINAL HEAD ft	PERMEABILITY ft/day	TRANS-MISSIVITY ft^2/day
SHALLOW	8 - 3/4	2	90	365	2470	2308.7	1.28	114
DEEP	8 - 3/4	2	94	365	2470	2311.7	1.30	122

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

COYOTE SPRING VALLEY
SLUG PERMEABILITY TEST RESULTS
WELL 12S/63E-29db1

28 MAY 81 TABLE E-2



LEGEND

Ertec Carbonate Boring	Well Location
•—2	Spring Location

NORTH

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

LOCATION MAP, CARBONATE WELL AND OFFSITE SPRINGS, COYOTE SPRING VALLEY

28 MAY 81

FIGURE E-4

Step-drawdown testing was performed in mid-December 1980. The test consisted of three separate discharge rates of 70 minutes each. Discharge ranged from 151 to 595 gpm (10.5 to 38 l/s). Data recorded during the test are listed in Table E-3, and graphically presented in Figure E-5. The discharge rates, durations, drawdowns, and specific capacities are listed below:

Step-Drawdown Summary

Discharge Rate (gpm)	Duration (min.)	Drawdown (feet)	Specific Capacity (gpm/ft dd)
151	70	0.7	216
359	70	1.6	224
595	70	4.2	142

Specific capacities were high, indicating high potential yield. At the beginning of the test, depth to water was 352.8 feet (107.5 m) below land surface. Temperature was warm (34°C), indicating possible deep regional circulation of the water.

The constant discharge test was started after 24 hours of recovery from the step-drawdown test and continued for 77 hours. At the start of the constant discharge test, water level was 352.8 feet (107.5 m) below land surface. Discharge rate during the test was approximately 538 gpm (34 l/s) but ranged from 517 to 567 gpm (33 to 36 l/s).

Temperatures were measured throughout the tests and held steady at 93°F (34°C). The maximum drawdown during the test was 3.7 feet (1.1 m) and occurred during an inadvertent momentary pumping surge 140 minutes into the test. At the end of the

Date	Time	Depth to Water below Reference Point feet	Discharge, gpm	Remarks
12/19	0810	352.85		Static water level pumping started Step No. 1
	0812	353.45		
	0814	353.53	151	
	0816	353.53		
	0818	353.55		
	0820	353.53		
	0825	353.50		
	0830	353.61		
	0835	353.60		
	0840	353.58		
	0845	353.59		
	0850	353.59		
	0900	353.57		
	0910	353.57		
	0920	353.57		Pumping increased Step No. 2
	0922	354.80		
	0924	354.57		
	0926	354.54	365	
	0928	354.54		
	0930	354.53	359	
	0935	354.55		
	0940	354.53		
	0945	354.52		
	0950	354.50		
	0955	354.51		
	1000	354.46		
	1010	354.50		
	1020	354.44	354	
	1030	354.43		Pumping increased Step No. 3
	1032	357.10		
	1034	357.06		
	1036	357.10		
	1038	357.08		
	1040	357.10	595	
	1045	357.08		
	1050	357.12		
	1055	357.08		
	1100	357.16		
	1105	357.07		
	1110	357.08		
	1120	357.15		
	1130	375.12		
	1140	357.05		Pumping stopped
12/20	0745	352.86		Static water level pumping started constant discharge test
	0755	352.85		
	0800	352.85		
	0801	355.88		
	0802	356.13	525	
	0803	356.20		
	0804	356.13	517	
	0805	356.11		
	0806	356.19	525	
	0807	356.10	517	
	0808	356.10		
	0809	356.11		
	0810	356.10		
	0812	356.15	532	
	0814	356.47		
	0816	356.20		
	0818	356.22		
	0820	356.19		
	0825	356.30	540	
	0830	356.30		

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

AQUIFER TEST DATA, CARBONATE WELL
COYOTE SPRING VALLEY, 13S/63E-23dd
PAGE 1 OF 2

28 MAY 81 TABLE E-3

Date	Time	Depth to Water below Reference Point feet	Discharge, gpm	Remarks
12/20	0835	356.26		
	0840	356.16	540	
	0845	356.19		
	0850	356.19		
	0855	356.14		
	0900	356.22		
	0910	356.19		
	0920	356.42		
	0930	356.21		
	0940	356.13	538	
	0950	356.22		
	1000	356.21	536	
	1020	356.61	567	
	1040	356.23	538	
	1100	356.21	536	
	1130	356.19		
	1200	356.18	540	
	1230	356.25		
	1300	356.21		
	1400	356.20	538	
	1500	356.18		
	1600	356.24	540	
	1705	356.19		
	1800	356.29		
	2000	356.30		
	2201	356.39		
12/21	0000	356.42		
	0200	356.42		
	0400	356.36	538	
	0800	356.29	536	
	1200	356.25	538	
	1600	356.32	540	
	2000	356.37	538	
12/22	0000	356.49	540	
	0800	356.32	538	
	1400	356.25	539	
	2002	356.33	538	
12/23	0200	356.46	540	
	0800	356.36	536	
	1300	356.18	539	Pumping stopped Recovery measurements started
	1301	352.55		
	1301.5	352.82		
	1302	352.85		
	1302.5	352.88		
	1303.25	352.88		
	1304	352.87		
	1305	352.86		
	1306	352.90		
	1307	352.87		
	1308	352.86		
	1309	352.83		
	1310	352.83		
	1315	352.83		
	1320	352.83		
	1325	352.83		
	1330	352.87		
	1335	352.81		
	1340	352.80		
	1405	352.87		
	1431	352.80		
	1500	352.80		
	1530	352.83		
	1600	352.81		
	1630	352.81		

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

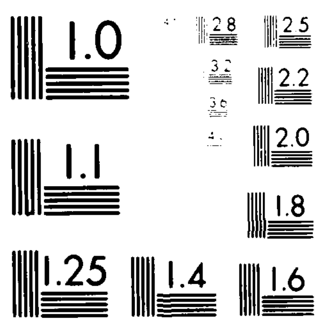
AQUIFER TEST DATA, CARBONATE WELL
COYOTE SPRING VALLEY, 13S/63E-23dd
PAGE 2 OF 2

28 MAY 81 TABLE E-3

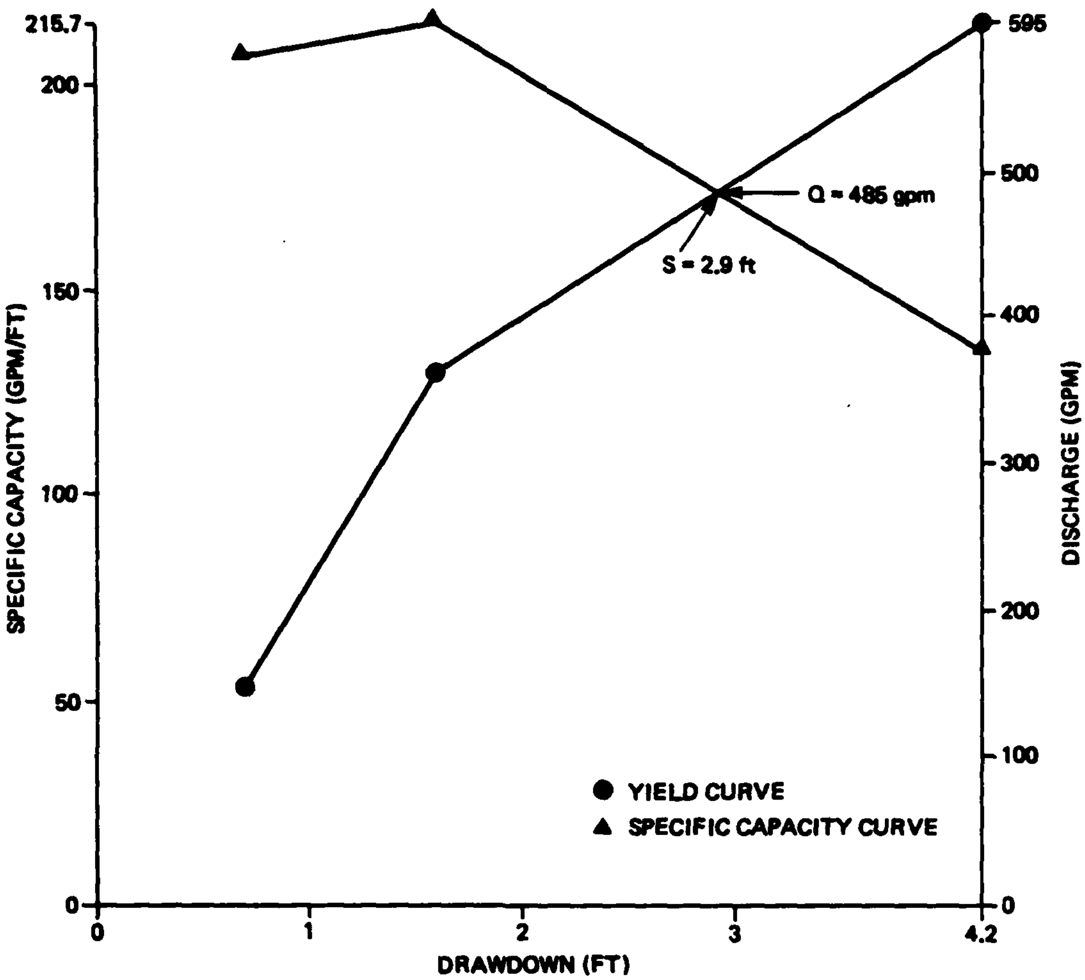
AD-A113 220 ERTEC WESTERN INC LONG BEACH CA F/G 8/8
MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME I. COY--ETC(U)
MAY 81 F04704-80-C-0006
UNCLASSIFIED E-TR-51-I NL

2 OF 2
AD A
113220

END
DATE
FILMED
04-82
DTIC



MICROCOPY RESOLUTION TEST CHART



S - Drawdown in feet
Q - Discharge in gallons per minute

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

SPECIFIC CAPACITY AND YIELD
CARBONATE AQUIFER TEST

28 MAY 81 FIGURE E-6

test, the drawdown was 3.3 feet (1.0 m). At the termination of the constant discharge test, the water level in the test well rebounded to static level within two minutes. The water level and discharge data are listed in Table E-3.

During the test, six springs in the Muddy River Springs area were monitored for temperature, conductivity, and discharge. The locations of the springs are shown on the map in Figure E-4 and the measurements listed in Table E-4. The flows at the spring did not show any effects of pumping. This, however, is an inconclusive result given the distance between the springs and the well and the magnitude and duration of the aquifer test.

For cavernous limestone aquifers, hydraulic coefficients calculated by methods devised basically for homogeneous porous media must be applied with caution. Nevertheless, aquifer tests in limestone aquifers do yield drawdown responses similar to porous media, and the results can provide an estimated transmissivity for a particular location. However, at this site, the aquifer was not stressed sufficiently during pumping to enable such an analysis. The specific capacity data indicate that the estimated transmissivity might be on the order of 40,000 ft^2/d (3717 m^2/d) on the basis that transmissivity can often be approximated as 2000 times specific capacity.

The well could not be pumped at more than 1000 gpm (63 l/s) because of the relatively small diameter of the well and consequent pump size restriction. For an adequate test, a well and

Location (Figure E-4)	Date	Time	Temperature (°C)	(°F)	Electrical Conductivity (µmhos/cm) at 25°C
#1	12/19/80	1400	31	88	970
#2	12/19/80	1435	29	84	900
#3	12/19/80	1450	31	87	900
#4	12/19/80	1530	30	86	920
#5	12/19/80	1600	30	86	1000
#6	12/19/80	1625	30	86	940
#1	12/22/80	1007	31	88	960
#2	12/22/80	1015	29	84	900
#3	12/22/80	1025	31	87	880
#4	12/22/80	1035	30	86	910
#6	12/22/80	1045	30	85	910

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

OFFSITE WATER QUALITY
MEASUREMENTS, SPRINGS

28 MAY 81

TABLE E-4

pump should be designed to yield in excess of 2000 gpm (126 l/s). This is being implemented in the work that is presently being conducted by Ertec in Coyote Spring Valley.

Water Quality

Water samples were collected during the step test and during the constant discharge test and analyzed in the field for temperature, pH, electrical conductance, and alkalinity. These samples were collected at the end of each of the three steps and at 12-hour intervals during the constant discharge test. The following is a summary of the field water quality data collected from the carbonate well during testing.

Ec 710 - 770 μmhos/cm
pH 7.7 - 8.0
Alkalinity 252 - 260 mg/l
Temperatue 34°C

Results of laboratory testing are listed in Appendix D.

APPENDIX F

WATER RIGHTS

APPENDIX F

Source: Underground

Basin: Coyote Spring

Owner of Record	Date Priority	Point of Diversion	Water Right Acre - ft/yr	Place of Use
Desert Paradise, Inc.	7/28/77	10S/62E-25db	159.26	10S/62E 25, 36
Doris Conger	8/08/77	13S/63E-23ab	800	13S/63E 23
Ernest R. Conger	8/08/77	13S/63E-23aa	800	13S/63E 23, 24
Malcom Lee Lewis	8/08/77	13S/63E-11dc	800	13S/63E 11, 14
Lois Lewis	8/08/77	13S/63E-14ca	800	13S/63E 14
Clarvid A. Lewis	8/08/77	13S/63E-14cb	800	13S/63E 14
Barbara Lewis	8/08/77	13S/63E-14ba	800	13S/63E 14
Herman Britz	9/18/77	13S/63E-23ac	100	13S/63E 23
David Paul Fuller	10/25/77	13S/63E-26aa	100	13S/63E 26
Leonie M. Fuller	10/25/77	13S/63E-26da	100	13S/63E 26
Vera L. Holton	10/25/77	13S/63E-23dd	100	13S/63E 23
Rita T. Chabafy	11/7/77	13S/63E-8ca	100	13S/63E 8
Hubert S. Szanto	11/7/77	13S/63E-17b	100	13S/63E 17
Chabafy	11/7/77	13S/63E-8c	100	13S/63E 8
Parker	11/7/77	13S/63E-17a	100	13S/63E 17
Melvin R. Lallement	3/20/78	13S/63E-8aa	100	13S/63E 8
Margaret B. Hopper	3/20/78	13S/63E-5cd	100	13S/63E 5
Grace M. Lallement	3/20/78	13S/63E-5dc	100	13S/63E 5
Graciabel H. Lallement	3/20/78	13S/63E-8ba	100	13S/63E 8
Milton S. Earl	3/26/79	13S/63E-11da	1600	13S/63E 11, 14
Dan Earl	3/26/79	11S/62E-24da	1600	11S/62E 24, 25
Larna Earl	3/26/79	11S/62E-13ab	1600	11S/62E 11, 24
Kenneth Joseph	3/26/79	13S/63E-23da	1500	13S/63E 23, 24, 25
Maria Leavitt	3/27/79	11S/62E-25da	1600	11S/63E 31, 30 11S/62E 25, 30
Max V. Leavitt	3/28/79	11S/63E-7cb	1600	11S/62E 12 11S/63E 7
Kathy S. Leavitt	7/16/79	13S/63E-2ca	1600	13S/63E 2, 11
Earl Leavitt	7/16/79	13S/63E-23ab	800	13S/63E 23
Earl Leavitt	1/08/80	13S/63E-14ab	800	13S/63E 14

Source: Nevada State Engineer – Division of Water Resources, 1980

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

COYOTE SPRING VALLEY
GROUND – WATER
PERMITS AND PENDING APPLICATIONS

28 MAY 81 TABLE F-1

APPENDIX F

Source: Surface Water

Basin: Coyote Spring

Owner of Record	Date Priority	Point of Diversion	Water Right Acre - ft/yr	Place of Use	Remarks
Rachael Schlarman / Rachael Ballow	3/08/15	11S/63E-24db	8.98	Same	Granger Sp
W. S. Lamb	11/11/16	11S/61E-12ac	18.10	Same	Elderberry Sp
Hiko Land and Cattle Co.	3/05/20	N/A	2.17	Same	Pony Sp
Buckhorn Cattle Co.	3/18/40	10S/62E-11dc	5.0	Same	Evergreen Ch
USA	7/26/46	11S/61E-35da	0.72	Same	Lamb Sp
USA	7/26/46	14S/61E-29da	0.72	Same	Perkins Sp
USA	9/13/48	13S/61E-1ad	2.39	Same	Grapevine Sp
USA	11/1/60	14S/61E-30dd	0.12	Same	Sawmill SP
USA	3/31/61	15S/62E-7da	0.07	Same	Wamp Sp
USA	3/31/61	15S/61E-12ca	0.29	Same	Mormon Wells
John W. Richard	N/A	11S/63E-13db	3.36	Same	Coyote Sp

Source: Nevada State Engineer — Division of Water Resources, 1980.

N/A - not available

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

COYOTE SPRING VALLEY
SURFACE—WATER RIGHTS

29 MAY 81

TABLE F-2

DATE
FILMED

4-8