NUREG/CR-5107

Hydrogeologic Characterization of Basalts

The Northern Rim of the Columbia Plateau Physiographic Province and of the Creston Study Area, Eastern Washington

Prepared by T.D. Steele, J.A. Paschis, R.A. Koenig

In-Situ, Inc.

Prepared for
U.S. Nuclear Regulatory
Commission

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ABSTRACT

This report provides a general but comprehensive characterization of hydrogeologic and hydrogeochemical baseline conditions for the Creston area located along the northern rim of the Columbia Plateau physiographic province. Historical as well as recent data and other available information from previous studies and alternative sources have been considered in this baseline hydrological characterization. These include data and information on water levels, aquifer characteristics, and water quality for shallow basalt units comprising the Wanapum Formation and the Grande Ronde Formation in the Creston study area and for the general region surrounding this study area. The overall goal of this hydrologic characterization was to provide useful information leading to the selection of the Roza Member of the Wanapum Formation as the study's basalt horizon and for other related, subsequent study components of In-Situ's research project.

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This report was prepared by In-Situ Inc. on behalf of the U.S. Nuclear Regulatory Commission (NRC) under contract NRC-04-85-114. The report was prepared by T. D. Steele, J. A. Paschis, and R. A. Koenig, with assistance from S. C. Way, J. E. Benedik, Jr., and J. M. Reverand. Dr. Way was originally designated as In-Situ's Project Manager. Dr. Steele, Water Resources Manager and Associate with In-Situ Inc., has served as Project Manager of the study since May 1986. Dr. D. L. Chery, Jr., served as Project Manager for the NRC through June 1987, and Mr. T. J. McCartin is the current NRC Project Manager.

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EXECUTIVE SUMMARY

The purpose of contract NRC-04-85-114 is to assist the Waste Management Branch of the U.S. Nuclear Regulatory Commission (NRC) in preparing site-review guidelines for planned repositories of high-level radioactive waste in saturated fractured geologic media. This report provides a general characterization of hydrogeologic and hydrogeochemical baseline conditions for the Creston study area, selected by the NRC for subsequent geologic and aquifer characterizations accomplished through various wellfield testing methods by In-Situ Inc. These results will contribute to a comparative study of models serving to guide investigators considering comparable fractured geologic media, specifically addressing predictive length scales, travel times, and directions of contaminant transport from a proposed hypothetical repository site.

Historical data and information from a variety of sources are available on water levels, aquifer characteristics, and water-quality conditions for shallow basalt units comprising the Wanapum Formation and the Grande Ronde Formation for the Creston study area as well as the general region surrounding this study area. To supplement this baseline hydrologic information, two test NX-size boreholes were drilled and cored through the entire Wanapum Formation and into the upper interval of the Grande Ronde Formation in the study area. These boreholes were geophysically logged, and straddle-packer slug tests were performed at short intervals throughout the depth of the Roza Member of the Wanapum Formation. Based upon historical as well as these recently-collected data, the Roza Member was selected as the study's target horizon. Finally, a research wellfield for basalt-unit testing and for monitoring conditions, primarily in the Roza Member, was designed. These field investigations are to be integrated into other theoretical-aspect study components and computer-modeling analyses included as part of the overall project.

1. INTRODUCTION

1.1 Background

In 1985, In-Situ Inc. was awarded Nuclear Regulatory Commission (NRC) Contract NRC-04-85-114, entitled "Flow of Groundwater and Transport of Contaminants through Saturated Fractured Geologic Media from High-Level Radioactive Waste." The overall contract objective as presented in the Request for Proposal (RFP No. RS-RES-85-114) indicated that the work to be provided to NRC should establish a sound basis, both theoretical and practical, for NRC commitments: (1) to provide pre-licensing guidance to the U.S. Department of Energy (DOE) in technical areas related to hydrogeology, and (2) to evaluate the technical content of DOE's documents leading to licensing decisions about high-level waste (HLW) disposal in a saturated fractured geologic medium.

As a result of recent recommendations by DOE on five candidate sites (three salt, one welded tuff, and one basalt medium), it was concluded by NRC that the proposed work should be conducted on a saturated basalt medium to serve their best interests. In-Situ Inc. had located a basalt test site near the town of Creston, Lincoln County, Washington, which had an existing data base for some hydrogeologic and hydrogeochemical characteristics. Some important features of the selected Creston study area are:

- Representation of Wanapum Formation and Grande Ronde Formation basalts at relatively shallow depths (land surface to 100s of feet below land surface).
- Availability of an existing shallow monitoring-well network for a power-plant siting feasibility study, as well as historical records (water levels, water-quality data, and selected aquifer testing results) for nearby irrigation and water-supply wells.
- An abundance of areal and site-specific hydrogeologic and hydrogeochemical data for the northern part of the Columbia Basalt Plateau.
- Possible existence of discrete hydraulic features, such as a potential fault conduit, and the presence of heterogeneous and anisotropic media at the Creston study site.
- Up to 15 years of water-level monitoring data for several wells in the general study area.

After successful negotiation with the Washington Water Power Company and the State of Washington, the Creston study area was made available to In-Situ Inc. for a project duration of at least five years. As part of the overall study plan, a series of multi-well pumping tests and tracer tests were proposed to study the hydraulic controls (including fracture distribution) of the Roza Member of the Wanapum Formation basalts and

the scaling effect of hydraulic conductivity, dispersion coefficient, and effective porosity. Various methods were examined and used in the data analysis. Also, continuum models are being studied and compared to developed discrete-fracture models. In-Situ is investigating, experimentally and theoretically, methods to calibrate models, depicting the process of fractured-media flow based upon site-specific aquifer characterization studies, including pumping tests, geophysical logging, radiogenic dating, drill-core evaluation, and non-radioactive tracer tests.

1.2 Purpose and Scope

The purpose of this interim report is to provide a general but comprehensive characterization of hydrogeologic and hydrogeochemical conditions for the Creston study area and for the general region along the northern rim of the Columbia Plateau physiographic province. The available literature was found to be extensive. Data from numerous sources were inventoried and are summarized in this report. Only minimal interpretation of the data can be provided at this time (June 1987). Nonetheless, the overall goal of this hydrologic characterization is to provide useful information for other related, subsequent study components outlined in In-Situ's (1985) technical study plan.

This characterization provides the background for site-specific testing of the basalt formations present at the study site. A research wellfield was designed, as described in Chapter 5, to support this field testing. The wellfield design was implemented with modifications, ten wells were drilled as shown in Fig. 5.1, and field testing is under way.

1.3 Study-Area Description

The study area is located about 60 miles west of Spokane, south of U.S. 2 near Creston, Washington (Fig. 1.1). The specific area for potential field study encompassed (1) a land parcel of approximately eight sections owned by the Washington Water Power Company and located between one and five miles south of the town of Creston in Lincoln County, and (2) a state-owned section (Section 16) located about six miles south of Creston and generally southwest of the Washington Water Power Company parcel. The area is generally delineated by Range 34 East (R.34E) and by the lower half of Township 26 North (T.26N) and the upper half of Township 25 North (T.25N) in Lincoln County, Washington (Fig. 1.2). Field investigations completed, in progress, and planned by In-Situ involve primarily the State of Washington section (Section 16) in this specific study area. Adjacent areas within a six- to eight-mile radius have been considered for detailed inventorying of well records, associated water-quality data, and relevant hydrogeologic baseline characterization. Because of the existence and relevance of regional studies dealing with the Columbia Basalt Plateau, aspects of those studies (generally involving the northern part of this region) were evaluated and results selectively summarized for this report. For purposes of inventorying existing well logs in the general area of interest, a region 30 miles in an east-west direction (Ranges 32 through 36 East) by 18 miles in a north-south direction (Townships 24 through 26 North) was considered.

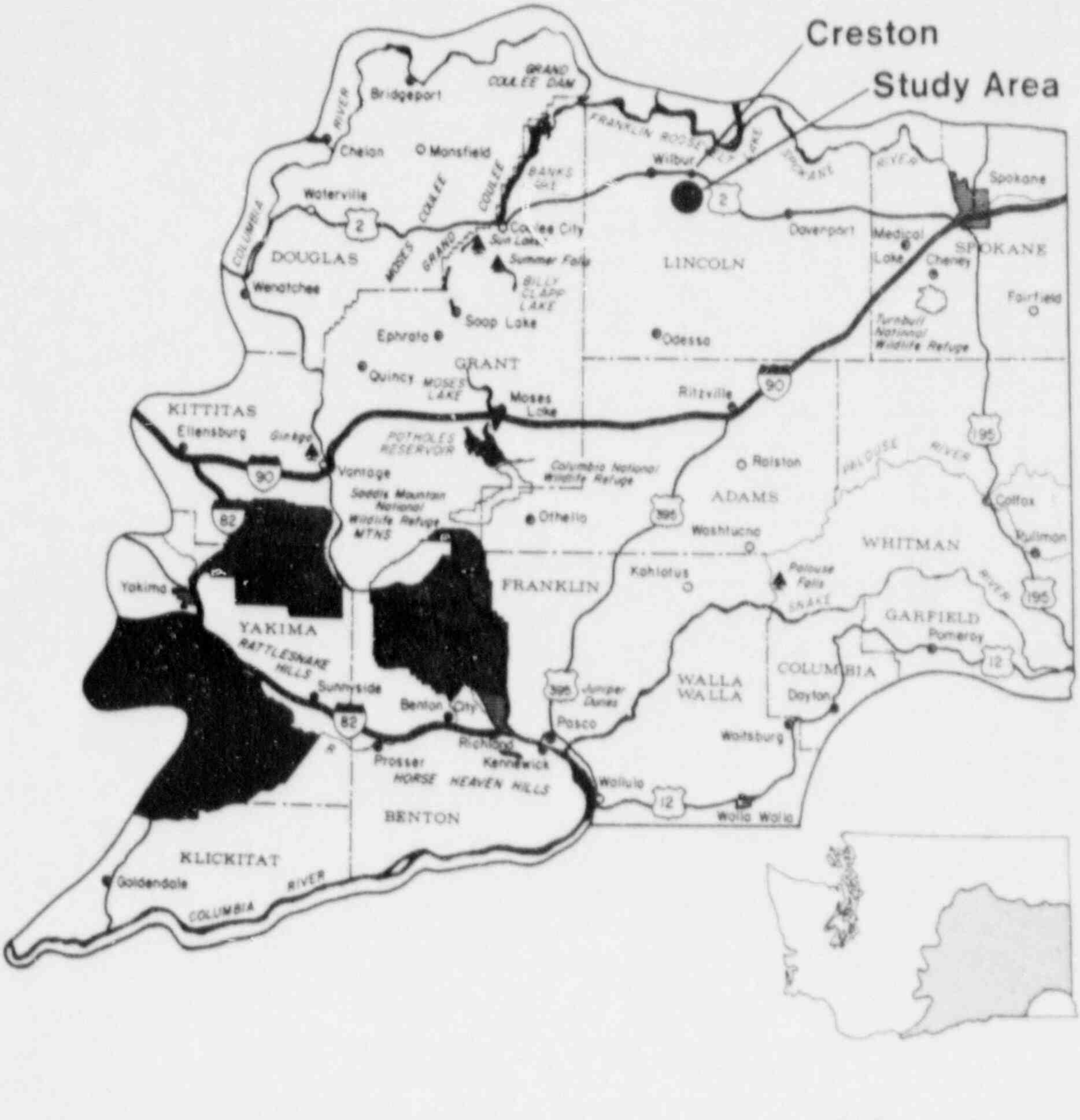


Fig. 1.1. Map showing general location of Creston and the study area, eastern Washington (from John A. Alvin, Between the Mountains, A Portrait of Eastern Washington, Northwest Geographer Series no. 1. Northwest Panorama Publishing Inc. Bozeman, MT, 1984, p. 4; copyright 1984 by John A. Alvin).

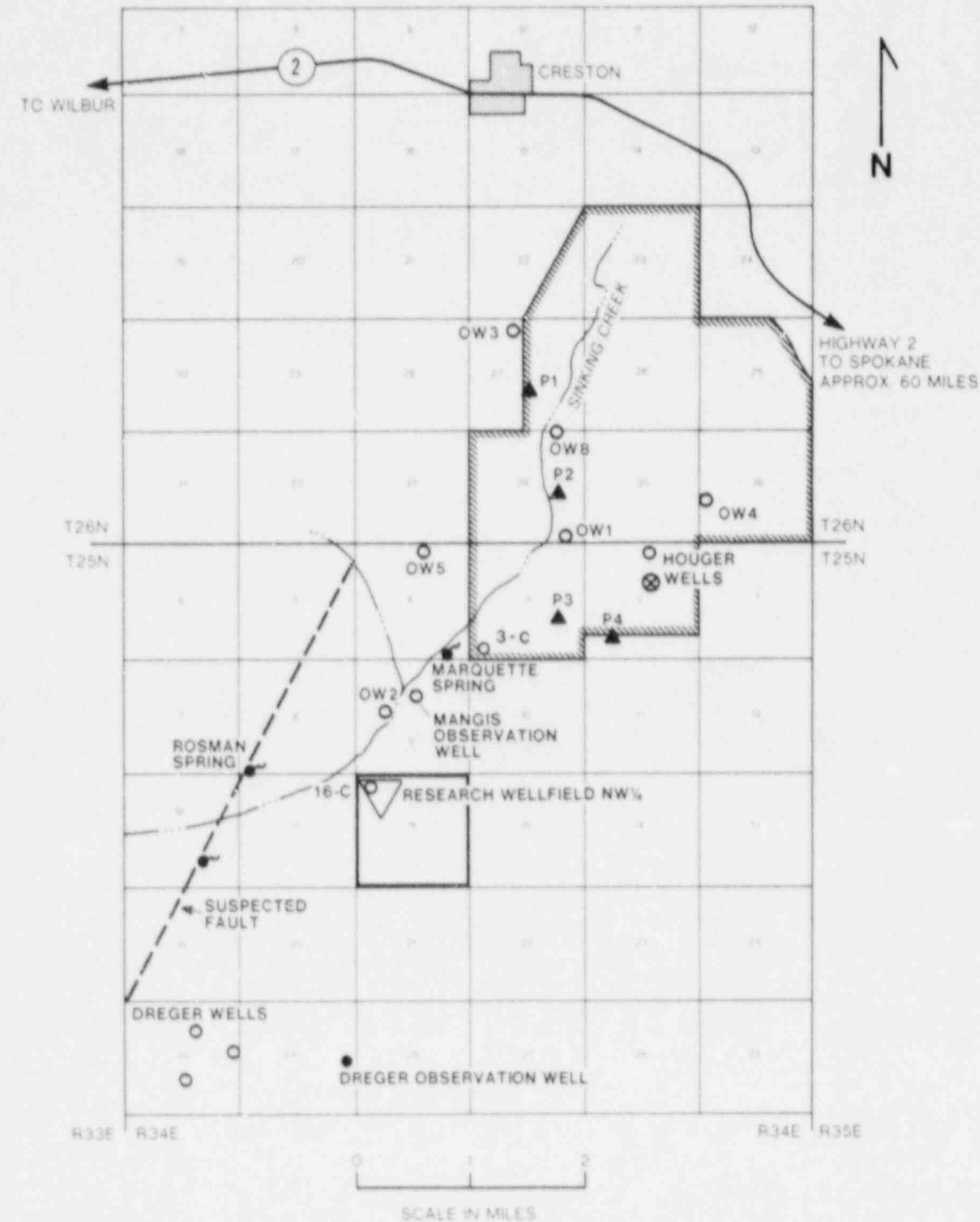


Fig. 1.2. The Creston study area, showing location of the research well-field in the northwest quarter of Section 16 and selected nearby wells.

2. REGIONAL HYDROGEOLOGIC CHARACTERIZATION

Relevant information and data have been compiled from a variety of sources dealing with the following aspects of the general region encompassing the northern part of the Columbia Plateau physiographic province as well as the Creston study area:

- o geology
- o hydrology
- o water quality
- o geophysical logs and drill core
- o isotopic dating of water

The results of a number of reconnaissance surveys of the area and model-interpretive and data studies were available for this characterization. Sources of data and information are identified throughout and in the References; a list of contacts for this characterization is given in Appendix Table A.1. One primary goal of this review of data and information sources was to identify conflicting or inconsistent descriptions and relevant data needed to characterize the hydrologic conditions of the Creston study area and of the general region.

2.1 Areal Studies - An Overview

A number of reference sources in the literature address the aspects of the study area and region that provide a general hydrogeologic and hydrogeochemical characterization. Selected results which contribute to this characterization are discussed in the following sections.

2.1.1 Geologic Studies

Regional geologic studies have documented the structural, tectonic, and stratigraphic history of this region of the Columbia Basalt Plateau. Primary investigations and ongoing studies have been performed by the U.S. Geological Survey (USGS) characterizing the Columbia River Basalt Group formations (Bingham and Grolier, 1966; Grolier and Bingham, 1971; Bauer and others, 1985; Swanson, 1967; Swanson and Wright, 1978a, 1978b; Swanson and others, 1979a, 1979b, 1979c, 1979d; Drost and Whiteman, 1986). State of Washington studies of the geologic area include those of Macklin (1961), Silar (1969), Hooper (1982), Olson (1984), and Wildrick (1985). Other useful references include studies reported by Spencer (1963), Huber (1975), Short and others (1976), and Sheriff (1984).

Geologic History. The Columbia Plateau physiographic province is shown in relation to other western U.S. provinces in Fig. 2.1. Volcanic deposition occurred during much of the Cenozoic Era (beginning 60 million years ago). Basaltic and andesitic eruptions are well documented in the Paleogene Period (beginning 30 million years ago). Deposition was on an

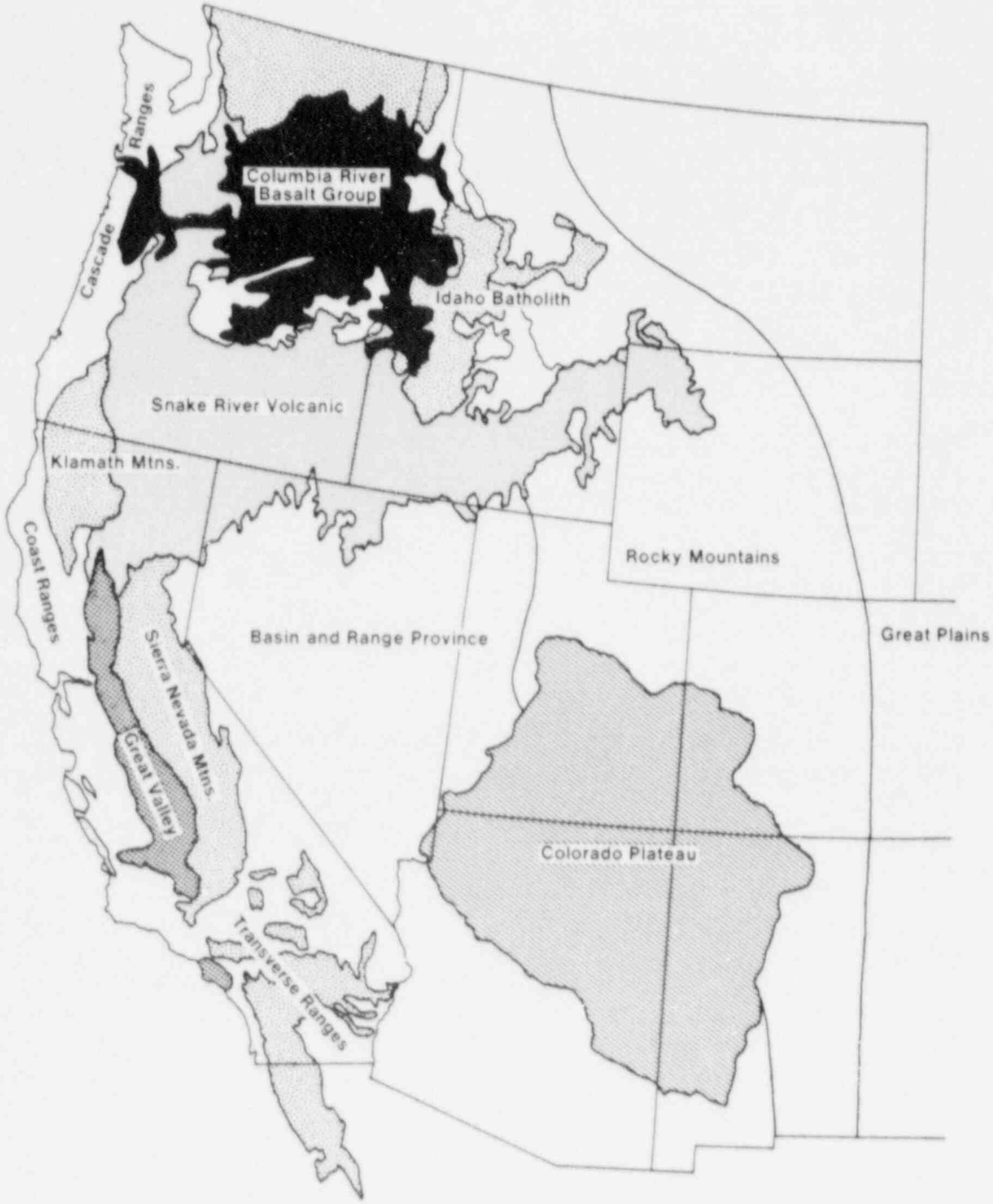


Fig. 2.1. Geologic provinces and terranes of the Western United States, showing the area presently covered by the Columbia River Basalt Group (after Spencer, 1962, and Huber, 1975).

irregular surface of much older crystalline rocks whose pre-basalt relief may have been about 3,000 feet (ft) (Swanson and others, 1979b). The lavas covered about 100,000 square miles (mi^2) of the province with an estimated 35,000 cubic miles (mi^3) of rock (Spencer, 1963), as outlined in Fig. 2.1. Subsequent asymmetric depression of this province was due to tectonic changes rather than lithostatic depression or magma chamber collapse (Swanson and others, 1979b; Hooper, 1982). The numerous basaltic flows aggregate a thickness in excess of 10,500 ft near the central part of the basin (Raymond and Tillson, 1968).

The source of the lava extrusions was differentiated mantle magma (Hooper, 1982). These tholeitic lavas tapped deep crustal fractures in the eastern part of Washington and in western Idaho. The basalt erupted on the surface in individual flows as thick as several hundred feet. Due to their low viscosity, individual flows persisted laterally over large distances and progressively accumulated to thicknesses controlled by basin geometry and subsidence.

During periods of magmatic quiescence, limited deposition of siltstones, mudstones, and tuffaceous rocks occurred (less than 30 ft thick, according to Swanson and others 1979b). These deposits contain dated fossils which corroborate radiogenic dates for the basalts at 6 to 16.5 million years before the present or Miocene (Swanson and others, 1979b).

Over the period of Miocene Age vulcanism, magnetic polar variations and reversals imprinted various paleomagnetic polarity in the magnetite of the basalts (Swanson and others, 1979b; Hooper, 1982; Sheriff, 1984). Swanson and others (1979b) also noted the flows can be characterized by distinctive chemistry. Because of the lithologic similarity throughout the stratigraphic section, these two characteristics are important in identification and correlation of individual basalt flows.

During the Pleistocene Epoch (1 million years ago), the area north of the Columbia Plateau physiographic province was covered by continental glaciers. As this glaciation retreated, its previous perimeter generated localized moraines which acted as dams forming glacial lakes. The lakes breached their morainal dams of unconsolidated till and generated the Columbia River gorge and coulee-scabland physiography (Silar, 1969; Short and others, 1976; Baker, 1981). Prehistoric Lake Missoula breached its confines and the Creston study area was inundated and eroded by the Spokane Flood (USGS, 1973). Following these glacial events of 10,000 years ago, the northern part of the Columbia Plateau received redistributed loess. More specifically, parts of the Creston study area are covered by loess and coarser glaciofluvial sediments.

Stratigraphy. The basalts of the Columbia Plateau are large in volume (50,000 mi^3), areal extent (approximately 80,000 mi^2), and number of individual flows (in excess of 107), and are complex in chemistry and magnetic polarity (Hooper, 1982). Lesser volumes of discontinuous sedimentary interbeds also are present. Erosion of unknown thicknesses of basalt also occurred during non-deposition of these units during the Miocene Age.

Formation Character -- A summary (Hooper, 1982) of numerous geological studies of the stratigraphic record of the Columbia River Basalt Group is shown in Fig. 2.2. The Creston study area is believed to have Grande Ronde Formation basalt at depth with a possible local separation by the sedimentary Vantage Member of the Ellensburg Formation. Overlying these lithologies are the Wanapum Formation basalts. The Roza Member is exposed ten miles south and five miles north of the study area (Swanson, 1979a). The Priest Rapids Member is the outcropping, partly eroded basalt at the study area. The Frenchman Springs and Eckler Mountain Members have not been mapped in the Creston vicinity by Swanson and others (1979a).

Imnaha basalt flows are generally confined to the eastern part of the Columbia Plateau filling topographic lows on the basement rocks. Hooper (1982) concluded that 20 to 25 eruptions occurred over a 500,000-year period. This represents an average of 20,000 years between volcanic eruptions. He also concluded that magnetic polarity was normal. The Grande Ronde Formation basalt eruptions occurred next over a 2,000,000-year span, generating over 60 voluminous flows (Hooper, 1982). This formation accounts for 85 percent of the Group (Hearn and others, 1985).

Group	Subgroup	Formation	Member	Magnetic Polarity	K/Ar Dates
Columbia River Basalt Group	Yakima Basalt Subgroup	Saddle Mountains Basalt	Lower Monumental	N	6 my
			Ice Harbor	N,R	8 my
			Buford	R	
			Elephant Mountain	N,T	
			Pomona	R	12 my
			Esquatzel	N	
			Weissenfels Ridge	N	
			Asotin	N	
			Wilbur Creek	N	
			Umatilla	N	13.5 my
		Wanapum Basalt	Priest Rapids	R_3	
			Roza	T,R_3	
			Frenchman Springs	N_2	
			Eckler Mountain	N_2	14.5 my
		Grande Ronde Basalt		N_2	
				R_2	
		Picture Gorge Basalt (R_2, N_1)		N_1	
				R_1	16.5 my
		Imnaha Basalt	T	?	
				N_0	17.0 my
			R_0?	?	

Fig. 2.2. Columbia River Basalt Group, magnetic polarity and age (from Peter R. Hooper, "The Columbia River Basalts," Science, v. 215, 19 March 1982, p. 1464, copyright 1982 by the AAAS). The Saddle Mountains, Frenchman Springs, and Eckler Mountain units are not present in the Study Area. N = normal, R = reversed, T = transitional magnetic polarity.

An important cessation in vulcanism at 14.5 million years before present (Hooper, 1982) resulted in significant weathering and local sedimentary deposition and is represented by the Ellensburg Formation sedimentary interbed rocks. The Wanapum Formation basalt eruptions marked renewed chemical and paleomagnetically variable vulcanism with 9 to 12 flows (Hooper, 1982). The basalt flow of the Roza Member of the Wanapum Formation was very fluid and is estimated to have traveled three miles per hour over its 200-mile extent, according to calculations by Hooper (1982). Finally, the Saddle Mountain Formation basalt vulcanism persisted longest but was least voluminous with its 10 flows. These flows were localized along structural and topographic lows and projected westerly across the entire plateau, reaching the Pacific Ocean.

The intensity of vulcanism over time in the Columbia Basin is shown diagrammatically in Fig. 2.3. The Wanapum Formation and Grande Ronde Formation basalts are the principal extrusive rocks that underlie the Creston study area. Older intrusive and metamorphic rocks are present in the area.

Flow Detail -- Bauer and others (1985) describe the general megascopic character of the basalt flows from bottom to top as basal colonnade, entablature, and flow top (shown in Fig. 2.4). The basal colonnade contains 20 percent of the flow and is characterized by vertical, repetitive jointing and discontinuous, horizontal jointing. The entablature comprises about 70 percent of the flow volume and is characterized by diversely oriented, fan-shaped arcuate joints with vesicular parts near the top (Bauer and others, 1985). The flow top or interflow is vesicular basalt and clinker, which account for about 10 percent of the flow volume and provide the most permeable zone. The preferential water movement in the vesicular flow tops and interbeds would be horizontal, whereas vertical movement of lesser volume is expected in the entablature and colonnade.

Structural Geology. The Columbia River basalts were erupted at a time coincident with Cascadian andesitic vulcanism to the west and rising Idaho Batholith to the east. Hooper (1982) surmised that the Columbia Basin was also subjected to north-south compression forming east-west folds and extensive tensional fissures which conveyed the basaltic magma to the basin surface as shown in Fig. 2.5

Regional Features -- In addition to the relief on the pre-basalt crystalline basement rocks, Swanson and others (1979b) determined that the Columbia Basin in southeast Washington had a paleoslope down to the west. This conclusion is supported by deposition of the ancestral Columbia River to the west in the Wenatchee area (mapped as the Vantage Member of the Ellensburg Formation). Additionally, the thickening of the major basalt flow is toward the west. Although flows emanated in eastern Washington, many of the major flows covered the southern part of the state and reached the Pacific Ocean. The deepest known part of the Columbia Basin and, coincidentally, the thickest basalt section is near Pasco, Washington, approximately 100 miles south-southwest of the Creston study area. A borehole drilled on behalf of the Atomic Energy

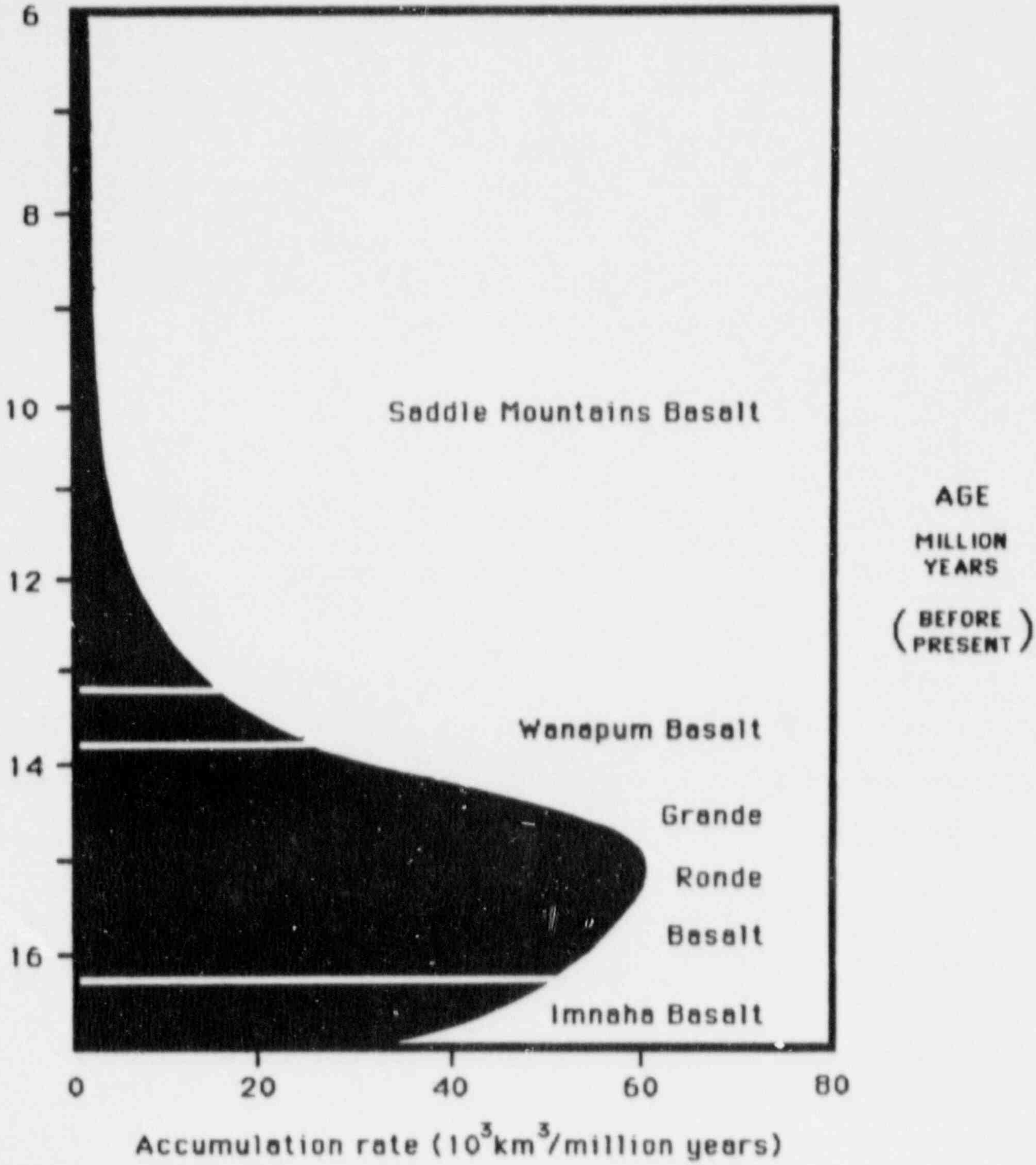


Fig. 2.3 Rate of Columbia River Basalt accumulation over time (after Hooper, 1982).

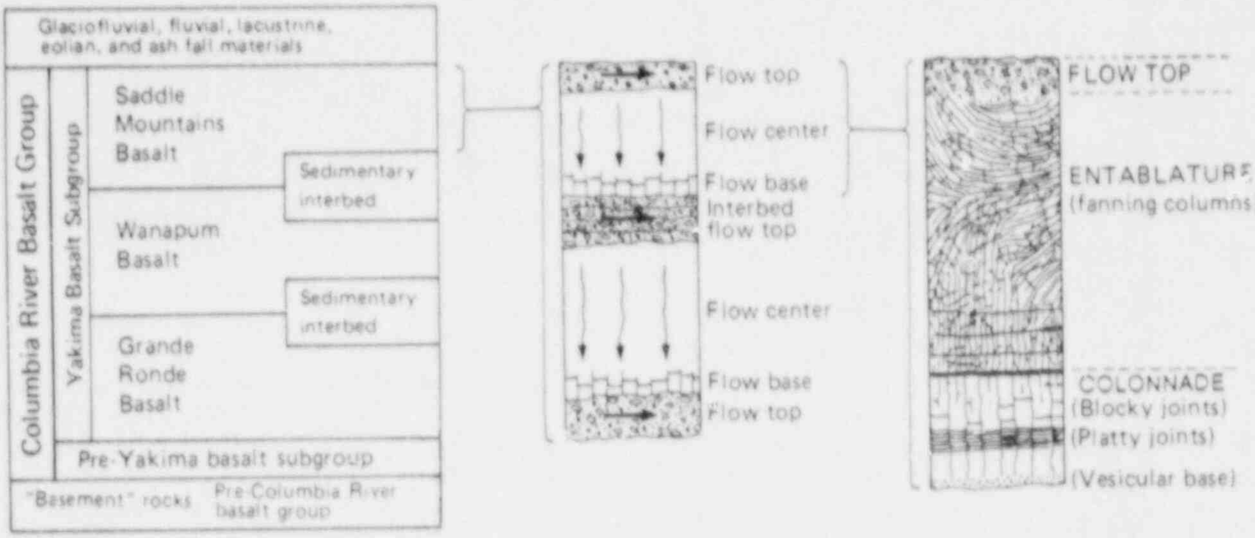


Fig. 2.4. Basalt-flow characteristics of the Columbia River Basalt Group (modified from Bauer and others, 1985).

Fig. 2.5. Feeder dikes (heavy lines) and lava extent of the Columbia River Basalt Group; hatched lines represent anticlinal ridges (from Peter R. Hooper, "The Columbia River Basalts," Science, v. 215, 19 March 1982, p. 1465, copyright 1982 by the AAAS).

Commission (AEC) near Pasco reached 10,455 feet, terminating in basalt (Raymond and Tillson, 1968).

Geologic data on the thickness and configuration of the basalts in the Creston study area are very limited. Creston Butte, a hill located in T.26N, R.34E, Section 21, with 300 feet of relief, is about a mile west of the northwest corner of the study area. It is composed of older Mesozoic- to Paleozoic-age quartzites surrounded by younger Miocene-age basalts. About 7½ miles south, the Dreger observation well in T.25N, R.34E, Section 29, penetrates 1,225 feet of basalt from a drill site 200 feet lower (Olson, 1984). Therefore, along the western side of the study area, the paleoslope on the pre-basalt basement rocks could exceed 180 feet per mile to the south.

Fig. 2.6 shows a generalized geologic cross-section extending from the Columbia River across the Creston study area and continuing southwest through the Pasco Basin. Preliminary structural contours on the top of the Grande Ronde basalt beneath Creston have gradients of approximately 20 feet per mile to the southwest. Bauer and others (1985) generalized that regional dips in the northwest area of the Columbia Plateau (including the study area) are less than 5 degrees to the southwest and the folding is broad and gentle. Reconnaissance mapping by Swanson and others (1979b) shows a series of folds in the basalt exist about 15 miles west, trending toward the study area.

Study-Area Photolineaments -- Fig. 2.7 shows the Creston study area outlined on a vertical aerial photograph and the location of a U-2 photolineament trending north 23 degrees east documented by Wildrick (1985). Using vertical, black and white stereo aerial photographs at a scale of 1" = 0.8 mile, a total of 143 site and peripheral lineaments were mapped and plotted according to decreasing reliability from 1 to 3:

1. all adjacent rocks are cut in high-relief exposures (these would be most likely to persist in depth) -- 6 noted;

2. surface-rock fractures with projection downward indeterminate -- 77 noted;

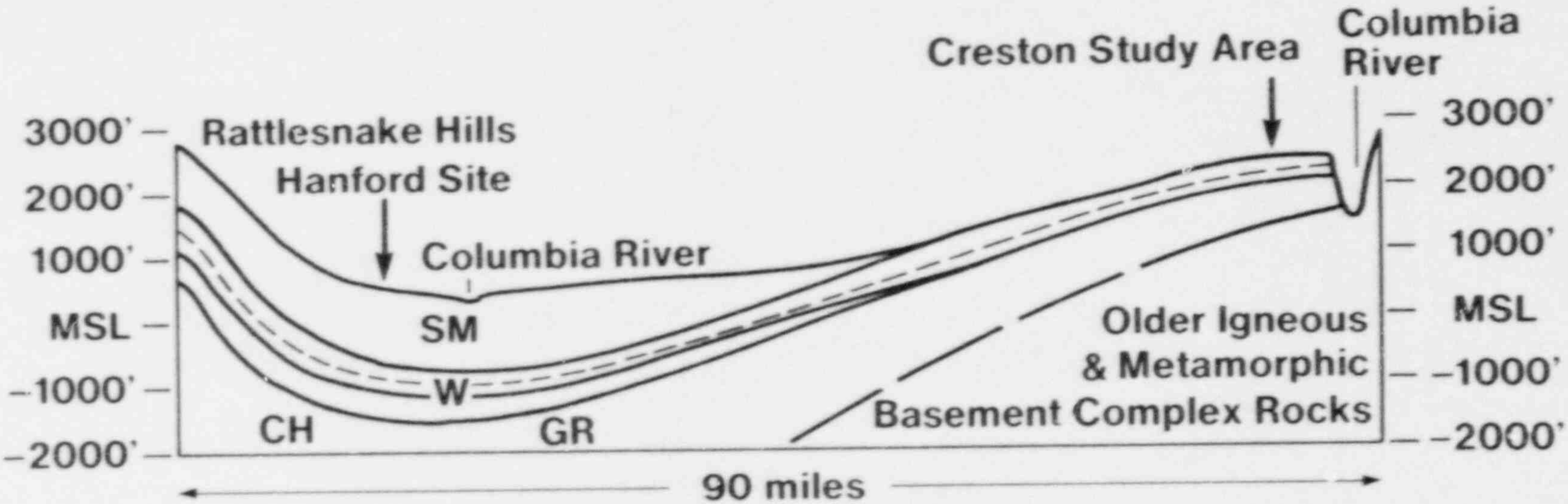
3. linear fracture in alluvium which might be controlled by a fracture in bedrock -- 60 noted.

After plotting the first two groups, the third group was plotted and found reasonably coincidental with trends generated by photo-observed rock fractures. A polar plot of these photolineaments is shown in Fig. 2.8. Preliminary conclusions are as follows:

1. wide scatter in lineaments exists bearing 015° through 125° from north (000°);

2. three strong lineament trends bear 020°, 090°, and 110°;

3. within the study area, the 020° trend appears most often, closely agreeing with the U-2 photolineament and possibly



Basalt Stratigraphy

		Hanford Site	Creston Study Area
SM	Saddle Mountains	Numerous Flows	Absent
W	Wanapum	Priest Rapids Roza Frenchman Springs	Priest Rapids Roza Absent
GR	Grande Ronde	Sentinel Bluffs (CH: Candidate Horizon) Schwana	Unamed Flows

Fig. 2.6. Generalized structural cross-section, from the Columbia River to the Fasco Basin.

Fig. 2.7. Northeast-trending U-2 photolineament (suspected fault, dashed line) plotted on 1982 vertical aerial photograph. Note coincidence of two springs (o) with suspected fault intersecting Sinking Creek. Two outlined parcels delineate leased Creston study area lands, showing section numbers. Irrigation wells shown are: 1, Rettkowski; 2, 3, Dreger; 4, Dr . (observation only); 5, 6, Houger.

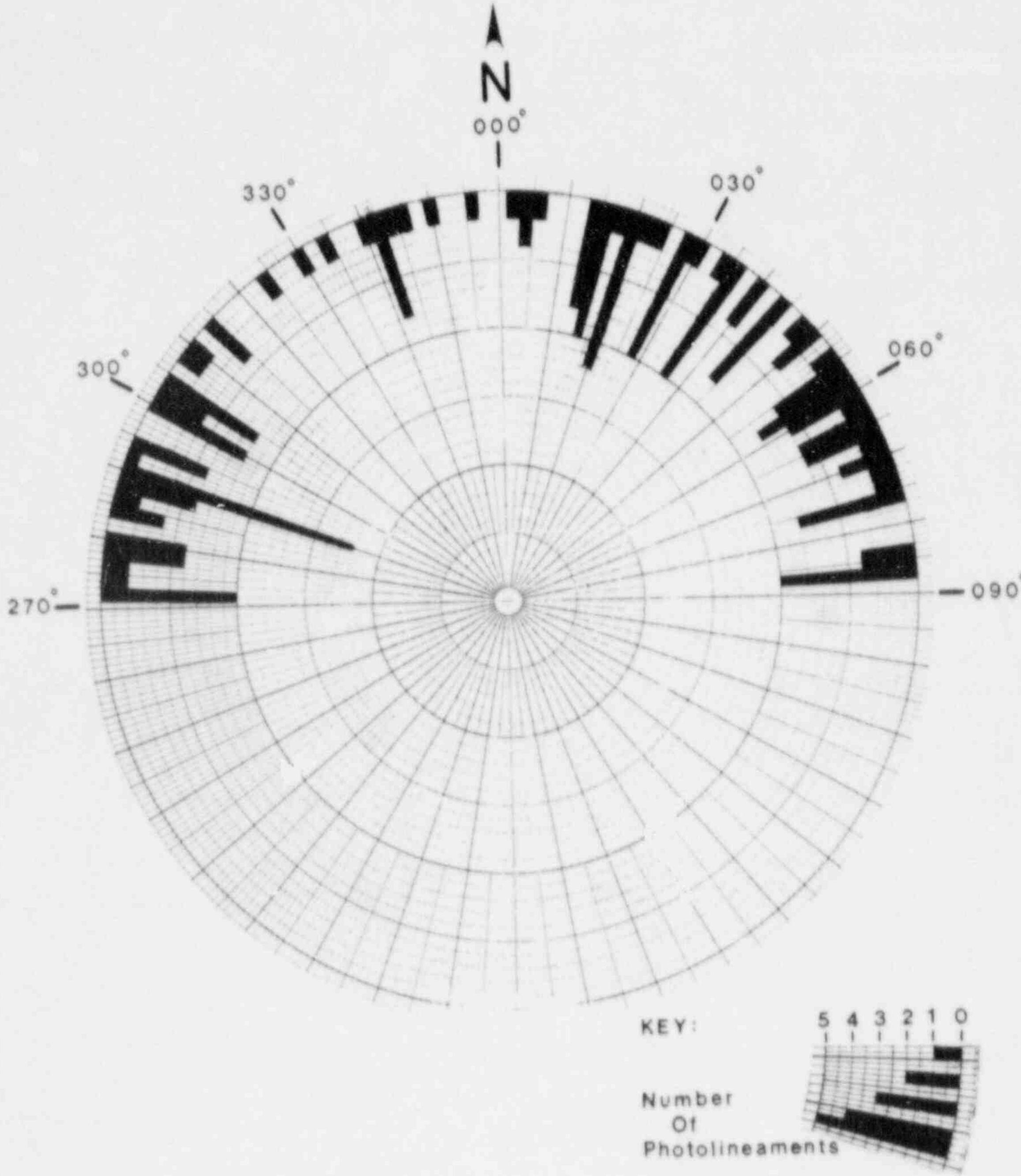


Fig. 2.8. Rose diagram of 139 photolineaments in the Creston study area determined from stereo photography overlap on Fig. 2.7.

indicating an en-echelon fracture set; the presence of alluvium and agricultural land use substantially reduce confidence on this inference in the study area; and

4. prominent peripheral photolineaments about the study area appear not to project toward the study area.

2.1.2 Hydrologic Studies

Data on climatology (areal precipitation patterns) and regional water-balance analyses were included in a comprehensive study by Silar (1969). For the specific study site, mean annual precipitation is approximately 13 inches (Wildrick, 1982). Annually, potential evapotranspiration (ET) rates, which are estimated to range from 20 to 25 inches in the study area (Tera Corporation, 1983a), exceed this hydrologic input; however, precipitation provides recharge to the underlying groundwater system seasonally during low ET demands.

Agricultural irrigation through groundwater pumping has increased over past decades in many areas along the northern rim of the Columbia Basalt Plateau. In association with the regionally complex geology and eroded surficial topography, flows in stream channels are highly irregular both temporally and spatially. Streamflow gains often are associated with discharge of springs; corresponding losses of flows may be associated with streams crossing over major zones of hydraulic conductivity in the underlying basalts or sedimentary interbeds.

Comprehensive hydrologic investigations have focused on characterizing regional groundwater systems (Newcomb, 1959, 1969; Bauer and others, 1985). More localized studies have concentrated on the Columbia Basin Project area (Walters and Grolier, 1960; Tanaka and others, 1974) and the Odessa-Lind area (Garrett, 1968; Luzier and others, 1968; Luzier and Burt, 1974; Luzier and Skrivan, 1975; Cline, 1984). More recent site-specific studies of the local area south of Creston were completed for the Washington Water Power Company by Tera Corporation (1980, 1981, 1983a, 1983b) for its proposed coal-fired power plant (Washington Water Power Company, 1981a, 1981b).

2.1.3 Water-Quality Studies

Determining water-quality conditions in basalts of the region aids in delineating water origin(s), source(s) of recharge, and residence time (see also Sections 2.1.5 and 2.6). Certain water-quality characteristics may impact selected beneficial uses of the water resources of the region. Regional studies summarizing water-quality conditions in the various basalts of the Columbia River Basalt Group include those by Silar (1969), Newcomb (1972), Hearn and others (1985), and Bortleson and Cox (1986). Theoretical studies of minerals solubility and reaction kinetics in basalt media have been reported by Deutsch and others (1981, 1982).

Major inorganic chemical concentrations in basalt aquifers of the region depict generally low dissolved solids and ionic compositional shifts in

a downward gradient from calcium-bicarbonate to sodium-bicarbonate to sodium-chloride or sodium-sulfate types. Areal profiles of sodium concentrations are given by Hearn and others (1985). A Piper diagram summarizing major-ion composition for approximately 100 samples collected from wells located in the northern Columbia Basalt Plateau is given in Silar (1969, Fig. 9).

Based on more than 500 samples for chemical analyses reported by Newcomb (1972), the average dissolved-solids concentration in groundwater native to the Columbia River basalt was about 275 mg/L, with calcium, sodium, bicarbonate, and silica present as the principal chemical constituents. The dissolved-solids concentrations commonly ranged from less than 200 mg/L to as much as 200 mg/L. According to Newcomb (1972, p. 41), "the origin of the dissolved material appears to lie primarily in the history of the water during its descent to the basalt and secondarily to the solution and exsolution of ions within the basalt."

2.1.4 Geophysical Logs and Drill Core

The Geohydrology Section of the Washington State University (WSU) College of Engineering has conducted and reported on numerous investigations involving the application of geophysical logging techniques to the basalt formations of the Columbia Basalt Plateau (Crosby and Anderson, 1971; Anderson and others, 1973; Crosby, 1973; Crosby and others, 1972, 1974, 1977; Siems and others, 1974; Summers and others, 1975a, 1975b; Poeter and Crosby, 1977). Until this study, drill core in basalts of the study area and adjacent region have been lacking, based upon information gathered for WSU. Professor Eilene J. Poeter, while affiliated with WSU (personal communication, January 31, 1986), reported that basalt drill core was obtained from a well drilled near the City of Cheney, located about 10 miles southwest of Spokane and east-southeast of the study area (Fig. 1.1). Selected parts of these drill core were examined and displayed interesting relationships between the basalt and the sedimentary interbed contact as well as being good lithologic examples. The repository of this drill core is the Geology Department of Eastern Washington University in Cheney. Other drill core for basalts of the region undoubtedly is available for wells in the Pasco Basin in the Hanford Reservation. Rockwell International (Hanford Operations) and Batelle Pacific Northwest Laboratories in Richland have been contacted regarding this information to assess possible relevance to basalts in the Creston study area to the north of the Hanford site (Appendix Table A.1).

2.1.5 Isotopic Dating Studies

A primary focus of the study by Silar (1969) was dating of groundwater from 44 samples. Water ages ranged from modern to over 16,000 years before present (B.P.); however, all but a few samples indicated ages between 0 and 6,000 years. Conclusions of this regional study were:

1. Groundwater in the higher-elevation plateau areas is predominantly younger than 6,000 years B.P., i.e. post-glacial (Post-Wisconsin). Modern age is an exception, indicating the

groundwater originated when the present topographic (land surface) relief was already in existence. It also indicates a slow water circulation below the plateau and relative isolation from diverting surface recharge.

2. Ages of groundwater from wells in valleys range from modern to 8,700 years, indicating a more intensive groundwater circulation along depressions with probable drainage effects on groundwater of the various aquifers and ages.

3. Variation in groundwater ages along the edges of valleys, on valley slopes, and on surface elevations, with frequent modern ages, indicates a relatively intensive groundwater circulation pattern in the morphologically dissected areas and a direct hydraulic connection of aquifers with the land surface.

4. Considerable variation of groundwater ages (excepting modern) has been established in artesian wells with overflow, thus indicating a slow water accumulation pattern in aquifers isolated from the surface.

5. No significant correlations between age and depth, or between age and altitude of an aquifer, were established.

Dating techniques for the above study used a procedure developed by Crosby and Chatters (1965). Complications in dating waters residing in volcanic-derived basalts are discussed by Chatters and others (1969). Some regional isotropic data have been collected by the USGS throughout the Columbia Basalt Plateau; however, no interpretation of these data yet has been made.

2.1.6 Pending Relevant Studies

Several ongoing and pending studies will be useful to the overall study effort, although formally documented results are not yet available.

The Tacoma office of the USGS's Water Resources Division currently is involved in a regional aquifer systems analysis (RASA) of the Columbia Basalt Plateau. A generalized digital computer model of this regional aquifer system is in development. Boundary conditions and aquifer characteristics of the basalt aquifers are in the process of being identified. USGS RASA reports completed to date include those by Bauer and others (1985), Hearn and others (1985), Drost and Whiteman (1986), and Whiteman (1986). According to J. J. Vaccaro, Project Chief of the USGS RASA study, generalized aquifer characteristics are being used rather than results from specific pumping tests because of the extreme heterogeneity of the basalt aquifers.

Professor E. J. Poeter, while affiliated with Washington State University, indicated that development of a laboratory physical model to help define the effects of fractures in basalts on water movement is planned. The proposed model involves full-acoustic wave forms. Later phases of

this project (funded by Rockwell-Hanford) will draw on relationships in the field as indicated by drill core.

2.2 Location of Wells

Existing water-supply wells were inventoried for the study area (locally south of the Town of Creston) and for the general region (the northern part of the Columbia Basalt Plateau). Sources for the inventory consisted of retrievals from the USGS System 2000 (GWSI) and WATSTORE files and manual searches through well files of the State of Washington Department of Ecology (DOE) office in Spokane. Information on well locations will be summarized in this section; later sections will describe other data associated with these wells.

2.2.1 Study Area

A total of 51 well entries were identified from site-specific well-inventory searches. These consisted of 41 entries from the USGS System 2000 (GWSI) file and 10 wells associated with the Tera Corporation (1983b) groundwater baseline study. The locations of these wells are shown on Fig. 2.9, and the entries are summarized in Table 2.1. Several of the USGS entries involve a multiple-completion well consisting of six piezometers installed to evaluate the potentiometric head in multiple aquifers of the basalts (Olson, 1984). Hence, the number of distinct wells actually totals 45. These study-area wells are bounded by an area 12 miles in a north-south direction and 11 miles in an east-west direction (Fig. 2.9). The Tera Corporation wells installed for the Creston Project study are clustered in about the middle of this area.

The Department of Ecology operates a groundwater-monitoring program largely distinct from the USGS water-level program (see Section 2.3). A total of 17 DOE monitoring wells (Fig. 2.10) were identified for purposes of this characterization. All but six of the DOE wells were located within the study area; however, only six of the eleven DOE wells within the study coincide with USGS monitoring wells (Figs. 2.9 and 2.10). The six DOE monitoring wells located adjacent to the study area were to the west (Fig. 2.10). Descriptions of the DOE monitoring wells are given in Table 2.2.

A local inventory by Tera Corporation (1980) involved 47 wells. This inventory included the four P-series wells used for pumping tests (Table 2.1) as well as six other wells included in previous inventories. Hence, 37 wells in this inventory appear to be distinct and exclusive of other source files (Table 2.2).

2.2.2 Regional Wells

As part of a regional study on geochemical controls on water quality in basalt aquifers of the Columbia Basalt Plateau, about 2500 wells in this region were inventoried and 418 wells were selected for sampling during up to three surveys between the summers of 1982 and 1983 (Hearn and others, 1985). Of these wells, three are in the general study area

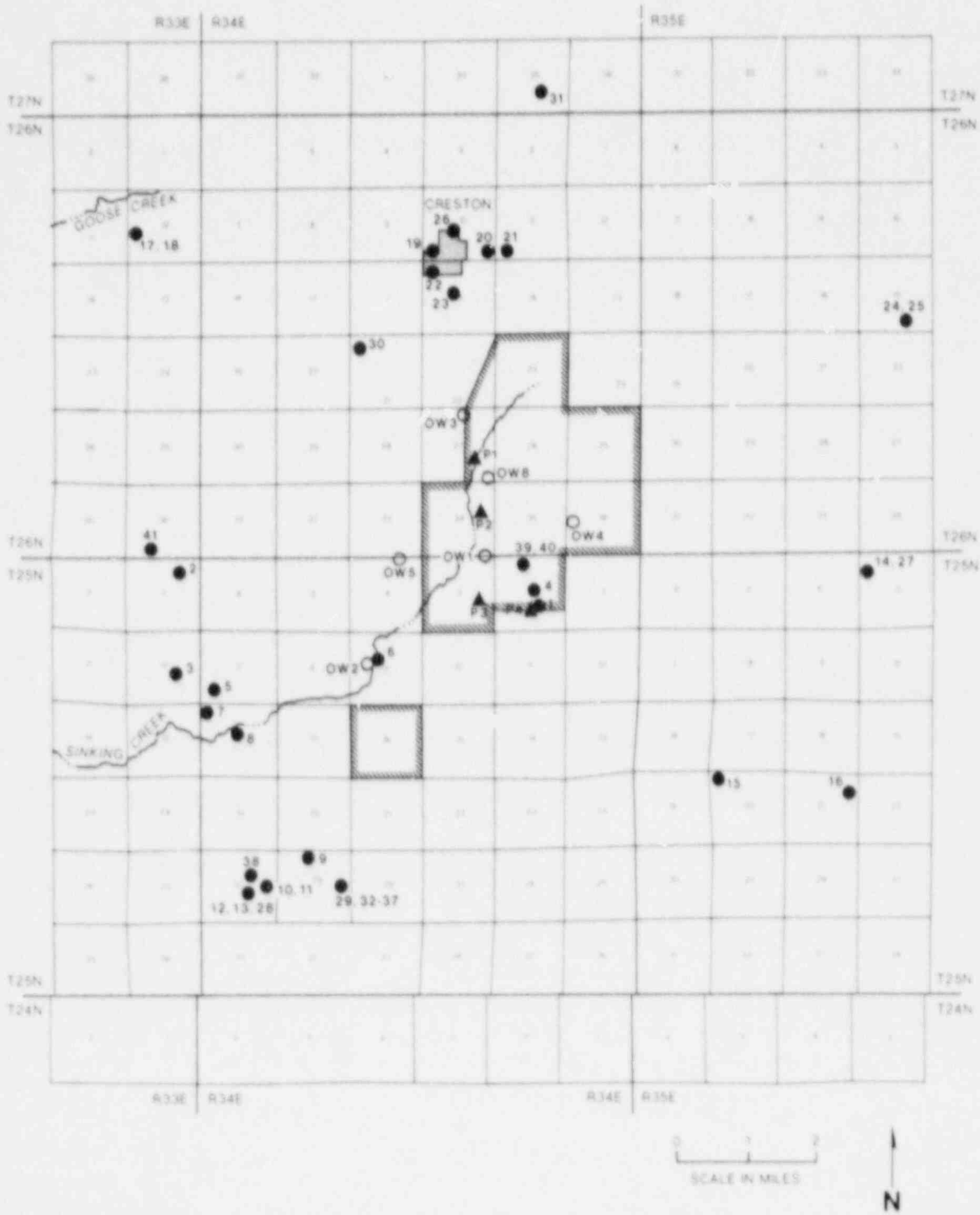


Fig. 2.9. Locations of USGS and Tera Corporation wells in the Creston study area. See Table 2.1 for well descriptions.

TABLE 2.1

INVENTORY OF LOCAL STUDY-AREA USGS AND TERA CORPORATION WELLS

USGS Station ID	Latitude	Longitude	Township/Range Section ID	Owner Description	Geologic Unit Code[3]	Well Depth (ft)	Well Elevation (ft MSL)	ISI Map #[4]
474159118360101[2]	474154	1183605	25/33-01B01	Richard Dreger	122WNPM	60	2280	2
474034118355001			25/33-12K01	William F. Dreger		202	2241	3
			25/34-02	Tera Corporation		140	2319	P4
474200118294401			25/34-02C01	Merwin Houger		610	2357	39
474200118294402			25/34-02C01D1	Merwin Houger		550	2357	40
474130118293001			25/34-02G01	Merwin Houger	122CBRV	320	2340	4
474128118293001			25/34-02K01	Merwin Houger	122WNPM	220	2352	1
			25/34-04K	Tera Corporation	122BSLT	165	2315.2	OW5
474010118352501			25/34-07N01	Dreger		180	2276	5
			25/34-09	Tera Corporation	122BSLT	117	2237.5	OW2
474046118321701			25/34-09F01	Charles Mangis	122CBRV	211	2243	6
474010118352502			25/34-18D02	William Dreger	122WNPM	200	2275	7
473955118345701			25/34-18F01	William Dreger	122CBRV	42	2200	8
473847118333501			25/34-29C01	Edward F. Dreger		96	2271	9
473758118325201			25/34-29J01D1	Washington DOE		1233	2285	29
473758118325202[1]			25/34-29J02	Washington DOE	122GDRD	1106	2285	32
473758118325203[1]			25/34-29J03	Washington DOE	122GDRD	949	2285	33

TABLE 2.1

INVENTORY OF LOCAL STUDY-AREA USGS AND TERA CORPORATION WELLS (continued)

USGS Station ID	Latitude	Longitude	Township/Range Section ID	Owner Description	Geologic Unit Code[3]	Well Depth (ft)	Well Elevation (ft MSL)	ISI Map #[4]
473758118325204[1]			25/34-29J04	Washington DOE	122GDRD	715	2285	34
473758118325205[1]			25/34-29J05	Washington DOE	122WNPM	413	2285	35
473758118325206[1]			25/34-29J06	Washington DOE	122WNPM	319	2285	36
473758118325207[1]			25/34-29J07	Washington DOE	122WNPM	259	2285	37
473818118343701			25/34-30G01	Richard Dreger		596	2280	38
473800118342501			25/34-30J01	Ed Dreger	122WNPM	375	2266	10
473800118333401			25/34-30J02	Richard C. Dreger	122CBRV	500	2255	11
47375211 8344301			25/34-30K01	Edward F. Dreger	122WNPM	265	2250	12
473748118344201			25/34-30K02	Edward F. Dreger	122CBRV	705	2247	13
473817118343701			25/34-30K02D1	Richard B. Dreger		705	2247	28
4741421 8235501			25/35-03E01	Wash. St Hwy 5	122WNPM	90	2345	14
474142118235502[2]	474142	1182355	25/35-03E01D1	Wash. St Hwy 5/ Dick Scholl	122WNPM	200	2345	27
473913118261702[2]	473915	1182620	25/35-20D01	Victor Alt/ Everett Lake	122GDRD	410	2250	15
473905118235801			25/35-21H01	Stephens	122WNPM	100	2320	16

TABLE 2.1

INVENTORY OF LOCAL STUDY-AREA USGS AND TERA CORPORATION WELLS (continued)

USGS Station ID	Latitude	Longitude	Township/Range Section ID	Owner Description	Geologic Unit Code[3]	Well Depth (ft)	Well Elevation (ft MSL)	ISI Map #[4]
474550118363801			26/33-12M01	USAF 1-H	122CBRV	294	2420	17
474550118363802			26/33-12M02	USAF 2-H	122CBRV	292	2421	18
474205118361701			26/33-36P01	August Oreger	122WNPM	350	2300	41
474553118310801			26/34-10L01	Town of Creston		766	2450	26
474544118311901			26/34-10N01		110BSLT	29	2440	19
474541118302601			26/34-10R01	Marquette		80	2440	20
474537118300101			26/34-11N01	John Robinson			2441	21
474523118462901			26/34-15D01	Town of Creston	122CBRV	288	2400	22
474458118311401			26/34-15F01	Town of Creston	122CBRV	455	2480	23
474430118324601			26/34-21D01	Gerald Krause	122WNPM	235	2452	30
			26/34-27	Tera Corporation		214.5	2370	P1
			26/34-27	Tera Corporation	122BSLT	119	2313.6	OW8
			26/34-27	Tera Corporation	122BSLT	180	2383.8	OW3
			26/34-34	Tera Corporation		142	2295	P2
			26/34-35	Tera Corporation	122BSLT	165	2347.7	OW1

TABLE 2.1

INVENTORY OF LOCAL STUDY-AREA USGS AND TERA CORPORATION WELLS (continued)

USGS Station ID	Latitude	Longitude	Township/Range Section ID	Owner Description	Geologic Unit Code[3]	Well Depth (ft)	Well Elevation (ft MSL)	ISI Map #[4]
			26/34-36	Tera Corporation	122BSLT	137	2370.8	OW4
474453118225601			26/35-15Q01	Sam Schnider	122WNPM	206	2480	24
474440118230601			26/35-15Q02	Sam Schnider		550	2530	25
474538118293301			27/34-35K01	Robert Taylor	122WNPM	265	2420	31

1) Multiple-completion piezometers.
2) Also see Table 2.3.
3) BSLT = Basalt
   CBRV = Columbia River Basalt Group
   GDRD = Grande Ronde Basalt
   WNPM = Wanapum Basalt.
4) See Fig. 2.9.

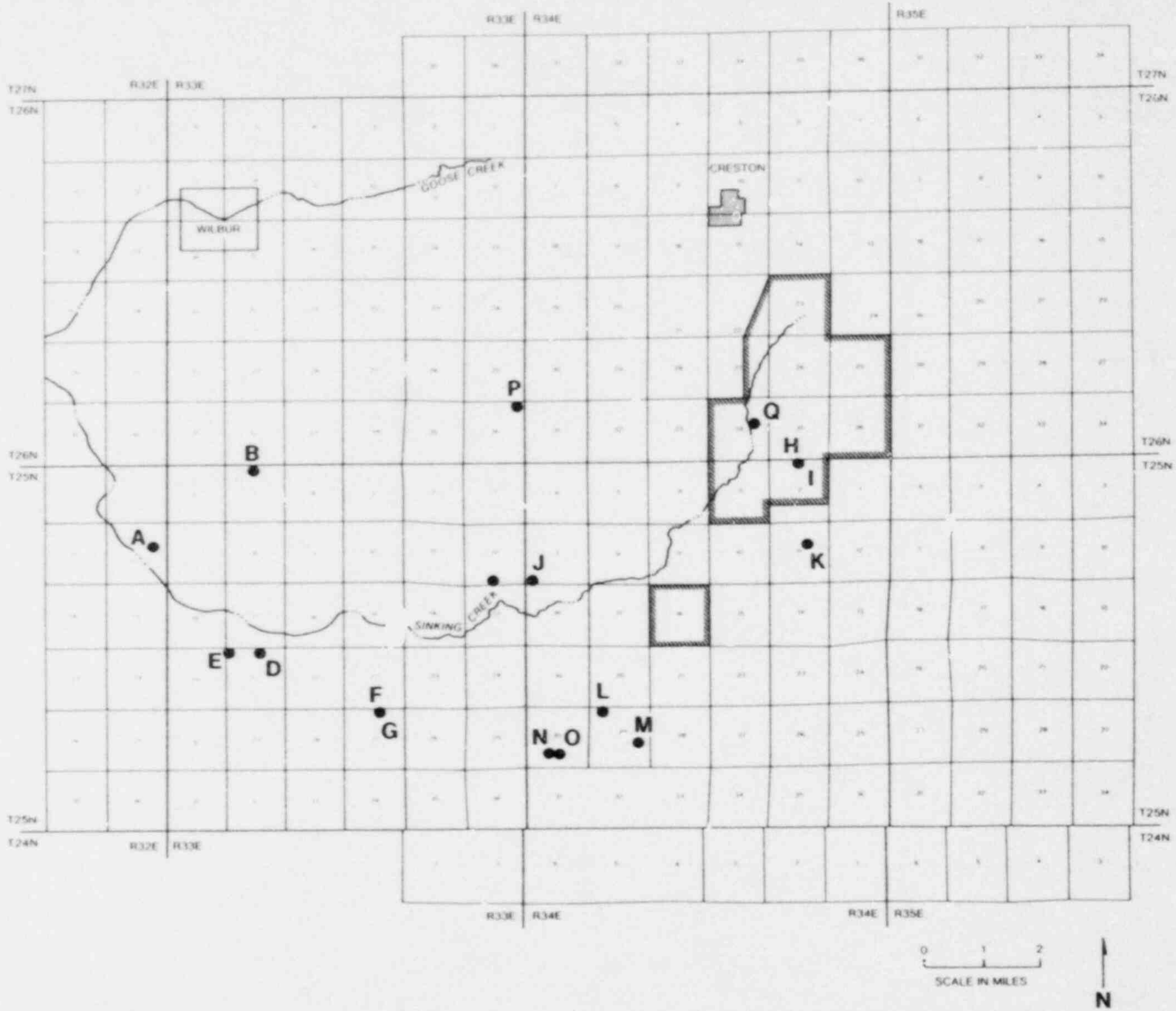


Fig. 2.10. Locations of State of Washington Department of Ecology monitoring wells south and west of the Creston study area. See Table 2.2 for well descriptions.

TABLE 2.2

INVENTORY OF WASHINGTON STATE DEPARTMENT OF ECOLOGY WATER-LEVEL MONITORING WELLS

USGS Station ID[1]	Latitude	Longitude	Township/Range Section ID[2]	Owner Description	Geologic Unit Code[3]	Well Depth (ft)	Well Elevation (ft MSL)	Map Nos.[4]
			25/32-12J1	Clarence Wagner		--	2100	A
			25/33-05C1	Edward F. Dreger		--	--	B
			25/33-12P	Tiegs		--	--	C
473800118432501			25/33-20B	Robert Bauer		235	--	D
			25/33-20D	Wyborney		--	--	E
			25/33-27A1	Ernest Rettkowski		--	2315	F
			25/33-27A2	Ernest Rettkowski		--	2320	G
474200118294401			25/34-02C01	Merwin Houger		610	2357	H(39)
47413011[illegible]3001			25/34-02G01	Merwin Houger	122CBRV	320	2340	I(4)
474010118352501			25/34-07N01	Dreger		180	2276	J(5)
			25/34-11G1	Carl Nelson		--	2275	K
473847118333501			25/34-29C01	Edward F. Dreger		--	2230	L
			25/34-29J	Richard Dreger		--	2285	M
473752118344301			25/34-30K01	Edward F. Dreger	122WNPM	265	2250	N(12)
473748118344201			25/34-30K02	Edward F. Dreger	122CBRV	705	2247	O(13)
			26/33-36A	William Rosman		--	2398	P
			26/34-34G	Nelson		--	2288	Q

1) See Table 2.1.
2) Township(N)/Range(E)-Section with subsection designation.
3) CBRV = Columbia River Basalt Group; WNPM = Wanapum Basalt.
4) See Figs. 2.9, 2.10.

(corresponding to earlier-designated wells), another three are located near the study area several miles to the southwest, and other selected wells are in the surrounding area (generally to the south of the study area). The locations of 21 regional wells included in the USGS reconnaissance survey and considered in this study are shown in Fig. 2.11, and general well descriptions are given in Table 2.3.

In summary, data and relevant information from various sources are available for 110 wells:

35 USGS System 2000 files for the study area (41 entries, less 6 for the multiple-completion cluster-piezometer Dreger well)
10 Tera Corporation (1983b) wells for the study area
37 non-coincidental wells from Tera Corporation (1983b) report
11 non-coincidental wells from DOE monitoring program
17 non-coincidental wells from USGS study

110 total mutually exclusive wells

In addition, copies of well-drilling logs were obtained from DOE files in Spokane for a broad region of the northern Columbia Basalt Plateau covering an area 18 miles in a north-south direction (Townships 24, 25, and 26 North) by 30 miles in an east-west direction (Ranges 32 through 36 East), as generally shown in Fig. 2.10. Wells having drill logs on file are indicated in Appendix Table A.2.

2.3 Water Levels

Interpreting water-level data from the Columbia Plateau region is made difficult by the complex geologic structure, common well-completion practices, seasonal water-level changes, and varied water-level time intervals. The open-hole wells prevalent in the region penetrate two or more aquifers exhibiting different water levels. In these cases, the wellbore becomes a conduit for interaquifer flow, and the observed water level in the well is a composite of potentiometric heads in the aquifers penetrated. Fig. 2.12 illustrates the interaction that typically occurs between aquifers in an open-hole well. Nested piezometers (a set of piezometers isolated by cement plugs in a single well) have been installed in at least four wells in the study area. This special completion method allows measurement of the water level in each aquifer where a piezometer is installed (see Fig. 2.13). Brief reviews of studies containing water-level data follow.

2.3.1 USGS Studies

Generalized water-level contours over the majority of the Columbia Basalt Plateau were reported by Luzier and others (1968) and Luzier and Skrivan (1975). These contours, shown in Figs. 2.14 and 2.15, respectively, are based on a blend of data from wells penetrating the basalts at varying depths. A notable feature of this regional depiction is a groundwater divide across the extreme northern part of the plateau intercepting the study area. The boundary appears to coincide with a topographic divide where surface water and groundwater on the northern

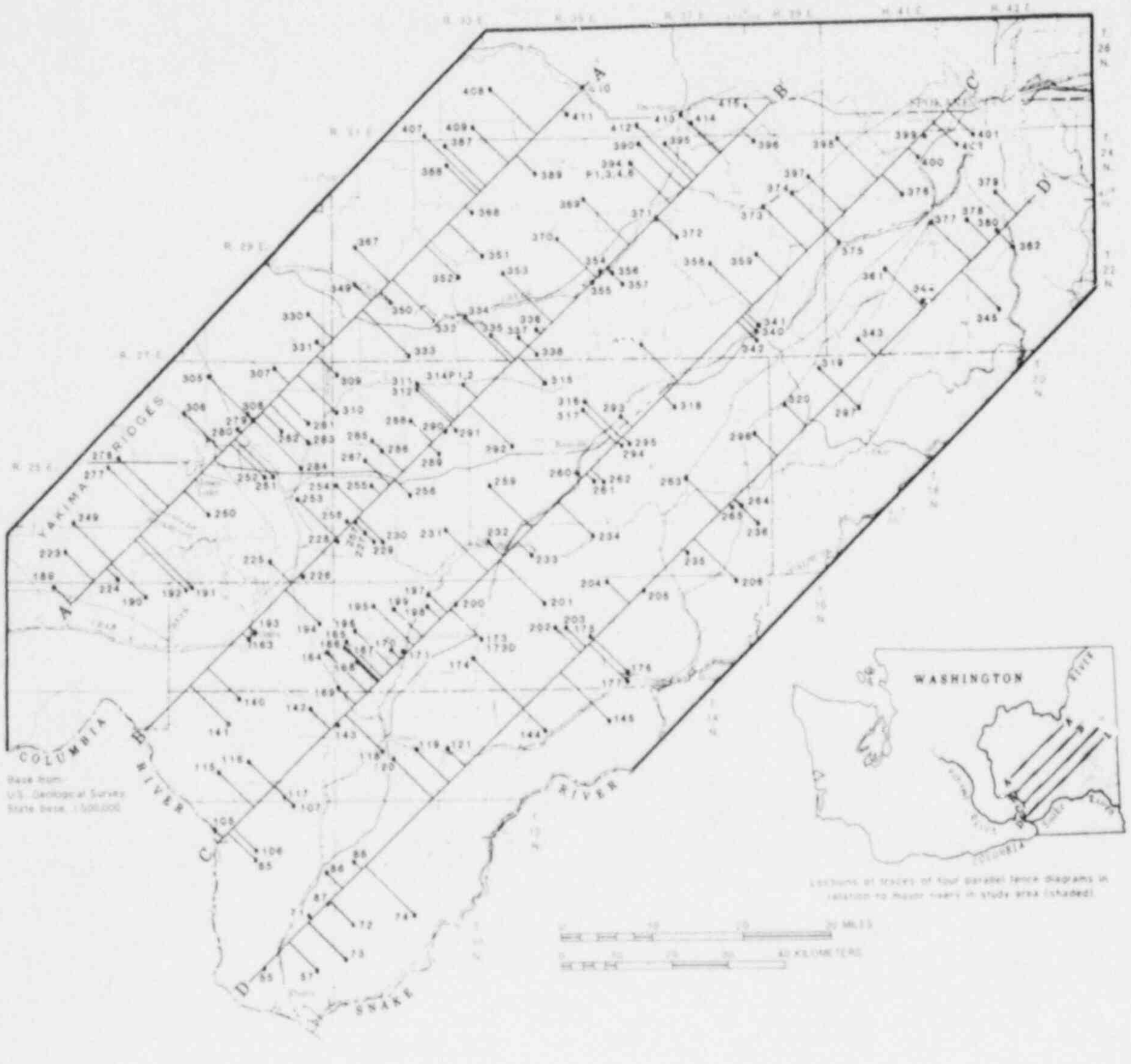


Fig. 2.11. Regional map showing USGS monitoring-well locations south of the study area (from Hearn and others, 1985). See Table 2.3 for well descriptions and Appendix Table A.5 for listing of associated water-quality data.

TABLE 2.3

INVENTORY OF SELECTED REGIONAL USGS WELLS

USGS Station ID[3]	Latitude	Longitude	Township/Range Section ID[1]	Owner Description	Geologic Unit Code[2]	Well Depth (ft)	Well Elevation (ft MSL)	USGS Map No.[4]
473012119450001	473015	1194941	23/24-09E01	Howard Long	122GDRD	625	2160	--
473044119243101	473045	1192438	23/27-10B01	Gilbert Lester	122CBRV	830	1855	--
474748118381601	473018	1183814	23/33-10A01	W. Zagelow	122WNPM	146	2080	368
473052118224201	473100	1182240	23/35-03H01D1	Helen Sandygren	122CBRV	445	2315	369
473025117570701	473020	1175708	23/38-12A01	Town of Edwall	122WNPM	100	2340	373
473103117533901	473107	1175333	23/39-04B01	Mike Paul	122CBRV	300	2395	374
473103117382801	473109	1173824	23/41-04F01	Kenneth D. Chi	122WNPM	100	2390	376
473057117251001	473056	1172510	23/43-06G01	John Burke	122WNPM	125	2410	379
473517120091501	473433	1200807	24/21-13A03	Pott-Loyd	122GDRD	475	4080	--
473457119434101	473449	1194444	24/25-18E01	L.F. Juchmes	122CBRV	515	2475	--
473640119355601	473630	1193552	24/26-06H01	Marion Balyard	122WNPM	205	2400	--
473632119520101	473632	1191652	24/28-03B01	Coulee City 4-B Jenkins	122GDRD	550	1610	--
473225119594301	473224	1190930	24/29-27P01	Earl Kane	122WNPM	242	1805	--
473443118531501	473431	1185319	24/31-14E01	Bill Evans	122WNPM	250	1995	--
474215118355001	473519	11842[illegible]	24/33-06Q01	Ken McMillan	122WNPM	185	2035	387
473427118420001	473436	1184200	24/33-18H01	Alvin Schmier	122WNPM	350	1985	388
473227118341001	473329	1182949	24/34-23L01	William G. Hardner	122CBRV	596	2249	389

TABLE 2.3

INVENTORY OF SELECTED REGIONAL USGS WELLS (continued)

USGS Station ID[3]	Latitude	Longitude	Township/Range Section ID[1]	Owner Description	Geologic Unit Code[2]	Well Depth (ft)	Well Elevation (ft MSL)	USGS Map No.[4]
473644118161701	473644	1181608	24/36-03D01	Maurice Fink,	122WNPM	125	2380	390
473442118162202	473441	1181627	24/36-16A02	State of Washington	122WNPM	160	2372	394-P1
473442118162204	473441	1181627	24/36-16A04	State of Washington	122WNPM	261	2372	394-P3
473442118162205	473441	1181627	24/36-16A05	State of Washington	122WNPM	365	2372	394-P4
473442118162208	473441	1181627	24/36-16A08	State of Washington	122GDRD	750	2372	394-P6
473117118110901	473558	1181133	24/37-06Q01	George Schraeff	122WNPM	165	2365	395
473625117592401	473641	1175930	24/38-02D01	Fred R. Michael	122WNPM	85	2400	396
473230117460301	473224	1175057	24/39-26K01	Hew Williams	122WNPM	100	2440	397
473547117464701	473553	1174716	24/40-05Q01	Robert H. Diet	122WNPM	50	2400	398
473612117335001	473612	1173350	24/41-01J02	Clarence Wynl	122WNPM	60	2390	399
473435117362201	473435	1173622	24/41-14D01	City of 4 Lakes	122GDRD	775	2410	400
473614117282101	473609	1172822	24/42-02E02	Harold Kegel	122WNPM	100	2324	401
473454117302001	473450	1173014	24/42-09Q03	Keith Kopp	122GDRD	325	2350	402
473908120042601	473904	1200423	25/22-21H01D1	City of Waterville 3	122GDRD	615	2640	--
473837119424601	473842	1194255	25/25-20Q01	Carl Helsig	122GDRD	640	2255	--
474100119040001	474118	1190421	25/30-05L01	John Dormaier	122WNPM	220	1885	--
473943118483401	473946	1184841	25/32-17K01	Thomas Kirk	122WNPM	300	2060	--

TABLE 2.3

INVENTORY OF SELECTED REGIONAL USGS WELLS (continued)

USGS Station ID[3]	Latitude	Longitude	Township/Range Section ID[1]	Owner Description	Geologic Unit Code[2]	Well Depth (ft)	Well Elevation (ft MSL)	USGS Map No.[4]
473648118452301	473648	1184519	25/32-35P01	Wilbur Sec/ T. McPherson	122GDRD	1139	2135	407
474159118360101	474154	1183605	25/33-01B01	Richard Dreger	122WNPM	60	2280	408
473829118381901	473829	1183822	25/33-27A02	Ernest Rettkowski	122CBRV	865	2320	409
474142118235501	474142	1182355	25/35-03E01D1	Dick Scholl. [illegible] St. Hwy.	122WNPM	200	2345	410
473913118261702	473915	1182620	25/35-20D01	Everett Cole	122CBRV	410	2250	411
473754118152001	473754	1181520	25/36-27Q01	Laurence E. Ensor	122WNPM	324	2368	412
473848118091901	473848	1180919	25/37-21L04	City of Davenport/ Schillinger	122GDRD	975	2410	413
473832118081801	473819	1180818	25/37-27E01	Gary Newcomb & Gunning	122WNPM	100	2420	415
473946118003701	473935	1180038	25/38-15N01	Leslie D. Bennett	122WNPM	121	2480	--
474346120023801	474259	1200132	26/22-25N01	Tony Long	122GDRD	325	2855	--
474337118454201	474336	1184542	26/32-26D01	James F. Rosman	122WNPM	166	2060	--
474556118431101	474557	1184308	26/33-07E01	Evan Jenson/Bg Bnd Glf	122WNPM	154	2160	--
474435118425401	474435	1184254	26/33-19D01	Earl Ferguson	122CBRV	233	2175	--

1) Township(N)/Range(E)-Section with subsection designation.
2) CBRV = Columbia River Basalt Group; GDRD = Grande Ronde Basalt; WNPM = Wanapum Basalt.
3) Source: USGS WATSTORE header-file retrieval (February 4, 1986).
4) See Fig. 2.11.

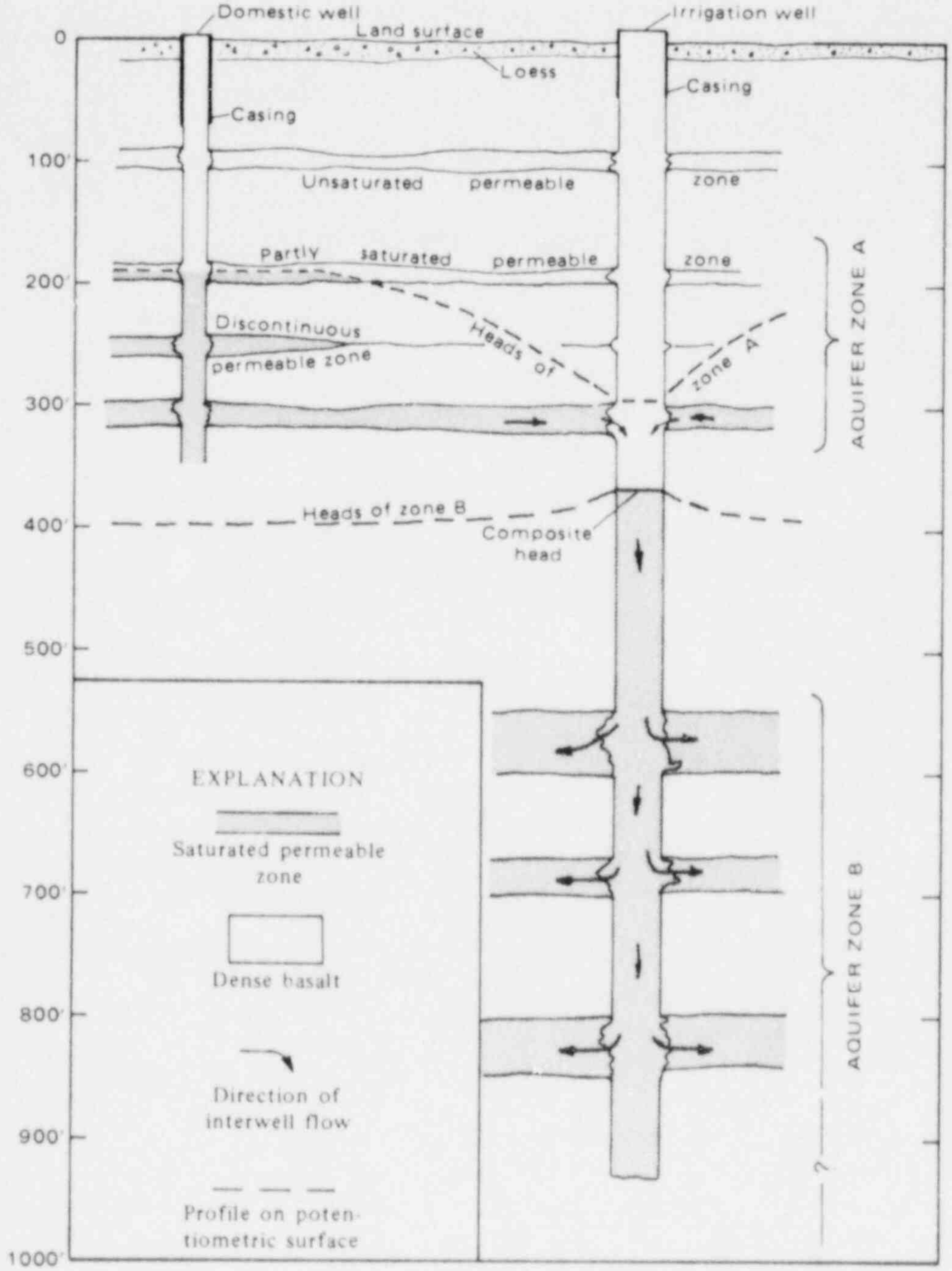


Fig. 2.12. Generalized schematic diagram showing wellbore as a conduit for interaquifer flow (from Luzier and Skrivan, 1975).

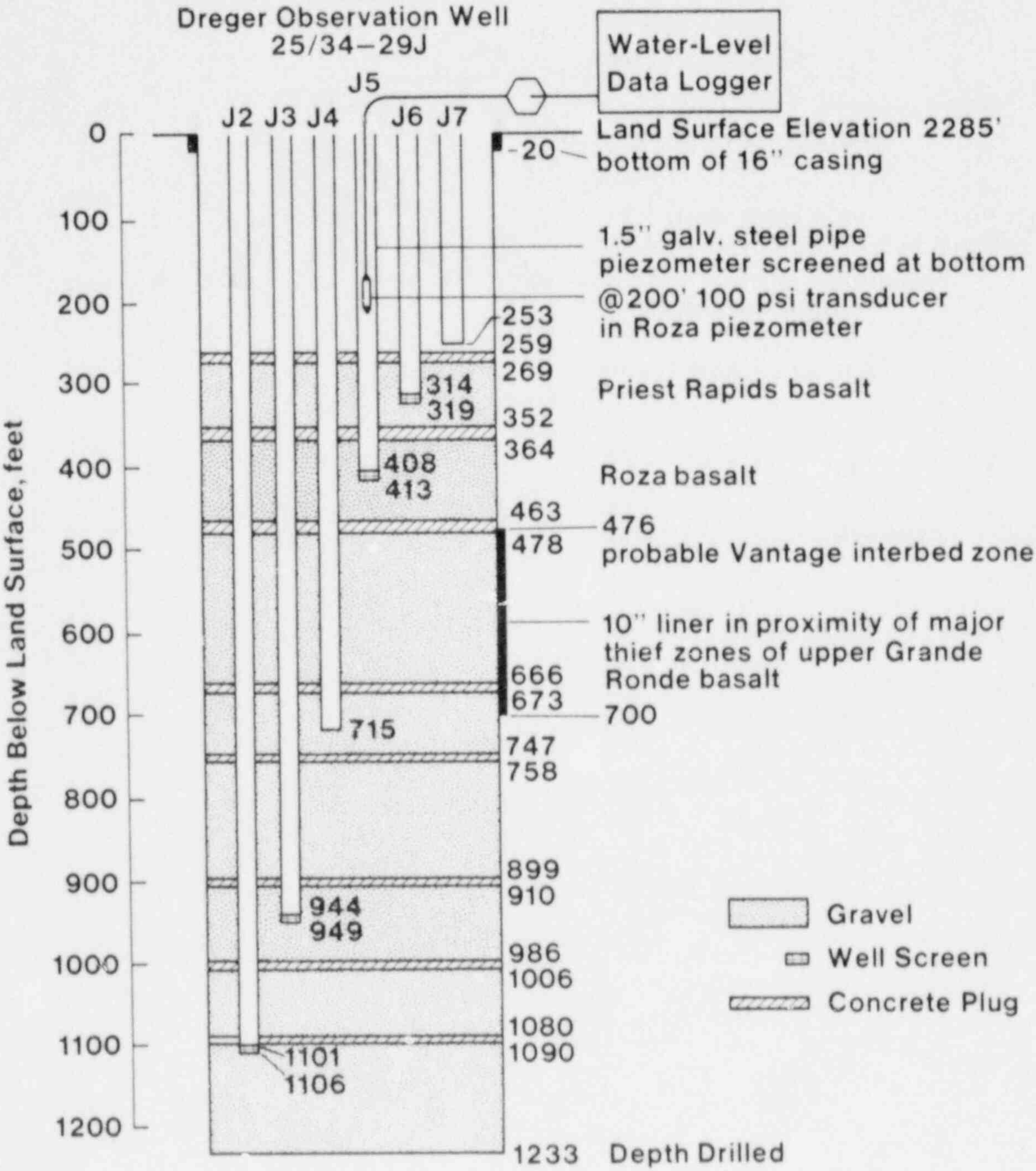


Fig. 2.13. Diagram of aquifers and multiple piezometers. Well 25/34-29 (Dreger observation well), J2-J7, showing water-level monitoring of piezometer J5 (after Olson, 1984).

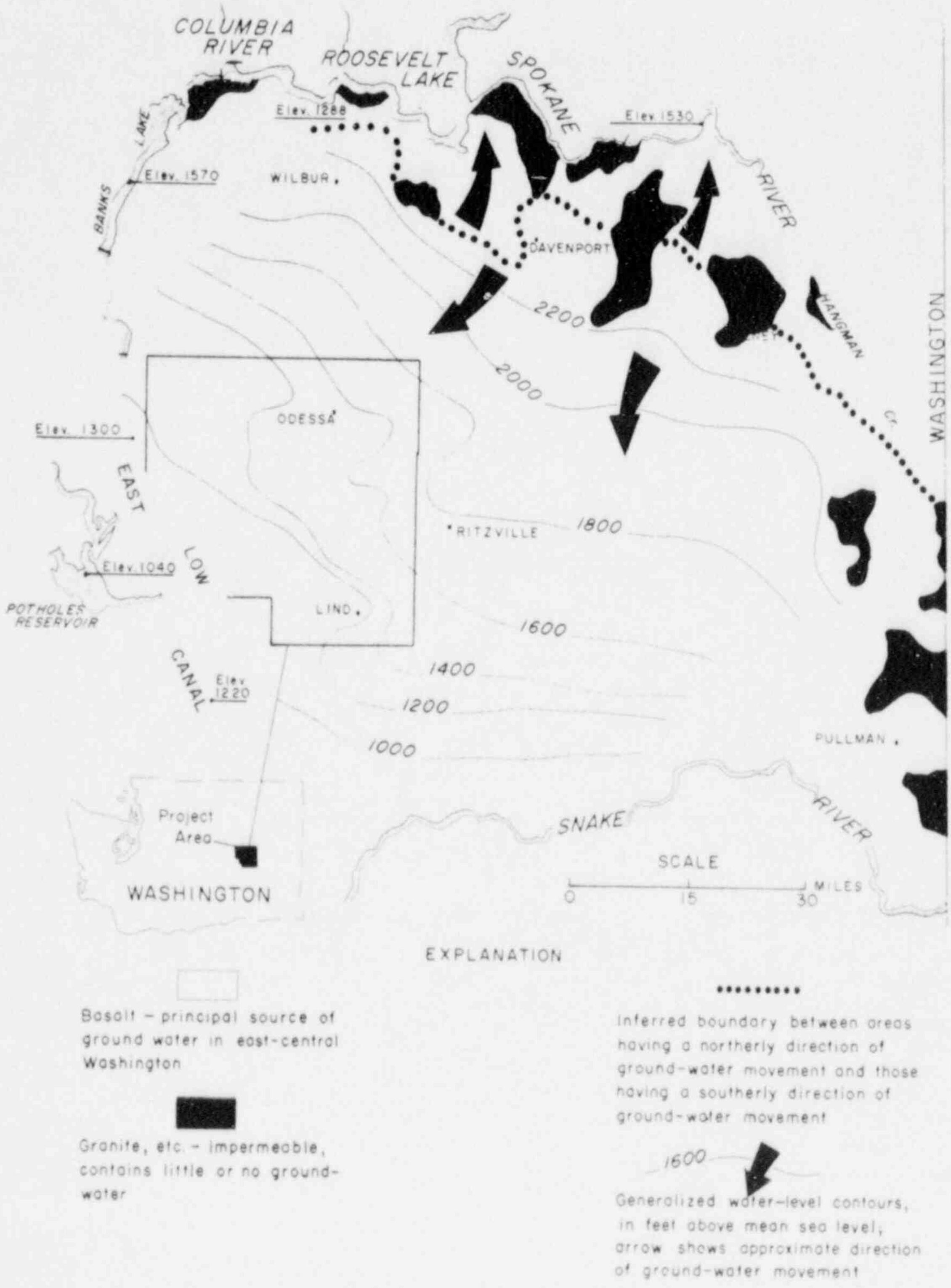


Fig. 2.14. Regional movement of groundwater in east-central Washington (from Luzier and others, 1968).

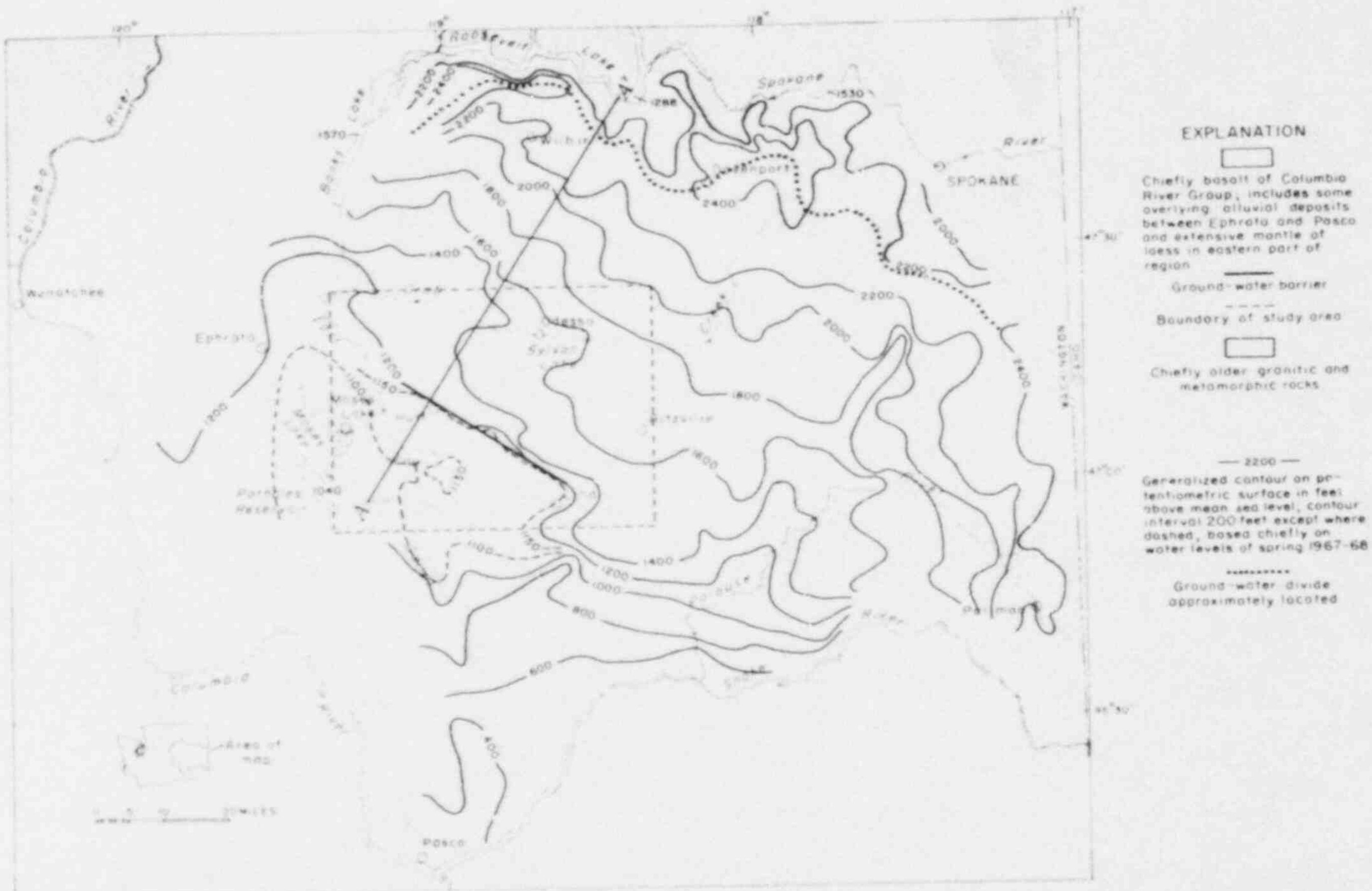


Fig. 2.15. Potentiometric surface map of east-central Washington (from Luzier and Skrivan, 1975). Cross-section A-A' is show in Fig. 2.18.

side flow northward to the Spokane River and Columbia River (Roosevelt Lake) and on the southern side (the bulk of the study area) southwestward to the Columbia River. However, generalized groundwater flow patterns in the Wanapum Formation and Grande Ronde Formation basalts depicted by Hearn and others (1985) omit the groundwater divide (Fig. 2.16). Other recent water-level contour maps for the Wanapum Formation aquifer show a groundwater divide in the general area shown in Figs. 2.15 and 2.16 (Bauer and others, 1985, Plate 3). Data were lacking for a similar occurrence in the Grande Ronde Formation aquifer (Bauer and others, 1985, Plate 4) in this part of the study area.

2.3.2 Site-Specific Data

Based upon available records, seasonal variations in water levels in the 51 wells located in the specific study area (see Section 2.2.1) are summarized in Table 2.4. Data are lacking for some of the three-month periods for many of the wells; wells are completed in various intervals penetrating different aquifers. A water-level-contour map for the study area (Fig. 2.17) was developed using elevations of springs and March-through-May data (to the extent possible) from wells less than 400 feet deep. These data reflect general contours of the shallow aquifers in the Wanapum Formation basalt. Insufficient data are available to develop a contour map of water levels for the deeper Grande Ronde Formation basalt aquifers.

The areal pattern and elevations of the water-level contours in the study area appear to be consistent with the generalized regional contours shown in Figs. 2.14 and 2.15. Groundwater generally flows northward in the northern third of the study area and southwestward in the southern two-thirds. However, the influence of topographic features on the contours is much more prominent at the smaller scale of Fig. 2.17. Patterns of surface drainage and groundwater flow in the shallow Wanapum Formation basalt aquifers are similar.

Water-level data from the USGS multiple piezometer nest, located about 4.5 miles southwest of the Creston site (Fig. 2.9, reference numbers 29 and 32 through 37, and Table 2.4), support the concept of downward groundwater movement from the Wanapum Formation basalt to the Grande Ronde Formation basalt, as indicated in Fig. 2.18. The Grande Ronde Formation basalt underlying the site is about 350 feet below the land surface, and water levels of the Grande Ronde Formation aquifers, based upon recent limited data, are about 50 feet lower than those of the Wanapum Formation.

The DOE water-level records, summarized in Table 2.5, were compared with the data used to develop the water-level contours on Fig. 2.17. Relevant data from the two sets of records appear to be compatible. Some more recent reconnaissance-level data collected for this study are tabulated for the Tera wells and the Dreger observation well piezometer cluster in Appendix Table A.3.

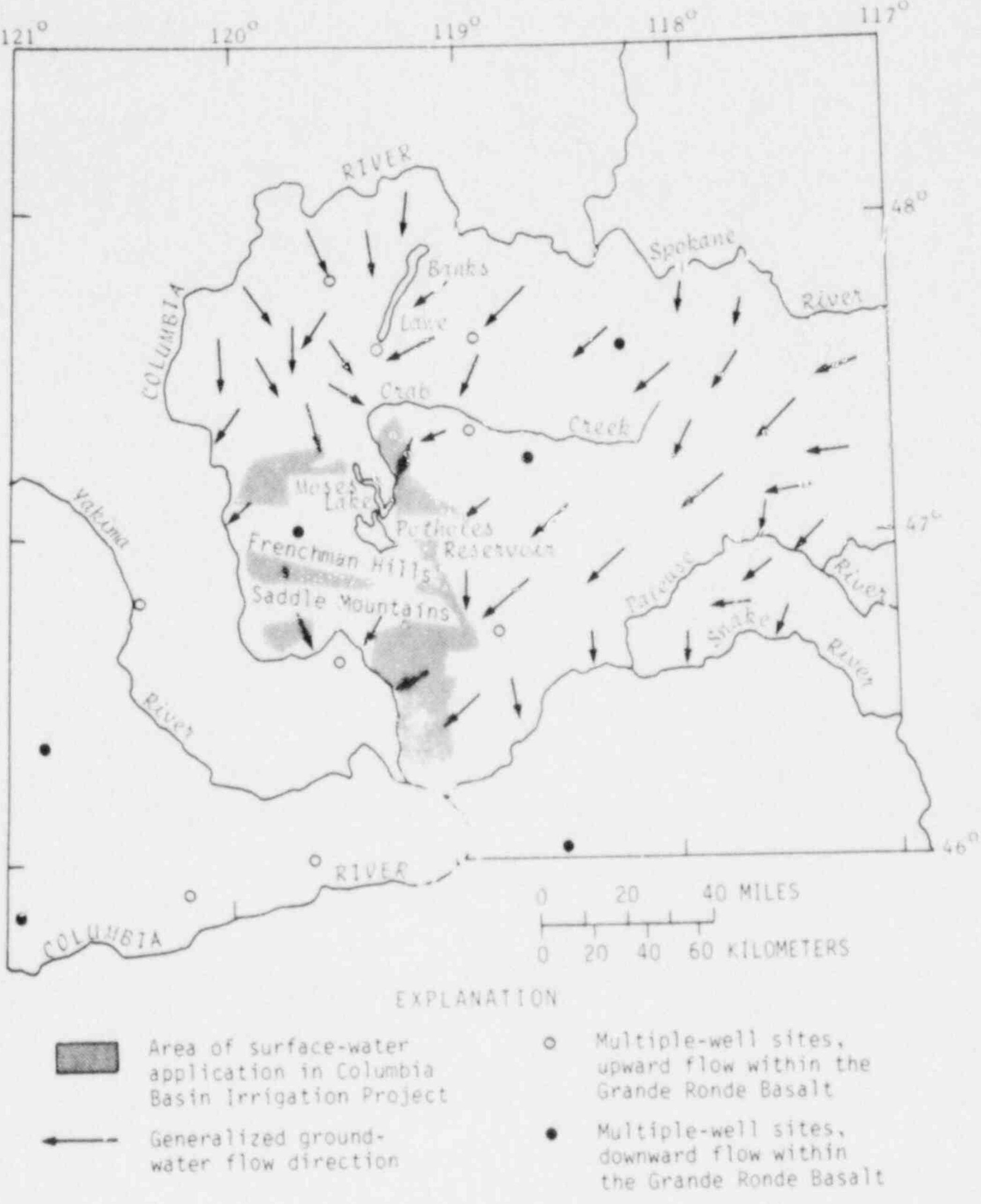


Fig. 2.16. Generalized groundwater flow, Wanapum and Grande Ronde Basalts, Columbia Plateau Region (from Hearn and others, 1985).

TABLE 2.4

SUMMARY OF WATER-LEVEL RECORDS, USGS AND TERA CORPORATION STUDY-AREA WELLS

Township/Range Section ID[1]	Depth to Aquifer	Aquifer Altitude (ft)	Depth of Well (ft)	Depth to First Opening (ft)	Contributing Depth (ft)	Water Level Measurement Date(s)	Land Surface Altitude (ft)	Seasonal Water Levels (ft MSL) Sept-October	Dec-Jan	March-April	June-July	Average Water Level (ft MSL)	Map Well No.[2]
25/33-01B01	0	2280	60	24	24-60	7/1948	2280	--	--	--	2276.0		2
25/33-12K01	?	?	202	25	25-202	11/19/1966	2245	--	--	--	--		3
25/34-02	?	?	140	19	19-140	Quarterly 1980-1982	2319	2267.7	2275.0	2255.8	2282.4		P4
25/34-02C01	?	?	610	52	52-610	3/21/1979	2357	--	--	2137.0	--		39
25/34-02D0101	?	?	550	300	300-550	3/25/1980	2357	--	--	2229.8	--		40
25/34-02G01	40	2300	320	60	60-320	1967-1979	2340	2245.3	--	2243.9	2226.8		4
25/34-02K01	16	2336	220	18	18-220	8/15/1980	2352	--	--	--	--		1
25/34-04K	?	?	165	145	145-165	Quarterly 1980-1982	2315.2	2264.6	2272.6	2266.6	2263.7		OW3
25/34-07H01	?	?	180	?	?	9/17/1958	2276	2240.5	--	--	--		5
25/34-09	?	?	117	90	90-117	Quarterly 1980-1982	2237.5	2225.0	2233.7	2227.3	2221.2		OW2
25/34-09F01	?	?	211	?	?	1967-1985	2243	2225.7	2233.8	2233.9	2223.7		6
25/34-18D02	0	2275	20?	30	30-200	10/1967	2275	2245	--	--	--		7
25/34-18F01	?	?	42	?	?	11/19/1966	2200	--	--	--	--		8
25/34-29C01	?	?	96	?	?	1966-1969	2271	2262.5	2262.7	2265.6	2263.6		9
25/34-29J0101	?	?	1233	22	22-1233	3/2/1983	2285	--	--	1822.0	--		29
25/34-29J02	501	1784	1106	1090	1090-1106	1983-1985	2285	1885.8	--	--	--		32
25/34-29J03	501	1784	949	944	944-949	1983-1985	2285	1739.3	--	1737.2	--		33
25/34-29J04	501	1784	715	700	700-715	1983-1985	2285	1758.2	--	1737.3	--		34
25/34-29J05	0	2285	413	364	364-413	1983-1985	2285	2123.9	--	2221.8	--		35
25/34-29J06	0	2285	319	269	269-319	1983-1985	2285	2123.9	--	2221.5	--		36

TABLE 2.4

SUMMARY OF WATER-LEVEL RECORDS, USGS AND TERA CORPORATION STUDY-AREA WELLS (continued)

Township/Range Section ID[1]	Depth to Aquifer	Aquifer Altitude (ft)	Depth of Well (ft)	Depth to First Opening (ft)	Contributing Depth (ft)	Water Level Measurement Date(s)	Land Surface Altitude (ft)	Seasonal Water Levels (ft MSL) Sept-October	Dec-Jan	March-April	June-July	Average Water Level (ft MSL)	Map Well No.[2]
25/34-29J07	0	2285	259	22	22-259	1983-1985	2285	2198.8	--	2239.2	--		37
25/34-30G01	?	?	596	304	304-596	11/05/1983	2280	--	--	--	--		38
25/34-30J01	0	2266	375	59	59-37	1968-1975	2266	2195.0	--	2235.1	--		10
25/34-30J02	40	2215	500	63	61 500	1985	2255	2157.0	--	2207.1	--		11
25/34-30K01	39	2211	265	72	72-265	1966-1980	2250	2188.5	2205.9	2214.3	2181.2		12
25/34-30K02	?	?	705	70	70-705	1966-1981	2247	2201.3	2206.1	2209.2	2173.8		13
25/34-30K0201	?	?	705	77	77-705	2/1970	2247	--	--	--	--		28
25/35-03E01	0	2345	90	22	22-90	1967-1976	2345	2299.5	--	--	--		14
25/35-03E0101	0	2345	200	91	91-200	1983-1985	2345	2302.0	--	2297.1	--		27
25/35-20D01	255	1995	410	5	3-410	1964-1985	2250	2220.5	2230.9	2236.2	2217.9		15
25/35-21H01	0	2320	100	20	20-100	8/7/1975	2320	--	--	--	--		16
26/33-12H01	40	2380	294	269	269-294	8/6/1959	2420	--	--	--	--		17
26/33-12H02	31	2390	292	267	267-292	9/15/1959	2421	2241	--	--	--		18
26/33-36P01	0	2300	350	72	72-350	2/1968	2300	--	--	--	--		41
26/34-10L01	?	?	766	15	15-766	1981-1985	2450	2301.7	--	2312.4	--		26
26/34-10N01	?	?	29	?	?	10/4/1949	2440	2431.7	--	--	--		19
26/34-10R01	?	?	80	?	?	9/18/1968	2440	2393.8	--	--	--		20
26/34-11N01	?	?	+100	?	?	9/18/1968	2441	2336.7	--	--	--		21
26/34-15D01	?	?	288	?	?	?	2400	--	--	--	--		22
26/34-15F01	?	?	455	?	?	6/30/1947	2480	--	--	--	2264.0		23

TABLE 2.4

SUMMARY OF WATER-LEVEL RECORDS, USGS AND TERA CORPORATION STUDY-AREA WELLS (continued)

Township/Range Section ID[1]	Depth to Aquifer	Aquifer Altitude (ft)	Depth of Well (ft)	Depth to First Opening (ft)	Contributing Depth (ft)	Water Level Measurement Date(s)	Land Surface Altitude (ft)	Seasonal Water Levels (ft MSL) Sept-October	Dec-Jan	March-April	June-July	Average Water Levels (ft MSL)	Map Well No.[3]
26/34-21DD1	52	2400	235	53	53-235	1979-1985	2452	2327.3	---	2321.1	---		30
26/34-27	?	?	214.5	37	37-214.5	Quarterly 1980-1982	2370	2294.4	2299.5	2298.7	2296.9		P1
26/34-27	?	?	119	100	100-119	Quarterly 1980-1982	2313.6	2278.8	2284.8	2278.2	2277.4		OW8
26/34-27	?	?	180	161	161-180	Quarterly 1980-1982	2383.3	2286.8	2290.8	2297.2	2285.5		OW3
26/34-34	?	?	142	40	40-142	Quarterly 1980-1982	2295	2274.1	2277.4	2267.0	2274.6		P2
26/34-35	?	?	165	150	150-165	Quarterly 1980-1982	2347.7	2267.9	2273.5	2269.6	2265.9		OW1
26/34-36	?	?	137	121	121-137	Quarterly 1980-1982	2370.8	2282.8	2288.3	2285.0	2287.3		OW4
26/35-15QD1	0	2424	206	115	115-206	1964-1985	2424	2296.9	2308.3	2311.5	2268.7		24
26/35-15QD2	?	?	550	55	55-550	1964-1985	2394	2311.5	2309.0	2314.0	2308.4		25
27/34-35KD1	12	2408	265	20	20-265	1983-1985	2420	2303.1	---	2305.2	---		31

1) Township(N)/Range(E)-Section with subsection designation where appropriate.
3) See Fig. 2.9.

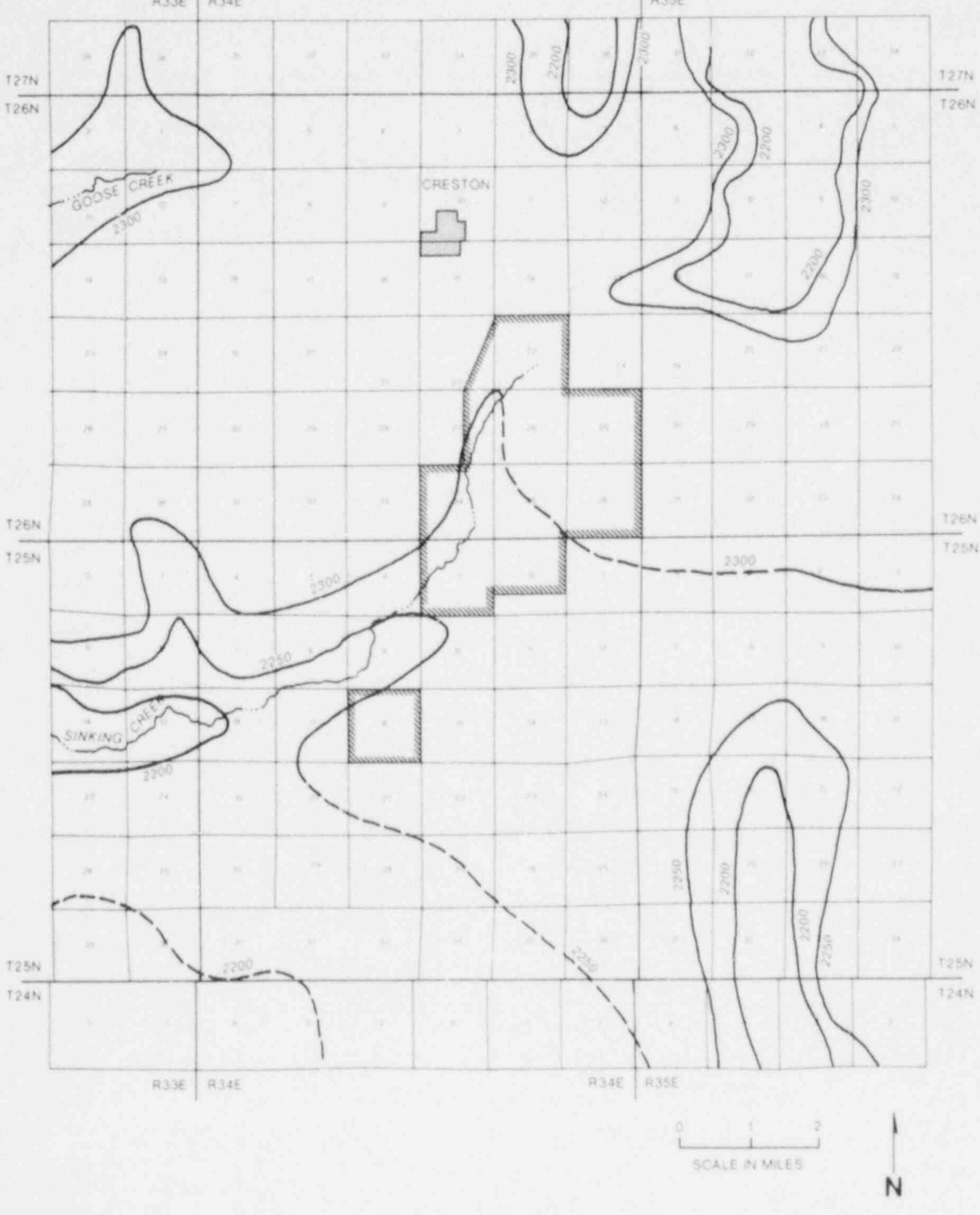


Fig. 2.17. Water-level contours of Wanapum Formation Basalt aquifer. Levels are March-through-May averages, when available. Data from Tera Corporation (1983a) and USGS WATSTORE retrieval (January 22, 1986).

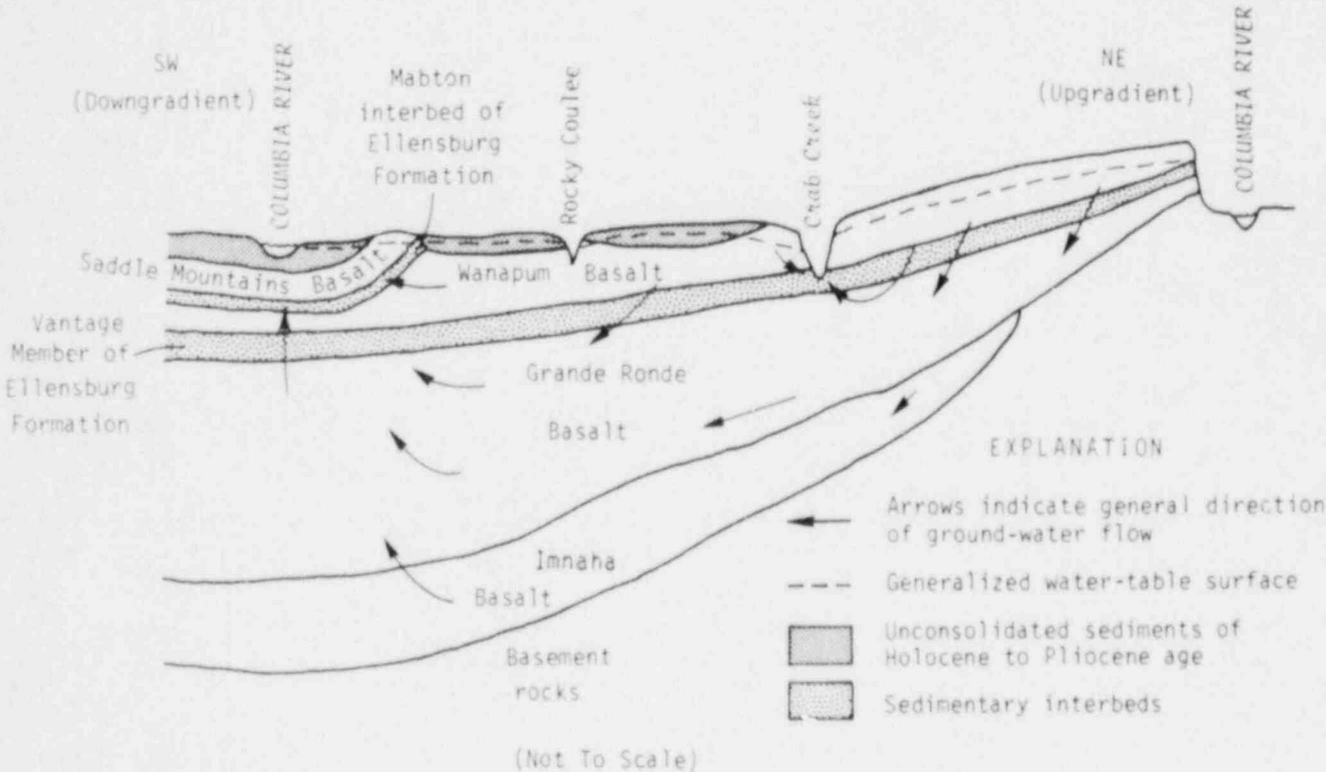


Fig. 2.18. Generalized geologic cross-section showing regional ground-water flow (modified from Hearn and others, 1985). Section location is shown on Fig. 2.15.

TABLE 2.5

SUMMARY OF WATER-LEVEL RECORDS, DOE MONITORING WELLS

Township/Range Section ID[1]	Well Elevation (ft MSL)	Seasonal Water Levels, ft MSL (Depth to water, ft) Sept-Oct	Dec-Jan	March-April	June-July	Average Water Level ft MSL (ft Δ)	No. of Values
25/32-12J1	2100	2072.4 (27.6)	2062.6 (34.4)	2081.1 (18.9)	2068.8 (13.2)	2075.8 (24.2)	22
25/33-05C1	—	— (20.1)	— (18.8)	— (19.2)	— (23.9)	— (20.0)	25
25/33-12P	—	— (7.0)	— (6.2)	— (5.0)	— (6.5)	— (5.9)	15
25/33-20B	—	— (164.6)	— (149.7)	— (—)	— (—)	— (157.5)	5
25/33-20D	—	— (198.8)	— (186.6)	— (174.8)	— (182.6)	— (186.9)	9
25/33-27A1	2315	2004.1 (310.9)	2017.0 (298.0)	2025.8 (289.2)	2012.2 (302.8)	2016.6 (298.2)	28
25/33-27A2	2320	1975.2 (342.8)	2008.0 (310.0)	2018.4 (299.6)	1949.4 (368.6)	1989.7 (328.3)	20
25/34-02C01	2357	2213.5 (143.5)	2219.3 (137.7)	2226.2 (130.8)	2214.3 (142.7)	2219.2 (137.8)	17
25/34-02G01	2340	2237.4 (102.6)	2240.7 (99.3)	2244.6 (95.4)	— (—)	2241.9 (98.1)	11
25/34-07N01	2276	2241.9 (34.1)	2241.6 (34.4)	2245.2 (30.8)	2243.3 (32.7)	2242.9 (33.1)	24
25/34-11G1	2275	2261.2 (13.8)	2262.7 (12.3)	2267.6 (7.4)	2265.0 (10.0)	2264.7 (10.3)	25
25/34-29C01	2230	2221.8 (8.2)	2217.7 (12.3)	2223.2 (6.8)	2224.0 (6.0)	2221.5 (8.5)	28
25/34-29J	2285	1973.1 (311.9)	2014.6 (270.4)	2017.7 (267.3)	1971.5 (313.5)	1990.6 (294.4)	12

TABLE 2.5

SUMMARY OF WATER-LEVEL RECORDS, DOE MONITORING WELLS (continued)

Township/Range Section ID[1]	Well Elevation (ft MSL)	Seasonal Water Levels (ft MSL) something from TDS (ft) Sept-Oct	Dec-Jan	March-April	June-July	Average Water Level ft MSL (ft Δ)	No. of Values
25/34-30K01	2250	2216.3 (33.7)	2214.6 (35.4)	2217.8 (32.2)	2211.7 (38.3)	2215.9 (34.1)	24
25/34-30K02	2247	2215.3 (31.7)	2214.1 (32.9)	2217.1 (29.9)	2210.8 (36.2)	2215.1 (31.9)	24
26/33-36A	2398	2316.7 (81.3)	2314.6 (83.4)	2311.7 (86.3)	2312.9 (85.1)	2313.9 (84.1)	20
26/34-34G	2288	2283.2 (4.8)	2286.0 (2.0)	2289.5 (-1.5)	2286.0 (2.0)	2285.4 (2.6)	9

1) Township(N)/Range(E)-Section with subsection designation. See Table 2.2.

2.3.3 Data Synthesis

The preliminary water-level analyses discussed above are subject to uncertainties introduced by complex geology and well-construction practices. Further data analysis should focus on available well-construction information correlated with well-log information indicating water-bearing zones. Consideration should be given to detecting possible inter-aquifer hydraulic communication through open-hole wells, which may influence the design and interpretation of pumping or tracer tests at the site.

2.4 Water-Quality Characterization

The following sections discuss the data sources for assessing water-quality conditions, followed by a general data synthesis to develop an overall water-quality characterization of the groundwater in the study area as well as the region.

2.4.1 Tera Corporation

As part of a program to collect baseline data, Tera Corporation conducted on behalf of the Washington Water Power Company a total of seven water-quality surveys during 1980-1982 by sampling four designated pumping wells (P-1 through P-4) and six designated observation wells (OW-1 through OW-5 and OW-8) in the study area south of the Town of Creston (Fig. 2.9). These data are summarized in Appendix Table A.4. The types of chemical constituents included indicator field measurements (pH, temperature, and specific conductance), major ion species, nutrients, numerous trace metals, gross radioactive (alpha and beta) indicator measures, and indicators of sanitary quality (Tera Corporation, 1983a).

2.4.2 USGS Investigations

A 1972 regional study (Newcomb, 1972) described general water-quality characteristics of groundwater in the basalts of the Columbia River Group in the three-state area of Washington, Oregon, and Idaho (see Section 2.1.3). As part of a recent regional study (Hearn and others, 1985), the USGS sampled numerous wells in the Columbia Basalt Plateau during three surveys: summer 1982, spring 1983, and summer 1983. Selected data are reported in Appendix Table A.5. More extensive data are found in the USGS WATSTORE system. Constituents analyzed involved indicator field measurements (pH, temperature, and specific conductance), the major ion species, nitrate, silica, and iron.

2.4.3 WSU Study

Silar (1969) reported chemical-composition analyses for 51 samples collected throughout the Columbia Basalt Plateau and obtained from other sources. These data were summarized using a Piper diagram (Fig. 2.19), and are reported in Appendix Table A.6. The bulk of the samples were characterized as a calcium-bicarbonate-type water (Fig. 2.20), con-

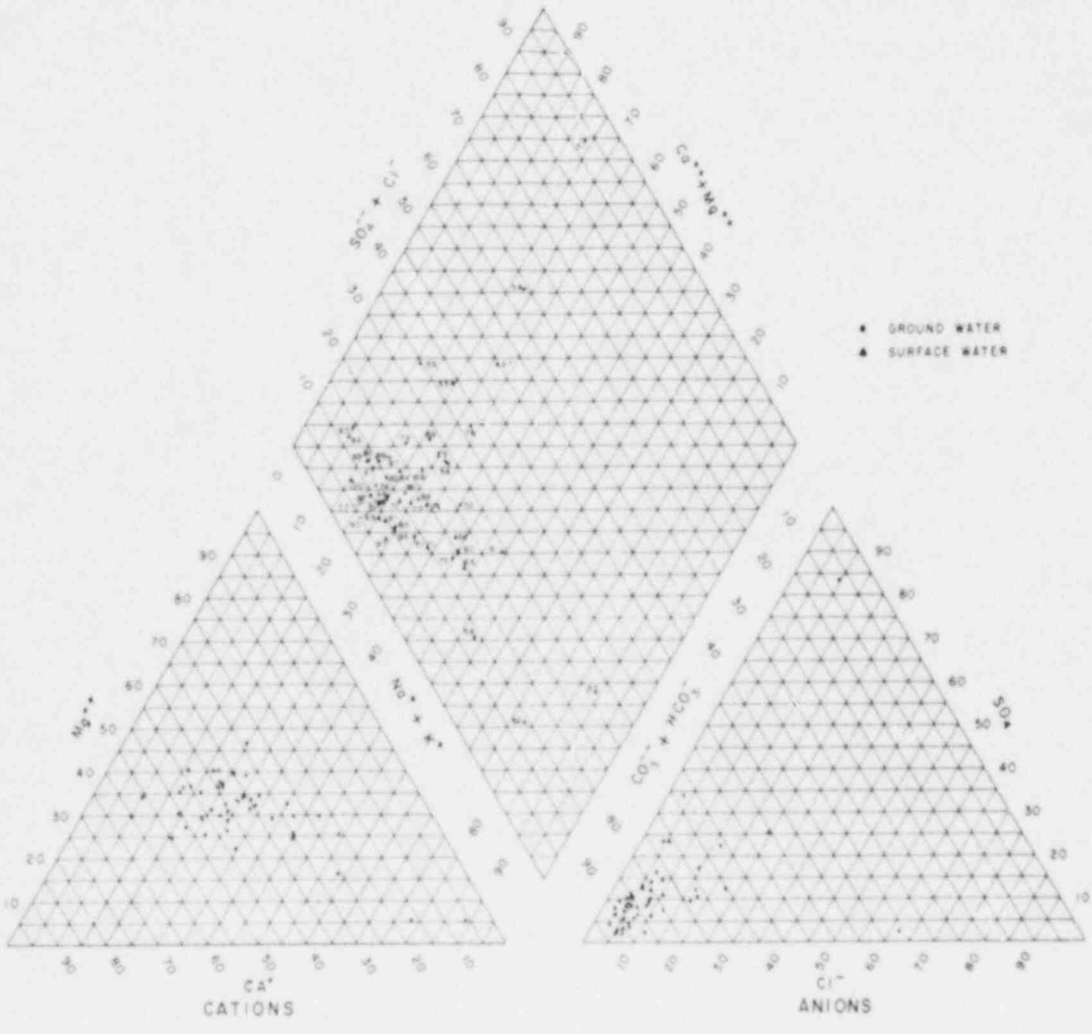


Fig. 2.19. Piper diagram, water-quality data from WSU study (from Silar, 1969). Well numbers referred to in Appendix Table A.6.

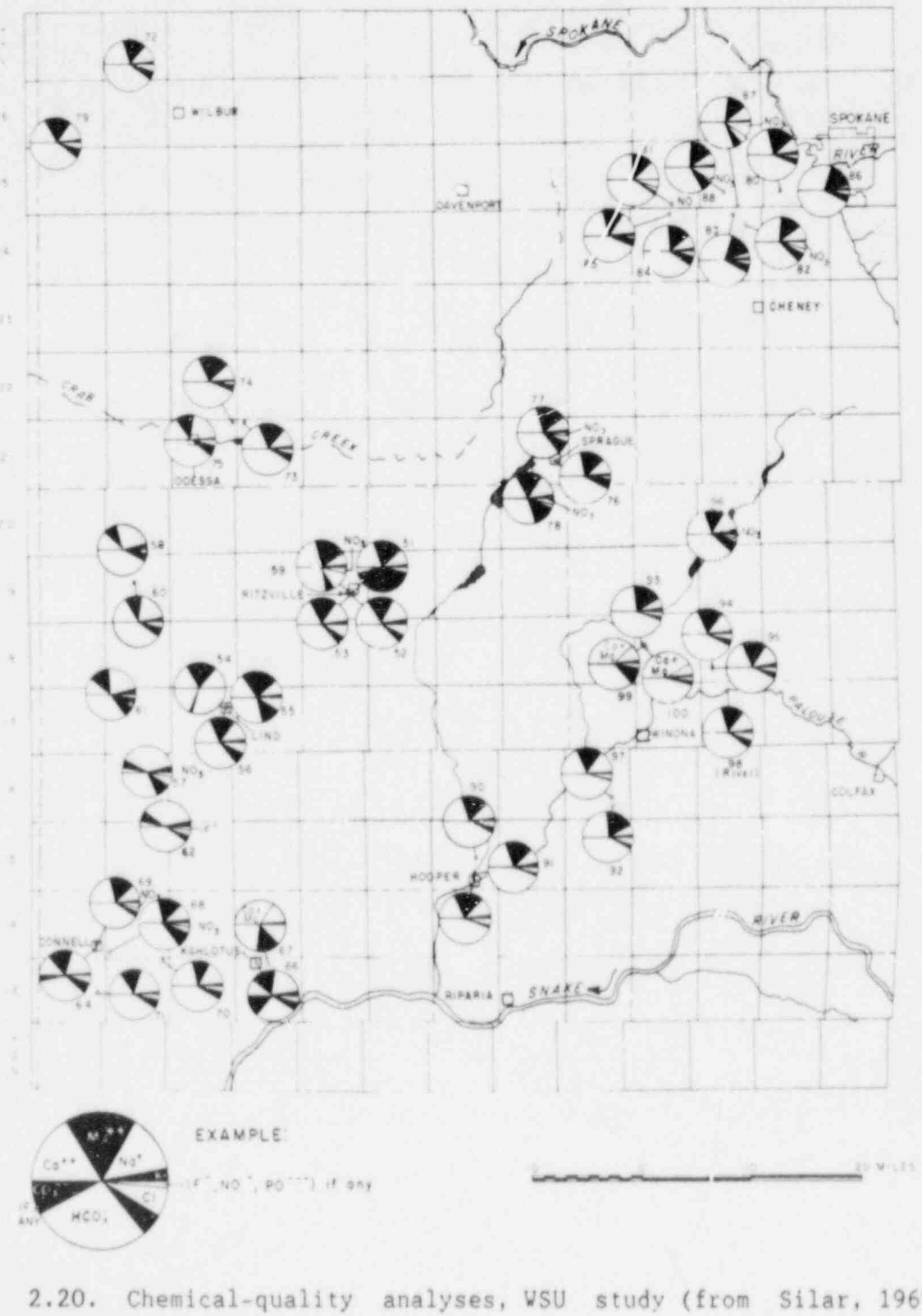


Fig. 2.20. Chemical-quality analyses, WSU study (from Silar, 1969).

sistent with data collected as part of a more recent USGS study (Hearn and others, 1985).

2.4.4 State of Washington Department of Social and Health Services

Selected chemical (predominantly trace-metal) analyses have been reported for six municipal water-supply wells in and around the study area (Appendix Table A.7). These data were obtained from files of the State of Washington's Department of Social and Health Services office in Spokane.

2.4.5 Data Synthesis

In summary, despite the availability of region-wide water-quality data, the complexity of the basalt's flow system precludes insight locally in the Creston study area as to flow patterns and origins of water. Further analysis of the data in conjunction with consideration of details of well construction and completion in more distinct aquifers in the basalts has been designated an essential part of recent field investigations and wellfield implementation to be discussed in a subsequent study report.

2.5 Geophysical Logs

A total of 124 geophysical logs are available at Washington State University for the four-county area of the eastern Columbia Basalt Plateau (Appendix Table A.8). These are distributed by county (see Fig. 1.1) as follows:

Lincoln County	34
Spokane County	9
Adams County	29
Grant County	52
Total	124

Though several sets are incomplete, each suite of about 10 logs commonly includes neutron (neutron or gamma), caliper, and flow-meter logs. This total includes logs for the Cheney Well No. 5, for which drill core also is available. A typical set of borehole logs is shown in Fig. 2.21.

2.6 Isotopic Data

Data on naturally occurring radioisotopes are available from two known sources in the general Columbia Basalt Plateau region. A major focus of a WSU study (Silar, 1969) was analysis of radiocarbon dating for wells sampled in the eastern Columbia Basin (Fig. 2.22). These data are summarized in Appendix Table A.9. Data on O^{18}, C^{14}, and H^3 were collected on selected samples as part of the USGS water-quality surveys (Hearn and others, 1985). These data are summarized in Appendix Table A.10.

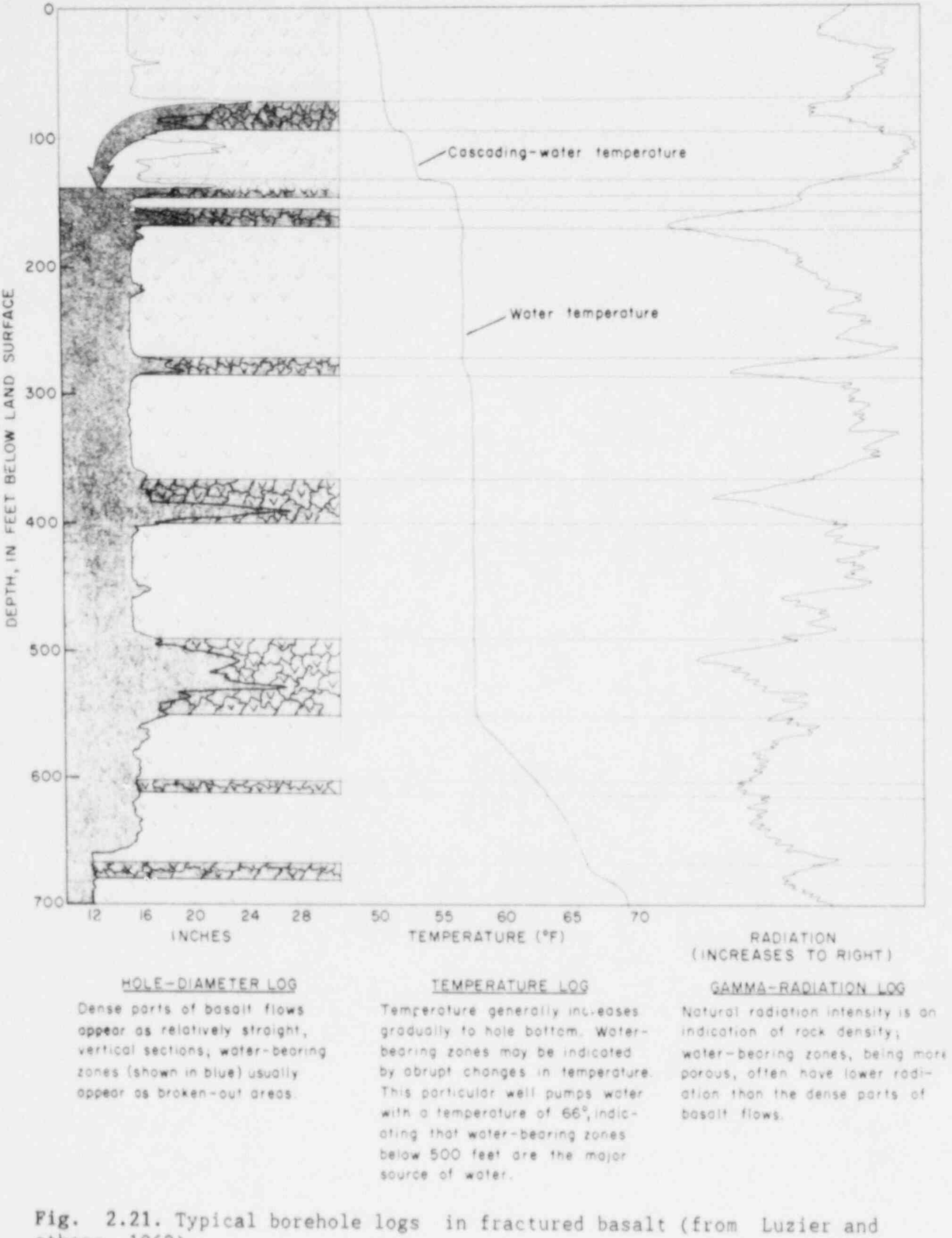


Fig. 2.21. Typical borehole logs in fractured basalt (from Luzier and others, 1968).

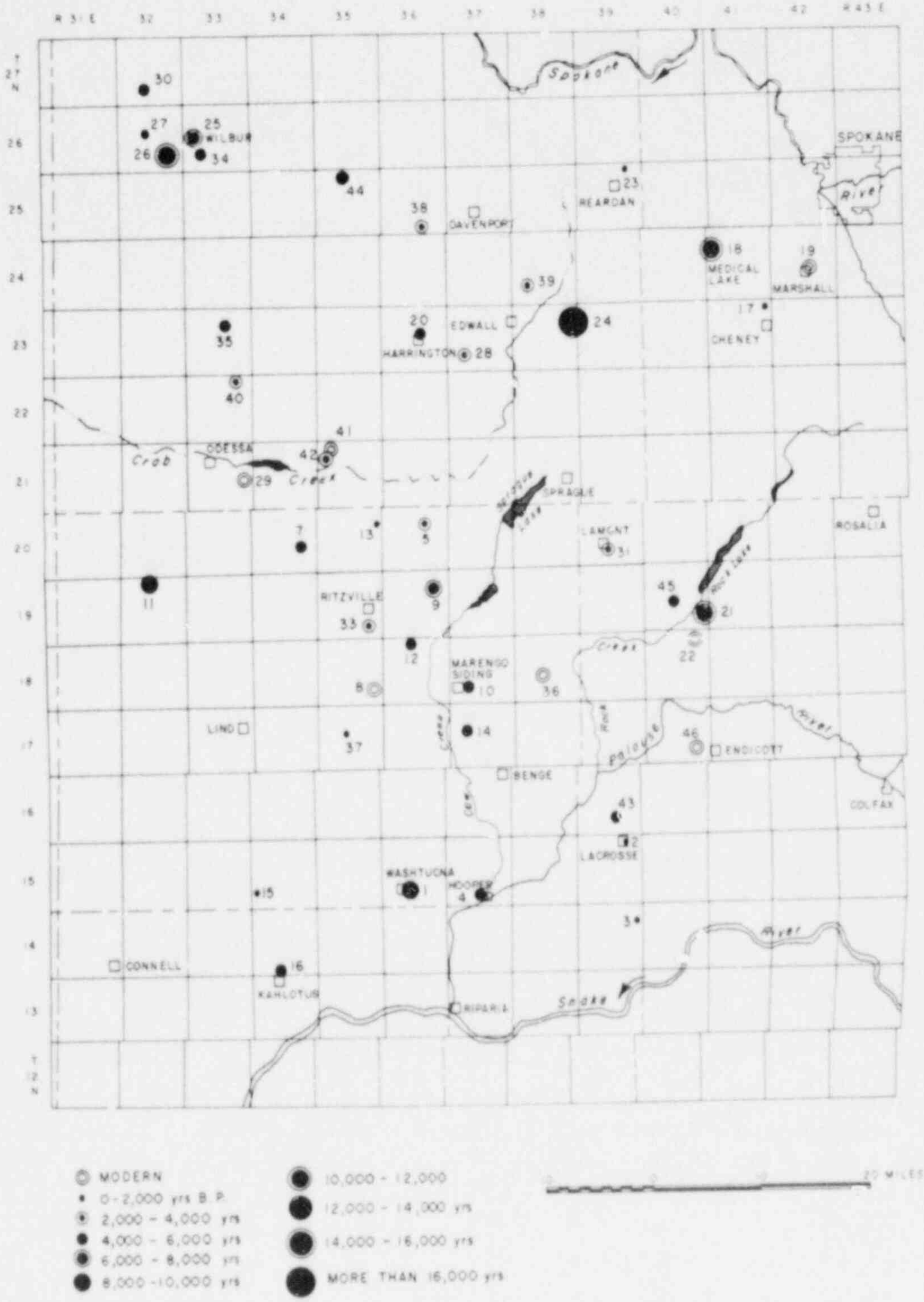


Fig. 2.22. Radiocarbon ages of regional groundwater, southeastern Washington (from Silar, 1969).

2.7 Aquifer-Test Information

Because several basalt units have been interconnected by open-hole wells commonly completed in the northern Columbia Plateau region, the results of aquifer tests completed in the study area and in surrounding areas are difficult to interpret. Additionally, fracturing and flow-top areas influence the flow of water within and between the basalt units. Estimates of transmissivity by the USGS (Luzier and Skrivan, 1975) for the area southwest of the study area range from 20,000 to 60,000 gallons per day per foot (gpd/ft). Values of storativity were estimated to range from 2×10^{-3} to 6×10^{-3}/ft. In the Sinking Creek area, Wildrick (1982) estimated an average transmissivity of 12,000 gpd/ft.

An aquifer test performed by DOE in March 1980 (Wildrick, 1982) resulted in the following aquifer characteristics:

Well	Transmissivity	Storativity
Houger pumping well (T.25N, R.34E, 2G1)	90,000 gpd/ft	4×10^{-5}/ft
Houger observation well (T.25N, R.34E, 1F1)	580,000 gpd/ft	6×10^{-5}/ft

A pumping test of the Rettkowski well (T.25N, R.33E, 27H2), located along Sinking Creek south of Wilbur (Wildrick, 1985), yielded an estimated transmissivity of 26,000 gpd/ft, and a storativity of 2×10^{-4}/ft.

A number of bailer and pumping tests were performed on the study site by Tera Corporation (1983b) to estimate the properties of flow tops A and B (which they called "first shallow aquifer" and "second shallow aquifer," respectively) in the Priest Rapids Member of the Wanapum Formation. Transmissivities of the flow tops ranged from 16,000 to 80,000 gpd/ft, and averaged about 42,000 gpd/ft. Values of storativity ranged from 1×10^{-3} to 8×10^{-6}/ft, and averaged about 2×10^{-4}/ft. Tera Corporation did not attempt to study the vertical permeability of the dense basalt between the two flow tops in the Priest Rapids Member.

Bauer and others (1985) have proposed that the primary flow direction in the dense basalt is vertical along columnar fractures, whereas the primary flow direction in the flow tops is horizontal. Therefore, additional testing is needed to define directional transmissivities, including a delineation of horizontal and vertical values. Also, both the flow tops and dense interior basalts should be investigated. Presently, the porosity of the dense basalts and flow tops of the northern part of the Columbia Plateau region is largely unknown.

2.8 Geomorphic Setting

Most of the topographic relief in the Creston study area is generally confined between altitudes of 2250 and 2450 feet (ft) above mean sea

... (MSL). Nearby Creston Butte is visibly higher, reaching its peak t . 6 ft MSL. The present landform is a result of catastrophic erosion by the Spokane Flood on underlying Columbia River basalts (Baker, 1981). Following deposition of glaciofluvial sediments, wind deposition of loess has provided arable cropland that presently is irrigated from aquifers within the underlying basalts. Agricultural production generally consists of extensive areas of wheat, barley, and alfalfa (Fig. 2.23) . Within the study area, however, 80 percent of the land is used for livestock grazing (Fig. 2.23). These areas are covered principally by sage, shrub, and grasses. Sinking Creek is the main surface drainage for the study area; Sinking Creek's flow forms waterfowl wetlands or low-gradient streams and frequently disappears locally beneath flat pasturelands.

2.9 Stratigraphy

A general surficial geologic map of the Creston study area is shown in Fig. 2.24. Four crystalline formations are mapped, although Holocene loess, cultivation, wetlands, and vegetation limit the geologic exposures. The geologic map shows essentially bedrock. Those parts of the Wanapum Formation basalt covered by sediments are not delineated. Sedimentary cover may persist to depths of more than 50 ft. The limited relief permits observation of only discontinuous parts of each formation.

Outcropping of a complete basalt cooling unit occurs very rarely in the study area. Most often obscured are the flow contacts, which apparently disaggregate more easily, promoting soil and vegetation development. Better exposures can be seen at selected locations along Sinking Creek. The Wanapum Formation, a basalt estimated to be 300 ft thick, underlies the majority of the study area. Subsequent drilling and hydrologic analyses have concentrated on the lower part of this formation. Where exposed, this formation is comprised of a series of basalt cooling units, each with thicknesses of a few tens of feet.

The Grande Ronde Formation basalts, immediately underlying the Wanapum Formation, are at least 600 ft thick underlying the Creston study area, based on exposures near the Columbia River to the north of Creston observed during field reconnaissance visits during the spring of 1986. The Grande Ronde Formation is exposed several miles northeast of the study area below the head of Welsh Creek. This unit is comprised of much thicker cooling units and was the earliest basalt to cover much of the basement rock in the study area (Swanson and others, 1979b).

The crystalline basement rocks are the unnamed micaceous q : zite of Creston Butte and an intruding granitoid possibly related to the Idaho Batholitic event (Swanson and others, 1979b). Contacts of the Wanapum Formation basalts with the basement rocks also are obscured. A generalized geologic cross-section across the northern edge of the study area is shown in Fig. 2.25.

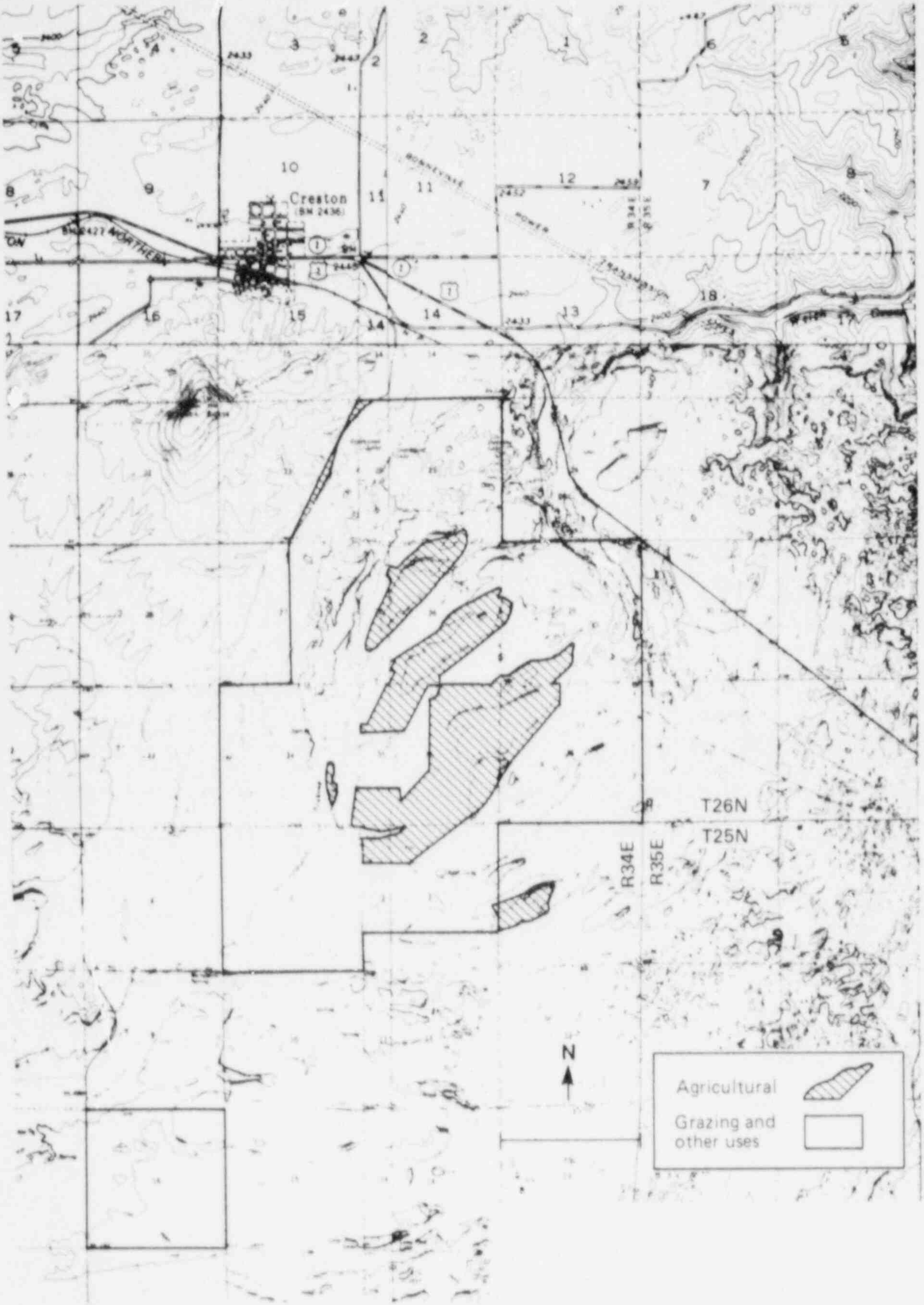


Fig. 2.23. Map showing areal land-use patterns, Creston study area.

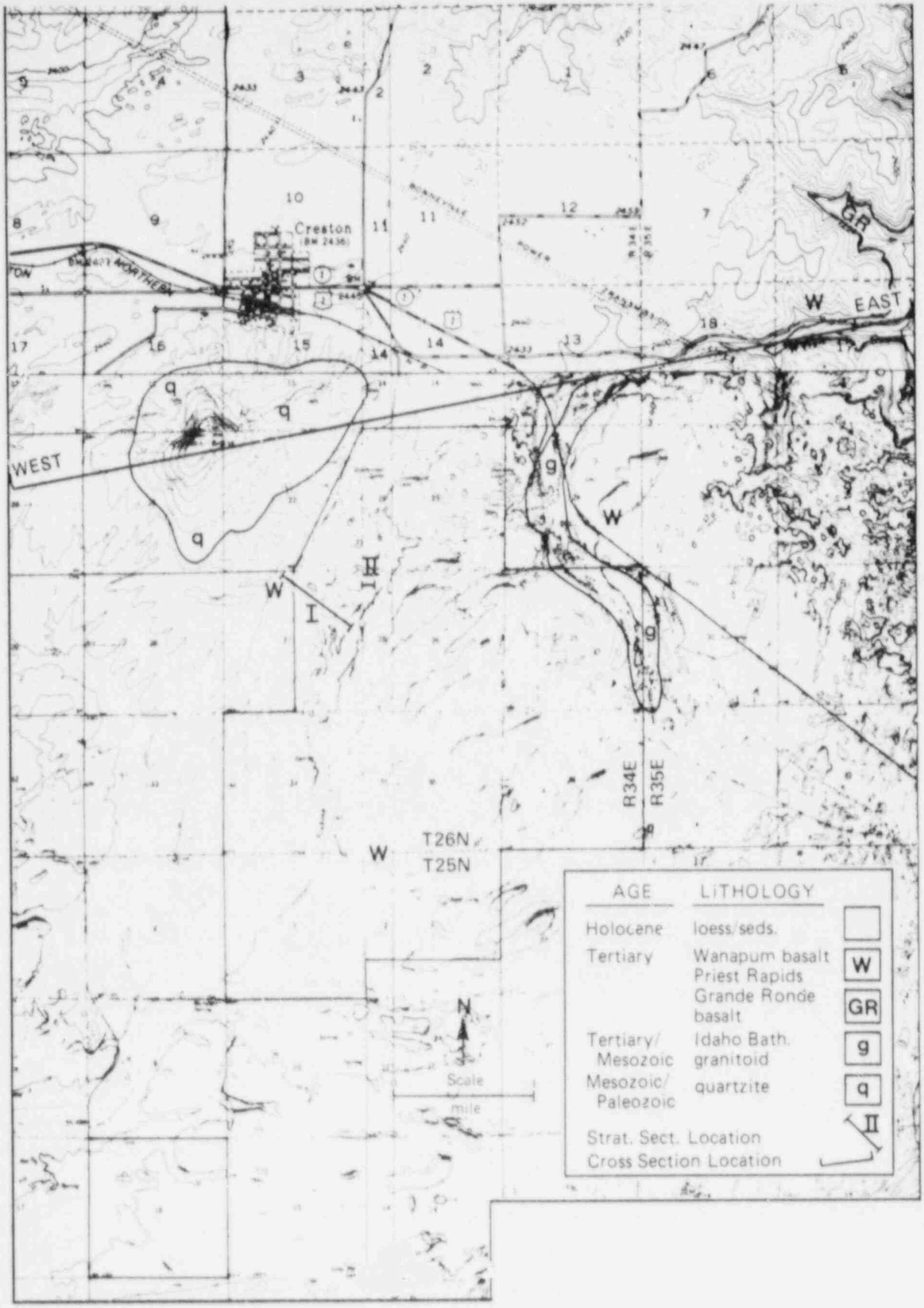


Fig. 2.24. Surficial geologic map, Creston study area (after Swanson and others, 1979b). The indicated geologic cross-section is shown in Fig. 2.25, stratigraphic se ions in Figs. 2.27, 2.28, and 2.30.

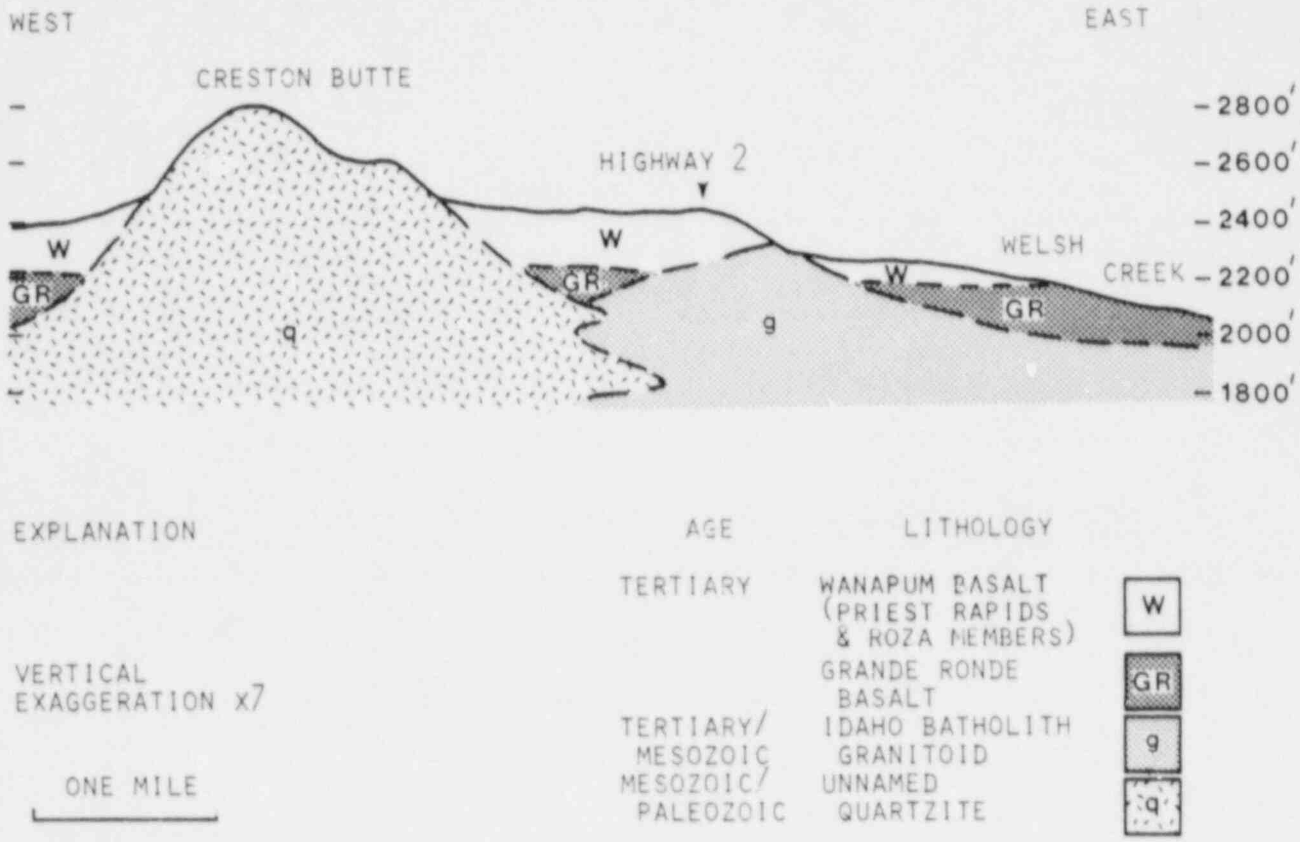


Fig. 2.25. Geologic cross-section, Creston Butte to Welsh Creek. Section location is shown on Fig. 2.24.

2.10 Measured Stratigraphic Sections

Three stratigraphic sections were measured as a part of preliminary reconnaissance-level field investigations during April and May 1986. The locations of two of these are shown in Fig. 2.24, and a third is five miles northeast of the study area. For these sections, an attempt was made to quantify the intensity of fracture development in terms of frequency (fractures per meter) along the horizontal (H) and vertical (V) directions. Present-day weathering increases the surficial fracture frequency and affects fracture filling and widening. Miocene paleo-weathering also could have similarly affected both the Wanapum Formation and Grande Ronde Formation basalt flows. The basalt deposition occurred over a three-million year period ending 13.5 million years ago for the Wanapum Formation (Hooper, 1982). Vertical fractures are usually prominent, extending five feet or more, and are typically associated genetically with the colonnade part of the lava flow's cooling history. A photograph showing a cross-sectional perspective of colonnade cooling fractures is shown in Fig. 2.26. Water flows would likely be downward in the colonnade (Bauer and others, 1985). Horizontal fractures are generally less persistent but of greater frequency, and are formed throughout the flow unit. They are especially prominent in the basal chilled zone. Vesicular basalt overlying the dense, massive colonnade generally is characterized by shorter, randomly oriented fractures.

The vesicular basalt, originally containing volcanic gases, develops a texture of small (~1 mm or less), widely separated bubbles which grade upward, becoming larger (~10 mm across or more) and more closely spaced. The enlargement of these vesicles and their increasing number undoubtedly reflects a response to upward decreasing confining pressure on the lava. After lithification, this provides evidence that both the upward direction and the atmospheric side of the flow are being approached. Where this texture was observed, it is described as normal zoning. During the next lava depositional event, the contrasting dense, massive colonnade texture would be developed. This obvious textural change was helpful in identifying flow-contact proximities. This relationship has been used only to a limited extent, as shown on available drillers' logs obtained from the offices of the Washington State Department of Ecology in Spokane. At the top of the flows, the relatively intense degree of vesicular development often has decreased the basalt density by as much as an estimated one-fourth of its normal density.

In Stratigraphic Section I (Fig. 2.27), the outcropping basalt lithology was measured from Sinking Creek southeastward toward Tera well OW-3. Using the basalt textural change as an indication, flow contacts probably exist at elevations of 2302, 2322, 2346, and 2374 ft MSL, averaging about 25 ft in thickness. Thus, the elevation of Sinking Creek may be coincidental with the base of the "first shallow aquifer" (flow top A) in the Priest Rapids Member of the Wanapum Formation, as identified by Tera Corporation (1980).

The site of Stratigraphic Section II (Fig. 2.28) was selected because it has the best outcrop exposure of a complete lava-flow cooling unit. The [illegible] basalt cooling units average approximately 21 ft in thickness, with

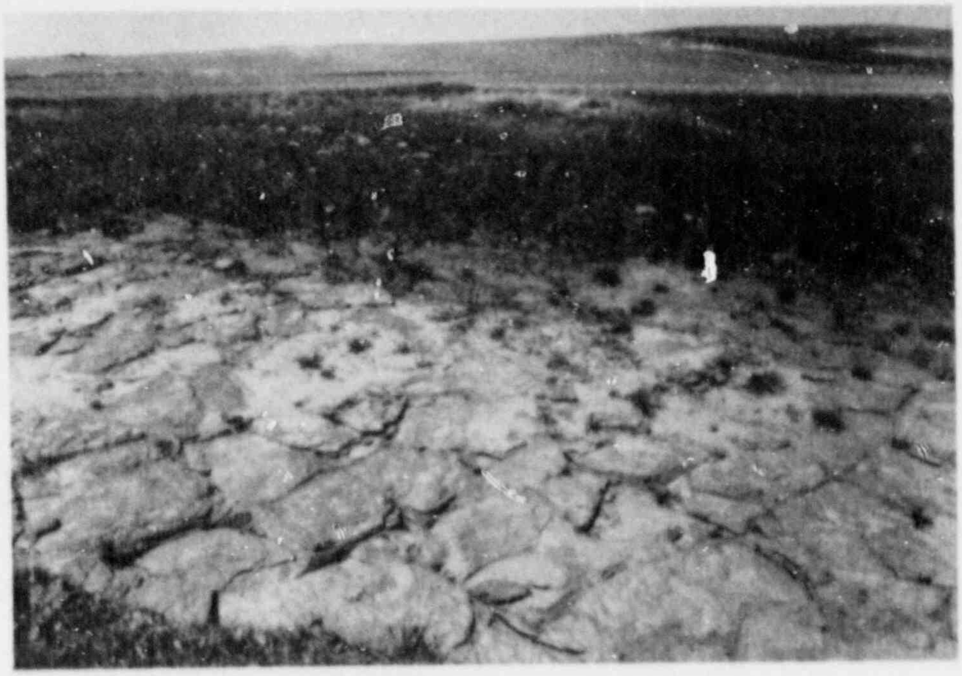


Fig. 2.26. Photograph showing the frequency and length persistence of vertical cooling fractures in the colonnade portion of the Wanapum Basalt. The gently sloping dry wash permits a rarely exposed view of a horizontal cross-section of the colonnade. Average fracture spacing is about two feet. Fracture width has been enlarged due to weathering. Location of site is about 300 feet south of well OW-3; Creston Butte is on the skyline at the right.

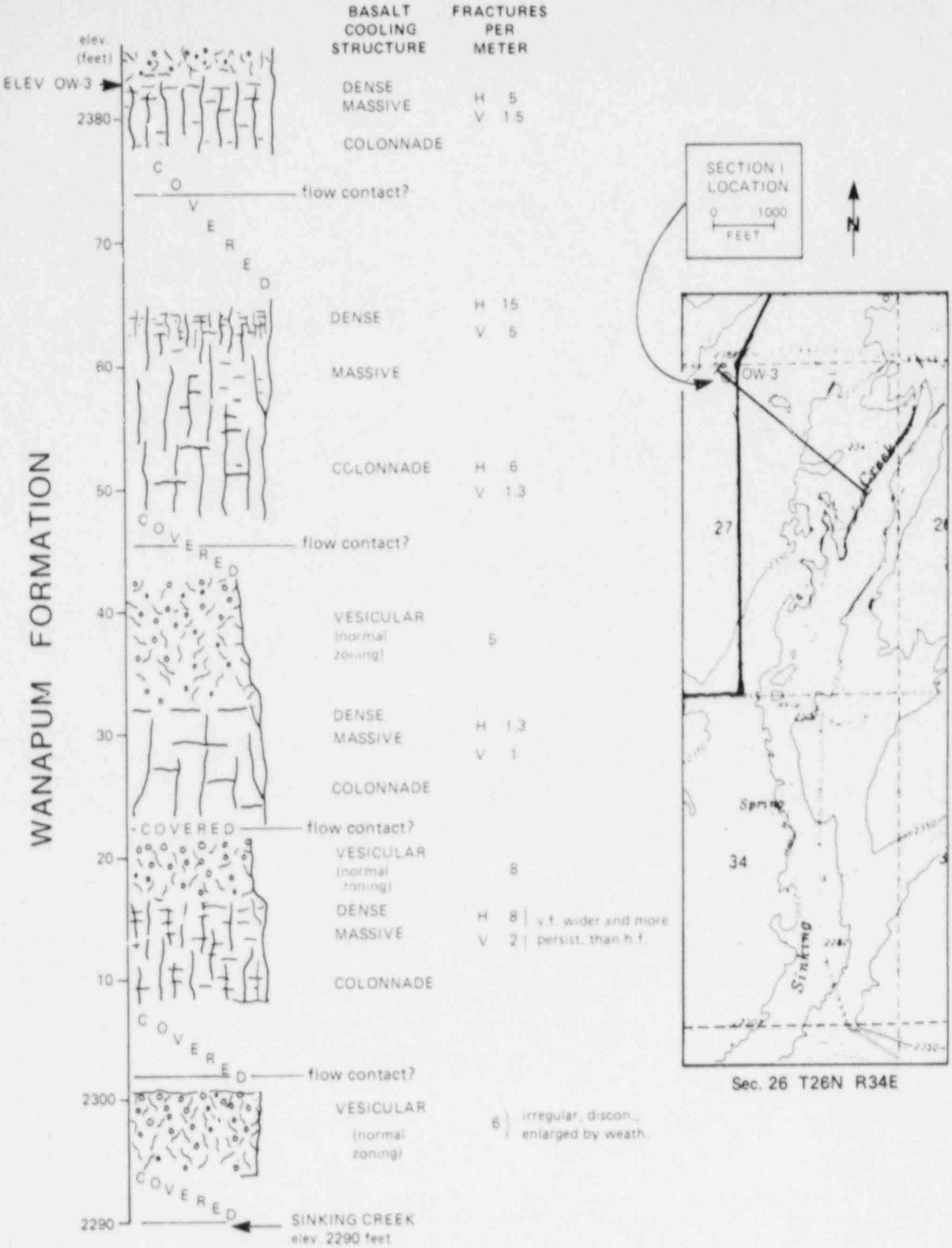


Fig. 2.27. Stratigraphic Section I (Section 26, T.26N, R.34E).

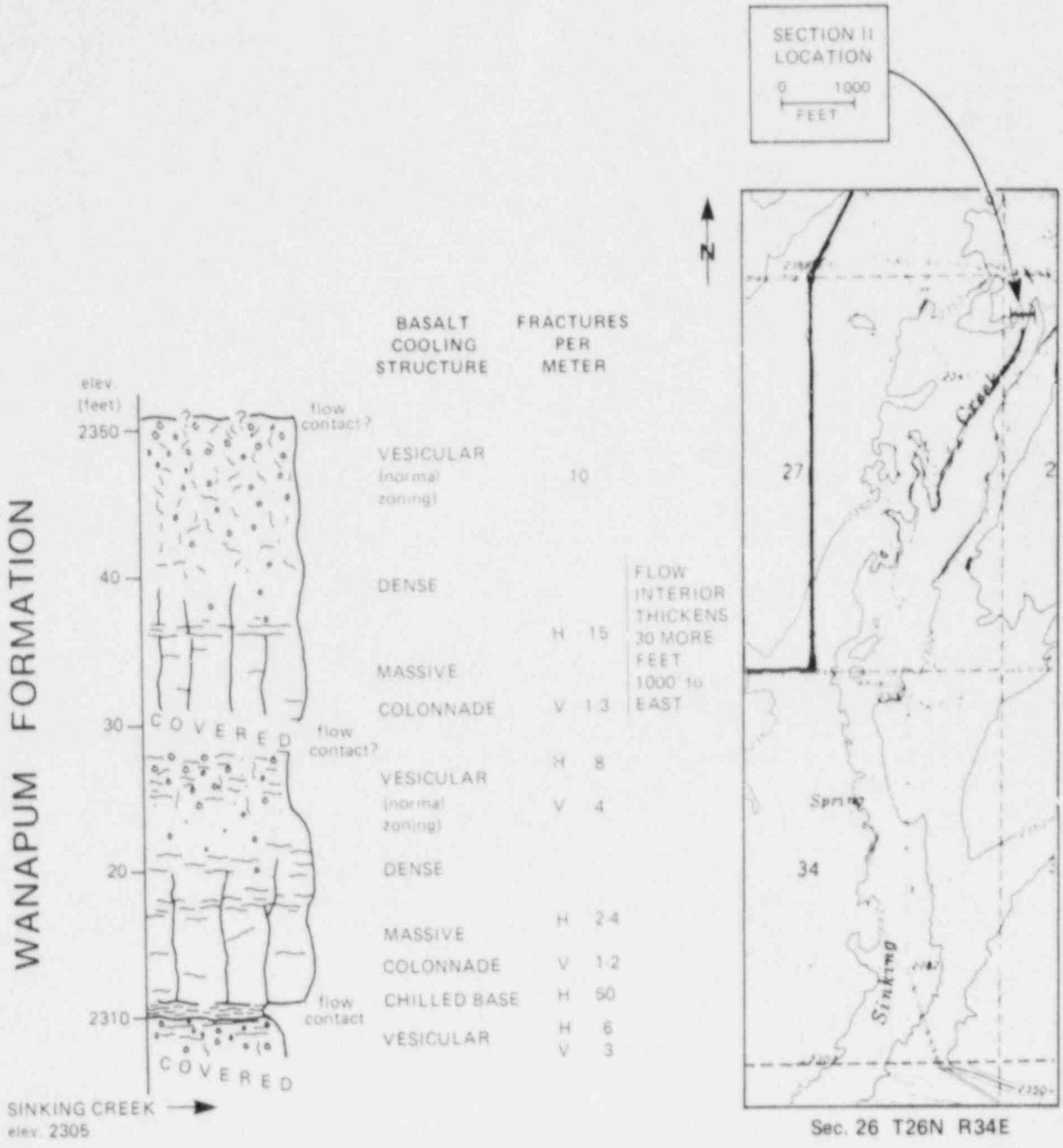


Fig. 2.28. Stratigraphic Section II (Section 26, T.26N, R.34E).

flow contacts at elevations of 2310, 2330, and 2352 ft MSL. The basalt cooling unit between 2310 and 2330 ft MSL may correlate with the basalt cooling unit at 2302-2322 ft MSL depicted in Fig. 2.27. The apparent dip for this basalt cooling unit along the south-southwest direction is approximately 8 ft (vertical) in 1900 ft (horizontal). This value is comparable to the 20-ft/mi gradient calculated by Tera Corporation (1980).

Fig. 2.29 is a photograph of the completely exposed basalt cooling unit shown in the lower part of Fig. 2.28. This 20-ft-thick basalt cooling unit was deposited on the vesicular portion of an earlier, solidified basalt cooling unit. The lowest part of the cooling unit has a chilled base composed of horizontal, platy fractures with a frequency exceeding an estimated 50 per meter. The lower dense interior of the cooling unit is an irregular colonnade with prominent vertical fractures. The upper part of the interior is a similar dense, massive basalt with prominent horizontal fractures. The top half of the cooling unit is composed of vesicular basalt that is even more fractured but with shorter length persistence. At the top surface, the bulk density is markedly less because of the vesicular development.

Stratigraphic Section III was measured at a location to transect the contact between the Wanapum Formation and the Grande Ronde Formation, as shown in Fig. 2.30. The field contact for the section was taken from the regional mapping by Swanson and others (1979b). The typical colonnade and entablature structures have been largely obliterated by recent physical weathering and talus cover. The Grande Ronde Formation basalt cooling units are thicker and quite vesicular. The uppermost vesicular basalt did not affect magnetic compass readings. The formation contact is flat, shows no erosional incisement, and contains no visible sedimentary interbed. The Wanapum Formation basalt has much less outcrop, probably due to greater weathering and soil development. The lowest basalt cooling unit of the Wanapum Formation is an estimated 70 ft thick. Near the formation contact, the Wanapum Formation basalt is coincident with decreased slope; it is fresh, dense, massive, slightly porphyritic, feldspar-bearing, and it profoundly affected magnetic compass readings due to polarized magnetite.

2.11 Subsurface Geology

Detailed hydrologic characterization of the fractured basalt media in the Creston study area will focus on the Roza Member located in the lower part of the Wanapum Formation. Based on Tera Corporation's (1980) analyses of the Priest Rapids Member's "first shallow aquifer" and "second shallow aquifer" (flow top A and flow top B, respectively) the initial proposed program was to evaluate this system in detailed field investigations consisting of drilling along with tracer and pumping tests. The two flow tops are about 75 ft and 150 ft, respectively, below ground surface. A third aquifer, known as the "irrigation zone aquifer" (Tera Corporation, 1980), lies 50 ft or more beneath a separating "dense basalt. Wildrick (1982) generalized an upper-, middle-, and lower-zone aquifer assemblage spanning both the Wanapum and Grande Ronde Formations. A more detailed subsurface hydrologic evaluation by Tera

Fig. 2.29. Wanapum Formation basalt flow unit, Section 26, T.26N, R.34E.

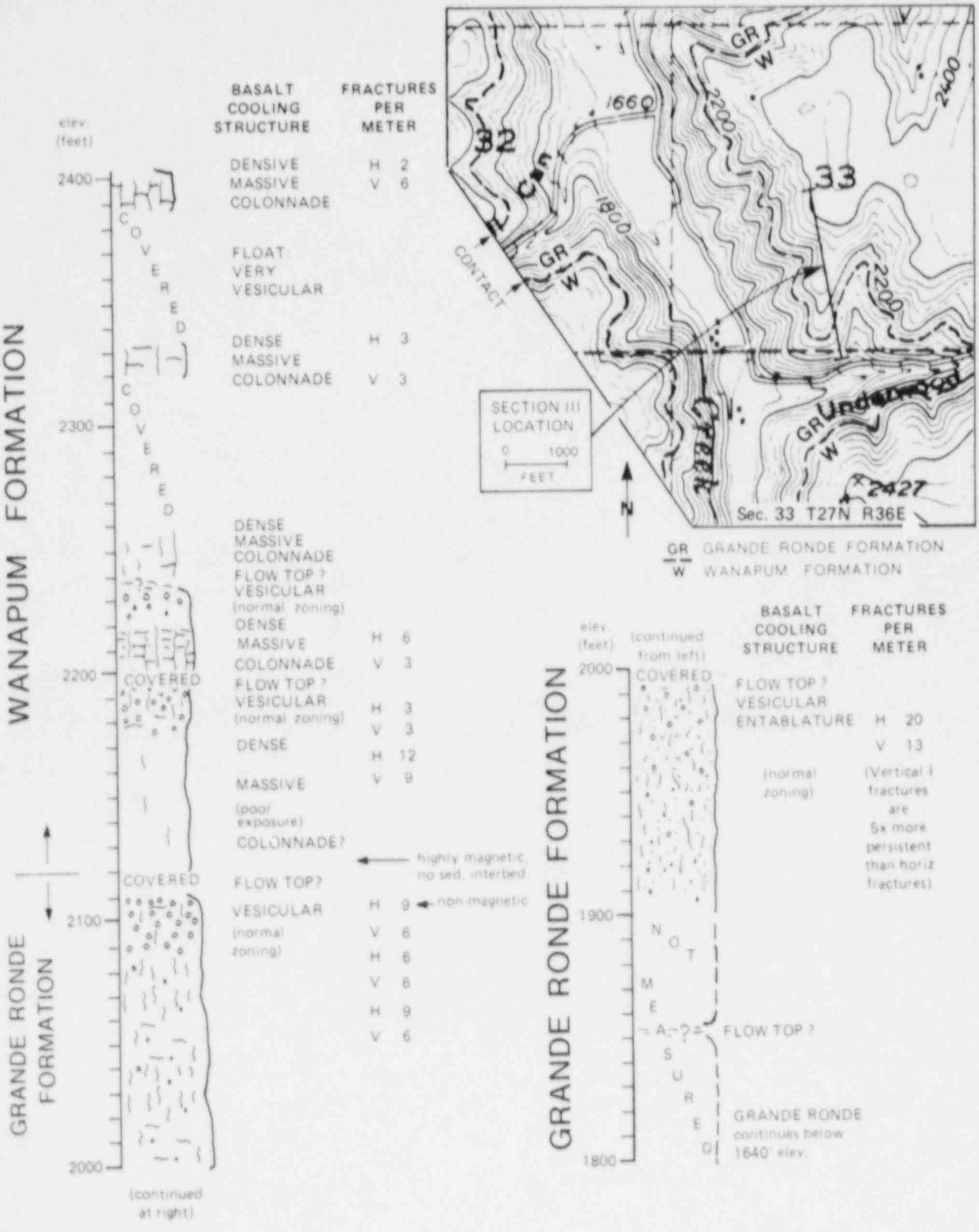


Fig. 2.30. Stratigraphic Section III (Section 33, T.27N, R.36E).

Corporation (1980) for the Washington Water Power Company has defined the aquifers, shown in Fig. 2.31. The geologic characterization was derived from drillers' logs and partial electric borehole logs.

The cross-section shown in Fig. 2.31 contains an interpretive mismatch as a result of combining two cross-sections generally to the north and south of well P-2 from the Tera Corporation (1980, 1983b) reports. The mismatch is likely due to incompleteness of Tera's cross-section definition in the area between OW-3 and P-2. The left side of the composite cross-section does not show the upper surface of the "first shallow aquifer." Also, in that part of the cross-section the piezometric surface marked "9/2/80" (dashed line) should be relocated to match the piezometric surface shown for Tera wells OW-1 to P-2, shown on the right side of the composite cross-section.

Fig. 2.32 is a cross-section illustrating deeper subsurface geology than that shown in Fig. 2.31.

2.12 Summary

Based on the reference sources, literature, and professional contacts, the following statements can be made:

1. A large number of existing studies provide reconnaissance-level data and information on geologic structure and hydrologic conditions in the study area as well as the extended northern part of the Columbia Basalt Plateau.

2. This chapter has inventoried and summarized data on the following aspects of a hydrogeologic characterization:

    - o area geology
    - o location of wells
    - o water levels
    - o water-quality conditions
    - o geophysical logs
    - o isotopic dating
    - o aquifer-test information

3. Recent and ongoing studies by the USGS and WSU were particularly helpful sources of additional information; and contacts with designated individuals within these institutions as well as the DOE, Rockwell-Hanford Operations, and Battelle-Pacific Northwest Laboratory have been made.

4. The information summarized here was used to select a basalt unit test horizon (Chapter 4) and to design pumping and tracer tests for this test horizon (Chapter 5).

5. A number of hydrologic tests have been performed in the study area, largely for generalized, reconnaissance-level, environmental studies and for water-supply investigations. More detailed information on directional hydraulic conductivities,

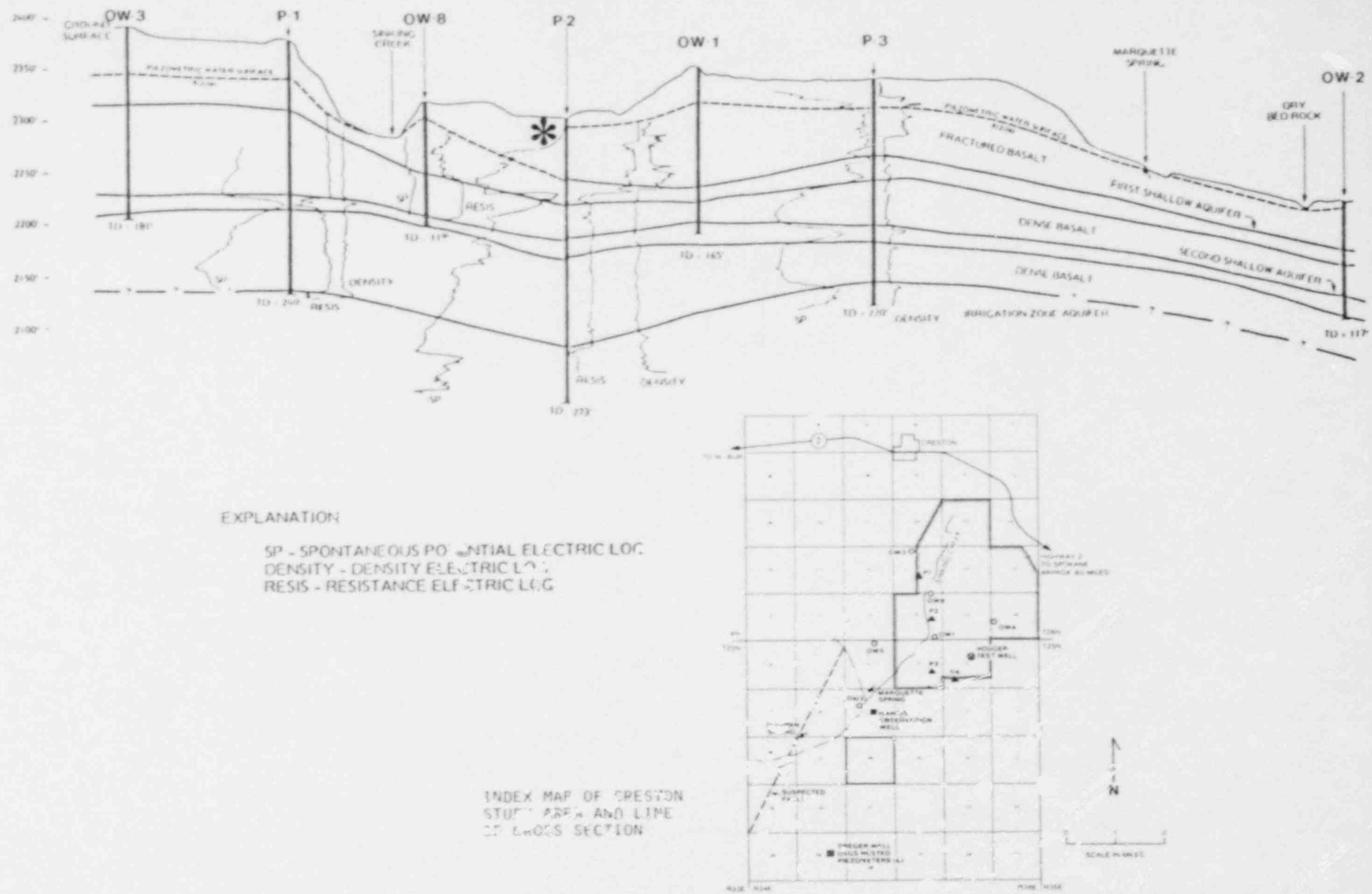


Fig. 2.31. Cross-section of upper Wanapum Formation (Priest Rapids Member) basalt aquifer, well OW-3 to well OW-2 (from Tera Corporation, 1980). See text for explanation of *.

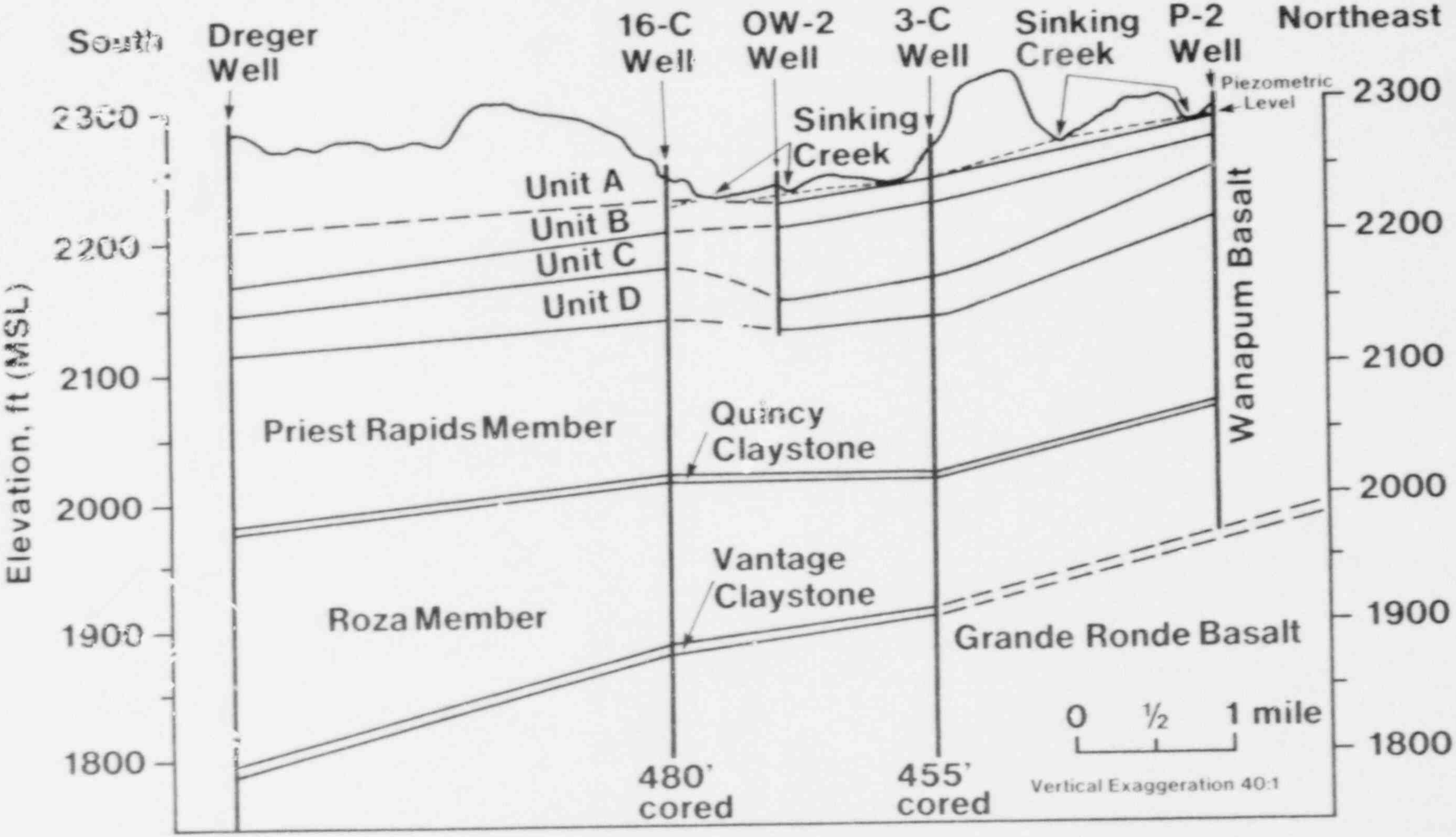


Fig. 2.32. Generalized geologic cross-section of the entire Wanapum Formation, Tera well P-2 to the Dreger observation well (from Wood and Poeter, 1986). Units A, B, C, and D are subparts of the Priest Rapids Member.

scaling effects of the hydraulic properties, dispersivities, fracture characterization, and stress-dependent hydraulic conductivity is included in subsequent project-related interim reports for this investigation.

3. STUDY-AREA CORE-DRILLING AND BASALT-UNIT TESTING PROGRAM

In order to gather more detailed subsurface data, especially for fracture characterization, two diamond-core holes were drilled through the Wanapum Formation and into the upper part of the Grande Ronde Formation during the late summer and early fall of 1986. The drilling program was designed to provide information for site-specific fracture characterization, for determining flow-top locations, for characterizing aquifers, and for designing additional pumping and observation wells to be used in the basalt-unit testing program (Chapter 5). The boreholes subsequently have been used as water-level and tracer-monitoring observation wells.

3.1 Core Description

3.1.1 Borehole 16-C

Diamond-core drilling of an initial borehole (16-C) was conducted from August 22 through September 5, 1986. The vertical NX (3-inch-diameter) core hole was located in the northwest corner of Section 16, T.25N, R.34E, at a land-surface elevation of about 2244 ft MSL (see Fig. 1.2). The 2-inch-diameter core obtained from the NX-borehole resulted in samples of parts of the basalts and sedimentary interbeds and revealed lithologies, cooling fractures, tectonic structures(?),* and hydrologic qualities of rock units to a drilled depth of 455 ft (Table 3.1).

Core recovery for borehole 16-C exceeded 97 percent; loss was mainly due to incompetent fault filling. The drill core was photographed and lithologically characterized. The drill hole was geophysically logged by WSU to a depth of 427 ft. The geophysical logs have been processed and have been compared with nearby lithologic logs (Wood and Poeter, 1986). The borehole was located on an abandoned roadway and drill-site reclamation has been completed. Through placement of an inflated packer (see Chapter 4), this borehole has served as a monitoring and test observation well and is secured by a locked threaded cap.

Upon removal of the drill string, the drill hole at 16-C bridged at 365 ft in less than 20 hours. This prevented upper aquifers (Roza and

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* A suspected fault showing slickensides indicative of oblique movements in chlorite-filled fractured basalt was observed and logged in the interval from 34 to 120 ft. A second fault was also indicated by core in the interval from 404 to 455 ft. These are the most prominent features of structural disturbance observed in the core and likely reflect crustal disturbance in this part of the Columbia River Basalt Province whose scale is unknown. (Is it local or regional? Can it be attributed to basin downwarping, pre-basalt magma conduits, or other factors?) Hence it is questioned as (?). These two features do bear some significance because the upper appears relatively impermeable, whereas the lower is likely highly permeable to groundwater.

TABLE 3.1
DRILLING SUMMARY, BOREHOLE 16-C

Footage (ft below land surface)	Approximate Elevation (ft/MSL)	Description
0-1	2244-2243	Overburden soil.
1-34	2243-2210	Thin interlayered vesicular and dense textured but locally scoriaceous basalts. Driller reported all drill fluid (well water of Kevin Houger well in T.25N, R.32E, Section 9 likely "sourcing" from flow top A which is coincident with Sinking Creek) lost to basalt unit at 26 ft. Lithology at this location was scoriaceous basalt and rubblized vesicular basalt. This position likely is correlative with flow top A ("first shallow aquifer" as used in Tera Corporation reports).
34-120	2210-2124	Vesicular basalt with decreasing number and size of vesicles and decreasing fracture frequency in a downward direction; faults of steep dip are intersected at between 50 and 75 ft and characterized by slickensides and total field-identified chlorite filling to 1½ inches width.
120-228	2124-2016	Dense basalt about twice as fractured as overlying vesicular part of this flow. The base of the Priest Rapids Member of the Wanapum Formation is vesicular for about 4 inches. The lowest basalt flow of this member is an estimated 194 ft thick and contains no obvious flow top B (or "second shallow aquifer"), as expected, other than several broken zones. Geophysical logs may define the aquifer along with detailed core review.
228-230	2016-2014	Sedimentary interbed of conglomeratic claystone that may serve as an aquitard. This was judged to be correlative with the Quincy diatomite.

TABLE 3.1
DRILLING SUMMARY, BOREHOLE 16-C
(Continued)

Footage (ft below land surface)	Approximate Elevation (ft/MSL)	Description
230-240	2014-2004	Vesicular basalt, partly rubblized and rather strongly chloritized, and vugular upper part of the Roza Member of the Wanapum Formation. This entire basalt unit contains 1-cm size tabular, euhedral feldspar crystals.
240-256	2004-1988	Gradational decrease in vesicles and ecrease in fracture abundance.
256-361.5	1988-1882.5	Dense basalt, fractures decreasing toward base. End of Roza Member and base of Wanapum Formation.
361.5-365.5	1882.5-1878.5	Sedimentary interbed of completely chloritized, possibly tuffaceous claystone. This is judged to represent facies of Vantage Member of the Ellensburg Formation. Prominently expansive and caving. Likely an aquitard.
365.5-390	1878.5-1854	Vesicular basalt of the upper Grande Ronde Formation.
390-404	1854-1840	Dense basalt with base of uppermost basalt flow.
404-455	1840-1789	Thin interlayered vesicular and dense textured basalt flows. Very prominent "thief zone" beginning at 404 ft lithologically coincident with interconnected vesicles and abundant fractures. A fault with 1 ft of core loss existed between 445-448 ft. The hole terminated in a clay-filled fault zone with hematite alteration.

Priest Rapids Members) from communicating hydraulically with the Grande Ronde Formation aquifers. As a result, aquifers in the overlying Wanapum Formation filled the borehole to a static water level at approximately 45 ft below land surface. This was the approximate static water level prior to intersecting the 404-ft "thief zone" (Table 3.1).

3.1.2 Borehole 3-C

A second drilled core hole (3-C), was located in the southwest corner of T.25N, R.34E, Section 3, approximately 1½ mi northeast of borehole 16-C, at an elevation of about 2265 ft MSL (see Fig. 1.2). The core drilling was conducted from September 13 through October 1, 1986. The inclined -80.5° NX (3-inch-diameter) borehole had an unsurveyed bearing of 016 degrees. The purpose of this inclination (10 degrees off vertical) was to enhance the possible intersection of vertical basalt cooling fractures. This drilling strategy was justified, as noted by the near-10-degree fractures in the resultant core. The hole inclination also provided limited core orientation at horizontally intersected sedimentary bedding planes. The 2-inch-diameter core obtained from the borehole contained samples of parts of the basalts and sedimentary interbeds and revealed basalt flows, cooling fractures, no obvious tectonic structures, a high-volume aquifer and "thief zone," and other hydrologic qualities of rock units in the drilled course of 480 ft (Table 3.2).

Core recovery of borehole 3-C was more than 99 percent. Marquette Spring, located approximately 2000 ft west of borehole 3-C, was pumped at a rate of 8 gallons per minute (gpm) for drill-hole fluid at this drill site. As formation characteristics warranted (regarding swelling and caving), several borehole fluid additives -- W-90 cement, Poly Drill, limited potassium chloride and bentonite -- were used in the drill hole below 350 ft. The drill core was photographed and lithologically characterized. The resultant borehole was geophysically logged by WSU to a depth of 480 ft inside the drill string to protect the electric sondes from caving zones. Other segments of the borehole were logged as open hole where not caved.

3.1.3 Subsequent Field Investigations

After logging of 3-C, drill hole 16-C was re-entered for geophysical logging of drilled intervals which now were believed to contain thermally equilibrated water which previously had been absent. Because Tera Corporation's monitoring well OW-2 is located between the two boreholes (see Fig. 1.2), several geophysical logs were also used from that well. All resultant geophysical logs were included in the correlation study conducted by WSU (Wood and Poeter, 1986).

Borehole 3-C was located on the opposite side (east) of an inferred ten-mile-long photolineament with reference to borehole 16-C. After removal of the drill string in borehole 3-C, the static water level was measured at 14.4 ft below land surface on October 2, 1986. Selected aquifers from these boreholes were sampled for chemical analysis, and slug tests were performed on both boreholes 3-C and 16-C. Inflatable

TABLE 3.2
DRILLING SUMMARY, BOREHOLE 3-C

Footage (ft below land surface)	Approximate Elevation (ft/MSL)	Description
0-1	2265-2264	Overburden soil.
1-25.5	2264-2239.5	Priest Rapids Member basalt flows of the Wanapum Formation; vesicular upper third, outcrop to south (400 ft) shows 2-ft diameter colonnades, broken zone at base.
25.5-42.5	2239.5-2222.5	Next older flow, upper two-thirds vesicular, locally containing montmorillonite; lower third dense basalt, generally well fractured.
42.5-102	2222.5-2163	Upper 20 ft vesicular; remainder dense basalt, locally containing pyrite.
102-130.5	2163-2134.5	Upper two-thirds vesicular, locally with interconnections, shows oxidation; a relatively productive aquifer begins at 102 ft, capable of generating in excess of 100 gpm, specific conductance 140 µmhos/cm, probably coincident with flow top B, ("second shallow aquifer").
130.5-252	2134.5-2013	Oldest Priest Rapids Member basalt flow of the Wanapum Formation, upper 80 ft vesicular, contains fractured zone at 144-146 ft capable of "thiefing" 8 gpm drill water supply; lower 30 ft dense basalt, relatively low fracture density in this flow.
252-254	2013-2011	Tan carboniferous claystone interbed, aquitard can provide core orientation and fossils. This was judged equivalent to the Quincy Member.
254-355	2011-1910	Roza Member of lowest part of Wanapum Formation. Interlayered vesicular to textures from 254-315 ft; 312-348 ft contains palagonite breccia zones with an especially prominent zone at 317-324 ft incompletely filled with about 5% voids. Thief zone shown and local caving disclosed by geophysical logging 320-330 ft. At 349 ft, core orientation was possible; moderately fractured.

TABLE 3.2
DRILLING SUMMARY, BOREHOLE 3-C
(Continued)

Footage (ft below land surface)	Approximate Elevation (ft/MSL)	Description
355-361	1910-1904	Sedimentary interbed: green chloritized tuffaceous expansive claystone locally containing carbonized wood judged to be equivalent to Vantage interbed of the Ellensburg Formation. Extremely difficult to core drill due to swelling of clays; continued drilling was best achieved using potassium chloride and bentonite at 90+ cps viscosity.
361-480	1904-1785	Upper part of Grande Ronde Formation basalt. Upper 1.5 ft intensely chloritized as a rubbly paleoweathered zone; down to 372 ft contains abundant scattered but large vesicles, thereafter only scattered vesicles; essentially dense basalt transitionally beginning about 380 ft and continuing to total depth drilled, except for local internal vesicular horizon 426.5-434.5 ft. Contains irregular, low-angle rough fractures, probably colonnade cooling fractures but mainly abundant, wavy, randomly oriented, tight fractures of short continuity. Contains sparse pyrite, chlorite, and manganese oxides.

packers were installed in both boreholes set up with hydrologic-monitoring instruments for water-level measurements over the winter of late 1986 and early spring of 1987.

3.2 Geophysical-Correlation Analyses

This section contains excerpts from the conclusions/recommendations section of Wood and Poeter (1986).

Stratigraphic correlations of the top of the Grande Ronde Formation and the Roza Member and the Priest Rapids Member of the Wanapum Formation are distinct within the Creston study area, because of the interbeds which separate these units. However, characterizing the thickness and distributions of aquifers within these major geologic basalt units proved to be difficult. The vesicular flow tops of the basalt units sampled from the core drilling vary in thickness over short distances in the Creston study area.

However, effective fracture porosity was not addressed in this analysis. It may be argued that fracture porosity is more important than primary porosity in controlling groundwater flow. Communication between vesicular zones may not occur unless fractures exist which connect the zones. The difference between the effective fracture porosity and primary porosity is difficult to delineate using the geophysical logs recorded in this study. Drill-core analysis may also miss vertical fractures if the drill bit penetrates the center of a columnar joint, although it should be noted that borehole 3-C was drilled at an angle offset 10 degrees from vertical in an attempt to address this concern. A basalt unit with high porosity as measured by geophysical methods may not be a prolific aquifer if it is not in hydraulic connection with other vesicular zones via fracturing. The converse also is true: although a given basalt unit may give every indication of being a dense basalt with low porosity, it may be in hydraulic connection with other zones via vertical fractures. The delineation of vesicular flow tops was based on geophysical logging methods which are not sensitive to fracture porosity verses vesicular porosity. Possibly the best aquitards in the study area may be the clay interbeds, as indicated by the head changes across these intervals during drilling and downhole water velocities measured by the flow meter. The relatively clay-rich interbeds and the dense flow interiors tend to hydraulically isolate the vesicular flow tops. Given the complex lithology, great care should be exercised when making general comments about the characteristics of specific aquifers in this area. Subsequently, planned aquifer tests will help to define where significant hydraulic communication occurs between vesicular zones via fracturing.

The focus of this geophysical-correlation analysis was a composite geologic cross-section based upon geophysical logs from a total of five wells or boreholes (Fig. 3.1). This can be compared to the more generalized geological cross section given in Fig. 2.31. A detailed stratigraphic correlation between this analysis and other regional correlations conducted by previous studies would be useful, particularly if this study were to be extended to other parts of the Columbia Plateau

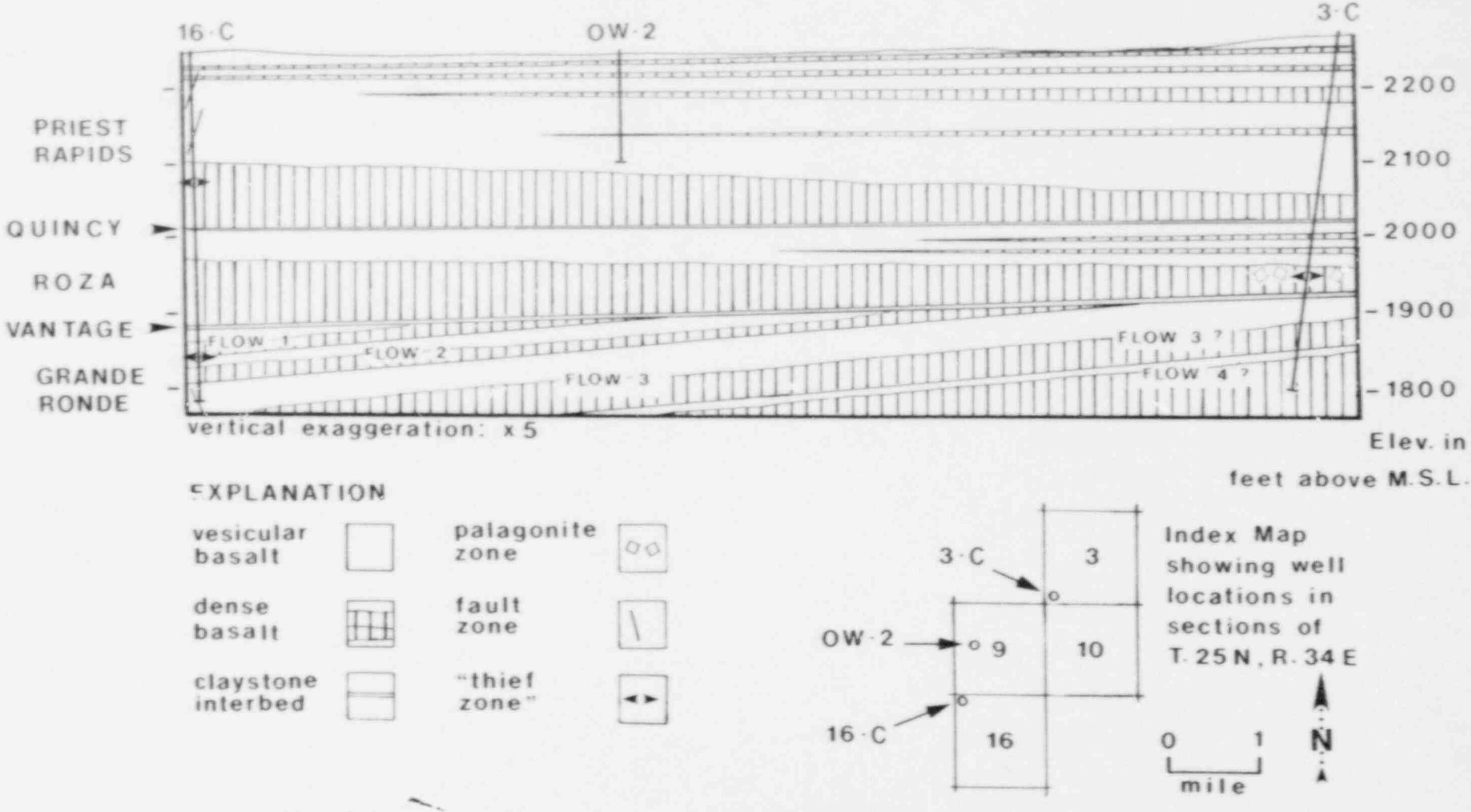

Fig. 3.1. Geolog.. cross-section, borehole 16-C to borehole 3-C.

Region. The stratigraphic correlation depicted in Fig. 3.1 is tentative. In order to be confirm the stratigraphy, a geochemical analysis of selected core samples for the various basalt units has been recommended.

3.3 Basalt-Unit Testing

Water-level monitoring instruments and pneumatic inflatable packers were installed in boreholes 16-C and 3-C during late October 1986. Areal water-level measurements were surveyed during the period of October 21-26, 1986, and water-level monitoring in boreholes 16-C and 3-C begun on October 22, 1986.

3.3.1 Water-Level Monitoring

"Hermit" data loggers (manufactured by In-Situ Inc.) and pressure transmitters for recording water-level changes over time were set up in Tera well OW-2, the Dreger observation well, and boreholes 3-C and 16-C. Following the core drilling, further evaluation was judged useful to assess static water levels measured for the Roza Member and Priest Rapids Member of the Wanapum Formation. Composite static water levels in October 1986 for boreholes 16-C and 3-C were 19.0 and 14.4 ft below land surface, respectively, for open boreholes interconnecting the Priest Rapids Member and the Roza Member of the Wanapum Formation. By installing a pneumatic packer at the top of the Roza Member with a piezometer to the casing collar of each borehole, the hydraulic heads in both of these basalt units could be measured. Table 3.3 compares water-level measurements before and after packer installation.

TABLE 3.3
STATIC WATER LEVELS MEASURED BEFORE AND AFTER INSTALLATION OF PACKERS AND PIEZOMETERS, OCTOBER 22-25, 1986

Measurement point	Water level (ft below ground surface)	
	Before installation	After installation
Borehole 16-C	19.0 ft (composite Priest Rapids/Roza)	32.2 ft (Priest Rapids Member) 30.0 ft (Roza Member)
Borehole 3-C	14.4 ft (composite Priest Rapids/Roza)	≤ 0 ft (above casing collar) (Priest Rapids Member) 29.0 ft (Roza Member)
Dreger obs. well Piezometer J-5	n.a.	70.0 ft (Roza Member)
Tera well OW-2	n.a.	7.25 ft (Priest Rapids Member)

An apparent continuous claystone aquitard layer (the Vantage claystone) occurs between the Roza Member of the Wanapum Formation and the Grande Ronde Formation basalts (see Fig. 2.31). Because the claystone likely contains montmorillonite clays, the composite Grande Ronde Formation may not influence appreciably the borehole hydrology, due to post-drilling caving at the Vantage claystone.

The geophysical logs were briefly reviewed by Mr. T. R. Weber of WSU prior to field installation of the packers. Temperature and flowmeter logs indicated a subtle interval of water loss at a depth of 172 ft below land surface in borehole 16-C. Waters from above this interval are flowing down and out of the borehole at this vertical position. Simultaneously, waters from below this interval are flowing up and out borehole 16-C at this vertical position. Field-measured temperature, specific conductance, and pH at 125 ft and at 250 ft below land surface in borehole 16-C are shown in Table 3.4.

After packer installation (see Section 3.3.2), a Hermit water-level monitor and two 50-psi pressure transducers were installed in borehole 16-C. These recorded the new, formation-specific static water levels in the Roza Member (axial) and Priest Rapids Member (annular) piezometers. The initial water-level changes were rapid and differentiated the 19-ft composite head measured in the previously open borehole into the following levels: 32.2 ft below land surface for the Priest Rapids Member and 30.0 ft below land surface for the Roza Member (Table 3.3). A minor thief zone exists at 172 ft below surface as shown by the geophysical

TABLE 3.4
FIELD MEASUREMENTS OF WATER QUALITY, BOREHOLES 16-C AND 3-C,
OCTOBER 22-25, 1986

Basalt Member	Bore-hole	Depth below land surface (ft)	Temper-ature (°C)	Specific conductance (umhos/cm)	pH (std. units)	Comments
Priest Rapids	16-C	125	13.0	180	8.1	--
Roza	16-C	250	11.5	190	8.4	--
Priest Rapids	3-C*	102	12.5	140	7.6	Slight iron taste

* No data were taken in this borehole from the Roza aquifer because (a) it was inaccessible due to packer installation, (b) the overlying Priest Rapids aquifer is flooding the lower parts of the borehole, and (c) at the palagonite zone of the Roza aquifer thiefing accounts for commingling and loss of artesian waters of both aquifers prior to packer installation.

logs. Before packer installation, water entered the borehole from aquifers in the lower part of the Roza Member. The placement of the packer at the 228-ft Quincy aquitard now restricts those waters from the borehole. On the other hand, water levels above the Quincy packer are depleted by the outflow capacity at the 172-ft thief zone which under post-packered conditions results in a net head loss to the Priest Rapids aquifer. The Hermit was programmed to measure water levels every 24 hours and then was secured in a locked steel box to the wellhead casing. Water-level monitoring is planned to extend at least through the spring of 1987. These data contributed to the wellfield design (Chapter 5).

3.3.2 Packer and Piezometer Installation Details

Two complete packer assemblies (serial numbers 34B86-303 & 304) were obtained from the Aardvark Corporation of Puyallup, Washington, for field installation, with ancillary fittings, unslotted and slotted 1-inch schedule-80 PVC pipe.

Borehole 16-C. Twelve 10-ft lengths of 0.028-inch slotted, 1-inch i.d. and one 10-ft length of unslotted schedule-80, flush-threaded and bottom-end-capped PVC pipe were connected to the 2-inch-diameter (pre-inflated) packer base. Twenty-three 9.9-ft lengths and 4 ft of unslotted 1-inch schedule-80 PVC pipe were installed on the top of the packer. A high-pressure nylon inflation tube was taped and threaded to this assembly to transmit 210 pounds per square inch (psig) nitrogen for inflation of the packer. The packer was placed at 228 ft below land surface (2014 ft MSL) and, after inflation, confined the borehole for an estimated 20 inches. Net confining pressure of the packer was 125 psig. At this position, the Priest Rapids Member basalt is relatively unfractured and dense, separated from the underlying Roza Member basalt by the two-ft-thick Quincy claystone aquitard. A piezometer-installation diagram for borehole 16-C is shown in Fig. 3.2.

Borehole 3-C. Borehole 3-C was found during the late-October 1986 field survey to be blocked between 45 and 55 ft below land surface. This necessitated borehole re-entry using the track-mounted drill with a tri-cone bit. The Diamond Drill Contracting Company crew was able to re-open this constriction, which they determined was due to necked NX casing. The borehole then was measured open to 300 ft below land surface (approximately 1965 ft MSL). Geophysical logging had previously revealed a 130 gallon-per-minute (gpm) aquifer beginning at 102 ft below collar. In addition, at approximately 320 ft, this flow left the borehole (through water loss) into an intraformational palagonite breccia. Four 10-ft sections of slotted, 1-inch, bottom-capped, schedule-80 PVC pipe were placed below the packer and twenty-five 9.9-ft sections of unslotted, 1-inch schedule-80 PVC pipe were placed above the packer. Upon lowering the packer below the high-volume aquifer at 102 ft below land surface, additional downward force due to water flow was felt on the packer and pipe string, which was supported by nylon rope at the top of the surface casing. The packer was placed at 247 ft below land surface and inflated with nitrogen at 200 psig. This depth position was in slightly fractured, dense basalt of the Priest Rapids Member, overlying the Quincy claystone aquitard (Fig. 3.3). Following inflation,

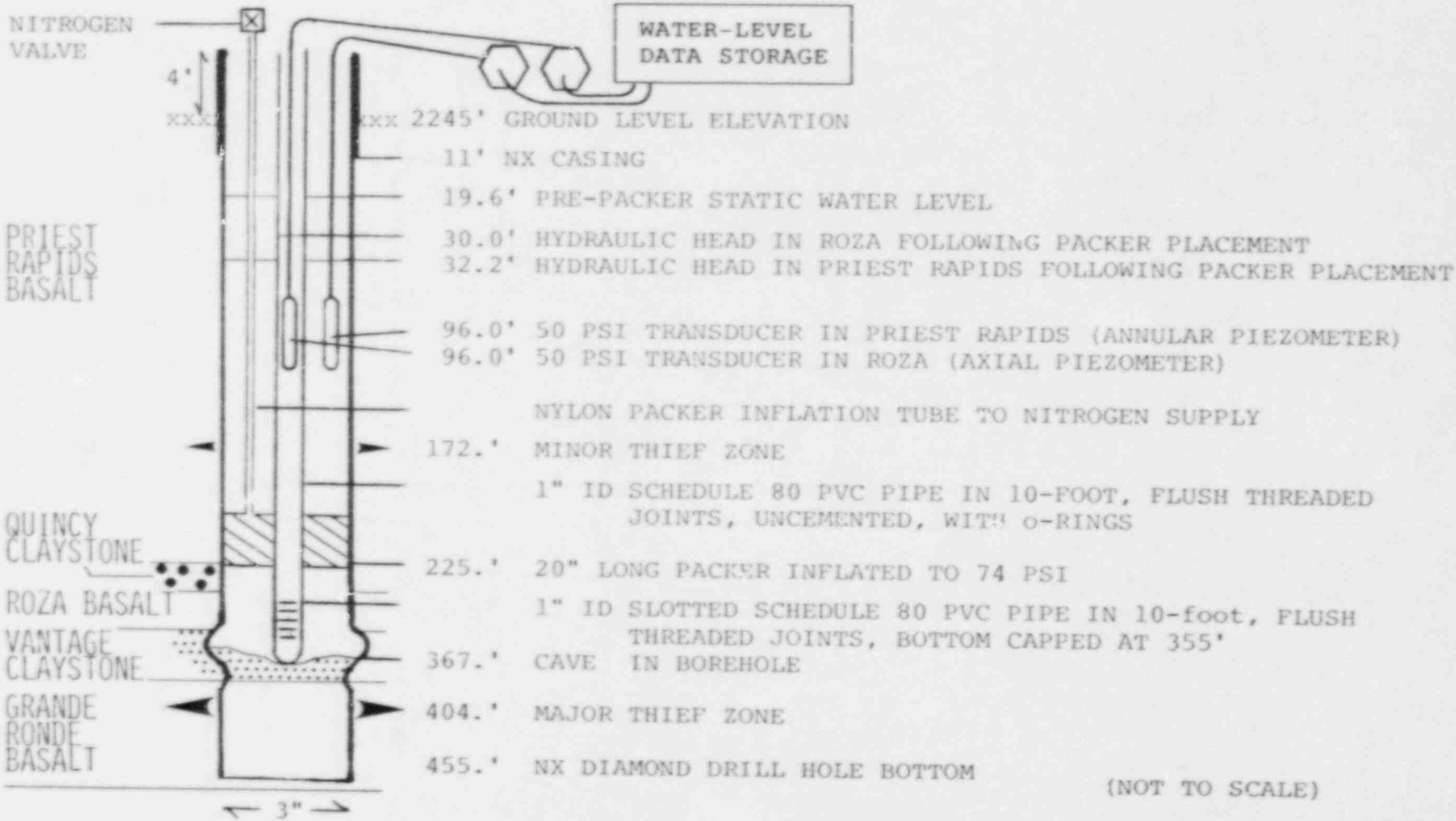

Fig. 3.2. Packer placement and water-level monitoring, borehole 16-C.

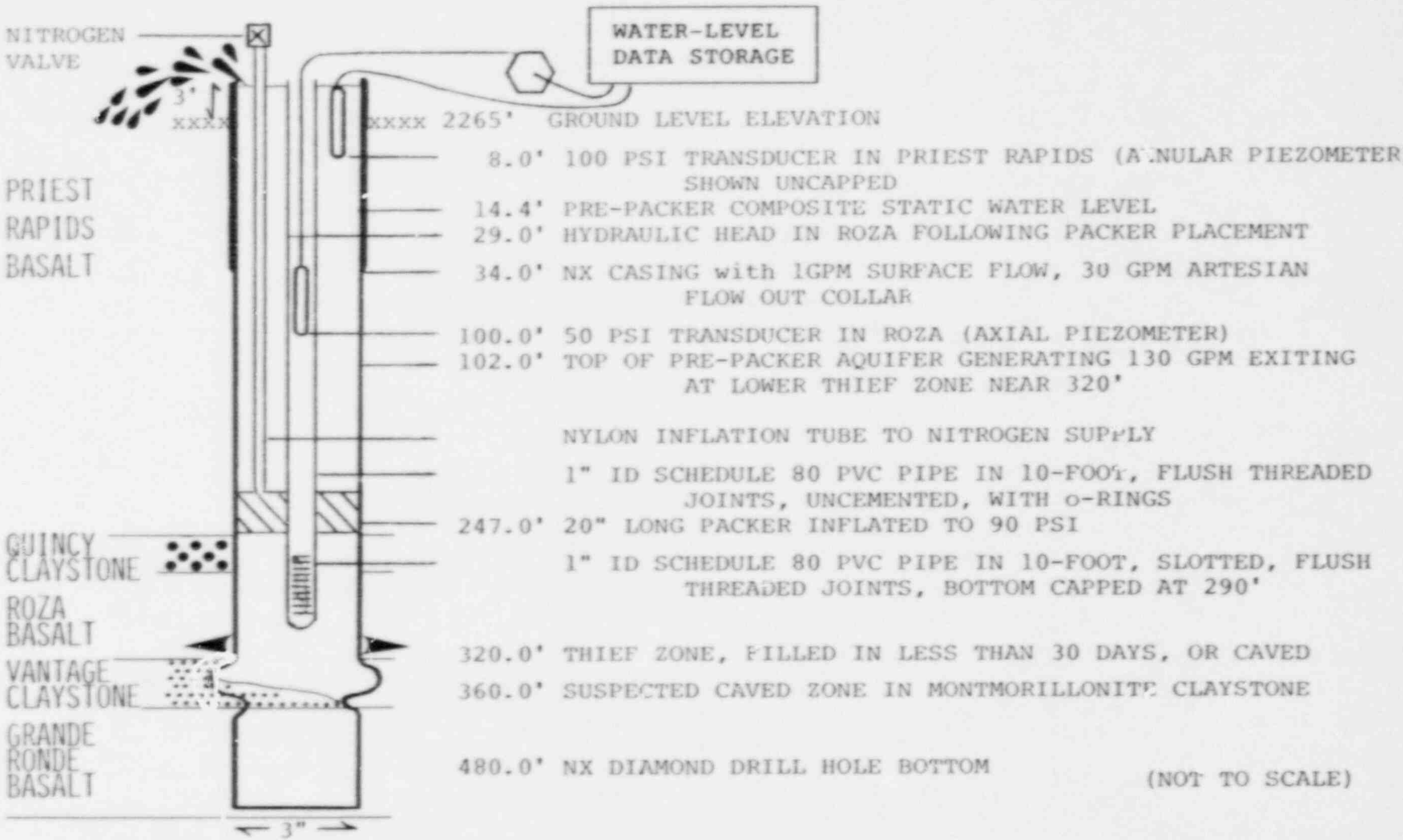

Fig. 3.3. Packer placement and water-level monitoring, borehole 3-C.

the packer reversed the downward water flow and, as expected, a flow of about 30 gpm was discharged from the 3-inch open casing. At the collar, temporary cascading of annular water into the axial piezometer produced a vacuum. The net pressure inflating and supporting the packer was 93 psig. The water was sampled; field-measured values of this Priest Rapids Member aquifer sample are shown in Table 3.4. The net discharge may have been limited by artesian head and infiltration into the borehole wall above the aquifer.

A Hermit water-level-data logger and two pressure transmitters (one 50-psi and one 100-psi) were placed in borehole 3-C to record new static water levels in the Roza Member (axial) and Priest Rapids Member (annular) piezometers (Fig. 3.3). The initial water-level changes were rapid and differentiated the 14.4-ft composite head measured in the previously open borehole into these levels: artesian to surface for the Priest Rapids Member and 29.0 ft below land surface for the Roza Member (Table 3.3). The ground surrounding the casing showed water flows of about 1 gpm. A modified casing cap was designed to support the packer assembly in the event of packer deflation, to permit repositioning of the pressure transmitter, and to seal off 30 gpm artesian water at the casing collar. Fig. 3.3 shows the borehole 3-C packer placement and set-up for water-level monitoring.

Some of the resultant water-level monitoring data from boreholes 16-C and 3-C from late 1986 are given in Fig. 3.4.

Dreger Observation Well. At this well (T.25N, R.34E, Section 29) two miles south of the study area, an SE1000A water-level monitor and a 100-psi pressure transmitter were set at a depth of approximately 200 ft below top of casing in piezometer 1111 (designated by the USGS as J-5). A static water level of 70 ft below land surface was measured on October 22, 1986, and 163 ft below land surface on December 1, 1986. This instrumentation was set to monitor Roza Member water-level values in this piezometer having a total depth of about 410 ft. The installation diagram is shown in Fig. 2.13 (p. 35). The SE1000A was replaced by a Hermit on December 2, 1986.

Tera Well OW-2. A similar set-up was made at well OW-2 drilled by the Tera Corporation (T.25N, R.34E, Section 9, located between boreholes 16-C and 3-C; see Fig. 1.2) in the deeper piezometer (second shallow aquifer) to monitor water levels in the Priest Rapids Member of the Wanapum Formation. A static water level of 7.25 ft below ground level was measured on December 1, 1986. An installation diagram for the SE1000A water-level monitor and 50-psi pressure transmitter for Tera well OW-2 is shown in Fig. 3.5.

Recent water levels measured in the Tera Corporation wells located throughout the Creston study area as well as in the Dreger observation well piezometer J-5 are summarized in Appendix Table A.3.

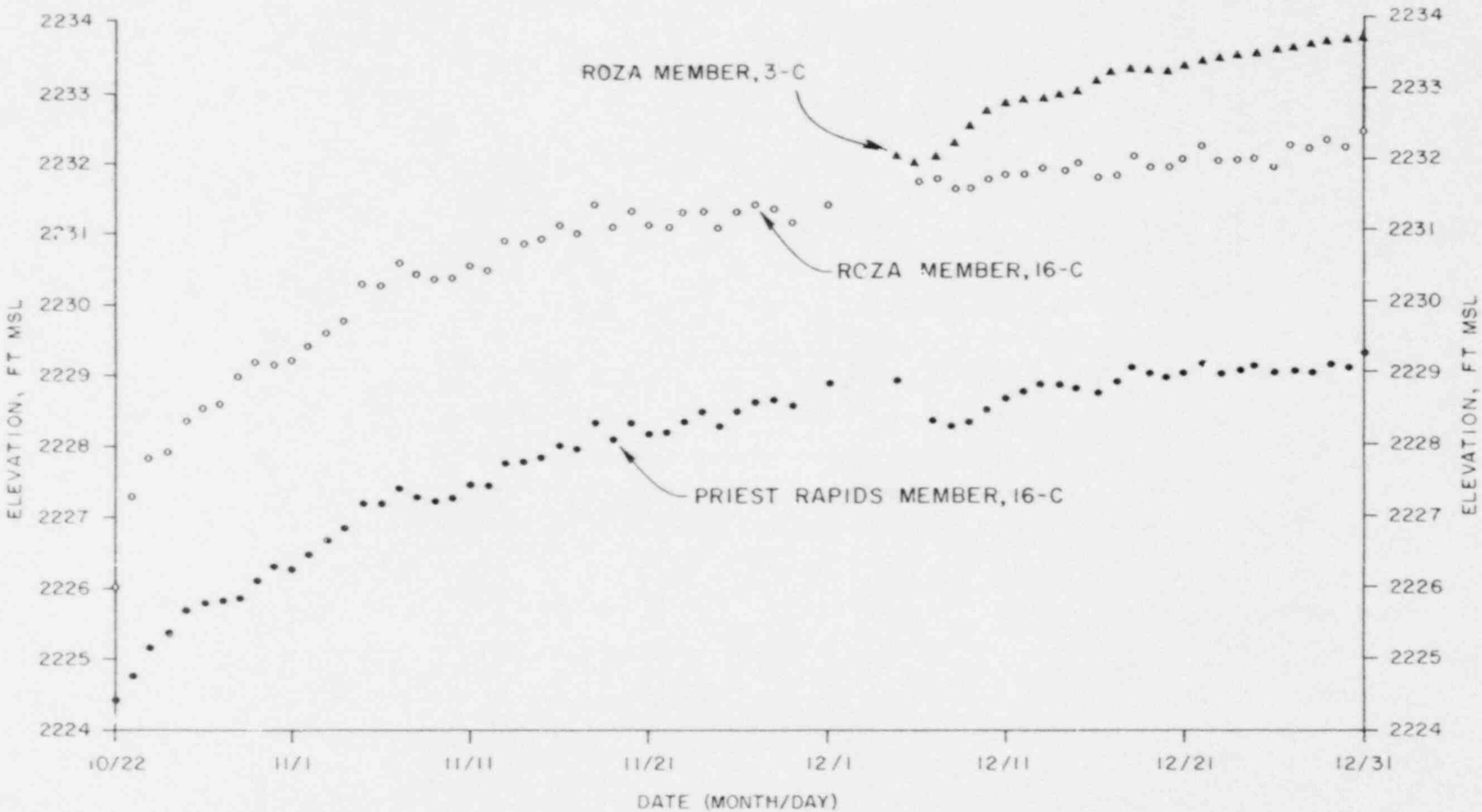

Fig. 3.4. Water levels in boreholes 16-C and 3-C for the Wanapum Formation, late 1986.

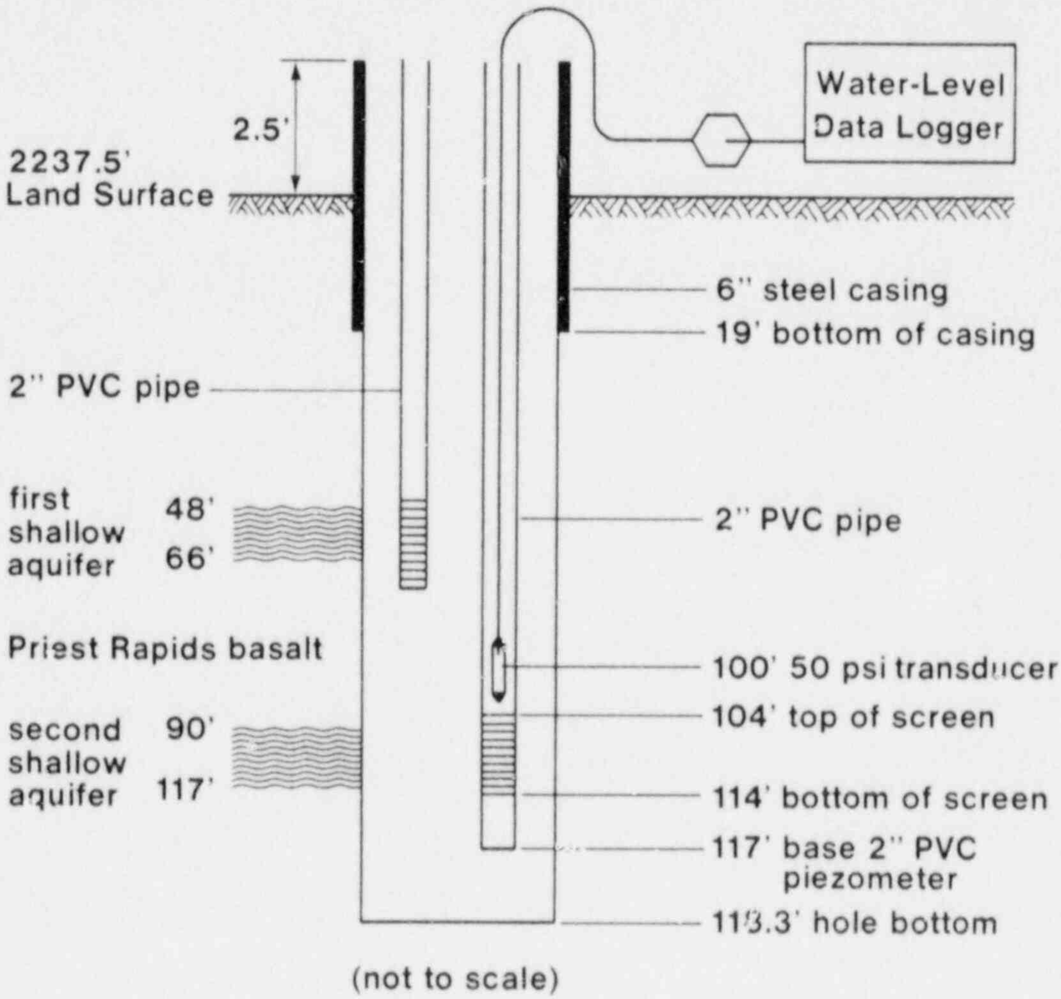

Fig. 3.5. Water-level monitoring, lower piezometer, Tera well OW-2 (after Tera Corporation, 1983b).

3.3.3 Water Quality

Field measurements of water quality in boreholes 16-C and 3-C were shown previously in Table 3.4. In general, specific-conductance values were relatively low (ranging from 140 to 190 µmhos/cm), reflecting what was expected from previously collected data (see Appendix Table A.4).

3.4 Barometric-Pressure Monitoring

Because of the elasticity of a confined aquifer like the Roza Member of the Wanapum Formation, water levels tend to fluctuate with changes in atmospheric pressure. The barometric efficiency is defined as the ratio of the change in water level observed in a well to the corresponding change in atmospheric pressure.

Although the influence of barometric efficiency was not discussed in In-Situ's technical proposal (In-Situ Inc., 1985), it is important to recognize that the value of storage coefficient can be obtained through a method other than the pumping test, to serve as a check for the planned pumping-test results. We have, therefore, set up a barograph on-site to monitor atmospheric pressure change continuously over time. The barograph recording chart is replaced monthly, and the data collected will be used to verify the theory and to estimate a storage coefficient for the Roza Member.

3.5 Straddle-Packer Slug Tests

A series of straddle-packer slug tests have been completed on borehole 16-C to obtain a vertical profile of hydraulic-conductivity variations with depth in the Roza Member (Table 3.5 and Fig. 3.6). Fig. 3.6 indicates that the hydraulic conductivity of the flow top (approximately the first ten feet of the Roza Member) at this location is much greater than that of the denser basalt in the interior zone of the Roza Member.

TABLE 3.5
HYDRAULIC CONDUCTIVITY VS. DEPTH, ROZA MEMBER, BOREHOLE 16-C

Depth from surface (ft)	Hydraulic conductivity (ft/d)
230-243	6.88
240-253	0.03
250-263	0.07
260-273	0.27
270-283	0.09
280-293	0.11
290-303	0.13
300-313	0.10
310-323	0.07
320-333	0.11
330-343	0.16

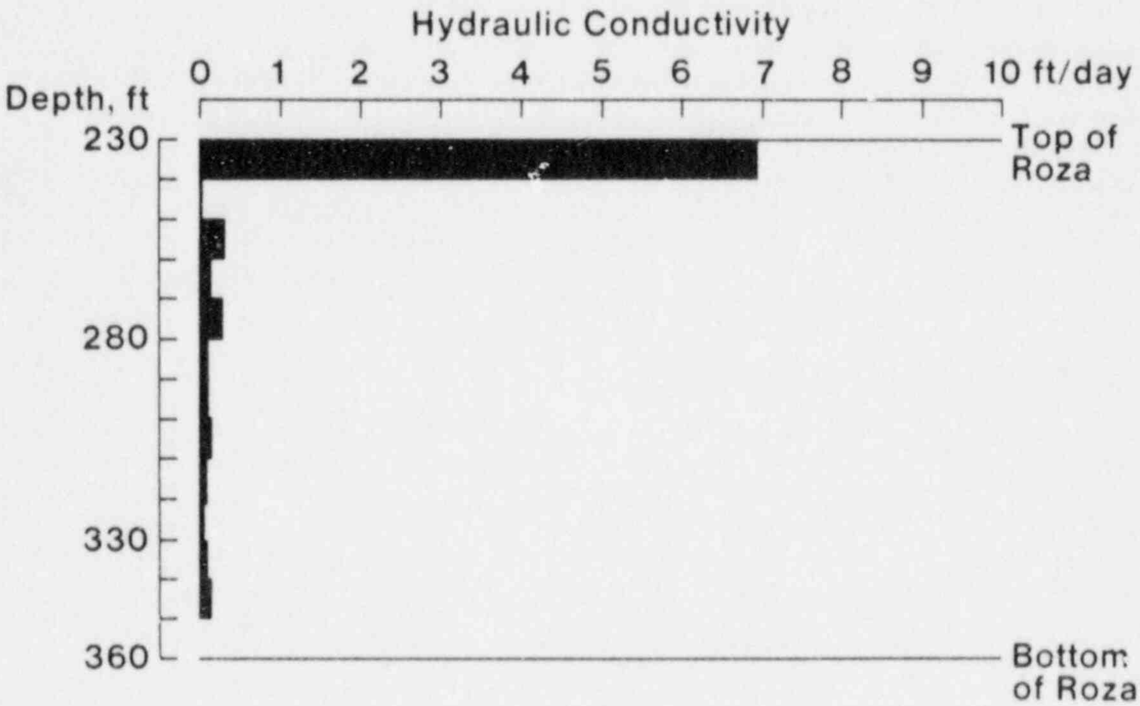

Fig. 3.6. Hydraulic conductivity profile, Roza Member, borehole 16-C.

4. SELECTION OF THE ROZA MEMBER AS THE STUDY'S TARGET BASALT UNIT

Based upon the above-described assessment and evaluation of available data and information, the Creston study area was judged to contain three stratigraphic horizons in the Columbia River basalts that were possible candidates for detailed hydrologic analyses in this study, namely the basalts of the Priest Rapids Member and the Roza Member of the Wanapum Formation, and the basalts of the Grande Ronde Formation. Each candidate lithologic unit was found to have a range of merits and drawbacks. After careful consideration of all three stratigraphic horizons, the Roza Member of the Wanapum Formation was selected as the target basalt unit for this study. Salient points of the rationale for this selection are provided in the following sections.

4.1 Comparison of the Priest Rapids, Roza, and Grande Ronde Basalts

In order to partially meet certain field-related aspects of the project objectives, it was considered critical that the following conditions characterize the selected basalt unit for the planned range of field investigations:

- it should be a fractured, rather than a porous-dominated, basalt;
- it should be a confined aquifer; and
- the test horizon should be saturated.

The known geologic section of the Creston study area from land surface to approximately 450-500 ft below land surface, as derived from core drilling at the study area (see Section 3.0 above), has been shown in Figs. 2.32 and 3.1. The geologic sequence for this vertical geologic profile may be summarized, in descending order by increasing age, as follows:

Priest Rapids Member (Wanapum Formation) basalts
Quincy claystone
Roza Member (Wanapum Formation) basalts
Vantage claystone
Grande Ronde Formation basalts

The Priest Rapids Member basalts in the Creston study area are comprised of numerous thin upper flows which overlie thicker flows. Several Tera Corporation wells interconnect the so-called first and second shallow aquifers ("flow top A" and "flow top B," respectively) (Tera Corporation, 1980, 1983b) found in the Priest Rapids Member basalts in some parts of the study area (see Figs. 1.2, 2.31, and 3.5). This interconnecting condition would tend to discourage the study's proposed hydrologic testing in this basalt member. Also, this relatively shallow basalt unit is likely to be more influenced by annual meteoric recharge

cultural effects of the irrigated croplands within the Sinking Creek drainage basin. Prior hydrologic monitoring and pumping tests of the Tera Corporation wells provide baseline hydrologic data and information for the Priest Rapids Member over about a five-year period (see Table 2.4 and Appendix Table A.4). This basalt unit has the greatest apparent fracture density in the drill core of the possible basalt units investigated for this study. The 2-ft-thick Quincy claystone does form a lower confining boundary to the Priest Rapids Member. Recent packer emplacement and water-level measurements indicate in boreholes 16-C and 3-C that the Priest Rapids Member basalts are characterized by artesian heads at selected locations. Although the Priest Rapids Member may include a tectonic structure at borehole 16-C, which is desirable for purposes of this study, the lack of upper confinement, the expected variation in water levels, and the existence of an apparent minor zone of short-term water loss during drilling weighed against the selection of this basalt unit.

The Roza Member basalt unit is composed of fewer, thicker flows than the Priest Rapids Member basalts. The upper part of the Roza Member is confined by the Quincy claystone and the lower part by the Vantage claystone, averaging about 4 ft in thickness. This basalt unit exhibited the least amount of fracturing of the three core-drilled basalts (see Section 3.0). The very uppermost flow interval was characterized by local interconnection between vesicles and along the paleoweathered rubblized basalt flow top. Recent packer emplacement and water-level measurements indicate the Roza Member aquifer is under confined conditions. Localized relatively narrow intervals of short-duration water loss during drilling may be associated with restricted, open intraformational palagonite breccia zones. Additional merits of the Roza Member include its relatively high (locally artesian) water level and relative geologic simplicity reflected by the presence of a single basalt flow in the area of T.25N, R.34E, Section 16 (as characterized by the core obtained from borehole 16-C), which tends to reduce some of the uncertainty in hydrogeologic characterization of this basalt unit. Both geologic and hydrologic conditions of the Roza Member reflect certain idealized boundary conditions for the computer-model analyses anticipated for this study. Although it initially appears that the Roza Member basalt unit lacks a tectonic structural feature, the Roza Member conforms better than the Priest Rapids Member to the stated objectives of the study because it appears to be saturated throughout its confined thickness and is segregated by upper and lower confining zones.

The Grande Ronde Formation is composed of one to four basalt flows and is moderately fractured in the Creston Study area. Based upon core available from boreholes 16-C and 3-C (see Section 3.1), the uppermost vesicular flow segment exhibits local interconnection between vesicles. This formation locally contains a prominent "thief zone" in the Creston study area which could negate the saturated characteristics of the test unit desired in the study. The composition of the overlying Vantage claystone suggests a high montmorillonite content evidenced by swelling characteristics and further demonstrated by caving and drill-string seizure during core drilling (see Section 3.0). Due to the designed depth limit of core drilling performed for this study, the existence of

a lower confining lithology is unknown, although the Vantage claystone would certainly form an upper confining horizon to the Grande Ronde Formation. The Vantage claystone would cause significant difficulty during well drilling that also could require special conditions for successful well completion, if the Grande Ronde Formation were selected for testing.

Our preliminary field investigations yielded the following information regarding the Roza Member:

- o Average hydraulic conductivity in the Roza Member = 0.3 ft/day
- o Hydraulic conductivity of the flow top = 7 ft/day
- o Thickness of the Roza Member = 130 ft
- o Thickness of the flow top = 10 ft
- o Depth of the Roza Member = 230-360 ft below land surface
- o Depth of the flow top = 230-240 ft below land surface
- o Hydraulic gradient = 15 ft/mi, generally in a southwest direction
- o Natural groundwater flow = 180 ft/yr
- o Static water level is approximately 20 ft below land surface during the nonirrigation (winter) period
- o Available drawdown for pumping is approximately 200 ft

In summary, the Roza Member of the Wanapum Formation, especially underlying the southern part of the Creston study area at T.25N, R.34E, Section 16, appears most favorable based upon existing data and information for subsequent hydrologic testing because of the following factors:

- o it is expected to be minimally affected by nearby water-supply wells (including those with open holes interconnecting more than one aquifer;
- o it is saturated;
- o it may be characterized as a lower fracture frequency basalt as opposed to overlying, higher fracture frequency basalts which may approach characteristics of an effective porous medium;
- o it is flanked by claystones having relatively low hydraulic conductivities;
- o it is at a moderate depth for wellfield construction; and
- o it appears to be less likely than the Priest Rapids Member to affect and be affected by local seasonal (mid-May through mid-September) irrigation pumping.

4.2 Drilling Logistics and Well Costs

Core drilling showed some complicating hydrologic characteristics at borehole 3-C. High artesian flows were measured in the Priest Rapids Member basalt. Also, the Roza Member basalt at borehole 3-C contained an interval of moderate water loss during drilling (a so-called "thief zone"). The Vantage claystone was difficult to core drill, due to its montmorillonite composition. This interbed is believed to have subsequently caved in borehole 3-C and prohibited hydrologic evaluation of the Grande Ronde Formation basalt in borehole 3-C and likely in general in the Creston study area.

At borehole 16-C, in contrast, the upper two basalts are relatively free of these complicating basalt-unit conditions. The Vantage claystone caving was duplicated at this borehole as well, and the Grande Ronde Formation interval contains a major "thief-zone" interval.

Additional considerations against using the Grande Ronde Formation arise from fewer baseline data, unknown thickness of the basalts, and unknown aquifer confinement of the Grande Ronde Formation at the Creston study area. Wellfield costs would be highest in the Grande Ronde Formation basalt unit, and, if this horizon were to be used, wells might have to be partially penetrating in possibly unsaturated basalts.

Table 4.1 summarizes known basalt characteristics at borehole 16-C, where the Priest Rapids Member and Roza Member basalts are present. The Grande Ronde Formation characteristics are included in the table for purposes of comparison.

TABLE 4.1
SELECTED CHARACTERISTICS AT BOREHOLE 16-C

Characteristic	Priest Rapids Member	Roza Member	Grande Ronde Formation
Elevation	2245 ft MSL	2015 ft MSL	1880 ft MSL
Thickness	227 ft	132 ft	>> 90 ft
Weathered section	40 ft	15 ft	1 ft
Fractured section	187 ft	117 ft	89+ ft
Fracture frequency	4 per ft	3 per ft	9 per ft
Upper aquitard	None	2′ claystone	Unsaturated
Lower aquitard	2′ claystone	4′ claystone	Not drilled to depth
Tectonic intercept	Tight fault(?)	None	Open fault
Thief zone	Minor	None	Major
Nearest well (distance)	P-3 (10,000′)*	H (12,000′)**	H (12,000′)**
Water level, 12/1/86	27.8 ft	25.3 ft	Inaccessible
Approximate cost for 6" cased well	$4,200	$6,700	>$8,000

* See Fig. 1.2 and Table 2.1.

** See Fig. 2.10 and Table 2.2 (Merwin Houger well T.25N, R.33E, Section 02, code C01).

5. WELLFIELD DESIGN AND BASALT-UNIT TESTING PROGRAM

This section summarizes a preliminary plan for wellfield design for field pumping tests and tracer tests in the 130-foot-thick Roza Member of the Wanapum Formation at the Creston study area. This material is extracted from a previously submitted interim document (In-Situ, Inc., 1987a). This wellfield design and testing program have since been implemented, and results of these field investigations constitute the topic of a separate project report.

The objectives of the preliminary wellfield design were:

1. to obtain the directional hydrologic properties of the Roza Member,

2. to obtain information on scaling effects for the Roza Member, and

3. to gain the maximum hydrologic information with a minimum number of wells (some wells will be used for both pumping tests and tracer tests) and within a reasonable amount of time.

In order to satisfy these objectives, we have performed, or are in the process of completing, preliminary testing, which includes:

- o coring of borehole [illegible] nd 16-C to study the stratigraphy of the Priest Rapid [illegible] a Members of the Wanapum Formation and the upper Gra[illegible] nde Formation (described in Chapter 3 above).

- o measuring static water elevations in boreholes 3-C and 16-C and in the Dreger observation well in December 1986 to estimate the natural regional groundwater flow gradient for the Roza Member aquifer (described in Chapter 3 above).

- o completing a series of straddle-packer slug tests on borehole 16-C to obtain a vertical profile of hydraulic conductivity with depth in the Roza Member (see Chapter 3 above).

- o monitoring water-level changes in the Roza Member and the Priest Rapids Member using the continuous water-level recorders installed in four study-area wells (see Chapter 3 above).

- o collecting water samples from the Roza Member to characterize certain specific baseline water-quality conditions. Especially important are baseline analyses of sodium, potassium, and chloride concentrations, because KCl and/or NaCl are proposed for use as tracers (see Section 5.2 below).

5.1 Pumping-Test Design

Fig. 1.2 (p. 6) shows the location of the recently completed wellfield for project-related hydrologic testing, and Fig. 5.1 shows the proposed conceptual wellfield design for the field tests discussed in this chapter. The design was based on information collected from preliminary tests (including coring, straddle-packer slug tests, and water-level measurements) and from literature research. We judge that the design should be of adequate detail to achieve testing objectives as outlined in the project's Technical Proposal (In-Situ, Inc., 1985).

There are several criteria to be observed in designing a wellfield for pumping tests for aquifer characterization of the Roza Member; these include pumping rate, drawdown, test duration, radius of influence of pumping, and other testing restrictions.

5.1.1 Pumping Rate

For purposes of preliminary wellfield design, an adequate pumping rate was estimated to be about 50 gpm with approximately 200 ft of head; use of a Model GMB Red Jacket submersible pump and a 7.5 horsepower motor was recommended. A minimum well diameter of 6 inches would be required in pumped wells for this testing. The uncertainty in maximum pumping rate as a function of transmissivity for the Roza Member is shown in Figs. 5.2 and 5.3. Pumping rate is the one factor that can be controlled; so long as the pumping rate remains constant during the duration of the test, the analyses for characterizing transmissivities and storage coefficients based upon pumping drawdown will be the same whether the well is pumped at 50 gpm or at 30 gpm.

5.1.2 Drawdown

Fig. 5.4 shows the hypothetical distance-drawdown curve based on a pumping rate of 50 gpm. Based upon this preliminary design, a drawdown of more than 10 ft was expected in the piezometric surface of the Roza Member aquifer at a distance of 1000 ft. This anticipated drawdown is well within the capabilities of an automatic data recorder (In-Situ's Hermit) and pressure transmitter (with resolution of $\pm$ 0.01 ft). Drawdown is directly proportional to pumping rate, i.e., if the pumping rate were to be increased twofold, the drawdown would double.

5.1.3 Test Duration

Fig. 5.5 shows minimum test duration as a function of observation-well distance. Although the water levels in the observation wells in the Roza Member are expected to respond quickly to pumping, a unique solution to obtain aquifer characteristics would not be possible until the minimum test duration is achieved. For example, based upon a hypothetical pumping rate of 50 gpm and current transmissivity estimates for the Roza Member aquifer, an estimated minimum of 66 hours of pumping would be required for well 16-2, which is about 1000 ft from the proposed pumping well 16-3, to respond. Therefore, a pumping test duration of three days was recommended.

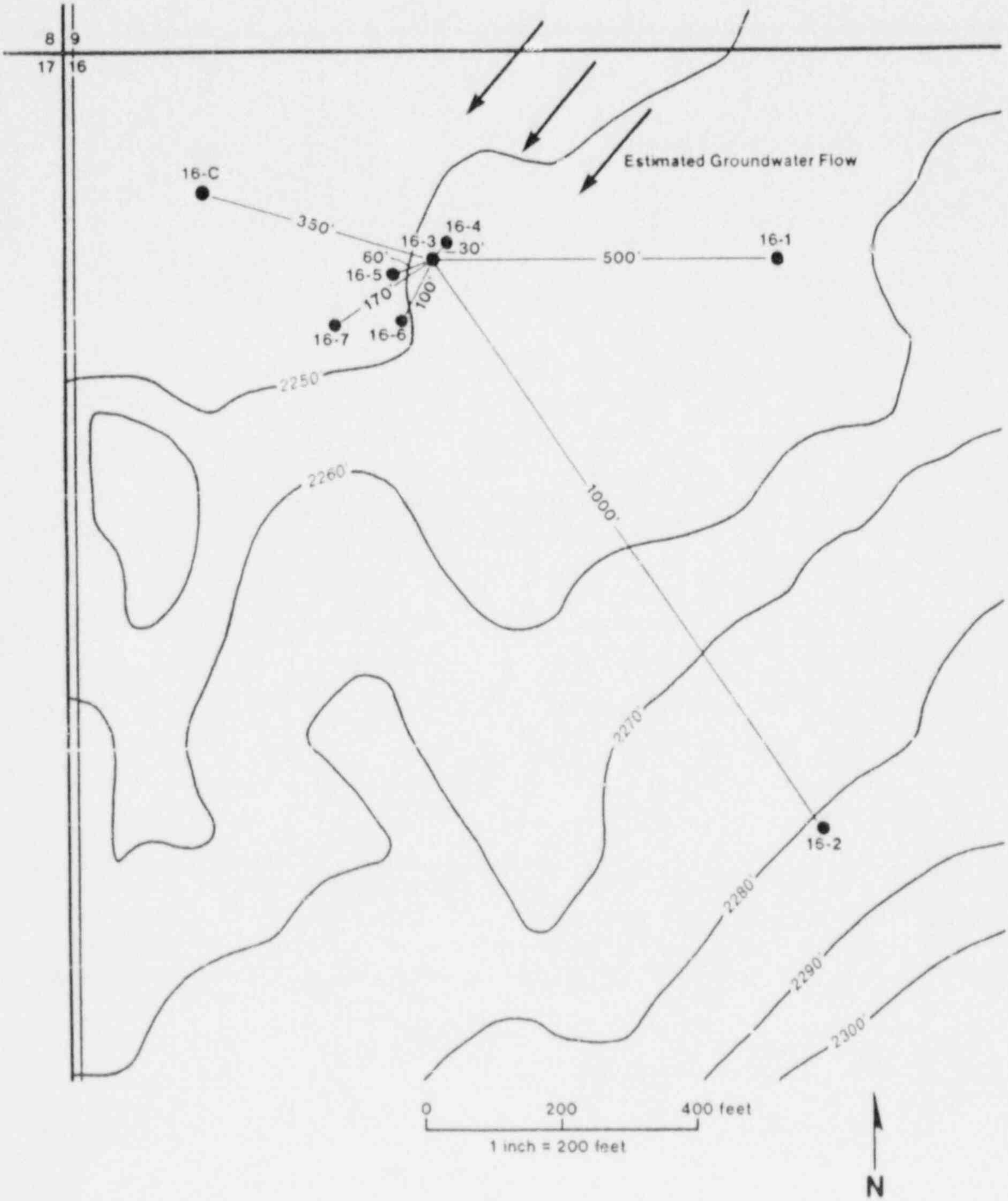

Fig. 5.1. Creston study area, conceptual wellfield design.

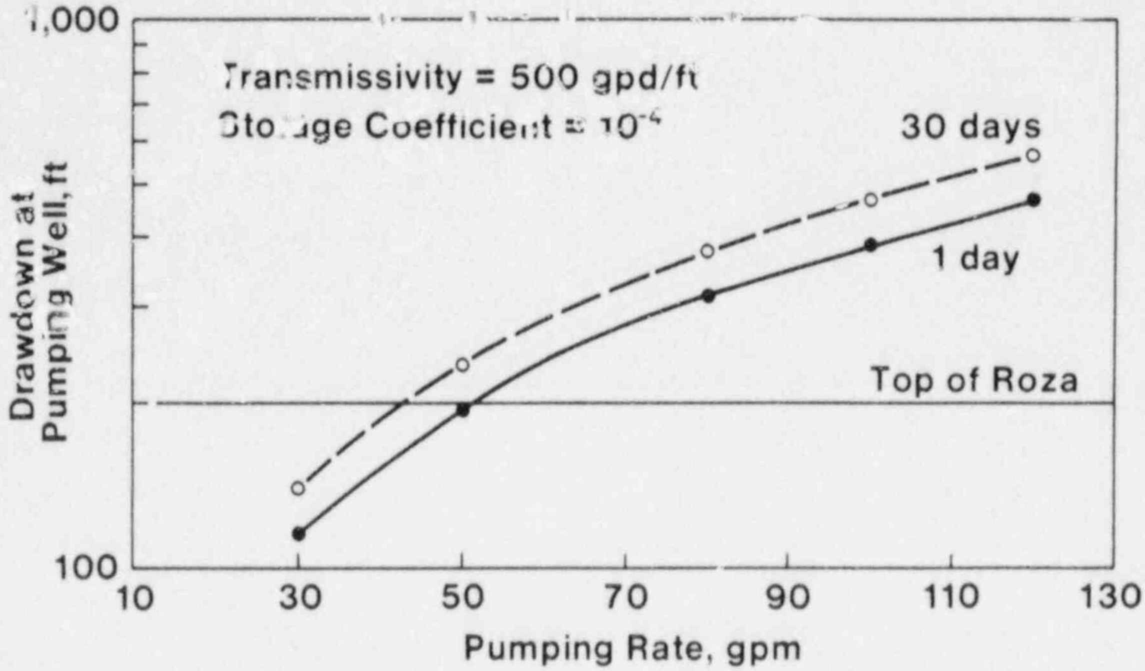

Fig. 5.2. Estimated drawdown at pumping well when transmissivity is 500 gpd/ft.

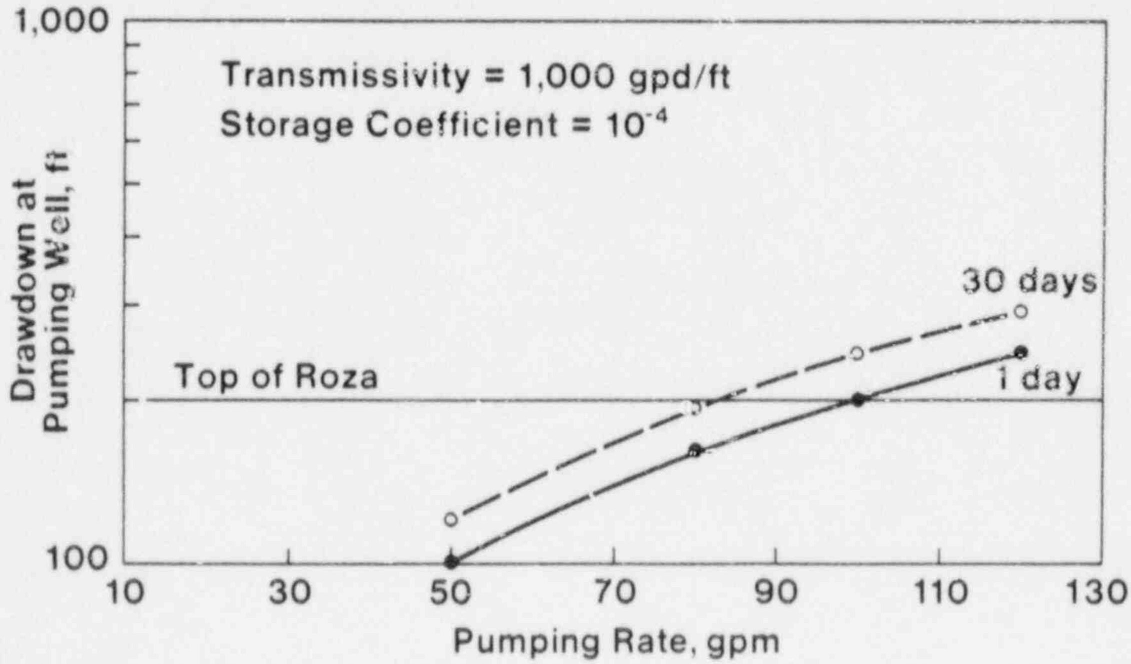

Fig. 5.3. Estimated drawdown at pumping well when transmissivity is 1000 gpd/ft.

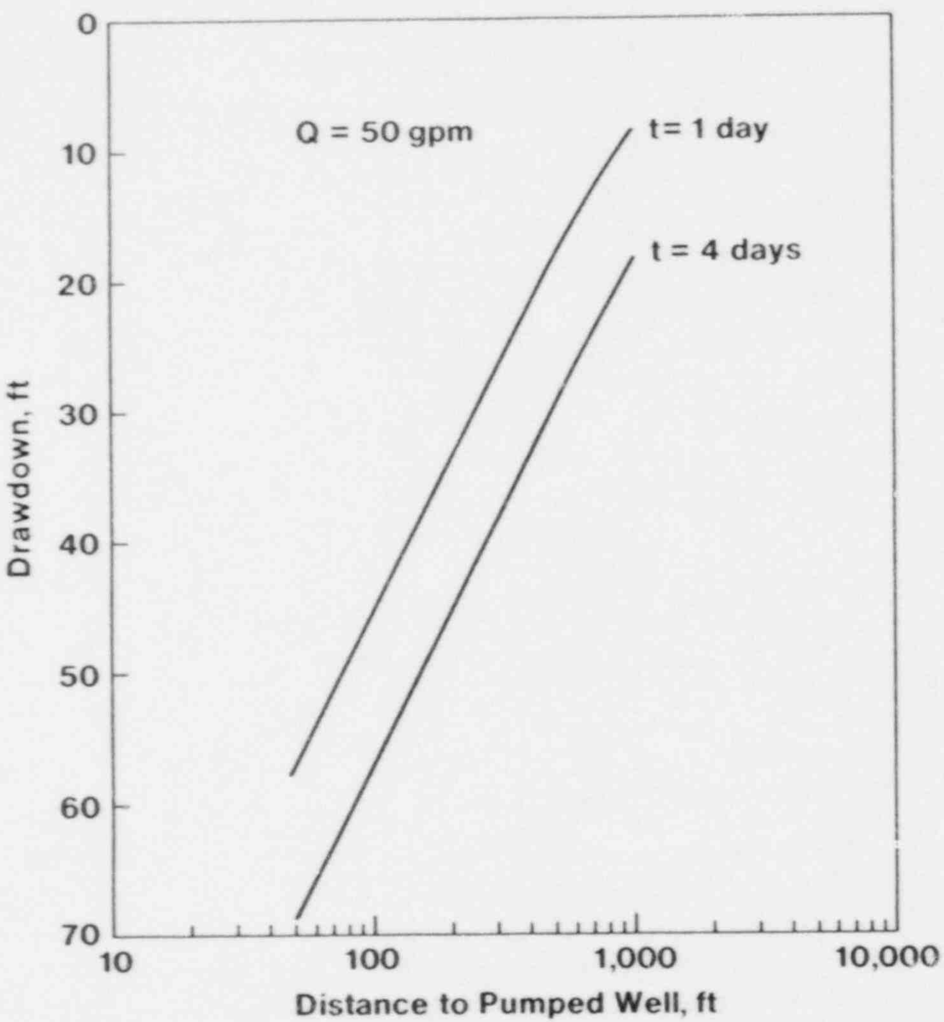

Fig. 5.4. Estimated drawdown at observation well.

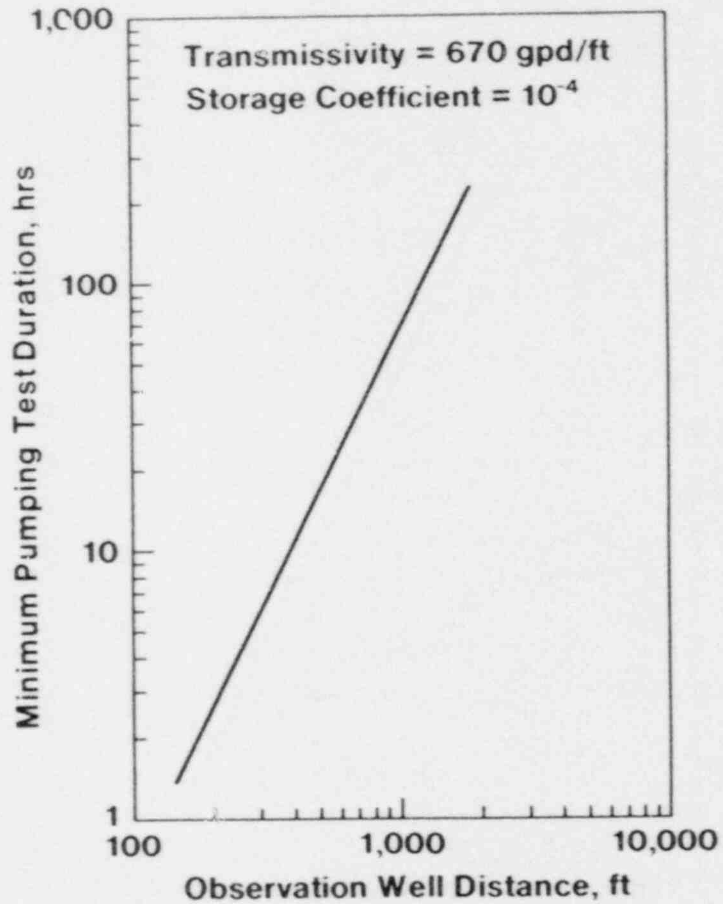

Fig. 5.5. Estimated minimum pumping-test duration.

5.1.4 Radius of Influence of Pumping

The radius of influence indicates how large an area a given pumping test might cover. For example, from Fig. 5.6, a three-day pumping test would cover an area with an estimated radius of 2200 ft for the assumed hydraulic characteristics of the Roza Member.

5.1.5 Other Testing Restrictions

In order to obtain directional hydraulic conductivity, a minimum of three observation wells located at different directions from the pumped well would be required. Thus, all the observation wells in our wellfield design would be located at different directions to gain maximum information on directional hydraulic conductivity of the Roza Member aquifer, the recommended test horizon.

5.1.6 Summary

A conceptual wellfield design based on these considerations is shown in Fig. 5.1. Upon review of the preliminary design and recommendation by the NRC, two additional wells were incorporated into the wellfield to monitor hydraulic confinement by the Quincy and Vantage claystones. Drawdown in the overlying Priest Rapids Member aquifer (well 16-8) and the underlying Grande Ronde formation aquifer (well 16-9) would indicate hydraulic connection with the Roza Member aquifer. This design combines the necessary requirements of tracer testing and pumping tests for aquifer characterization.

Three pumping tests were proposed, with configurations and estimated conditions as given in Table 5.1.

TABLE 5.1
PROPOSED PUMPING-TEST CONFIGURATIONS AND DURATIONS

Test	Pumping well	Observation wells	Pumping rate	Pumping duration	Recovery duration
Preliminary Pumping Test	16-3	16-1 16-2 borehole 16-C	50 gpm	1 day	2 days (est.)
Pumping Test 1	16-3	16-1 16-2 16-4 16-5 16-6 16-7 16-8 16-9 borehole 16-C	50 gpm	3 days	5 days
Pumping Test 2	16-7*	16-1 16-2 16-3 16-4 16-5 16-6* 16-8 16-9 borehole 16-C	50 gpm	3 days	5 days

* Reflects a change from the originally submitted wellfield design, for reasons that will be discussed in a forthcoming interim report.

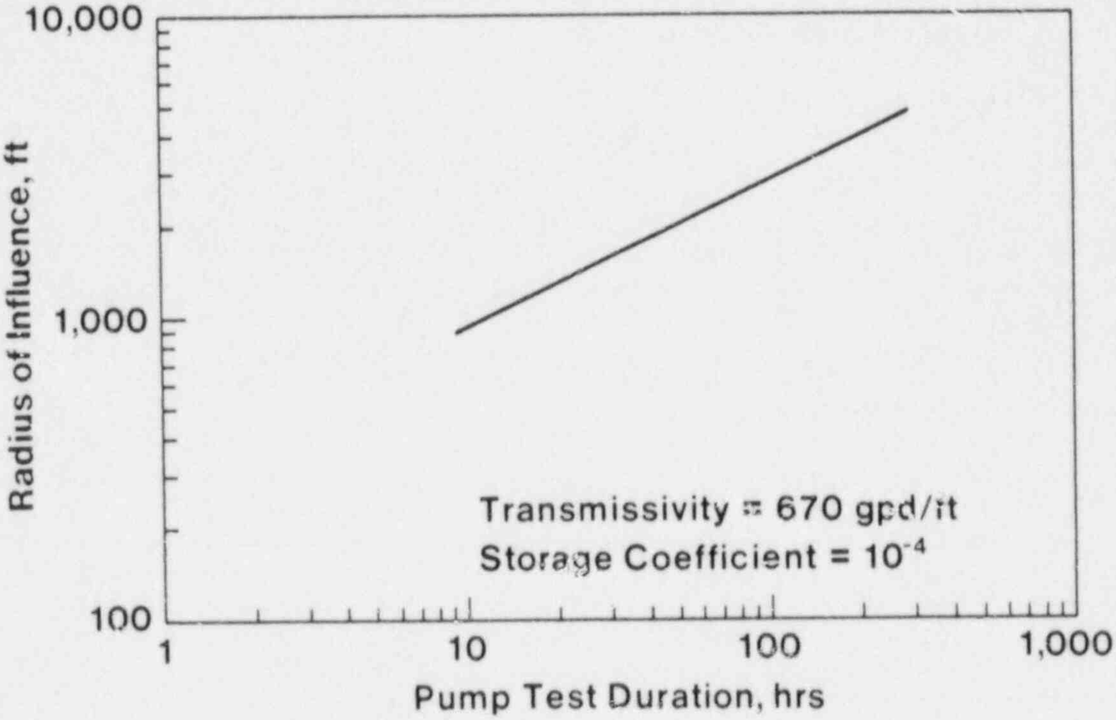

Fig. 5.6. Estimated radius of influence of pumping.

5.2 Tracer-Test Design

De Josselin de Jong (unpublished notes, 1972) derived equations to calculate the directional dispersion coefficient in anisotropic aquifers, based upon the results of the field tracer test. The method requires the injection of an instantaneous tracer slug into an upstream injection well. An intermittent schedule of staggered tracer slugs (at approximately thirty-day intervals) may be used. Time-concentration information in the groundwater in at least two downstream observation wells then would be recorded.

In designing the wellfield for the proposed tracer tests in the Roza Member aquifer, the following four factors were considered: natural groundwater flow, dilution factor, instrument detection limit for candidate tracers, and fracture frequency.

The velocity of groundwater flow is a key factor guiding the relative locations of the injection well (upstream) and the observation wells (downstream), and the expected duration of the tracer tests. Based on an estimated groundwater velocity for the Roza Member of 180 ft/yr, a well spacing of less than 100 ft should enable two or three tracer tests to be completed within approximately six months, based upon preliminary available data on hydraulic conductivities. With In-Situ's programmable data logger and downhole conductivity probe, the time-concentration data in the observation wells can be recorded automatically; thus, a number of one- or two-month tracer tests may be performed in a timely manner and very cost-effectively.

Guidelines in determining the initial tracer concentration, as well as approximate tracer concentrations at various well spacings, can be derived from the instrument detection limits. The representative tracer dilution factors, read from Figs. 5.7 and 5.8, will also provide tracer concentrations. The salt tracers planned for use are potassium chloride (KCl) and sodium chloride (NaCl), because either of these can be easily detected by our conductivity probe and they were environmentally acceptable to the Washington State Department of Ecology.

Table 5.2 summarizes the approximate expected concentration and dilution factors for sodium chloride at various distances and at two different angles from an injection well. A tracer test using multiple slugs is recommended, in conjunction with use of In-Situ's data-logging instrumentation, conductivity probes, and pressure transmitters.

The fourth factor to be considered in designing a wellfield for tracer tests is the fracture frequency. In order to obtain the true in-situ dispersion coefficient, well spacing should be at least one order of magnitude larger than the fracture spacing. Based on the results of the drill-coring program, the fracture frequency in the Roza Member is approximately 3 to 4 fractures per foot, thus dictating a recommended minimum well spacing of 10 ft.

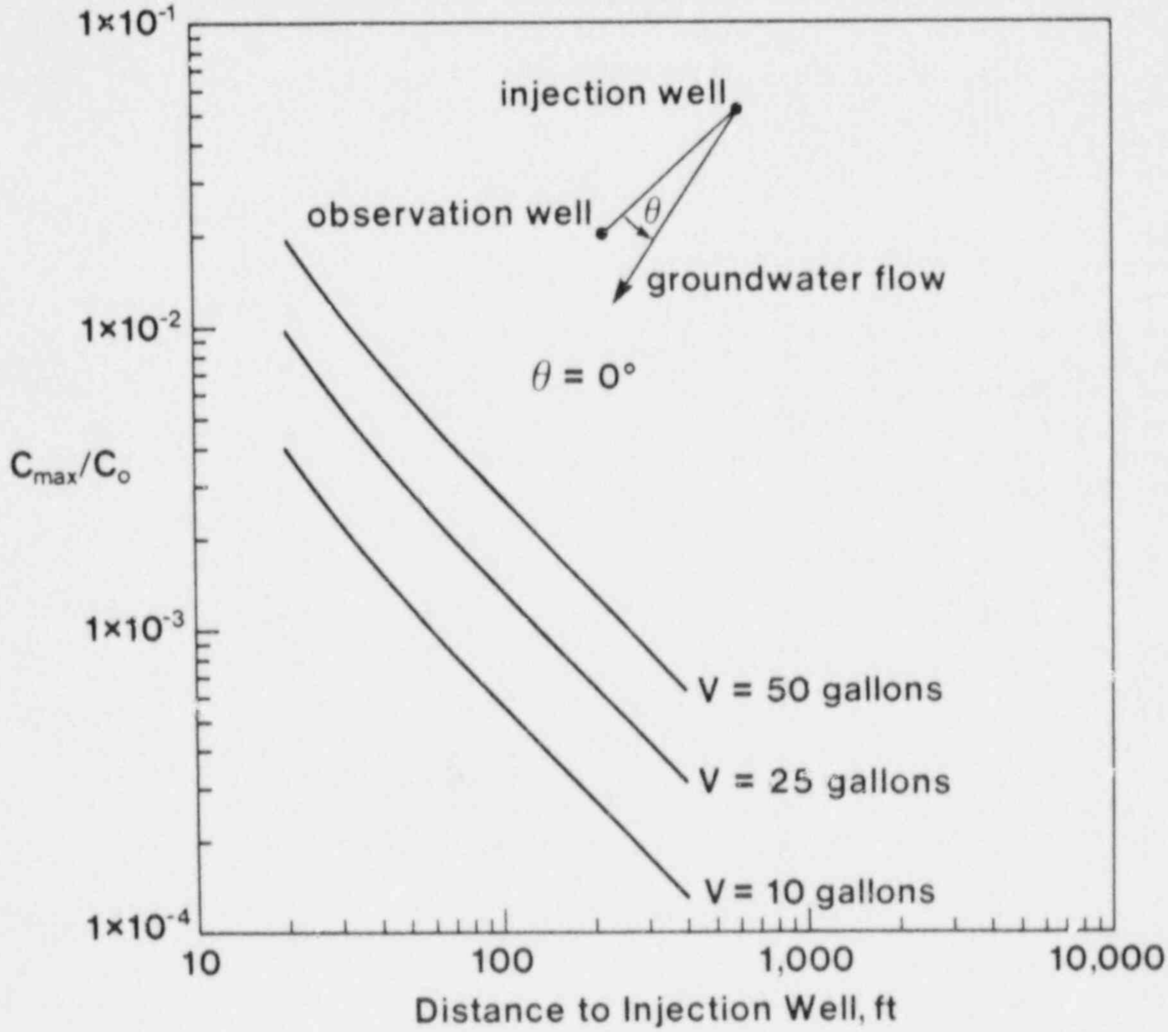

Fig. 5.7. Estimated tracer-dilution factor with $\theta = 0°$. V = initial volume of injected tracer; C_o = concentration of injected tracer; C_{max} = maximum tracer concentration observed in the observation wells.

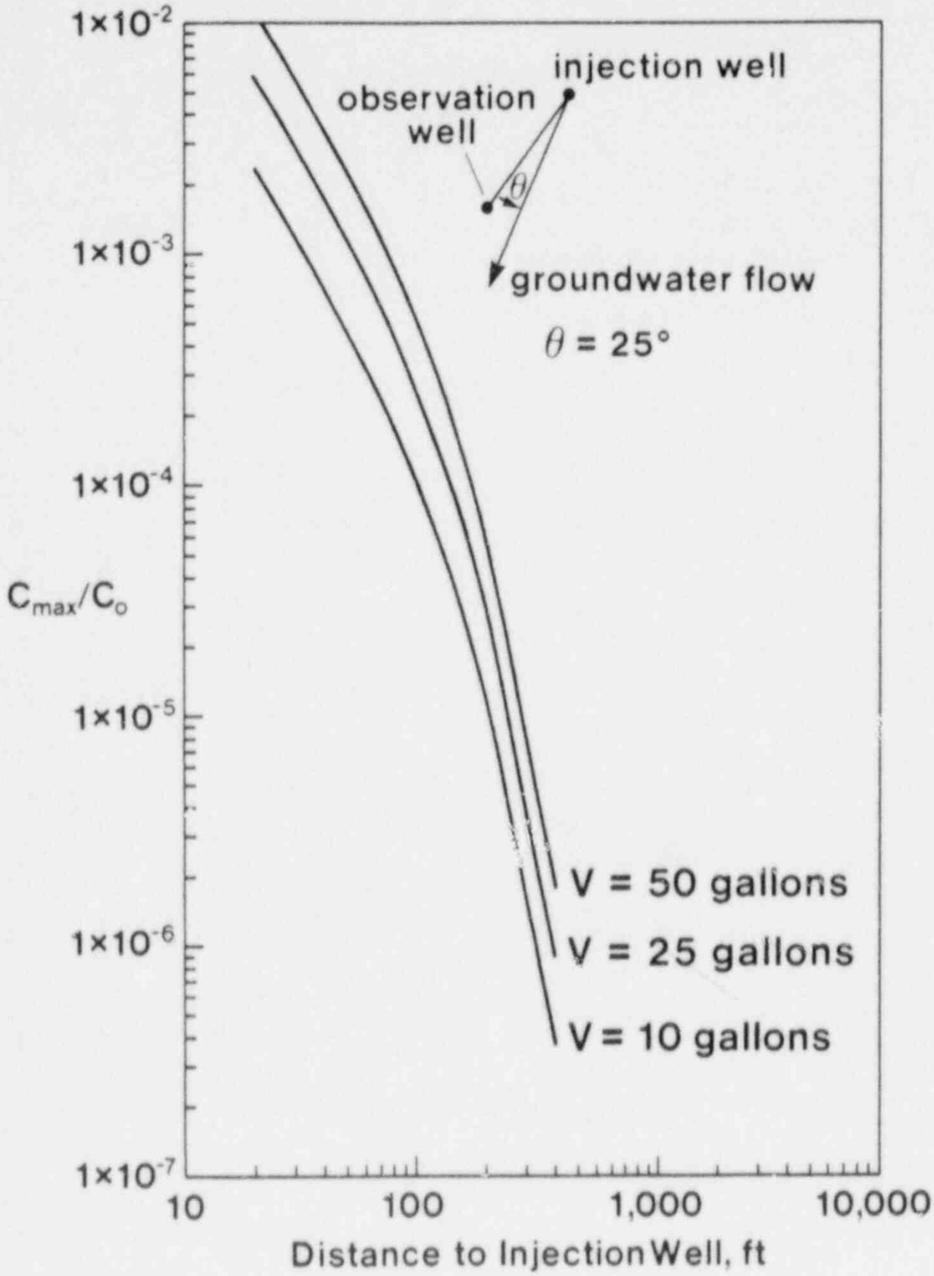

Fig. 5.8. Estimated tracer-dilution factor with $\theta = 25°$. V = initial volume of injected tracer; C_o = concentration of injected tracer; C_{max} = maximum tracer concentration observed in the observation wells.

TABLE 5.2

APPROXIMATE EXPECTED INCREMENTAL CONCENTRATION AND DILUTION FACTORS FOR SODIUM CHLORIDE AT VARYING DISTANCES AND ANGLES FROM AN INJECTION WELL

Detection unit	Distance from injection well to observation well (ft)			
	30	60	100	180
		$\theta = 0°$		
mg/l	780	340	200	110
meq/l	13.4	5.8	3.4	1.8
μS/cm	1600	680	380	190
Dilution factor (Fig. 5.7)	0.002	0.0009	0.0005	0.0003
		$\theta = 25°$		
mg/l	430	120	36	6.4
meq/l	7.3	2.1	0.61	0.11
μS/cm	880	240	70	11
Dilution factor (Fig. 5.8)	0.001	0.0003	0.0001	0.00002

Notes: Molecular weight of NaCl = 58.44 g/mole.
Solubility of NaCl at 0°C = 35.7 g/100 ml.
Assumed volume of injected tracer, V = 10 gallons.
θ = deviation from direction of groundwater flow (see Fig. 5.7 or Fig. 5.8).

Fig. 5.1 shows the design of the wellfield to be used for the tracer tests (wells 16-4, 16-3, 16-5, 16-6, and 16-7). The initial tracer test is proposed using well 16-4 as an injection well (with a single slug or multiple slugs of KCl or NaCl) and wells 16-3, 16-5, 16-6, and 16-7 as observation wells. Additional tracer tests may be run, possibly using Amino-G as a tracer and with pulsed rather than a single slug of tracer.

5.3 Well-Drilling Program

A two-phase approach to the well-drilling program was proposed. Phase 1 was to consist of percussion-hammer drilling, coring, and logging of wells 16-1 and 16-2 (Fig. 5.1) down to the bottom of the Roza Member, and obtaining vertical profiles of hydraulic conductivity by performing a series of straddle-packer slug tests. It is assumed that the flow top would constitute the dominant zone for the transport of potential groundwater contaminants. However, we proposed to complete all wells (wells 16-1 through 16-7, Fig. 5.1) fully penetrating the Roza Member.

After drilling wells 16-1 and 16-2, wells 16-3, 16-8, and 16-9 were drilled and completed. The top-of-casing elevations of new wells 16-1, 16-2, and 16-3 and existing borehole 16-C then were surveyed and the static water-level elevations (referenced to mean sea level) measured.

After drilling these three Phase 1 wells, a preliminary one-day pumping test was run using well 16-3 as the pumped well and wells 16-1 and 16-2 and borehole 16-C as observation wells. This test was designed to provide information on hydraulic conductivity, hydraulic gradient, and groundwater velocity. The latter hydraulic characteristic is particularly important in designing a wellfield for a tracer test. Based upon the results of this preliminary pumping test, the locations of proposed wells 16-4, 16-5, 16-6, and 16-7 were adjusted so that the tracer injected into well 16-4 might more readily be observed in wells 16-5, 16-6, and 16-7 within a "reasonable" period of time (days rather than months).

Phase 2 of the program was planned to consist of drilling wells 16-4, 16-5, 16-6, and 16-7. After completion of these wells, two pumping tests (described in Section 5.1 above) and one tracer test (described in Section 5.2 above) were performed using these Phase 2 wells.

All Roza Member wells completed according to the wellfield design in this plan were to be cased with a 6-inch i.d. blank steel casing and pressure-grouted throughout the Priest Rapids Member, to enable all wells to accommodate the submersible pump for contingency pumping. A preliminary schedule of wellfield drilling, completion and testing is shown in Table 5.3.

Three reasons partially motivated the scheduling of well drilling for this research wellfield, which was begun during the second week of February 1987. These are:

- o frozen overburden, allowing off-road overweight drilling-rig access until approximately mid-March,
- o the off-season of well drilling for contractors may provide an incentive for lower competitive bids, and
- o minimal chance that wellfield water levels would be affected by irrigation season pumping, expected to begin in mid-May 1987.

The two proposed pumping wells (16-3 and 16-6) were completed as shown in Fig. 5.9, except for minor modifications. Also, it should be noted that use of wells 16-6 and 16-7 were reversed for the second pumping test. One of these completed wells will be released to the State of Washington for livestock watering after cessation of our project field testing.

Five observation wells (16-1, 16-2, 16-4, 16-5, 16-7) were completed as shown in Fig. 5.10. Two of these wells (16-1 and 16-2) were percussion-

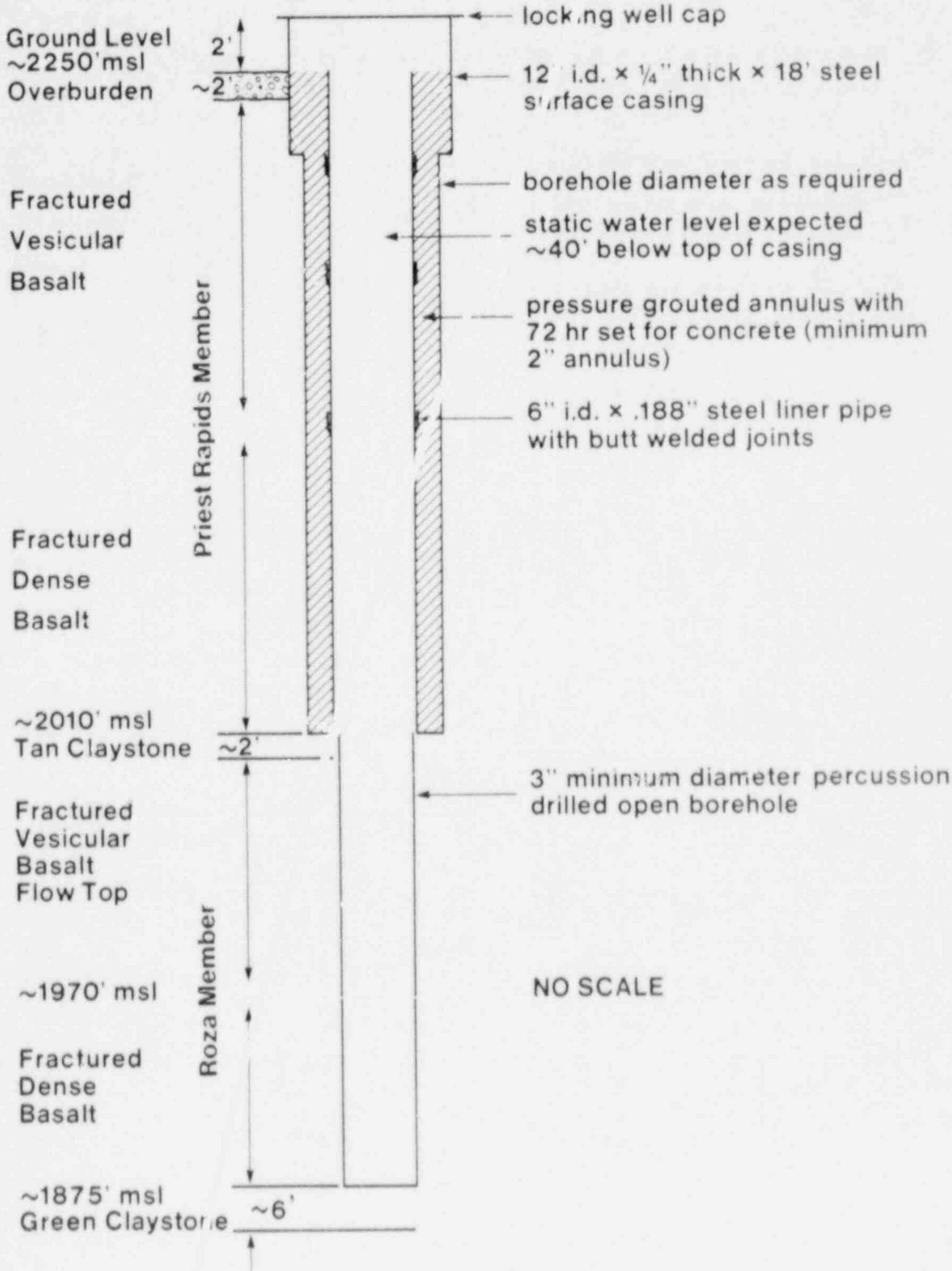

Fig. 5.9. Pumping-well schematic.

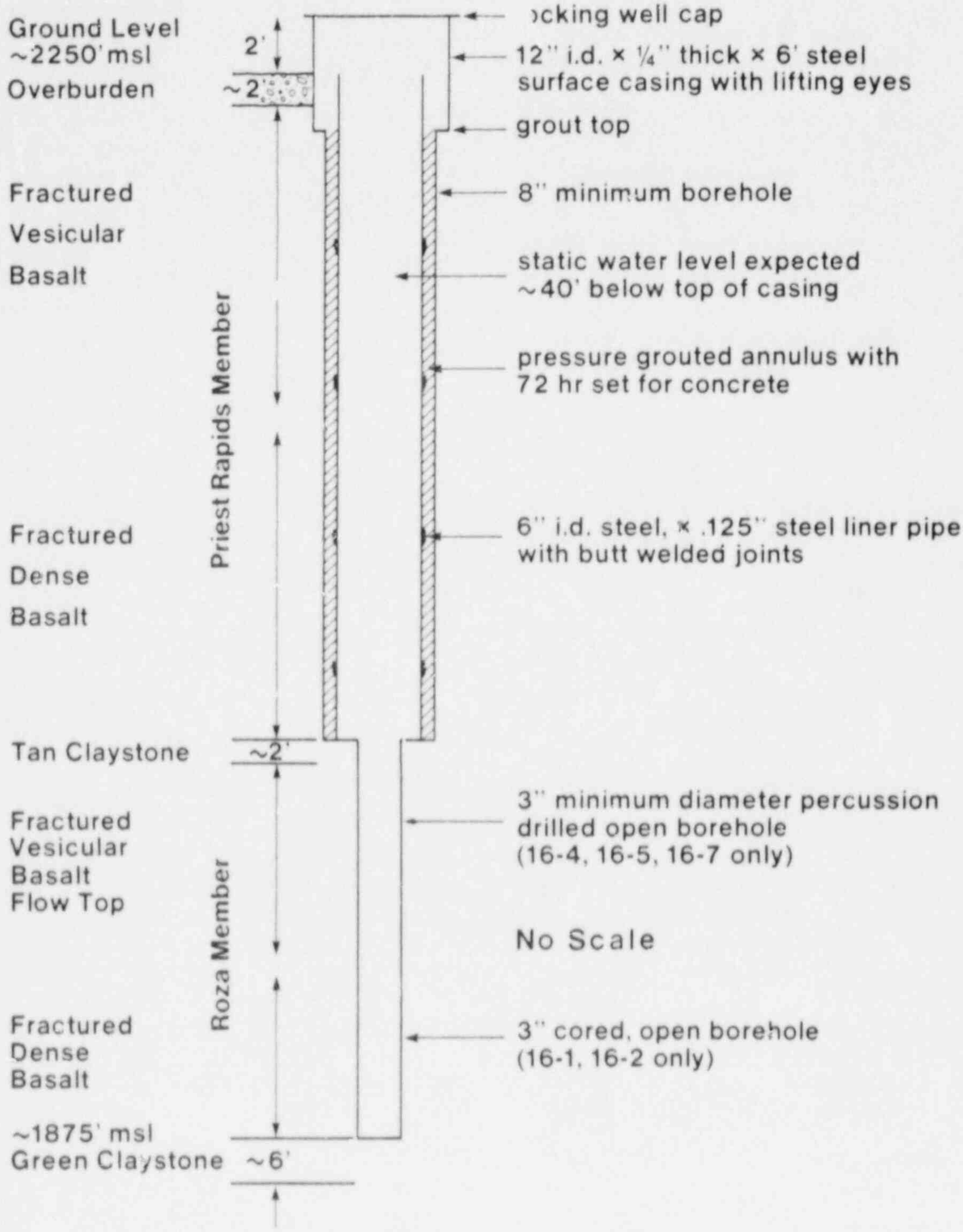

Fig. 5.10. Observation-well schematic.

hammer drilled through the Priest Rapids Member basalt and then NX-diamond-core-drilled (3-inch), as discussed above.

Following completion of project field testing, all test wells except the released water well will be abandoned (that is, plugged and grouted) in compliance with the State of Washington Department of Ecology water-well standards.

5.4 Wellfield Development and Hydrologic Testing

Completion of field tasks required a coordinated sequence of drilling, completion, and surveying within a time frame discussed in Section 5.3 and shown in Table 5.3. Evaluation of hydraulic-conductivity profiles, hydraulic gradient, and groundwater velocity for the Roza Member aquifer were planned to be completed by about May 15, 1987, prior to the onset of the normal irrigation pumping season. Fig. 5.11 is a flow diagram depicting the planned sequence of wellfield development and hydrologic testing.

The well-drilling contractor (Allbery Drilling Corporation of Spokane, Washington) supplied the percussion-rotary drilling rig, the well-service truck, pump, motor, standpipe, flow-control valve, flow meter, power supply, and discharge pipe. In-Situ staff monitored the three pumping tests using the equipment listed in Table 5.4. A typical example of an equipment configuration is shown in Fig. 5.12 for the preliminary pumping test, using one pumped well and three observation wells.

After completion of the wellfield pumping and recovery test, tracer tests were started. Tracer injections have taken place in upgradient well 16-4 and have been monitored in appropriate downgradient wells. The initial test involved injection of the tracer sodium chloride (NaCl) in the Roza Member flow top; hydraulic conductivity of most of the Roza Member had been profiled prior to tracer injection in the nearest downgradient well (16-3). A second tracer test involved injection of the tracer potassium chloride (KCl) in the dense basalt interior of the Roza Member, using the same well combination (16-4 for injection, 16-3 for initial detection). Water levels also were continuously monitored (at 1-hr intervals) in selected wells to detect changes in hydraulic gradient that may be induced by irrigation during the course of the tracer tests.

TABLE 5.3

PRELIMINARY WELLFIELD DEVELOPMENT AND TESTING SCHEDULE

Day	Well 16-1	Well 16-2	Well 16-3	Well 16-4	Well 16-5	Well 16-6	Well 16-7	All wells to date
1	Drill(w)							
2	Set casing(w)							
3	Grout(w)							
4	Grout	Drill(w)						
5	Grout	Set casing(w)						
6	Core(d)	Grout(w)						
7	Core(d)	Grout	Drill(w)					
8	Core(d)	Grout	Set casing(w)					Survey(s)
9	Core(d)	Core(d)	Grout(w)					
10	H-C test(i)	Core(d)	Grout					
11	H-C test(i)	Core(d)	Grout					
12		Core(d)	Drill R(w)					
13		H-C test(i)						Geophys(g)
14		H-C test(i)						Analysis(i)
15			Pump test(i)					
16				Drill(w)				
17				Set casing(w)				
18				Grout(w)				
19				Grout	Drill(w)			
20				Grout	Set casing(w)			
21					Grout(w)			
22					Grout	Drill(w)		
23					Grout	Set casing(w)		
24						Grout(w)		
25						Grout	Drill(w)	
26						Grout	Set casing(w)	
27							Grout(w)	
28				Drill R(w)			Grout	
29					Drill R(w)		Grout	
30						Drill R(w)		
31							Drill R(w)	
32								Geophys(g)
33			Pump test(w)					
34			Pump test(iw)					
35			Pump test(i)					
36								Recovery(i)
37								Recovery(i)
38								Recovery(i)
39								Recovery(i)
40								Recovery(i)
41						Pump test(w)		
42						Pump test(iw)		
43						Pump test(i)		
44								Recovery(i)
45								Recovery(i)
46								Recovery(i)
47								Recovery(i)
48								Recovery(i,w)
49				Tracer tests begin(i)				

Key: d: 3-man diamond drilling crew, truck mount rig, water truck

g: borehole geophysical logger

H-C: hydraulic conductivity profile in Roza Member basalt using straddle-packer slug test

i: In-Situ Inc. staff

R: Roza Member basalt ~230'-360', all grout in Priest Rapids Member basalt

s: 2-man land survey crew

w: 2-man drilling crew, rotary-percussion rig, pump service truck

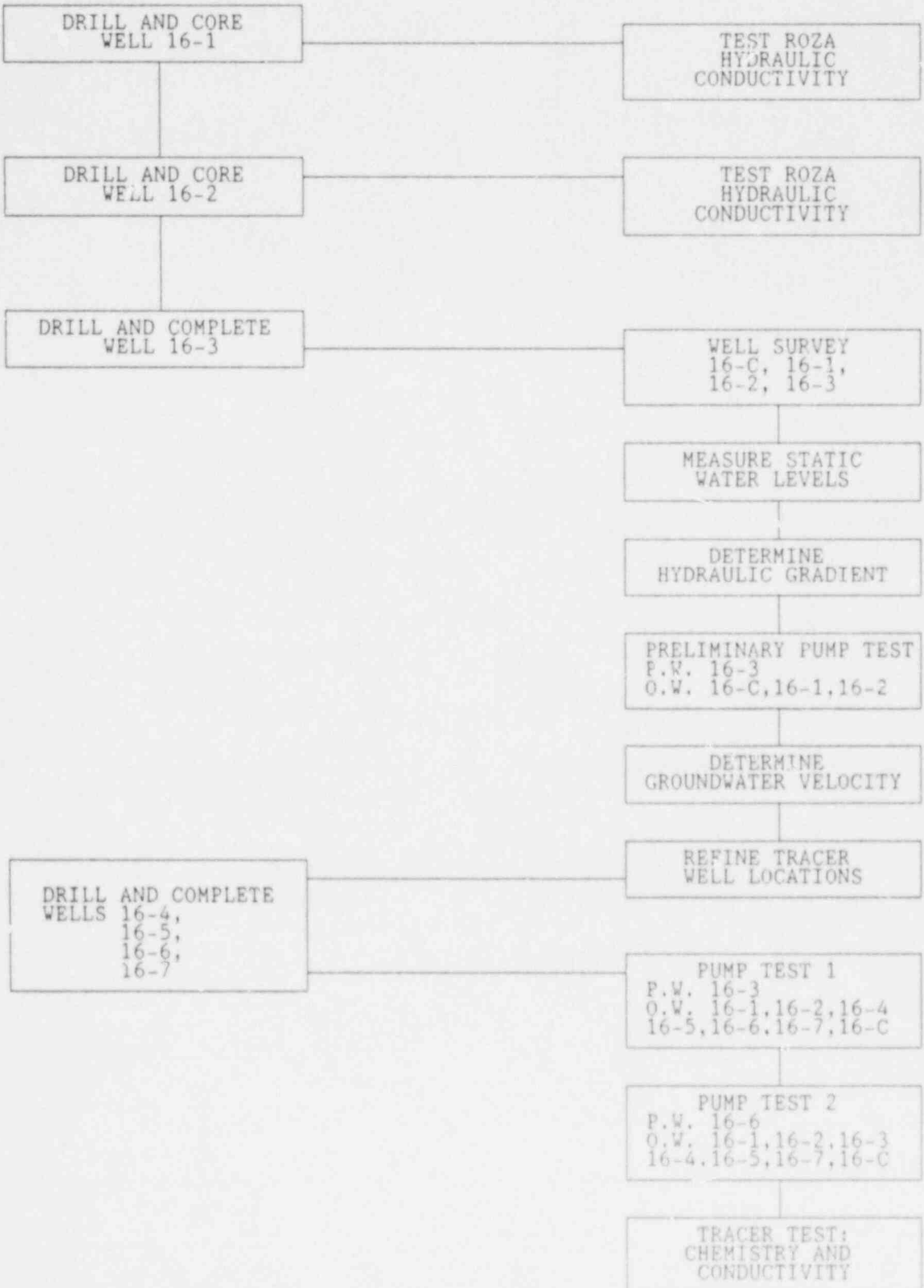

Fig. 5.11. Wellfield development and hydrologic testing sequence.

TABLE 5.4
PUMPING-TEST EQUIPMENT REQUIREMENTS

PRELIMINARY PUMPING TEST

Pumping well: 16-3
Observation wells: 16-1, 16-2, 16-C

Special requirements (prior to start of test):
- Survey elevations to top of casing
- Determine top and bottom elevations of test intervals
- Accurately measure static water-level elevations to top of casing

Equipment:

4	SE1000 data loggers
1	Transmitter 100 psi with standard 500-ft cable
2	Transmitters 50 psi
1	Transmitter 10 psi
1	Acoustic sounder (±0.01 ft accuracy)
1	Electric tape

PUMPING TEST NO. 1

Pumping well: 16-3
Observation wells: 16-1, 16-2, 16-4, 16-5, 16-6, 16-7, 16-8, 16-9, 16-C

Equipment:

1	SE200 data logger
2	SE1000 data loggers
1	Transmitter 100 psi with standard 500-ft cable
5	Transmitters 50 psi
1	Transmitter 10 psi
1	Acoustic sounder (±0.01 ft accuracy)
1	Electric tape

PUMPING TEST NO. 2

Pumping well: 16-7*
Observation wells: 16-1, 16-2, 16-3, 16-4, 16-5, 16-6*, 16-8, 16-9, 16-C

Equipment:

1	SE200 data logger
2	SE1000 data loggers
1	Transmitter 100 psi with standard 500-ft cable
5	Transmitters 50 psi
1	Transmitter 10 psi
1	Acoustic sounder (±0.01 ft accuracy)
1	Electric tape

* Represents a modification of the initial design (In-Situ, Inc., 1987).

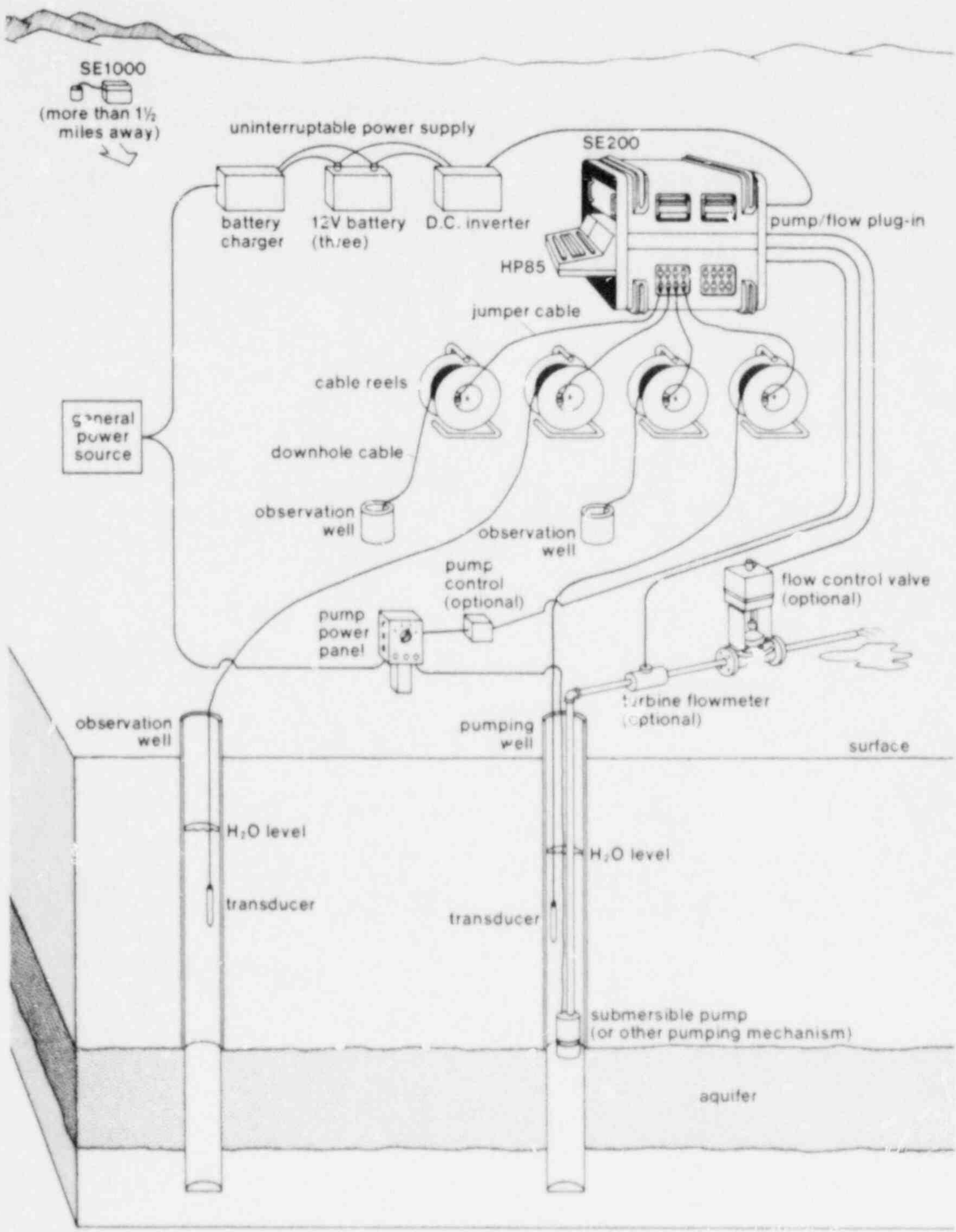

Fig. 5.12. Pumping-test instrumentation configuration.

6. INTEGRATION OF FIELD INVESTIGATIONS AND OTHER PROJECT TASKS

6.1 Theoretical Investigations

The theoretical aspects of effective porosity, large-scale dispersion coefficients, and matrix diffusion are to be incorporated into certain aspects of completed, ongoing, or planned field investigations involving the research wellfield. Specifically, aspects of effective porosity and dispersivity are being tested using injected salt-tracer solutions into selected intervals of the Roza Member of the Wanapum Formation. Preliminary field testing of matrix diffusion of the Roza Member has been conducted. It is hoped that field tests will be interrelated to a computer algorithm for matrix diffusion based upon best estimates of travel time in this basalt unit.

6.2 Computer-Modeling Analyses

Both continuum and discrete-fracture models are being developed and/or evaluated in conjunction with field-generated data from the research wellfield. In the case of the discrete-fracture models, emphasis is being placed on the probability distribution of each of the primary parameters of these models. Also, from the borehole core, estimates of fracture characteristics (aperture, spacing, and direction) are being obtained.

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APPENDIX TABLES

TABLE A.1
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TABLE A.1
(Continued)

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Davenport Washington Office
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7. Rockwell-Hanford Operations

Mr. Mike Thompson

8. Cominico Fertilizers (Wilbur Climatological Record)

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TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
24/32-10	NE 1/4 of NW 1/4 of NW 1/4	Wilbur Security Company	747
24/32-11	SE 1/4	Wilbur Security Company	471
24/32-11	NE 1/4 of NE 1/4	Wilbur Security Company	582
24/32-24	NE 1/4 of NE 1/4	Tom Haggarty	562
24/32-24	NE 1/4 of NE 1/4 of NE 1/4	E.C. Wagner	425
24/32-26	NE 1/4 of NW 1/4	Wilbur Security Company	300
24/32-26	NW 1/4 of SE 1/4	Wilbur Security Company	551
24/32-30	NW 1/4 of SW 1/4	Wilbur Security Company	786
24/32-30	NW 1/4 of SW 1/4	Wilbur Security Company	930
24/32-35	NW 1/4 of SE 1/4	Wilbur Security Company	635
24/33-18	SE 1/4 of NE 1/4	Alvin Schmierer	350
24/33-23	SE 1/4 of SE 1/4 of SW 1/4	Alvin Schmierer	1025
24/33-32	N 1/2	Alvin Schmierer	280
24/34-3	SW 1/4 of SW 1/4	Andy Rustemeyer	305
24/34-23	300' West of Center	Dale M. Bly	517
24/34-23	W 1/2	Wesdale Farms	596
24/34-28	SE 1/4 of NW 1/4	Donnell D. Looney	444
24/34-30	SW 1/4 of SE 1/4	Nealey Industries Inc.	775
24/36-2	SW 1/4 of SE 1/4	Reuben/Maurice Fink	610
24/36-2	W 1/2 of N 1/2	Reuben Fink	506
24/36-2	SE 1/4 of SE 1/4	Maurice Fink	400

TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS (continued)

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
24/36-2	NS (?) of SW 1/4	Reuben/Maurice Fink	165
24/36-3	NW 1/4 of NW 1/4	Reuben/Maurice Fink	125
24/36-11	SE 1/4 of NW 1/4	George Scharff for Mrs. R.H. Scharff	495
24/36-14	SE 1/4 of NE 1/4	Milton Hardy	70
24/36-16A	—	Well Hydrograph	744
25/32-1	SW 1/4 of SW 1/4	William Dreger	575
25/32-1	SW 1/4 of SW 1/4	William Dreger	100
25/32-2	SE 1/2	William Dreger	200
25/32-12	SE 1/4 of SE 1/4	Dale Wegner	427
25/32-12	E 1/2 of SE 1/4	Clarence Wagner	165
25/32-16	NW 1/4 of NW 1/4	John McKay	220
25/32-17	NE 1/4 of SE 1/4	Thomas Quirk	300
25/32-26	NE 1/4 of NE 1/4 of NW 1/4	Patrick J. Quirk	900
25/32-26	NE 1/4 of NE 1/4 of SE 1/4	John Wagner	40
25/32-26	SW 1/4 of SW 1/4 of NE 1/4	Patrick J. Quirk	650
25/32-28	SE 1/4 of SE 1/4	Archie Schroeder	417
25/32-32	SE 1/4 of NE 1/4	Creighton Sherwood	498
25/32-35	SE 1/4 of SW 1/4	Wilbur Security Company	587
25/32-35	SE 1/4 of SW 1/4	Wilbur Security Company	1139
25/33-18		Walter Tiegs	60

TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS (continued)

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
25/33-4	NW 1/4	William Dreger	100
25/33-4	Government Lot 4	William Dreger	505
25/33-4	NW 1/4 of NW 1/4	William Dreger	925
25/33-4	Government Lot 4	William Dreger	355
25/33-4	NW 1/4	William Dreger	520
25/33-7	NW 1/4 of NE 1/4	William Dreger	380
25/33-7	SE 1/4 of NE 1/4	William Dreger	100
25/33-7	SE 1/4 of NE 1/4	William Dreger	225
25/33-8D	SE 1/4 of SW 1/4 of NW 1/4	Glen C. Watson	335
25/33-9B	--	Arthur Eagle	390
25/33-10	NW 1/4 of NE 1/4	Robert Rosman	362
25/33-20	NE 1/4	Robert Bauer	235
25/33-27	NE 1/4 of NE 1/4	E.C. Rettkowski	865
25/33-27	S 1/2 of SE 1/4	E.C. Rettkowski	19
25/33-27	N 1/2 of N 1/2 of NE 1/4	E.C. Rettkowski	850
25/33-27	SW 1/4 of SE 1/4	Rettkowski Bros. Inc.	650
25/33-27	SE 1/4	E.C. Rettkowski	525
25/33-31	SW 1/4 of NE 1/4	Wilbur Security Company	495
25/33-31	SW 1/4 of NE 1/4	Wilbur Security Company	816
25/34-2	NE 1/4 of NW 1/4	Merwin Hauger	610

TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS (continued)

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
25/34-2	SW 1/4	Tera Corporation	220
25/34-2	SW 1/4 of NE 1/4	Merwin Hauger	320
25/34-3	NE 1/4 of SE 1/4	Tera Corporation	220
25/34-9	SE 1/4 of NW 1/4	Merwin Hauger	105
25/34-18D1	NW 1/4	R.T. Burt	180
25/34-18	NW 1/4	William Dreger	200
25/34-20	SE 1/4 of SW 1/4	William Dreger	340
25/34-29	NE 1/4 of SE 1/4	Richard Dreger	1225
25/34-30	NW 1/4 of NE 1/4	Richard Dreger	596
25/34-30	N 1/2 of SE 1/4	Richard Dreger	500
25/34-30	N 1/2 of SE 1/4	Richard Dreger	705
25/34-30	NW 1/4 of SW 1/4 of SE 1/4	Edward Dreger	266
25/35-3	NW 1/4 of SW 1/4	Washington St. Hwy. Dept.	200
25/35-3	SW 1/4 of NW 1/4	Washington St. Hwy. Dept.	90
25/35-4	NW 1/4 of SE 1/4	Blake Hall	97
25/35-4	NW 1/4 of SE 1/4	George L. Robinson	163
25/35-4	NE 1/4	George L. Robinson	123
25/35-18	N 1/2 of NE 1/4	Joseph Myers	104
25/35-20	NW 1/4 of NW 1/4	Victor Alt	1440
25/35-21	SE 1/4 of NE 1/4	Mr. Stephens	100
25/35-28	N 1/2 of NE 1/4	John McClish	160

TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS (continued)

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
25/36-2	NE 1/4 of NE 1/4	Jessie Kenny	71
25/36-20	NE 1/4 of SE 1/4	R.A. Morrison	404
25/36-21	E 1/2 of NW 1/4	Jack & William Sterett	404
25/36-21	NE 1/4 of SE 1/4	Fred W. Magin	314
25/36-21	NE 1/4 of SE 1/4	Harry Schneider	450
25/36-21	SE 1/4	Jerry Scheibner	390
25/36-22	SW 1/4 of NE 1/4	Eugene Stuckle	185
25/36-24	SE 1/4 of NW 1/4	Duane Horwege	256
25/36-27	SW 1/4 of SE 1/4	Laurence E. Ensor	324
25/36-28	E 1/2 of NW 1/4	Harry Schneider	400
25/36-34	SE 1/4 of NW 1/4 of SW 1/4	Mary E. Florin	148
26/32-1	SW 1/4 of NW 1/4	Bob Bandy	305
26/32-1	SE 1/4 of SW 1/4	J.H. & J. Mason Llewellyn	380
26/32-10	--	James Rettkowski	235
26/32-10	SE 1/4 of NE 1/4	Norman Gelb	752.5
26/32-10	SW 1/4 of NE 1/4	Norman Gelb	505
26/32-11	S 1/2	Jerry Stanford	220
26/32-11	SW 1/4 of NE 1/4	Ray O. Scheibner	86
26/32-11	NW 1/4 of SW 1/4 of NE 1/4	Ned Scheibner	310
26/32-11	S 1/2 of W 1/2 of NE 1/4	Ray O. Scheibner	86
26/32-12	SE 1/4 of SW 1/4	Ivan R. Moser	129

TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS (continued)

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
26/32-12	--	Andrew & Norma Upton	180
26/32-16	NE 1/4 of SW 1/4	The Sheffels Company	233
26/32-17	NW 1/4 of NE 1/4	Robert Sheffels	226
26/32-19	SE 1/4 of NW 1/4	Albert Semprimoinik	312
26/32-20	NE 1/4 of SW 1/4	Mark Sheffels	225
26/32-20	SE 1/4 of NW 1/4	James L. Nelson	275
26/32-20	NE 1/4 of SW 1/4	Robert Sheffels	290
26/32-21	SW 1/4 of NW 1/4 of SW 1/4	Frank L. Zimmerman	453
26/32-26	NW 1/4 of NW 1/4	James F. Rosman	166
26/33-3	SW 1/4 of SE 1/4	Jack Rodregus	240
26/33-6	SE 1/4 of SW 1/4	J.H. & J. Mason Llewellyn	100?
26/33-6	SE 1/4 of SW 1/4	J.H. & J. Mason Llewellyn	170
26/33-7	NW 1/4 of NW 1/4	Letha Barker	151
26/33-7	SW 1/4 of SW 1/4 of NW 1/4	Big Bend Golf & Country Club Inc.	154
26/33-8	NW 1/4 of SW 1/4? NE 1/4 of SW 1/4 of SW 1/4?	City of Wilbur	373
26/33-12	--	US Army Engineering District	291.5
26/33-12	--	US Army Engineering District	294
26/33-17	NW 1/4 of NE 1/4 of NW 1/4	G.W. Emerson Lumber Company	44
26/33-18	--	Town of Wilbur	900
26/33-18	--	Town of Wilbur	450

Table A.2 Sheet 6 of 8

TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS (continued)

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
26/33-18	SE 1/4 of S 1/2 of NE 1/4 of NE 1/4	Edwin Dean Angstrom	308
26/33-18	SW 1/4 of NE 1/4	Town of Wilbur	502
26/33-19	NW 1/4 of NW 1/4	Andy McInroy	233
26/33-29	SW 1/4 of SW 1/4	Fred R. Rux	120
26/33-29	SE 1/4 of SW 1/4	Herman Rux	160
26/33-29	SE 1/4 of SE 1/4 of SW 1/4	Herman & Walter Rux	288
26/33-31	E 1/2	Don & Virginia Piper	120
26/33-32	SW 1/4 of W 1/2	William Dreger	395
26/33-32	NW 1/4 of NW 1/4 of NW 1/4	William Drager	308
26/3[illegible]	NE 1/4 of NE 1/4	Edward F. Dreger	34
26/33-32	NW 1/4 of SE 1/4	Edward F. Dreger	426
26/33-33A	--	Edward F. Dreger	34
26/33-33	N 1/2 of NE 1/4	Edward F. Dreger	34
26/33-34	SE 1/4 of SW 1/4	Richard Dreger	450
26/33-34	NW 1/4 of SW 1/4	Richard Dreger	450
26/33-36	SE 1/4 of SW 1/4	August Dreger	350
26/34-10	SW 1/4 of NE 1/4 of SW 1/4	Town of Creston	766
26/34-15D	--	Verna Vincent	288
26/34-15F	SE 1/4 of NW 1/4	Verna Vincent/Town of Creston	455
26/34-21	NW 1/4 of NW 1/4	Rex Bean	250
26/34-23	NE 1/4 of S 1/2	Phil Krause	280

TABLE A.2

DOE INVENTORY SUMMARY, WELLS WITH DRILL LOGS (continued)

Township/Range Section-Description	Location	Owner Description	Well Depth (ft)
26/34-26	SE 1/4	Tera Corporation	273
26/34-35	NW 1/4	Tera Corporation	248
26/35-11	SW 1/4 of SW 1/4	Merle Angstrom	200
26/35-15	SW 1/4 of SE 1/4	Harold G. Bettys	206
26/36	Tract 217	Dan Hall	146
26/36-17	SW 1/4 of SW 1/4	Rodger D. Sullivan	25
26/36-17	SW 1/4	Ted Garfield	58
26/36-17	SW 1/4	Don Mahn	45
26/36-17	SW 1/4	Vernon Jacobson	60
26/36-19	NE 1/4	Robert W. Newman	7
26/36-21	NW 1/4	Wayne Pierce	160
26/36P	—	State of Washington (Anna Gunning)	205

Source: State of Washington DOE

TABLE A.3
WATER-LEVEL ELEVATIONS

Tera Corporation Pumping Wells
Creston, Washington

	Water-Level Elevation (ft MSL)			
Date	P1	P2	P3	P4
Data collected by Tera Corp.				
07/22/80	2301.6	2280.3	--	--
07/30/80	2302.7	2279.4	--	--
08/25/80	2300.0	2277.7	2269.7	2271.5
09/02/80	2299.9	2277.6	2269.9	2272.8
10/29/80	2293.3	2277.9	2271.3	2272.0
01/27/81	2299.5	2277.5	2272.2	2273.0
04/18 & 05/02/81	2298.7	2267.0	2281.9	2255.8
07/28 & 08/01/81	2296.9	2274.6	2249.2	2282.4
10/28-30/81	2293.8	2271.0	2262.4	2264.8
10/22-25/82	2296.0	2273.4	2249.2	2266.4
Data collected by In-Situ Inc.				
06/20/86	2304.8	2283.7	2275.1	2274.2
07/18/86	2303.3	2282.0	2273.2	2272.5
08/24/86	2301.75	2280.45	2271.7	2271.3
10/25/86	2300.35	2278.8	2275.9	2271.4
12/04/86	2300.2	2278.6	--	2272.3
03/06/87	2300.0	2278.3	2272.1	2273.0
04/08/87	2301.0	2279.4	2272.9	2273.8
05/07/87	2300.5	2280.1	2273	2272.6
06/21/87	2299.1	2277.4	2267.8	2268.1
08/05/87	2297.75	2276.25	2247.25	2267.89
10/09/87	2296.45	2274.50	2266.1	2266.99
12/21/87	2296.10	2274.10	2266.3	2267.59

		P1	P2	P3	P4
Land surface elevation (ft MSL)		2370	2295	2330.8	2319
Completed zone elevation (ft MSL)	Top	2333	2255	2312	2300
	Bottom	2158.7	2153.7	2185.8	2177.4

TABLE A.3 (continued)
WATER-LEVEL ELEVATIONS

Tera Corporation Observation Wells
Creston, Washington

	Water-Level Elevation (ft MSL)			
	OW1		OW2	
Date	Upper	Lower	Upper	Lower
Data collected by Tera Corp.				
07/22/80	2274.1	2273.6	2226.9	2226.9
07/30/80	2273.6	2273.1	2227.1	2226.8
08/25/80	2272.7	2272.3	2227.1	2226.5
09/02/80	2272.4	2272.1	2227.2	2225.6
10/29/80	2272.5	2272.4	2228.6	2230.6
01/27/81	2273.5	2273.5	2231.7	2233.7
04/18 & 05/02/81	2273.2	2269.6	2231.7	2227.3
07/28 & 08/01/81	2267.7	2265.9	2221.7	2221.2
10/28-30/81	2263.9	2263.9	2221.5	2222.1
10/22-25/82	2267.3	2267.3	2222.7	2222.2
Data collected by In-Situ Inc.				
06/20/86	2276.0	2275.7	--	--
07/18/86	2274.6	2273.8	--	--
08/24/86	2272.75	2272.5	2225.9	2223.5
10/25/86	2272.2	2272.1	2228.4	2230.25
12/04/86	2273.0	2272.9	2229.8	2233.0
03/06/87	2273.8	2273.5	2231.3	2234.3
04/08/87	2274.3	2273.9	2231.1	2234.8
05/07/87	2273.6	2263.2	2231.35	--
06/21/87	2269.0	2268.7	2224.3	2218.7
08/05/87	2269.08	2268.93	2225.1	2225.11
09/14/87	--	--	2224.95	2224.65
10/09/87	2268.01	2267.88	2225.40	2224.60
12/21/87	2268.09	2267.93	2228.88	2231.05

Land surface elevation (ft MSL)	2347.7		2237.5	
Screen elevation (ft MSL) Top	2223.7	2191.7	2185.5	2133.5
Bottom	2213.7	2186.7	2175.5	2123.5

Table A.3 Sheet 2 of 6

TABLE A.3 (continued)
WATER-LEVEL ELEVATIONS

Tera Corporation Observation Wells (continued)
Creston, Washington

Date	Water-Level Elevation (ft MSL) OW3 Upper	OW3 Lower	OW4 Upper	OW4 Lower
Data collected by Tera Corp.				
07/22/80	2331.8	2292.2	2291.4	2290.9
07/30/80	2237.3	2291.7	2290.6	2290.5
08/25/80	2338.1	2291.0	2289.7	2289.5
09/02/80	2339.2	2291.1	2289.4	2289.2
10/29/80	2339.4	2290.6	2280.0	2288.0
01/27/81	2337.6	2290.8	2288.3	2288.3
04/18 & 05/02/81	2340.4	2297.2	2288.9	2285.0
07/28 & 08/01/81	2334.7	2285.5	2283.8	2287.3
10/28-30/81	2329.4	2282.4	2279.9	2279.9
10/22-25/82	2334.2	2287.4	2280.6	2280.4
Data collected by In-Situ Inc.				
06/20/86	2337.6	2295.6	2294.9	2294.8
07/18/86	2337.6	2294.2	2293.2	2293.1
08/24/86	2327.8	2292.6	2291.3	2291.15
10/25/86	2337.6	2291.65	--	--
12/04/86	2337.6	2291.4	2288.4	2288.4
03/06/87	2337.4	2291.5	2287.8	2287.3
04/08/87	2337.6	2293.8	2289.1	2289.1
05/07/87	2238.5	2292.8	2289.9	2289.9
06/21/87	2337.4	2290.45	2287.2	2287.1
08/05/87	2357.39	2289.22	2285.77	2285.69
09/14/87	2336.97	2298.57	--	--
10/09/87	2236.47	2288.17	2284.04	2283.99
12/21/87	2336.14	2288.12	2283.34	2283.29

Land surface elevation (ft MSL)	2383.3		2370.8	
Screen elevation (ft MSL) Top	2314.3	2217.3	2282.3	2245.8
Bottom	2309.3	2206.3	2272.3	2235.8

Table A.3 Sheet 3 of 6

TABLE A.3 (continued)
WATER-LEVEL ELEVATIONS

Tera Corporation Observation Wells (continued)
Creston, Washington

Date	Water-Level Elevation (ft MSL)			
	OW5		OW8	
	Upper	Lower	Upper	Lower
Data collected by Tera Corp.				
07/22/80	2289.3	2272.3	2282.6	2283.5
07/30/80	2288.9	2271.7	2282.3	2283.2
08/25/80	2288.4	2271.2	2281.8	2282.3
09/02/80	2288.4	2270.9	2281.9	2281.9
10/29/80	2286.8	2269.1	2282.3	2282.6
01/27/81	2286.4	2272.6	2285.7	2284.8
04/18 & 05/02/81	2279.9	2266.6	2277.9	2278.2
07/28 & 08/01/81	2280.3	2263.7	2276.6	2277.4
10/28-30/81	2278.1	2261.0	2274.6	2274.4
10/22-25/82	2283.2	2263.8	2279.9	2279.4
Data collected by In-Situ Inc.				
06/20/86	2285.0	2273.8	2283.2	2285.0
07/18/86	2286.3	2272.4	2282.7	2284.1
08/24/86	2285.05	2271.05	2282.08	2282.2
10/25/86	2284.5	2270.4	2281.8	2282.5
12/04/86	2284.5	2271.2	2281.9	2282.6
03/06/87	2284.5	2272.0	2282.3	[illegible]
04/08/87	2284.5	2272.6	2282.3	[illegible]
05/07/87	2285.6	--	2282.4	2284.2
06/21/87	2284.6	2268.6	2281.8	2282.0
08/05/87	2284.12	2267.74	2281.00	2281.08
09/14/87	2285.69	2267.04	2280.18	2280.18
10/09/87	2283.34	2266.72	2279.88	2279.83
12/21/87	2282.89	2266.54	2280.28	2280.08
Land surface elevation (ft MSL)	2315.2		2313.6	
Screen elevation (ft MSL) Top	2342.2	2163.2	2248.6	2207.6
Bottom	2332.2	2153.2	2238.6	2197.6

Table A.3 Sheet 4 of 6

TABLE A.3 (continued)
WATER-LEVEL ELEVATIONS

Dreger Piezometer
Creston, Washington

	Water-Level Elevation (ft MSL)					
Date	J2 i	J3 ii	J4 iii	J5 iiii	J6 iiiii	J7 iiiiii
<u>Data from State of Washington Office Report #ER843, 1984</u>						
09/29/83	1732.6	1733.3	1733.8	2113.4	2113.5	2160.14
10/06/83	1732.1	--	--	2129.44	2129.42	2230.36
11/03/83	--	--	--	2183.47	2183.44	2231.09
12/01/83	--	--	--	2208.88	2208.82	2231.92
02/02/84	--	1733.75	1733.94	2217.0	2216.98	2234.7
03/06/84	1733.8	1734.1	1734.3	2218.66	2218.7	2230.55
03/30/84	--	--	--	2219.39	2219.35	2237.34
05/02/84	--	--	--	2219.93	2219.93	2242.76
05/24/84	--	1734.6	--	2158.55	2157.98	2242.0
07/18/84	--	--	--	2106.48	2106.36	2238.2
08/08/84	--	--	--	2156.56	2156.64	2237.81
09/07/84	--	--	--	2109.05	2109.06	2235.45
10/04/84	--	--	--	2167.22	2167.19	2231.34
10/23/84	--	--	--	--	2152.7	--
11/07/84	--	--	--	2214.12	2214.11	2237.48
05/08/85	--	--	--	2184.56	2184.65	2235.17
10/24/85	--	--	--	2208.27	2208.16	2232.17
03/25/86	--	--	--	2147.5	2147.57	2236.34
06/20/86	--	--	--	2110.9	2110.75	2234.5
07/17/86	2056.25	1735.5	1733.5	2103.0	2103.0	2237.0
<u>Data collected by In-Situ Inc.</u>						
08/31/86	2040.4	--	--	2105.38	2105.35	2233.04
10/22/86	--	--	--	2210.0	--	--
12/04/86	--	--	--	2217.15	--	--
03/04/87	2076.0	<1782.0	<1782.0	2218.9	2219.0	2234.5
04/04/87	2076.55	<1782.0	<1782.0	2218.83	2218.80	2234.13
04/17/87	2076.78	<1782.0	<1782.0	2219.40	2219.04	2234.42
04/24/87	--	--	--	2219.00	--	--
04/25/87	2076.6	<1782.0	<1782.0	2218.1	2218.2	2233.8

TABLE A.3 (continued)
WATER-LEVEL ELEVATIONS

Dreger Piezometer (continued)
Creston, Washington

	Water-Level Elevation (ft MSL)					
Date	J2 i	J3 ii	J4 iii	J5 iiii	J6 iiiii	J7 iiiiii
Data collected by In-Situ Inc. (continued)						
04/26/87	--	--	--	2218.0	2218.1	--
04/30/87	2076.10	--	--	2182.10	2182.31	--
05/01/87	2075.83	--	--	2169.52	2169.58	--
05/02/87	2075.70	--	--	2162.50	--	--
05/03/87	2078.82	--	--	2162.50	--	--
05/04/87	2078.19	--	--	2147.03	--	--
05/07/87	2076.85	--	--	--	--	2232.90
05/20/87	2069.38	--	--	2114.93	--	--
05/27/87	2065.54	1733.20	1733.35	2112.58	2112.50	2230.8
06/03/87	2062.59	--	--	2111.78	--	--
06/08/87	2059.87	1733.15	1733.20	2117.17	2117.10	2230.30
06/21/87	2054.50	1733.12	1733.33	2108.33	2108.35	2230.14
07/04/87	2060.70	--	--	2105.59	--	--
07/14/87	2057	1733.08	1733.06	2104.28	2104.30	2229.35
08/05/87	2050.01	1732.95	1733.10	2105.76	2105.60	2229.10
08/26/87	2046.91	--	--	2103.17	--	--
09/14/87	2042.15	1732.80	1733.10	2102.12	2101.95	2228.45
10/09/87	2031.16	1732.58	1731.45	2101.35	2101.20	2227.90

Land surface elevation (ft MSL) 2282

Screen elevation (ft MSL)	J2	J3	J4	J5	J6	J7
Top	1181	1338	1567	1874	1968	2262
Bottom	1176	1333	1567	1869	1963	2023

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM

Quarter[1])	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	pH (Field)	7.3	8.7 —	7.3	7.0	7.5	76	7.8	7.4	7.7	7.8
2		9.1	9.2	7.3	7.4	9.3	7.7	9.3	9.5	9.7	8.3
3		7.3	7.5	7.3	7.3	10.2	7.9	9.1	7.2	9.7	8.5
4		7.2	7.6	7.5	7.4	9.9	7.7	9.2	9.3	8.6	8.3
5		8.2	8.4	7.5	7.5	10.1	8.5	9.7	9.1	10.2	9.5
6		7.6	7.5	7.4	7.4	9.6	8.3	9.0	8.2	9.5	8.8
7		8.25	8.29	8.45	8.72	8.6	8.3	8.5	8.9	9.2	8.4
1	pH (Lab)	7.9	9.1 7.9	7.7	7.3	7.9	8.1	8.1	8.0	8.1	8.3
2		7.4	7.5	7.4	7.4	9.1	7.5	8.2	9.5	9.4	7.6
3		7.6	7.5	7.5	7.6	9.7	7.7	8.1	9.2	8.9	8.5
4		7.6	7.8	7.7	7.7	9.8	7.8	8.9	9.5	9.0	8.4
5		7.9	7.9	7.9	7.9	9.8	8.0	9.2	8.7	9.3	8.9
6		7.6	7.6	7.5	7.5	9.6	7.9	9.0	8.5	9.3	9.0
7		7.78	7.72	7.77	7.82				8.6	9.1	7.8
1	Temperature °C (Field)	17.1	13.9 12.7	11.0	13.5	14.4	15.2	—	14.4	12.6	—
2		10.3	10.8	10.2	10.5	11.2	11.0	10.2	10.8	8.8	10.3
3		7.4	8.0	8.8	8.2	8.3	8.5	9.4	10.2	9.1	8.3
4		12.5	13.7	14.5	17.6	19.3	10.7	11.7	13.8	11.1	13.7
5		16.0	12.5	13.3	14.9	16.0	13.5	14.6	14.5	11.7	14.4
6		8.8	8.9	11.7	10.8	10.6	9.4	9.6	11.1	8.2	9.8
7		10.7	9.5	9.3	10.1	9.2	10.5	10.4	9.8	10.4	9.6
1	Specific Conductance $\mu\Omega^{-1}cm^{-1}$ Field/Lab	263/230	177/162 173/160	224/170	195/168	261/235	235/220	- /215	161/148	274/243	--/190
2		312/208	219/150	276/200	283/208	278/200	192/260	197/163	228/185	286/203	244/180
3		272/190	119/143	235/190	209/170	293/235	287/220	189/140	186/145	287/185	212/165
4		214/200	138/135	287/188	205/185	192/205	208/200	173/115	237/140	179/155	166/148
5		224/215	159/155	197/200	192/180	241/240	262/245	148/135	154/1[illegible]	239/185	178/180
6		441/210	342/155	---/176	---/157	463/235	326/275	330/135	-0/160	246/175	379/183
7		209/243	135/162	170/.37	176/210	222/265	183/340	173/198	140/165	109/190	151/170
1	Carbonate CO_3 (mg/l)	0	10.8 0	0	0	0	0	0	0.0	10.8	0.0
2		0	0	0	0	21.6	0	0	40.8	39.6	0.0
3		0	0	0	0	48	0	0	16.8	8.4	3.6
4		0	0	0	0	50.4	0	4.8	26.4	12.0	1.2
5		0	0	0	0	46.8	0	6.0	9.6	18.0	9.6
6		0	0	0	0	40.8	0	6.0	2.4	16.8	13.2
7		0	0	0	0	0	0	3.6	3.6	14.4	0.0

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter[1)]	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Bicarbonate HCO_3 (mg/l)	86.6	69.5	77.0	70.0	103	89.1	103.7	75.6	114.7	95.2
			75.6								
2		91.5	78.1	75.6	77.0	85.4	106.1	61	57.3	75.6	92.7
3		92	79	74	68	72	113.5	69.5	61.0	72.0	77.0
4		79.3	78.1	75.6	76.9	67.1	114.7	56.1	56.1	65.9	81.7
5		91.5	75.6	74.4	65.9	65.9	115.9	52.5	61.0	59.8	70.8
6		[illegible]	75.6	72.0	62.2	59.8	117.1	57.3	79.3	63.4	70.8
7		76.9	75.6	72.0	72.0	95.2	111.0	78.1	89.1	74.4	76.9
1	Alkalinity as $CaCO_3$ (mg/l) Total (Field)	110	110	0	80	130	120	130	90	120	110
			100								
2		120	100	90	90.0	130	130	70	130	130	100
3		110	80	90	90	100	110	100	90	120	80
4		100	100	110	100	130	150	100	—	130	130
5		64	55	52	54	76	85	40	50	91	60
6		100	80	60	80	110	130	80	100	110	110
7		62	57	50	54	83	86	72	74	74	65
1	Alkalinity as $CaCO_3$ (mg/l) Total (Lab)	71	75	63	57	85	73	85	62	94	78
			62								
2		75	64	62	63	106	87	50	115	128	76
3		75	65	61	56	139	93	57	78	73	69
4		65	64	62	63	139	[illegible]	54	90	74	69
5		75	62	61	54	132	95	53	56	79	74
6		77	62	59	51	117	96	57	69	80	80
7		63	62	59	59	78	91	[illegible]	79	85	63
1	Turbidity (NTU)	16.5	46.2	0.9	0.7	1.6	6.0	3.5	3.5	2.5	5.4
			0.3								
2		10.5	45.0	2.0	1.7	24.0	8.6	57.0	48.0	20.0	3.9
3		8.5	120.0	2.2	2.6	10.0	2.5	87.0	21.	10.5	4.4
4		2.1	100.0	1.2	2.8	5.9	3.6	55.5	21.5	2.3	4.5
5		16.0	161.0	0.8	0.6	6.0	1.4	54.0	2.4	1.5	5.2
6		18.0	41.0	0.9	3.2	12.0	5.6	70.0	45	6.5	14.0
7		1.1	7.4	1.0	1.4	2.3	6.4	67.0	76	3.3	0.8
1	Total Dissolved Solids (mg/l)	184	136	157	142	182	198	169	134	184	155
			131								
2		193	129	156	176	161	190	66	151	185	149
3		178	121	159	151	153	136	70	125	164	137
4		195	124	180	165	181	165	69	143	185	150
5		166	130	156	155	184	179	74	135	174	144
6		170	135	176	160	163	204	70	129	178	152
7		197	144	175	179	205	258	136	154	160	151

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Suspended Solids (mg/l)	122.4	26.0	7.6	1.6	2.4	22.0	20.0	5.2	3.6	10.4
			0.9								
2		31.0	17.5	4.5	1.0	69.0	40.5	119.0	137.0	15.5	14.0
3		97.9	101.0	25.6	15.8	52.0	8.5	145.0	98.3	37.8	9.1
4		7.0	77.0	1.0	4.0	26.0	14.0	134.0	88.0	15.0	14.0
5		12.0	90.0	3.0	3.0	28.0	2.0	78.0	67.0	9.0	2.0
6		17.0	76.0	15.0	15.0	60.0	11.7	119.0	154.0	20.0	35.0
7		4.5	10.0	6.0	9.0	24.5	20.0	36.5	208.0	6.0	2.5
1	Color (Units)	12	18	9	6	8	6	7	9	7	7
			6								
2		25	45	30	20	35	20	35	30	30	30
3		13	500	8	8	14	10	40	10	8	12
4		—	—		—	—	—	—	—	—	—
5		—	—		—	—	—	—	—	—	—
6		—	—		—	—	—	—	—	—	—
7		—	—		—	—	—	—	—	—	—
1	Dissolved Oxygen (mg/l)	9.4	10.2	12.8	6.8	10.5	13.7	—	13.0	12.5	—
			7.9								
2		0.4	0.4	—	—	6.5	0.4	—	0.7	0.4	—
3		1.9	1.9	3.9	4.9	2.7	1.7	1.4	4.5	1.5	1.8
4		—	—	—	—	—	—	—	—	—	—
5		3.4	2.6	—	—	—	2.9	1.5	—	2.2	4.7
6		—	—	—	—	—	—	—	—	—	—
7		—	—	—	—	—	—	—	—	—	—
1	BOD_5 (mg/l)	2.1	2.5	1.6	1.6	2.1	2.0	2.9	2.8	2.3	2.6
			1.6								
2		0.0	0.3	0.0	0.0	16.3	1.2	4.2	2.7	0.6	0.9
3		1.3	1.6	1.4	1.2	1.3	1.4	1.9	1.7	0.8	1.4
4		1.2	2.0	1.2	1.4	0.9	1.4	3.1	2.8	1.2	1.3
5		2.1	3.5	1.2	1.2	1.1	1.7	2.6	1.2	1.4	1.3
6		0.1	1.6	0.1	0.1	0.1	0.2	1.8	0.6	0.4	1.0
7		1.3	1.8	1.2	1.5	0.9	3.1	1.6	2.2	2.4	1.2
1	COD (mg/l)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	• 0.1	• 0.1	• 0.1
			0.1								
2		15.6	6.2	12.5	15.6	95.0	25.0	31.0	38.1	21.8	18.7
3		10.6	7.1	21.2	7.1	21.2	3.5	21.2	21.2	3.5	3.5
4		4.9	2.5	9.8	12.3	9.8	9.8	19.7	32.0	4.9	9.8
5		6.0	4.0	10.0	6.0	18.0	10.0	10.0	18.0	10.0	8.0
6		• 5.0	18.0	5.0	9.0	23.0	14.0	32.0	14.0	14.0	14.0
7		• 5.0	• 5.0	• 5.0	• 5.0	17.8	20.7	11.8	11.8	5.9	• 5.0

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Phosphate - Ortho dissolved (mg/l)	0.07	0.08	0.04	0.06	0.06	0.07	0.06	0.13	0.05	0.07
			0.1								
2		0.06	0.03	0.07	0.09	0.04	0.01	0.01	0.07	0.01	0.04
3		0.05	0.02	0.08	0.07	0.04	0.01	0.01	0.07	• 0.01	0.06
4		0.06	0.03	0.08	0.07	0.05	0.01	0.01	0.06	0.01	0.04
5		0.05	0.05	0.12	0.09	0.06	0.04	0.01	0.08	0.03	0.06
6		0.05	0.03	0.08	0.07	0.06	0.03	• 0.01	0.08	0.02	0.05
7		0.06	0.06	0.07	0.09	0.07	0.03	0.01	0.08	0.04	0.07
1	Hardness as $CaCO_3$ (Total)	109	78	62	55	104	93	92	66	105	84.0
			70								
2		69	47	54	63	16	94	50	337	76	52.0
3		92	67	74	70	95	94	65	81	73	78
4		91	61	67	73	91	87	44	97	96	71
5		77	63	61	59	77	90	40	54	89	64
6		86	73	72	61	92	126	63	147	96	71
7		91	64	72	65	101	136	74	69	72	69
1	Ammonia N (mg/l)	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	0.1	• 0.1	• 0.1	• 0.1
			• 0.1								
2		• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1
3		• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1
4		—	—	—	—	—	—	—	—	—	—
5		—	—	—	—	—	—	—	—	—	—
6		—	—	—	—	—	—	—	—	—	—
7		—	—	—	—	—	—	—	—	—	—
1	Kjeldahl N (mg/l)	• 0.1	• 0.1	0.45	0.28	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1
			• 0.1								
2		• 0.1	• 0.1	• 0.1	0.14	0.7	• 0.1	• 0.1	0.3	0.1	• 0.1
3		• 0.1	0.14	0.14	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1
4		• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1
5		0.2	0.2	• 0.1	0.4	0.3	0.2	0.5	0.2	0.2	0.2
6		0.3	1.5	0.4	0.3	0.5	0.3	0.4	0.3	0.5	0.5
7		0.3	0.7	0.4	0.3	0.4	0.5	0.2	0.4	0.3	• 0.1
1	Nitrate N (mg/l)	6.8	1.1	1.8	2.2	2.5	1.3	2.5	1.2	2.1	1.7
			1.1								
2		6.4	1.0	2.1	4.8	2.2	1.0	0.1	1.2	1.4	1.3
3		5.2	0.8	2.6	4.3	3.1	0.2	0.6	1.2	1.4	1.8
4		7.5	0.7	5.7	2.6	3.1	0.3	0.1	1.2	1.5	1.7
5		4.7	2.2	2.5	3.9	3.2	0.9	0.7	1.1	1.6	1.7
6		4.1	2.1	2.7	3.6	4.2	1.3	0.4	1.5	2.0	1.2
7		7.0	1.2	2.1	4.2	12.0	5.3	12.4	5.3	4.9	7.1

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Nitrite N (mg/l)	* 0.01	* 0.01 * 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
2		* 0.01	0.09	* 0.01	* 0.01	0.33	0.09	* 0.01	* 0.01	* 0.01	* 0.01
3		* 0.01	* 0.01	* 0.01	* 0.01	0.16	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
4		* 0.01	* 0.01	* 0.01	* 0.01	0.17	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
5		* 0.01	* 0.01	* 0.01	* 0.01	0.13	0.02	* 0.01	* 0.01	0.01	* 0.01
6		* 0.01	* 0.01	* 0.01	* 0.01	0.06	* 0.01	* 0.01	* 0.01	0.02	0.04
7		* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	0.02	0.085	* 0.01	0.02	* 0.01
1	Organic N (mg/l)	* 0.1	* 0.1 * 0.1	—	—	* 0.1	0.1	* 0.1	* 0.1	* 0.1	* 0.01
2		—	—	—	—	—	—	—	—	—	—
3		* 0.1	0.14	0.14	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
4		—	—	—	—	—	—	—	—	—	—
5		—	—	—	—	—	—	—	—	—	—
6		—	—	—	—	—	—	—	—	—	—
7		—	—	—	—	—	—	—	—	—	—
1	Cyanide CN (mg/l) Total	* 0.01	* 0.01 * 0.01	0.01	0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
2		0.01	0.01	0.01	0.01	0.01	* 0.01	0.01	* 0.01	* 0.01	* 0.01
3		0.01	0.01	0.01	0.01	0.01	0.01	0.01	* 0.01	* 0.01	* 0.01
4		0.01	0.01	0.01	0.01	0.01	0.01	0.01	* 0.01	* 0.01	* 0.01
5		* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
6		* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
7		* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
1	Fluoride F (mg/l)	0.2	0.2 0.2	0.4	0.3	.2	0.3	0.3	0.2	0.3	0.3
2		0.5	0.4	0.4	0.4	0.3	0.6	0.6	0.5	0.7	0.5
3		0.5	0.3	0.4	0.3	0.4	1.0	0.8	0.4	0.8	0.3
4		0.3	0.2	0.3	0.3	0.3	0.6	0.3	0.3	0.5	0.3
5		0.3	0.2	0.3	1.1	0.2	0.6	0.3	0.2	0.5	0.2
6		0.3	0.1	0.2	0.1	0.1	0.5	0.3	0.1	0.5	0.2
7		0.2	0.1	0.2	0.3	0.2	0.3	0.3	0.1	0.4	0.2
1	TOC (mg/l)	1.1	1.8 0.6	2.7	1.0	1.5	2.0	2.4	2.6	2.6	2.0
2		2.2	1.3	3.4	3.0	21.0	2.6	6.5	6.1	3.0	2.9
3		1.5	1.7	2.5	2.1	3.1	1.0	6.4	4.1	1.6	1.6
4		1.1	1.1	2.9	3.4	3.0	2.3	4.2	4.9	1.5	2.7
5		2.8	2.6	[illegible]	3.9	4.1	3.2	4.3	2.6	3.0	2.8
6		1.4	5.3	[illegible]	3.8	4.7	3.5	6.9	2.8	2.9	2.8
7		1.6	1.3	2.7	2.4	2.5	3.5	1.9	4.7	2.3	0.3

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	GW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Oil and Grease (mg/l)	3.4	3.51	5.5	5.4	3.9	2.9	5.0	4.7	2.3	4.9
			2.4								
2		1.5	0.6	1.3	1.4	6.6	5.7	3.6	4.2	4.0	3.2
3		1.6	4.5	3.0	1.4	4.4	1.2	2.7	3.1	2.5	2.3
4		2.8	2.6	3.5	3.5	2.6	2.8	4.3	3.7	3.8	2.6
5		4.4	5.4	5.6	4.3	3.1	3.7	7.2	0.4	4.4	4.7
6		0.7	1.9	2.9	0.0	5.3	5.0	4.1	1.3	0.2	3.5
7		4.0	2.0	3.2	1.5	6.1	1.2	2.1	4.0	2.2	1.1
1	Phenols (mg/l)	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
			* 0.1								
2		* 0.01	* 0.01	* 0.01	* 0.01	* 0.1	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
3		* 0.01	* 0.01	* 0.01	* 0.01	* 0.1	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
4		* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
5		* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
6		* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
7		* 0.01	* 0.01	* 0.01	* 0.01	0.011	* 0.01	* 0.01	* 0.01	* 0.01	* 0.01
1	Silica Si (mg/l)	26.9	22.5	53.7	59.5	21.6	22.8	24.8	22.2/21.7	22.5/22.5	24.6/23.2
2		22.7									
		24.2	20.3	22.0	22.1	20.2	19.5	3.6	52.4/20.2	22.5/21.2	24.2/23.1
3		53.0	86.4	46.0	52.0	42.9	38.7	28.5	51.1/45.7	46.6/46.6	52.2/50.9
4		55.7	47.6	57.4	52.8	48.3	44.6	4.2	49.2	55.9	57.7
5		55.3	55.8	45.3	50.0	41.8	39.1	3.7	85.5	47.6	47.1
6		56.0	55.5	48.4	53.4	39.5	41.8	6.6	67.3	47.5	46.9
7		38.2	36.1	33.3	35.5	38.0	35.8	16.2	39.4	37.3	38.2
1	Sulfate SO_4 (mg/l)	21.5	8.0	24.5	10	30.5	25.2	8.8	7.7	18.6	9.3
			7.1								
2		15.4	8.4	24.0	15.4	18.7	46.6	15.2	13.3	21.4	11.4
3		13.0	8.4	23.9	12.2	19.5	73.3	11.6	13.0	19.0	11.6
4		15.1	8.0	14.5	20.8	16.5	20.5	10.5	12.0	15.7	10.3
5		11.5	8.4	21.8	12.1	17.6	25.5	7.5	11.1	15.2	10.2
6		12.0	11.6	20.9	10.4	21.3	49.0	8.5	10.9	16.0	18.3
7		16.3	9.2	20.1	13.1	28.0	66.0	78.1	11.0	14.1	10.5
1	Sulfide S (mg/l)	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
			* 0.1								
2		* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
3		* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
4		* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
5		* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
6		* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
7		* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	MBAS (mg/l)	* 0.07	0.05	0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05
			0.05								
2		* 0.05	* 0.05	0.05	* 0.05	* 0.05	* 0.05	0.05	* 0.05	* 0.05	* 0.05
3		* 0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05	* 0.05
4		—	—	—	—	—	—	—	—	—	—
5		—	—	—	—	—	—	—	—	—	—
6		—	—	—	—	—	—	—	—	—	—
7		—	—	—	—	—	—	—	—	—	—
1	Acidity (mg/l)	2.0	0.0	0.4	0.4	3.0	1.5	1.5	3.0	1.0	0.5
			3.0								
2		3.5	4.0	4.5	2.5	0.0	6.5	0.5	0.0	0.0	6.0
3		5.0	7.0	4.0	3.0	0.0	6.0	1.0	0.0	0.0	0.0
4		4.0	3.0	4.0	4.0	0.0	3.0	0.0	0.0	0.0	0.0
5		2.0	2.0	2.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0
6		5.0	4.0	4.0	4.0	* 1.0	4.0	* 1.0	* 1.0	* 1.0	* 1.0
7		3.0	3.0	3.0	2.0	1.0	3.0	0	0.0	0.0	3.0
1	Chloride Cl (mg/l)	4.0	2.5/2.0	4.5	2.0	3.2	3.0	5.5	1.7	4.7	3.5
			2.0								
2		3.0	2.0	4.3	0.4	2.0	3.5	5.7	2.5	4.5	2.5
3		3.5	2.5	5.0	3.5	3.0	3.0	4.0	3.0	4.5	3.5
4		3.5	2.5	5.5	5.0	3.0	3.0	3.0	3.0	5.5	3.5
5		2.8	1.5	4.0	3.0	2.5	2.0	2.0	2.0	4.0	2.5
6		3.0	2.0	4.5	2.0	2.5	3.0	2.5	2.0	4.0	2.5
7		5.3	2.9	6.8	5.3	4.0	5.6	10.0	3.2	6.3	4.6
1	Bromide Br (mg/l)	* 0.1	*0.1/*0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
			* 0.1								
2		0.8	0.4	0.8	0.8	0.2	0.7	* 0.1	0.7	0.8	0.5
3		* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1	* 0.1
4		—	—	—	—	—	—	—	—	—	—
5		—	—	—	—	—	—	—	—	—	—
6		—	—	—	—	—	—	—	—	—	—
7		—	—	—	—	—	—	—	—	—	—
1	Iodide I (mg/l)	0.004	0.002/0.001	0.001	* 0.001	0.002	0.004	0.005	0.002	0.013	0.008
			0.001								
2		0.006	0.003	0.006	0.006	0.002	0.004	* 0.001	0.002	0.009	0.002
3		0.005	0.003	0.004	0.004	0.002	0.002	0.001	0.002	0.007	0.002
4		0.005	0.001	0.005	0.004	0.002	0.002	0.001	0.001	0.006	0.001
5		0.006	0.005	0.001	* 0.001	0.002	0.001	* 0.001	* 0.001	0.006	* 0.001
6		0.002	* 0.001	0.004	0.002	0.004	0.004	0.003	0.001	0.002	0.002
7		0.005	0.002	0.002	0.004	0.004	0.002	0.003	0.004	0.007	0.004

Table A.4

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Sodium Na (mg/l)	12.6	8.1	12.4	8.7	9.6	11.5	11.6	8.1	14.3	9.6
			8.0								
2		12.5	8.1	12.6	16.7	20.8	17.2	13.3	9.5	15.7	9.1
3		12.7	7.9	12.7	12.2	23.6	16.5	11.9	9.4	15.6	8.7
4		12.1	8.1	16.5	12.8	23.1	15.4	11.7	9.7	15.6	9.0
5		12.3	8.2	12.7	12.4	23.5	16.9	12.1	9.4	15.2	9.2
6		12.9	8.8	12.7	9.4	18.8	14.8	12.4	9.1	15.0	14.8
7		12.9	8.4	13.2	16.4	10.5	15.2	10.8	8.9	13.7	9.0
1	Potassium K (mg/l)	2.12	1.7	1.7	1.9	2.1	2.8	2.0	1.8	2.5	2.2
			1.7								
2		2.6	1.9	2.4	2.5	3.5	3.9	3.0	2.7	2.8	2.3
3		2.4	1.9	3.3	4.2	7.4	5.5	3.4	5.1	2.6	3.9
4		2.1	1.7	2.3	2.1	3.2	3.1	2.5	2.3	2.4	2.3
5		2.2	1.6	2.1	2.2	3.8	3.3	2.3	2.2	2.6	2.4
6		2.0	2.4	2.2	2.2	3.3	3.3	2.7	2.2	2.2	2.3
7		1.8	1.4	1.7	1.8	2.1	3.1	1.9	1.8	2.3	1.8
1	Calcium Ca (mg/l)	24.5	19.8	15.5	13.4	27.6	22.0	25.2	18.1	28.9	21.9
			2.0								
2		17.5	13.6	16.0	13.1	18.0	21.4	7.8	21	27.7	16.4
3		20.0	20.6	18.8	17.5	28.8	20.0	16.9	22.2	19.4	21.3
4		24.0	17.2	18.0	20.4	30.6	20.8	11.3	29.2	30.8	21.6
5		18.0	18.0	19.8	16.2	24.9	21.3	9.9	17.6	28.0	19.8
6		16.9	16.0	17.7	14.4	22.0	26.0	11.4	18.0	23.9	18.0
7		26.1	20.1	22.5	20.5	29.5	25.2	19.5	23.6	23.2	20.9
1	Magnesium Mg (mg/l)	7.9	4.6	5.4	5.2	8.1	8.3	6.5	4.5	8.1	6.4
			4.9								
2		5.9	2.8	3.5	2.7	3.9		3.6	2.0	3.1	2.4
3		10.1	3.8	6.6	6.3	5.6	10.7	5.6	6.3	5.9	6.0
4		7.6	4.5	5.3	5.3	3.6	8.5	3.7	5.9	4.6	4.2
5		7.7	4.3	4.9	4.5	3.7	8.9	3.7	2.3	4.6	3.6
6		8.5	4.8	5.7	5.2	3.8	11.9	4.2	4.0	5.2	4.2
7		6.2	3.3	3.9	3.3	6.6	17.8	6.1	2.5	3.4	4.1
1	Cation/Anion balance (Me/l)	2.791/2.480	1.959/1.830	1.832/2.048	1.538/1.578	2.557/2.618	2.446/2.182	2.392/2.235	1.707/1.549	2.800/2.569	2.158/1.992
			1.791/1.526								
2		2.087/2.392	1.772/1.605	1.718/2.034	1.810/1.0	2.473/2.740	2.803/2.974	3.945/1.510	8.234/2.761	2.340/3.270	1.503/1.887
3		2.441/2.268	1.735/1.618	2.117/2.066	2.028/1.796	3.114/3.513	2.735/2.497	1.908/1.580	2.165/2.023	2.199/2.025	2.035/1.866
4		2.407/2.266	1.621/1.578	2.107/2.120	2.065/2.036	2.913/3.446	2.488/2.445	1.438/1.400	2.425/2.237	2.658/2.095	1.873/1.831
5		2.123/2.165	1.649/1.622	1.997/1.982	1.770/1.750	2.668/3.317	2.612/2.580	1.385/1.339	1.534/1.497	2.504/2.157	1.744/1.897
6		2.158/2.184	1.645/1.692	1.961/1.947	1.614/1.554	2.313/3.159	3.006/3.146	1.520/1.431	1.686/1.774	2.329/2.215	1.942/2.148
7		2.420/2.261	1.679/1.603	2.058/1.952	2.058/1.918	2.527/2.472	3.461/3.454	1.992/2.069	1.822/1.990	2.097/2.271	1.816/1.736

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Radium 226 (pCi/l)	• 0.2	• 0.2	• 0.1	• 0.1	• 0.4	• 0.5	• 0.3	• 0.5	• 0.2	• 0.8
			• 0.2								
2		• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.1	• 0.3	• 0.2	• 0.1
3		• 0.2	0.8	• 0.2	• 0.2	• 0.1	• 0.1	• 0.1	• 0.2	• 0.2	• 0.5
4		• 0.19	• 0.13	• 0.19	• 0.23	• 0.18	• 0.26	• 0.24	0.178 ± 0.12	• 0.07	• 0.39
5		0.10	0.13	0.12	0.14	0.14	0.11	0.12	0.17	• 0.1	0.15
6		• 0.04	• 0.04	0.05	• 0.03	• 0.04	0.08	• 0.04	0.09	• 0.03	0.06
7		• 0.6	• 0.6	• 0.6	• 0.6	• 0.6	• 0.6	• 0.6	• 0.06	• 0.06	• 0.06
1	Gross α (pCi/l)	• 3.1	• 0.7	• 2.2	• 2.0	• 2.6	• 2.8	• 2.7	• 1.6	• 2.3	• 1.8
			• 2.0								
2		2.6	1.7	4.1	2.2	3.5	3.0	3.2	• 2.4	2.5	2.3
3		• 2.4	• 2.2	• 2.0	• 1.8	• 2.8	• 3.1	• 2.2	• 1.8	• 3.2	• 2.0
4		• 2.1	• 2.0	• 1.3	• 2.5	• 2.2	• 2.0	• 2.2	• 1.3	• 2.1	• 2.2
5		• 1.3	• 1.4	• 1.4	• 0.3	• 1.4	• 1.2	• 1.2	• 1.5	• 1.7	• 1.3
6		• 1.6	• 1.2	• 1.4	• 1.1	1.9	• 1.5	• 1.6	• 1.4	• 1.2	• 1.3
7		• 2.0	• 2.0	• 2.0	• 2.0	• 2.0	• 2.0	• 2.0	• 2.0	• 2.0	• 2.0
1	Gross β (pCi/l)	2.3	1.3	2.6	2.2	1.5	2.4	1.2	1.0	2.0	1.9
			1.1								
2		3.0	2.0	4.0	3.0	4.0	5.0	3.0	3.0	3.0	3.0
3		3.0	2.0	3.0	3.0	7.0	5.0	3.0	3	4	3
4		• 23.0	• 23.0	• 22.0	• 22.0	• 22.0	• 22.0	• 23.0	22	22	22
5		• 23.0	• 24.0	• 22.0	• 4.4	• 23.0	• 23.0	• 24.0	• 22	• 22	• 22
6		• 19.0	• 18.0	• 18.0	• 19.0	• 19.0	• 20.0	• 19.0	• 19	• 19	• 18
7		• 3.0	• 3.0	• 3.0	• 3.0	• 3.0	• 3.0	• 3.0	3 ± 1	3	3
1	Aluminum Al (mg/l) Total/dissolved	1.0/0.6	0.52/0.51	•0.05/•0.05	•0.05/•0.05	0.59/0.52	0.51/0.51	0.49/0.46	0.51/0.47	0.51/0.51	0.61/0.51
			0.49/0.46								
2		0.65/•0.05	•0.05/•0.05	.10/0.05	•0.05/•0.05	1.61/•0.05	0.50/•0.05	0.40/•0.05	0.59/0.05	0.25/•0.05	0.20/0.05
3		0.55/•0.05	•0.05/•0.05	•0.05/•0.5	0.25/0.05	0.55/0.15	0.25/0.10	0.7/0.1	1.2/0.1	0.11/•0.05	0.18/0.18
4		0.07/•0.05	•0.05/•0.05	•0.05/•0.05	•0.09/•0.05	0.36/•0.05	0.07/•0.05	0.08/0.05	1.08/•0.05	.06/•0.05	0.14/•0.05
5		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	0.49/•0.05	0.12/•0.05	0.11/•0.05	5.42/•0.05	•0.05/•0.05	•0.05/•0.05
6		0.36/•0.05	0.39/•0.05	0.09/•0.05	0.33/•0.05	0.48/.10	0.34/•0.05	0.30/•0.05	5.77/•0.05	0.19/•0.05	0.71/•0.05
8		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.5/•0.05	•0.5/•0.5	•0.05/•0.05		4.48/•0.05	•0.05/•0.05	•0.05/•0.05
1	Antimony Sb (mg/l) Total/dissolved	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
			•0.1/•0.1								
2		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
3		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
4		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.01/•0.01	•0.1/•0.1	•0.1/•0.1
5		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
6		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
7		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Arsenic As (mg/l) Total/dissolved	•0.01/•0.01	•0.01/•0.01 •0.01/•0.01	0.02/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
2		•0.01/•0.01	•0.01/•0.01	0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
3		•0.01/•0.01	0.078/•0.01	•0.01/0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.047/0.047	•0.01/•0.01
4		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.03/0.03	•0.01/•0.01
5		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.03/0.02	•0.01/•0.01
6		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/0.01	•0.01/•0.01	•0.01/•0.01	0.03/0.03	•0.01/•0.01
7		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/0.01	•0.01/•0.01	•0.01/•0.01	0.05/0.048	•0.01/•0.01
1	Barium Ba (mg/l) Total/dissolved	•0.02/•0.02	•0.02/•0.02 •0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
2		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/0.04	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
3		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
4		• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	0.02	0.02
5		• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02
6		• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02
7		• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02	• 0.02
1	Boron B (mg/l) Total/dissolved	•0.1/•0.1	•0.1/•0.1 •0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
2		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
3		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
4		0.2/0.2	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	0.16/0.16	•0.1/•0.1
5		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
6		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
7		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
1	Beryllium Be (mg/l) Total/dissolved	•0.2/•0.2	•0.2/•0.2 •0.2/•0.2	•0.1/•0.1	•0.1/•0.1	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2
2		0.6/0.6	0.5/0.5	0.6/0.5	0.5/0.5	0.6/0.5	0.6/0.5	0.4/0.3	0.8/0.5	0.6/0.6	0.5/0.5
3		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
4		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
5		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	0.2/•0.1
6		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
7		•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1	•0.1/•0.1
1	Cadmium Cd (mg/l) Total/dissolved	•0.002/•0.002	•0.002/•0.002 •0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/0.002
2		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	0.003/•0.02	0.003/•0.002	•0.002/0.002
3		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/ .002	•0.002/•0.002
4		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
5		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
6		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
7		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	0.004/0.004	•0.002/•0.002	•0.002/•0.002

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Cesium Cs (mg/l) Total/dissolved	•0.01/•0.01	•0.01/•0.01 •0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
2		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
3		•0.1/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
4		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
5		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
6		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
7		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
1	Chromium Cr (mg/l) Total/dissolved	•0.005/•0.005	•0.005/•0.005 •0.005/•0.005	•0.01/•0.01	•0.01/•0.01	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	0.005/0.005	0.005/0.005	0.005/0.005
2		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.38/0.1	0.033/0.01	0.016/•0.1	0.132/0.015	0.020/•0.01	•0.01/•0.01
3		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
4		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.017/•0.01	•0.018/•0.002	0.02/0.02	•0.01/•0.01
5		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
6		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
7		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
1	Cobalt Co (mg/l) Total/dissolved	•0.02/•0.02	•0.02/•0.02 •0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
2		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
3		•0.02/•0.02	•0.03/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/0.02
4		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	0.015/0.003	•0.02/•0.02	•0.02/•0.02
5		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
6		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
7		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
1	Copper Cu (mg/l) Total/dissolved	•0.003/•0.003	•0.003/•0.003 •0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003
2		•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	0.02/•0.003	•0.003/•0.003	0.01/0.003	0.07/0.003	0.01/0.01	•0.003/•0.003
3		•0.003/•0.003	0.005/0.003	•0.003/•0.003	•0.003/•0.003	0.01/0.004	•0.003/•0.003	0.009/•0.003	0.01/•0.003	•0.003/•0.003	•0.003/•0.003
4		0.005/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	0.01/•0.003	•0.003/•0.003	0.017/•0.003	1.87/•0.003	•0.003/•0.003	•0.003/•0.003
5		•0.003/•0.003	•0.003/•0.003	0.003/0.003	•0.003/•0.003	0.01/•0.003	0.008/•0.003	0.012/•0.003	0.03/•0.003	•0.003/•0.003	•0.003/•0.003
6		•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	0.02/•0.003	0.02/•0.003	0.02/•0.003	0.020/•0.003	0.03/•0.003	•0.003/•0.003	•0.003/•0.003
7		•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	0.008/•0.003	•0.003/•0.003	0.036/•0.003	•0.003/•0.003	•0.003/•0.003
1	Iron Fe (mg/l) Total/dissolved	4.63/•0.01	6.9/•0.01 •0.01/•0.01	0.08/•0.01	•0.01/•0.01	•0.01/•0.01	0.62/0.01	0.54/•0.01	0.14/•0.01	0.07/•0.01	0.38/•0.01
2		1.82/0.04	8.00/0.27	0.40/0.02	0.35/0.01	4.70/0.03	1.28/0.01	43.00/•0.01	18.0/•0.01	.67/0.02	0.24/•0.01
3		2.13/0.12	151.00/0.07	0.08/0.02	0.55/0.02	1.45/0.03	0.32/0.04	52.00/0.03	0.5/0.01	0.51/•0.01	0.32/•0.01
4		0.90/•0.01	17.94/0.11	0.01/•0.01	0.44/0.01	0.60/•0.01	0.34/•0.01	19.64/0.01	1.87/•0.01	0.37/•0.01	0.29/•0.01
5		3.07/0.12	3.07/0.12	0.11/0.01	0.07/0.01	0.58/0.11	0.34/0.03	19.00/0.04	8.5/•0.03	0.41/0.03	0.28/0.03
6		3.64/0.13	25.40/0.05	0.22/0.02	0.53/•0.01	0.70/0.02	1.43/0.02	17.30/0.05	7.0/0.02	0.77/0.15	1.13/0.02
7		0.69/0.06	0.85/0.08	0.21/•0.01	0.40/0.01	0.23/0.01	0.82/0.01	13.11/0.10	8.27/0.01	0.19/0.01	0.09/0.01

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Lead Pb (mg/l) Total/dissolved	•0.02/•0.02	•0.02/•0.02 •0.02/•0.02	•0.01/•0.01	•0.01/•0.01	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
2		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	0.08/•0.02	0.03/•0.02	0.03/•0.02	0.14/•0.02	•0.02/•0.02	•0.02/•0.02
3		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	0.04/•0.02	•0.02/•0.02	0.02/•0.02	•0.02/•0.02	•0.02/ •0.02	•0.02/•0.02
4		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
5		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	0.05/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
6		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
7		•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02	•0.02/•0.02
1	Lithium Li (mg/l) Total/dissolved	•0.01/•0.01	•0.01/•0.01 •0.01/•0.01	0.003/0.003	0.003/0.003	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
2		0.009/0.009	•0.005/•0.005	0.005/0.005	•0.005/0.005	0.007/•0.005	0.022/0.021	0.014/0.01	0.010/•0.005	0.023/0.023	•0.005/•0.005
3		0.006/0.006	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	0.012/0.012	0.008/0.008	•0.005/•0.005	0.011/0.011	•0.005/•0.005
4		•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	0.014/0.014	0.009/0.009	•0.005/•0.005	0.014/0.013	•0.005/•0.005
5		0.007/0.007	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	0.011/0.011	0.009/0.009	•0.005/•0.005	0.01/0.01	•0.005/•0.005
6		•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	0.011/0.011	0.010/0.010	•0.005/•0.005	0.012/0.012	•0.005/•0.005
7		•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	•0.005/•0.005	0.008/0.008	0.005/0.005	0.005/•0.005	0.005/•0.005	•0.005/•0.005
1	Manganese Mn (mg/l) Total/dissolved	0.078/0.003	0.079/0.005 •0.003/•0.003	•0.01/•0.01	•0.01/•0.01	•0.003/•0.003	0.011/•0.003	•0.003/•0.003	0.004/•0.003	0.005/0.003	0.007/0.003
2		0.03/0.01	0.10/0.09	•0.003/•0.003	0.005/•0.003	0.09/•0.003	0.04/0.02	0.25/•0.003	0.27/•0.003	0.02/•0.003	0.01/•0.003
3		0.038/0.013	0.325/0.091	•0.003/•0.003	0.012/•0.003	0.033/•0.003	0.018/0.003	0.275/0.006	0.04/•0.003	0.01/•0.003	0.009/•0.003
4		—	—	—	—	—	—	—	—	—	—
5		—	—	—	—	—	—	—	—	—	—
6		—	—	—	—	—	—	—	—	—	—
7		—	—	—	—	—	—	—	—	—	—
1	Mercury Hg (mg/l) Total/dissolved	•.0003/•.0003	•.0003/•.0003 •.0003/•0.003	•.0002/•.0002	•.0002/•.0002	•.0003/•.0003	•.0003/•.0003	•.0003/•.0003	•0.0003/•0.0003	•0.0003/•0.0003	•0.0003/•0.0003
2		•.0002/•.0002	•.0002/.0002	•.0002/•.0002	•.0002/•.0002	•.0003/•.0003	•.0002/•.0002	•.0002/•.0002	•0.0002/•0.0002	•0.0002/0.0002	•0.0002/•0.0002
3		•.0002/•.0002	•.0002/•.0002	.0003/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•0.0002/•0.0002	•0.0002/•0.0002	•0.0002/•0.0002
4		•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•0.0002/•0.0002	•0.0002/•0.0002	•0.0002/•0.0002
5		•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•0.0002/•0.0002	•0.0002/•0.0002	0.0006/0.0003
6		•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•0.0002/•0.0002	•0.0002/•0.0002	•0.0002/•0.0002
7		•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•.0002/•.0002	•0.0002/•0.0002	•0.0002/•0.0002	•0.0002/•0.0002
1	Molybdenum Mo (mg/l) Total/dissolved	•0.05/•0.05	•0.05/•0.05 •0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
2		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
3		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
4		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
5		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
6		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
7		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05

TABLE A.4

WATER-QUALITY D. TA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Nickel Ni (mg/l)	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
	Total/dissolved		•0.01/•0.01								
2		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.02/•0.01	•0.01/•0.01	•0.01/•0.01
3		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.02/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
4		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
5		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.02/•0.01	•0.01/•0.01	•0.01/•0.01
6		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	0.01/•0.01	•0.01/•0.01	•0.01/•0.01
7		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
1	Selenium Se (mg/l)	•0.002/0.002	•0.002/•0.002	•0.002/•0.002	•0.004/0.004	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
	Total/dissolved		•0.002/•0.002								
2		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
3		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
4		•0.002/•0.002	0.003/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
5		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
6		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
7		•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002	•0.002/•0.002
1	Silver Ag (mg/l)	•0.003/•0.003	•0.003/•0.003	•.01/•.01	•0.01/•0.01	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003
	Total/dissolved		•0.003/•0.003								
2		•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003	•0.003/•0.003
3		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
4		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
5		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
6		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
7		•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01	•0.01/•0.01
1	Tin Sn (mg/l)	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.02/•0.02	•0.02/•0.02
	Total/dissolved		•0.2/•0.2								
2		•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2
3		•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2
4		•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2		•0.2/•0.2	•0.2/•0.2	•0.2/•0.2
5		•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2
6		•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2
7		•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2	•0.2/•0.2
1	Thallium Tl (mg/l)	• 0.05	• 0.05	• 0.05	• 0.05	• 0.05	• 0.05	• 0.05	• 0.05	• 0.05	• 0.05
	Total/dissolved										
2		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
3		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
4		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
5		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
6		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05
7		•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05	•0.05/•0.05

TABLE A.4

WATER-QUALITY DATA, STUDY-AREA BASELINE MONITORING PROGRAM (continued)

Quarter 1)	Constituent/Quarter	STATIONS									
		P-1	P-2	P-3	P-4	OW-1	OW-2	OW-3	OW-4	OW-5	OW-8
1	Titanium Ti (mg/l) Total/dissolved	*0.1/*0.1	*0.1/*0.1 *0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
2		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
3		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
4		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
5		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
6		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
7		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
1	Vanadium V (mg/l) Total/dissolved	*0.1/*0.1	*0.1/*0.1 *0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
2		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
3		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
4		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
5		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
6		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
7		*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1	*0.1/*0.1
1	Zinc Zn (mg/l) Total/dissolved	*0.01/*0.01	*0.01/*0.01 0.05/0.05	0.092/0.075	0.063/0.063	0.16/0.16	0.12/0.09	0.28/0.19	0.16/0.13	0.2/0.18	0.13/0.09
2		0.03/0.01	0.01/*0.01	0.02/0.01	0.02/*0.1	1.95/0.12	1.03/0.48	0.86/*0.01	0.80/0.01	0.32/0.02	1.76/0.42
3		0.04/0.03	0.09/*0.01	0.01/0.01	0.02/*0.01	0.49/0.06	0.12/0.04	0.93/*0.01	0.22/*0.01	0.11/0.02	0.91/0.49
4		*0.01/*0.01	0.01/*0.01	*0.01/*0.01	0.01/*0.01	0.53/0.05	0.07/0.02	0.36/*0.01	0.24/*0.01	0.05/*0.01	0.76/0.49
5		0.06/0.04	0.04/0.04	0.07/0.04	0.07/0.05	0.48/0.09	0.09/0.06	0.17/*0.01	0.31/0.04	0.06/0.06	0.62/0.35
6		0.02/0.01	0.04/0.01	0.01/*0.01	0.02/*0.01	0.36/0.02	0.13/0.02	0.17/0.01	0.17/0.01	0.05/0.01	0.12/0.02
7		*0.01/*0.01	*0.01/*0.01	*0.01/*0.01	*0.01/*0.01	0.06/0.04	0.09/0.04	0.04/0.01	0.24/0.01	0.03/*0.01	0.02/*0.01
1	Total Coliform (colonies/100 ml)	—	—	—	—	—	—	—	—	—	—
2		—	—	—	—	—	—	—	—	—	—
3		--	--	--	—	—	—	—	—	—	—
4		500 est	500 est	8,000 est	20,000 est	6,200 est	2,500 est	200 est	5,200 est	7,400 est	400 est
5		20,000 est	120,000 est	4,000 est	3,000 est	3,000 est	90,000 est	500 est	80,000 est	10,000 est	1,500 est
6		1,200 est	600 est	*10	3,400 est	*4	500 est	500 est	200 est	8	300 est
7		200 est	440 est	80	340 est	920 est	160 est	500 est	1,600 est	340	720 est
1	Fecal Coliform (colonies/100 ml)	—	—	—	—	—	—	—	—	—	—
2		—	—	—	—	—	—	—	—	—	—
3		—	—	—	—	—	—	—	—	--	--
4		1	1	1	2	1	1	1	*1	*1	*1
5		1	20	1	1	1	1	20	*5	*1	*1
6		2	28	*1	*1	*1	*1	*20	*10	*1	4
7		*1	73	*1	*1	1	*1	3	*1	*1	*1

1) Quarter 1 - July 1980 Quarter 3 - January 1981 Quarter 5 - July 1981 Quarter 7 - October 1982
Quarter 2 - October 1980 Quarter 4 - April 1981 Quarter 6 - October 1981

est - estimate * - less than ** - greater than

Source: Tera Corporation, 1983a.

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
450912118555101	82-08-30	1500	22.0	1190	1150	.0	8.0	8.1	1.9	.50	490
451100119125501	82-08-28	1320	19.5	570	554	--	7.5	8.3	11	3.6	190
	83-03-09	1130	19.0	495	512	5.8	7.7	7.9	5.6	3.7	170
	83-07-25	0915	18.5	525	518	5.1	7.7	7.9	7.3	3.6	190
451155119005801	82-08-31	0920	18.0	405	406	.0	9.6	8.3	.8	<.10	28
	83-05-16	0930	17.5	560	451	.8	6.3	7.5	2.7	.92	56
	83-07-22	1030	18.0	390	380	.1	9.5	9.3	1.9	<.10	21
451255118551801	82-08-31	1200	16.0	901	881	--	8.3	8.1	1.3	26	350
	83-03-07	1345	15.5	940	921	--	7.8	7.9	4.0	23	350
	83-07-20	1600	15.5	920	885	--	7.8	7.8	4.0	26	360
451305119115501	82-08-27	1250	17.0	575	589	--	8.0	8.2	4.4	3.6	220
	83-05-17	0920	17.5	632	638	6.1	7.2	7.9	30	5.3	260
	83-07-22	1230	17.5	650	653	5.0	7.3	7.8	24	5.6	290
451504118505701	82-08-31	1745	19.0	532	532	9.8	8.2	8.1	1.8	12	230
	83-03-09	0915	18.5	520	557	8.0	7.6	8.0	6.7	12	230
	83-04-08	0915	18.5	520	557	8.0	7.6	8.0	6.7	12	230
	83-07-20	1400	18.5	530	524	9.7	7.8	7.7	4.2	12	230
451610119200001	82-08-27	1630	26.5	514	507	1.4	8.0	8.6	4.2	<.10	60
	83-05-17	1330	26.0	495	508	1.3	8.1	8.0	3.2	<.10	60
451715119013501	82-08-27	1415	17.5	575	567	9.0	8.0	8.7	3.3	4.0	220
	83-03-08	1430	16.0	575	527	8.4	7.8	8.1	5.3	4.3	220
	83-07-19	1530	17.5	568	545	8.6	8.0	8.0	3.1	4.1	230
451733119084101	83-05-18	0940	22.0	445	459	.0	7.9	8.1	5.2	<.10	23
451813119012504	83-03-10	1545	17.0	645	662	8.2	7.8	7.9	4.8	13	240
451814118575001	82-08-30	0930	19.5	415	415	2.4	8.0	8.2	2.7	1.6	140
	83-03-09	0900	18.5	405	419	2.2	7.8	8.1	4.2	1.6	140
	83-07-20	0945	19.0	412	412	1.7	7.8	7.9	4.2	1.7	140
451904119072001	83-07-26	0945	16.0	705	685	8.1	7.6	7.9	10	6.9	240
452002118460101	82-08-30	1245	23.0	260	261	4.8	8.0	8.4	1.9	.87	71

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
82-08-30	400	396	96	61	69		23	9.7	95	118	.000	41
82-08-28	12	12	46	19	34	1	27	7.3	175	222	.000	27
83-03-09	29	29	42	17	30	1	26	8.2	173	178	.000	29
83-07-25	0	0	45	18	32	1	26	7.8	162	231	.000	30
82-08-31	0	0	7.7	2.2	74	6	79	11	161	192	5.0	26
83-05-16	0	0	16	4.3	72	4	69	10	167	344	.000	29
83-07-22	0	0	5.5	1.7	75	7	82	11	157	373	.000	27
82-08-31	220	220	80	37	36	.9	18	8.2	123	163	.000	90
83-03-07	220	220	77	38	38	.9	19	8.3	130	157	.000	99
83-07-20	230	229	79	39	39	.9	19	8.6	134	157	.000	110
82-08-27	0	0	47	26	31	.9	22	7.9	228	278	.000	24
83-05-17	17	17	52	32	34	.9	21	7.7	242	299	.000	27
83-07-22	46	46	56	36	30	.8	18	7.0	255	296	.000	30
82-08-31	81	81	46	28	17	.5	14	4.1	131	182	.000	32
83-03-08	97	97	46	29	17	.5	13	4.0	144	168	--	36
83-04-08	97	97	46	29	17	.5	13	4.0	144	168	.000	36
83-07-20	98	98	46	29	17	.5	13	4.3	143	167	.000	33
82-08-27	0	0	14	6.0	86	5	71	13	210	262	.000	13
83-05-17	0	0	14	6.2	85	5	71	12	209	254	.000	11
82-08-27	48	48	47	24	31	.9	23	4.8	167	206	.000	26
83-03-08	44	44	46	25	31	.9	23	4.7	176	212	.000	25
83-07-19	65	65	48	26	32	1	23	4.8	177	198	.000	25
83-05-18	0	0	5.2	2.4	90	8	84	12	198	262	.000	26
83-03-10	85	85	59	23	35	1	23	6.6	156	192	.000	36
82-08-30	1	1	24	19	30	1	30	10	131	167	.000	9.9
83-03-09	3	3	24	19	29	1	29	10	145	165	.000	9.5
83-07-20	1	1	24	19	30	1	30	10	144	167	.000	11
83-07-26	24	24	57	23	54	2	33	2.8	203	260	.000	37
82-08-30	0	0	17	6.9	24	1	40	6.5	94	119	.000	7.2

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
82-08-30	490	.70	61	890	1.2	--	110	230	920	--	51	370.00
82-08-28	56	.40	56	360	.48	--	<3	2	270	--	14	765.00
83-03-09	58	.40	58	330	.45	10	<3	<1	--	--	--	765.00
83-07-25	58	.40	57	360	.49	--	<3	<1	--	--	--	765.00
82-08-31	5.0	2.6	62	300	.40	--	4	7	30	--	26	370.00
83-05-16	10	2.5	61	370	.51	280	13	5	--	--	--	370.00
83-07-22	.8	2.9	63	370	.50	--	6	6	--	--	--	370.00
82-08-31	89	.40	50	470	.64	--	4	2	830	--	18	500.00
83-03-07	88	.50	49	480	.65	40	3	2	--	--	--	500.00
83-07-20	86	.40	49	490	.66	--	7	2	--	--	--	500.00
82-08-27	35	.40	47	360	.48	--	<3	13	280	--	23	510.00
83-05-17	12	.30	46	390	.53	50	<3	7	--	--	--	510.00
83-07-22	47	.30	44	400	.54	--	12	4	--	--	--	510.00
82-08-31	38	.50	59	310	.43	--	<3	26	380	--	15	600.00
83-03-08	38	.60	58	310	.42	20	6	1	--	--	--	600.00
83-04-08	38	.60	58	310	.42	20	6	<1	--	--	--	600.00
83-07-20	38	.50	59	310	.42	--	16	3	--	--	--	600.00
82-08-27	35	1.5	74	370	.51	--	13	29	84	--	39	565.00
83-05-17	32	1.6	72	360	.49	110	14	27	--	--	--	565.00
82-08-27	76	.50	41	350	.48	--	<3	1	390	--	11	515.00
83-03-08	75	.60	41	350	.48	20	11	1	--	--	--	515.00
83-07-19	72	.50	41	350	.47	--	13	3	--	--	--	515.00
83-05-18	.2	1.5	62	330	.45	100	73	23	--	--	[illegible]	470.00
83-03-10	75	.60	44	370	.51	20	5	2	--	--	--	515.00
82-08-30	53	.80	58	290	.39	--	<3	1	180	--	17	540.00
83-03-09	52	.90	59	280	.39	20	7	<1	--	--	--	540.00
83-07-20	52	.90	56	290	.39	--	14	3	--	--	--	540.00
83-07-26	90	.40	46	440	.60	20	6	<1	--	--	--	--
82-08-30	21	.60	69	210	.29	--	6	<1	67	--	13	550.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL-LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA-LYZING SAMPLE (CODE NUMBER) (00028)
82-08-30	125	--	80020	80020
82-08-28	430	--	80020	80020
83-03-09	430	3213075	1028	80020
83-07-25	430	3222034	1028	80020
82-08-31	298	--	80020	80020
83-05-16	298	3147130	1028	80020
83-07-22	298	3209098	1028	80020
82-08-31	243	--	80020	80020
83-03-07	243	3213080	1028	80020
83-07-20	243	3209090	1028	80020
82-08-27	292	--	80020	80020
83-05-17	292	3147115	1028	80020
83-07-22	292	3209093	1028	80020
82-08-31	175	--	80020	80020
83-03-08	175	3241502	1028	80020
83-04-08	175	3241502	1028	80020
83-07-20	175	3209094	1028	80020
82-08-27	1100	--	80020	80020
83-05-17	1100	3147117	1028	80020
82-08-27	211	--	80020	80020
83-03-08	211	3075013	1028	80020
83-07-19	211	3209088	1028	80020
83-05-18	473	3147112	1028	80020
83-/3-10	127	--	80020	80020
82-08-30	350	--	80020	80020
83-03-09	350	3217050	1028	80020
83-07-20	350	3209089	1028	80020
83-07-26	--	3222032	1028	80020
82-08-30	300	--	80020	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
462002118460101	83-03-08	1100	22.0	250	271	4.6	7.7	8.1	3.8	.93	72
	83-07-20	1200	23.0	260	261	4.9	7.9	7.9	2.4	1.0	73
462210119151001	83-03-10	0915	16.5	415	427	.8	7.9	8.0	3.0	<.10	130
462214119161301	83-05-31	1130	16.5	200	218	--	6.3	7.2	39	3.3	73
462219118570101	83-07-21	1900	17.5	622	610	7.2	8.0	8.0	3.5	5.6	250
462226119161601	83-05-31	1030	17.0	183	195	--	6.9	7.3	14	2.6	64
462230119015501	82-08-27	1045	18.0	690	671	--	8.0	8.4	3.6	9.2	250
	83-03-11	0900	15.5	645	674	--	7.7	7.9	8.0	9.3	260
	83-07-21	1715	18.5	660	652	9.7	8.0	8.0	3.5	9.5	260
462233119162001	83-05-31	0930	17.0	212	229	--	7.4	7.7	4.7	4.4	84
462249119002201	83-05-17	1600	16.5	830	830	8.7	7.8	8.0	6.2	8.1	380
	83-07-22	0815	17.0	838	816	8.5	7.8	7.9	6.3	13	400
462300118472201	83-07-19	1230	19.0	728	704	10.2	7.9	7.9	2.8	11	220
462405119125501	82-08-30	1430	24.5	435	433	.1	7.8	8.0	6.0	<.10	81
	83-03-09	1130	24.0	430	438	.4	7.9	7.9	4.9	<.10	82
	83-07-25	1315	24.5	423	427	.1	7.5	7.9	13	.22	81
462730119001501	82-08-30	1745	17.5	585	550	.8	8.2	8.4	2.0	1.7	110
	83-03-09	1415	16.5	515	586	2.6	8.3	8.2	1.6	1.9	120
	83-07-21	1445	17.5	588	607	.6	8.3	8.1	1.6	1.6	110
462737118562501	82-08-30	1615	21.5	375	374	3.4	8.2	8.2	1.7	3.4	73
	83-05-18	1310	21.0	380	388	3.3	7.8	8.0	4.4	4.1	78
	83-07-21	1315	22.0	375	371	3.2	8.0	8.0	2.5	3.4	77
462747119004701	83-03-10	1100	14.5	555	585	8.8	7.8	8.0	6.6	4.0	220
462757119165001	83-05-31	1300	18.0	424	450	--	7.8	8.0	5.6	4.1	190
462826119091501	83-05-23	1300	22.0	296	296	.1	8.1	8.2	1.8	<.10	69
	83-07-25	1130	21.5	286	289	.1	7.8	8.1	3.7	<.10	67
462925119094001	83-03-11	1100	12.5	370	404	3.4	8.3	8.3	1.6	<.10	25
463003119150201	82-08-30	1030	18.5	395	396	.2	8.2	8.3	1.9	<.10	53
	83-03-09	1630	18.5	378	405	.1	8.2	8.1	2.1	<.10	54
	83-07-26	1200	19.0	386	393	.2	8.1	8.1	2.7	<.10	56
463245119184001	83-06-03	1445	17.0	310	327	--	7.9	8.0	2.9	5.1	120
463245119193001	83-06-03	1545	18.5	390	414	--	7.8	7.9	4.0	7.7	160
463253119194401	83-06-02	2000	18.0	393	396	--	7.9	8.5	3.1	6.9	160
463301119273201	83-05-01	1215	18.0	320	340	--	8.0	8.4	3.4	<.10	56
463305119195001	83-06-02	1900	17.5	390	410	--	8.0	8.3	2.5	7.0	150
463328119201001	83-06-02	1700	18.0	399	404	--	7.8	8.4	4.0	6.1	150
463338119195901	83-06-02	1800	18.0	385	412	--	7.8	8.6	3.9	6.9	160
463340119043901	82-09-01	1615	17.5	745	741	7.8	7.8	8.0	4.7	8.2	340
	83-03-10	1430	17.0	735	744	8.4	7.6	8.0	8.6	7.9	320
	83-07-22	1000	17.5	735	712	7.5	7.7	7.9	6.0	7.6	330

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-03-08	0	0	17	7.1	24	1	40	6.3	130	119	.000	7.0
83-07-20	0	0	17	7.4	25	1	40	6.7	104	122	.000	7.3
83-03-10	4	4	28	14	34	1	35	8.3	132	151	.000	3.4
83-05-31	33	33	22	4.5	12	.6	25	2.9	59	49	.000	8.5
83-07-21	67	67	61	23	31	.9	21	6.6	182	220	.000	31
83-05-31	8	8	19	4.1	11	.6	26	2.6	55	69	.000	9.8
82-09-27	66	66	43	35	35	1	22	11	193	227	.000	39
83-03-11	52	52	44	36	35	1	22	11	188	251	.000	39
83-07-21	76	76	44	36	36	1	22	11	190	222	.000	38
83-05-31	24	24	26	4.7	9.7	.5	20	2.2	62	74	.000	7.9
83-05-17	180	181	60	57	25	.6	12	2.1	195	240	.000	55
83-07-22	190	193	60	60	27	.6	13	2.0	214	249	.000	54
83-07-19	100	104	46	25	61	2	37	9.4	117	139	.000	74
82-08-30	0	0	20	7.4	60	3	58	11	196	238	.000	19
83-03-09	0	0	20	7.8	60	3	58	11	202	243	.000	19
83-07-25	0	0	20	7.6	59	3	57	11	204	258	.000	20
82-08-30	0	0	30	8.5	81	3	57	18	158	198	.000	31
83-03-09	0	0	33	8.9	80	3	55	19	165	198	.000	34
83-07-21	0	0	29	8.1	80	4	57	20	169	200	.000	29
82-08-30	0	0	18	6.9	46	2	53	11	131	169	.000	8.7
83-05-18	0	0	19	7.3	47	2	53	11	140	176	.000	8.0
83-07-21	0	0	19	7.2	46	2	52	11	142	159	.000	8.6
83-03-10	9	9	53	22	29	.9	21	6.9	187	261	.000	23
83-05-31	7	7	49	16	19	.6	17	5.9	178	221	.000	9.4
83-05-23	0	0	18	5.9	32	2	47	6.2	114	143	.000	6.4
83-07-25	0	0	18	5.9	31	2	47	6.3	118	148	.000	6.4
83-03-11	0	0	6.8	1.9	72	7	79	13	167	204	.000	14
82-08-30	0	0	15	3.7	62	4	68	9.6	159	193	.000	19
83-03-09	0	0	15	3.9	63	4	68	9.6	168	208	.000	18
83-07-26	0	0	16	4.0	62	4	66	9.3	172	215	.000	20
83-06-03	6	6	31	11	15	.6	20	5.0	120	143	.000	6.0
83-06-03	27	27	43	12	18	.6	19	5.7	124	159	.000	11
83-06-02	31	31	34	12	18	.6	19	5.7	129	157	.000	12
83-06-01	0	0	16	4.0	56	3	65	7.1	172	215	.000	6.9
83-06-02	27	27	42	12	19	.7	20	5.6	128	155	.000	12
83-06-02	23	23	41	12	20	.7	22	5.1	130	157	.000	12
83-06-02	32	32	44	12	19	.7	20	5.4	128	155	.000	14
82-09-01	190	190	72	39	22	.5	12	5.1	150	185	.000	54
83-03-10	150	145	66	38	21	.5	12	5.1	157	215	.000	51
83-07-22	170	173	69	38	21	.5	12	5.1	158	190	.000	53

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-03-08	19	.70	69	210	.28	30	7	<1	--	--	--	550.00
83-07-20	20	.60	69	210	.29	--	7	2	--	--	--	550.00
83-03-10	81	.50	43	290	.39	20	34	39	--	--	--	495.00
83-05-31	19	.40	15	110	.17	--	--	--	--	--	--	385.00
83-07-21	87	.40	39	390	.53	--	7	2	--	--	--	535.00
83-05-31	17	.50	13	110	.16	--	--	--	--	--	--	375.00
82-08-27	70	.50	56	400	.55	--	5	<1	470	--	11	640.00
83-03-11	68	.60	57	410	.56	10	9	1	--	--	--	640.00
83-07-21	67	.60	55	400	.54	--	24	9	--	--	--	640.00
83-05-31	18	.50	13	120	.18	--	--	--	--	--	--	375.00
83-05-17	120	.30	50	490	.67	20	14	3	--	--	--	720.00
83-07-22	120	.40	51	500	.68	--	8	3	--	--	--	720.00
83-07-19	92	.40	58	430	.59	--	10	2	--	--	--	860.00
82-08-30	10	.80	68	310	.43	--	120	53	150	--	35	845.00
83-03-09	.9	.90	72	310	.42	70	150	47	--	--	--	845.00
83-07-25	1.6	.80	68	320	.43	70	130	46	--	--	--	845.00
82-08-30	94	.30	37	400	.54	--	4	67	130	--	21	625.00
83-03-09	100	.30	32	400	.55	30	8	64	--	--	--	625.00
83-07-21	89	.40	35	390	.53	--	6	59	--	40	--	625.00
82-08-30	27	.90	85	290	.37	--	6	<1	92	--	15	850.00
83-05-18	27	1.0	84	290	.40	40	16	2	--	--	--	850.00
83-07-21	27	1.0	80	280	.38	--	9	8	--	50	--	850.00
83-03-10	68	.30	41	370	.51	30	3	<1	--	--	--	592.00
83-05-31	28	.30	42	280	.37	--	--	--	--	--	--	431.00
83-05-23	23	.70	51	210	.29	30	10	8	--	--	--	890.00
83-07-25	24	.60	50	220	.29	30	5	9	--	--	--	890.00
83-03-11	14	1.7	61	280	.39	80	9	1	--	--	--	920.00
82-08-30	11	.80	62	280	.38	--	35	29	97	--	18	390.00
83-03-09	9.6	.90	62	280	.39	30	57	23	--	--	--	390.00
83-07-26	9.6	.90	61	290	.39	30	49	22	--	--	--	390.00
83-06-03	20	.30	36	190	.27	--	--	--	--	--	--	--
83-06-03	36	.40	38	240	.35	--	--	--	--	--	--	--
83-06-02	35	.40	38	240	.36	--	--	--	--	--	--	438.00
83-06-01	.8	.90	44	240	.30	--	--	--	--	--	--	--
83-06-02	35	.40	38	240	.36	--	--	--	--	--	--	--
83-06-02	37	.40	38	240	.35	--	--	--	--	--	--	--
83-06-02	35	.40	38	240	.36	--	--	--	--	--	--	--
82-09-01	120	.30	57	460	.63	--	6	5	670	--	15	914.00
83-03-10	120	.30	56	460	.63	20	<3	2	--	--	--	914.00
83-07-22	130	.30	55	460	.62	--	5	<1	--	--	--	914.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL-LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA-LYZING SAMPLE (CODE NUMBER) (00028)
83-03-08	300	3213088	1028	80020
83-07-20	300	3209096	1028	80020
83-03-10	196	--	80020	80020
83-05-31	74.00	3159012	1028	80020
83-07-21	310	3220117	1028	80020
83-05-31	75.00	3158113	1028	80020
82-08-27	230	--	80020	80020
83-03-11	230	3076025	1028	80020
83-07-21	230	3209087	1028	80020
83-05-31	77.00	3159002	1028	80020
83-05-17	237	3147116	1028	80020
83-07-22	237	3209097	1028	80020
83-07-19	540	3209092	1028	80020
82-08-30	746	--	80020	80020
83-03-09	746	--	1028	80020
83-07-25	746	3222031	1028	80020
82-08-30	410	--	80020	80020
83-03-09	410	--	1028	80020
83-07-21	410	3209099	1028	80020
82-08-30	1310	--	80020	80020
83-05-18	1310	3147113	1028	80020
83-07-21	1310	3209100	1028	80020
83-03-10	124	3080024	1028	80020
83-05-31	368	3158103	1028	80020
83-05-2[illegible]	[illegible]	3160050	1028	80020
83-07-25	552	3222033	1028	80020
83-03-11	997	--	80020	80020
82-08-30	413	--	80020	80020
83-03-09	413	--	1028	80020
83-07-26	413	3222035	1028	80020
83-06-03	98.00	3159020	1028	80020
83-06-03	105	3160112	1028	80020
83-06-02	420	3158127	1028	80020
83-06-01	287	3159008	1028	80020
83-06-02	88.00	3158124	1028	80020
83-06-02	79.00	3159013	1028	80020
83-06-02	95.00	3159010	1028	80020
82-09-01	458	--	80020	80020
83-03-10	458	3076022	1028	80020
83-07-22	458	3213087	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPERATURE (DEG C) (00010)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	SPECIFIC CONDUCTANCE LAB (UMHOS) (90095)	OXYGEN, DISSOLVED (MG/L) (00300)	PH (STANDARD UNITS) (004(?)	PH LAB (STANDARD UNITS) (00403)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	HARDNESS (MG/L AS CACO3) (00900)
463340119293001	83-06-02	1600	17.0	379	393	--	7.7	8.1	4.8	5.5	150
463355119204001	83-06-02	1445	17.5	410	427	--	7.3	8.3	12	5.4	160
463400119061001	82-09-01	1345	16.0	925	911	E8.0	7.9	8.2	5.6	8.0	380
	83-03-10	1250	15.5	955	900	9.2	7.5	7.9	16	6.8	360
	83-07-26	1530	16.0	845	863	9.2	7.6	7.9	13	7.4	350
463405119210101	83-06-02	1230	17.0	320	337	--	7.7	8.5	4.8	2.3	130
463419119210801	83-06-02	1330	11.5	165	184	--	7.3	8.9	6.0	.31	76
463423119223501	83-06-02	1030	17.0	321	339	--	7.7	8.0	5.5	1.3	110
463625119152801	83-03-14	1615	28.5	375	394	3.8	8.4	8.5	1.1	.22	3
	83-07-26	1340	29.5	382	390	--	8.4	8.4	1.1	<.10	4
463747119041601	82-09-01	0930	21.0	320	334	.1	8.0	8.3	2.8	<.10	81
	83-03-10	1000	20.0	341	386	1.5	7.9	8.0	4.5	<.10	94
	83-07-22	1200	20.5	435	433	.1	7.9	7.9	4.8	<.10	140
463748118511501	82-08-31	1530	--	310	310	7.4	8.0	8.2	2.4	.95	110
	83-03-10	1230	9.5	298	321	7.7	8.0	8.1	2.5	1.0	120
	83-07-21	1130	19.5	310	311	6.4	7.9	7.9	3.1	.99	120
463828118434701	82-09-02	0900	16.5	395	395	.4	8.7	8.6	.6	.54	45
	83-03-10	1030	--	--	--	.1	--	--	--	--	--
	83-03-10	1030	17.0	391	422	.1	8.8	8.7	.5	<.10	33
463857118474101	82-08-31	1300	18.5	420	417	5.8	7.9	8.4	3.8	3.9	100
	83-05-18	1500	18.0	471	486	6.0	7.8	8.0	5.3	5.5	120
	83-07-21	1300	18.5	449	442	6.6	7.8	7.9	5.0	4.5	120
463951119292101	82-09-02	1045	18.5	835	817	2.9	7.7	7.9	9.4	5.8	350
	83-05-20	1400	16.5	820	802	3.8	7.7	7.8	9.2	7.0	330
	83-07-21	1645	17.0	830	708	3.6	7.7	7.8	9.4	7.0	340
464042118212101	82-09-01	1345	29.0	790	778	E.1	7.5	7.8	25	.48	240
	83-05-20	1530	28.5	790	781	.1	7.4	7.7	31	.39	240
	83-09-03	1215	29.5	766	771	.1	7.2	7.7	49	.29	240
464048119212801	82-08-31	1630	22.5	660	667	E4.2	7.8	8.2	4.5	12	230
	83-03-10	1400	20.0	645	677	5.7	7.6	7.8	8.3	11	240
	83-07-27	0900	20.0	661	651	5.5	7.7	7.8	5.8	12	240
464132118581701	82-09-02	0930	17.5	440	446	7.8	8.0	8.2	3.1	2.0	180
	83-03-11	0950	17.0	440	449	7.7	7.6	8.0	7.4	1.9	170
	83-07-27	1030	17.5	432	433	--	7.8	8.0	4.9	1.9	170
464232119020801	82-08-31	0845	16.5	375	383	7.6	7.7	8.1	6.0	1.2	150
	83-03-14	1345	15.0	370	389	8.5	7.5	7.9	9.4	1.4	150
	83-07-26	1830	16.5	375	379	8.2	7.7	7.9	6.2	1.3	150
464407119391801	82-08-11	0900	21.0	300	311	3.4	7.8	8.4	3.7	.83	120
	83-03-16	0945	18.5	298	318	4.0	7.7	8.0	5.7	.71	120
	83-07-26	1720	20.5	310	309	--	7.9	7.9	3.0	.84	120

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	HARD-NESS, NONCARBONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-06-02	21	21	40	11	18	.7	21	5.2	122	152	.000	13
83-06-02	36	36	42	13	22	.8	22	5.2	123	149	.000	14
82-09-01	160	155	86	41	52	1	23	4.8	241	280	.000	49
83-03-10	100	101	80	39	51	1	23	4.3	255	317	.000	47
83-07-26	91	91	77	39	52	1	24	4.2	255	320	.000	47
83-06-02	2	2	37	8.0	21	.8	26	4.4	124	151	.000	7.4
83-06-02	6	6	22	5.2	6.6	.3	16	1.4	73	86	.000	1.4
83-06-02	0	0	34	7.2	27	1	33	5.5	138	172	.000	4.6
83-03-14	0	0	.77	.34	76	19	87	16	151	168	6.0	14
83-07-26	0	0	.79	.43	75	17	88	15	149	176	6.0	15
82-09-01	0	0	19	8.2	38	2	48	6.8	140	177	.000	10
83-03-10	0	0	22	9.4	40	2	46	7.1	167	225	.000	12
83-07-22	0	0	31	14	38	1	36	8.0	202	241	.000	12
82-08-31	0	0	25	12	18	.8	25	4.9	113	153	.000	9.2
83-03-10	0	0	27	12	18	.7	24	4.7	131	155	.000	10
83-07-21	0	0	27	13	18	.7	24	5.1	130	155	.000	8.6
82-09-02	0	0	13	3.1	69	5	74	6.9	131	177	5.0	7.8
83-03-10	--	--	--	--	--	--	--	--	--	184	--	--
83-03-10	0	0	9.5	2.2	76	6	80	6.9	163	184	7.0	9.2
82-08-31	0	0	23	11	48	2	49	5.5	140	188	.000	9.4
83-05-18	0	0	28	13	52	2	46	5.8	169	209	.000	11
83-07-21	0	0	[illegible]	13	51	2	47	5.8	165	200	.000	10
82-09-02	100	103	77	37	40	1	20	5.9	241	296	.000	55
83-05-20	92	92	73	36	41	1	21	5.7	230	291	.000	54
83-07-21	93	93	74	37	41	1	21	5.9	245	298	.000	55
82-09-01	0	0	37	35	80	2	40	19	396	489	.000	16
83-05-20	0	0	35	36	81	2	40	21	402	494	.000	14
83-08-03	0	0	35	36	82	2	41	18	402	491	.000	13
82-08-31	86	86	49	27	41	1	26	11	143	180	.000	30
83-03-10	73	73	50	29	42	1	26	11	149	209	.000	29
83-07-27	89	89	50	28	42	1	26	11	157	184	.000	30
82-09-02	19	19	36	21	22	.7	21	6.4	149	193	.000	17
83-03-11	16	16	33	21	22	.8	21	6.4	98	186	.000	11
83-07-27	13	13	34	21	22	.8	21	6.0	159	193	.000	14
82-08-31	0	0	30	19	22	.8	23	[illegible]	150	190	.000	7.7
83-03-14	0	0	29	18	21	.8	23	4.7	139	188	.000	8.3
83-07-26	0	0	28	19	21	.8	23	5.1	158	194	.000	7.9
82-08-11	2	2	30	11	17	.7	23	5.5	124	145	.000	7.4
83-03-16	0	0	30	11	17	.7	23	5.2	126	[illegible]	.000	[illegible]
83-07-26	0	0	30	11	17	.7	23	5.1	135		.000	7.3

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-06-02	38	.40	36	240	.33	--	--	--	--	--	--	--
83-06-02	50	.40	37	260	.37	--	--	--	--	--	--	--
82-09-01	150	.30	48	570	.77	--	4	2	810	--	18	890.00
83-03-10	150	.30	46	570	.78	30	8	<1	--	--	--	890.00
83-07-26	120	.80	51	550	.75	30	5	<1	--	--	--	890.00
83-06-02	31	.40	32	220	.30	--	--	--	--	--	--	--
83-06-02	14	.20	15	110	.14	--	--	--	--	--	--	385.00
83-06-02	23	.40	35	220	.28	--	--	--	--	--	--	413.00
83-03-14	19	2.4	66	290	.39	80	38	6	--	--	--	952.00
83-07-26	20	2.4	64	290	.40	80	39	3	--	--	--	952.00
82-09-01	11	.50	64	240	.33	--	35	51	170	--	13	995.00
83-03-10	13	.50	61	280	.37	30	84	71	--	--	--	995.00
83-07-22	17	.40	61	300	.41	--	790	150	--	--	--	995.00
82-08-31	21	.50	49	210	.29	--	4	<1	150	--	12	1070.00
83-03-10	19	.60	48	220	.29	30	<3	2	--	--	--	1070.00
83-07-21	20	.50	48	220	.29	--	10	<1	--	--	--	1070.00
82-09-02	44	.70	39	280	.38	--	39	2	44	--	29	785.00
83-03-10	--	--	--	--	--	--	--	--	--	--	--	785.00
83-03-10	33	.80	41	280	.39	30	120	<10	--	--	--	785.00
82-08-31	33	1.3	50	270	.37	--	<3	<1	120	--	17	785.00
83-05-18	43	1.3	49	310	.42	40	<3	<1	--	--	--	785.00
83-07-21	39	1.2	49	290	.40	--	3	<1	--	--	--	785.00
82-09-02	92	.30	42	500	.67	--	4	5	350	--	17	1000.00
83-05-20	92	.40	42	490	.66	40	7	3	--	--	--	1000.00
83-07-21	90	.30	41	490	.67	--	18	6	--	--	--	1000.00
82-09-01	17	.60	100	550	.74	--	32	42	190	--	81	1340.00
83-05-20	16	.70	100	550	.74	300	39	41	--	--	--	1340.00
83-08-03	17	.70	99	540	.74	300	21	41	--	50	--	1340.00
82-08-31	100	.30	61	410	.55	--	4	1	350	--	18	1085.00
83-03-10	110	.60	63	440	.59	20	<3	<1	--	--	--	1085.00
83-07-27	110	.50	60	420	.57	30	6	<1	--	--	--	1085.00
82-09-02	55	.40	58	310	.42	--	<3	3	270	--	12	1115.00
83-03-11	49	.50	58	290	.40	40	12	1	--	--	--	1115.00
83-07-27	48	.50	63	300	.41	40	14	1	--	--	--	1115.00
82-08-31	28	.40	53	260	.35	--	3	2	240	--	8	1016.00
83-03-14	27	.50	51	250	.35	40	20	6	--	--	--	1016.00
83-07-26	31	.50	51	260	.35	40	13	1	--	--	--	1016.00
82-08-11	24	.30	65	230	.31	--	<3	1	170	--	7	680.00
83-03-16	22	.30	59	240	.33	<10	72	4	--	--	--	680.00
83-07-26	22	.30	63	230	.31	<10	8	2	--	--	--	680.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-06-02	48.00	3159006	1028	80020
83-06-02	48.00	3158126	1028	80020
82-09-01	235	--	80020	80020
83-03-10	235	3080023	1028	80020
83-07-26	235	3222044	1028	80020
83-06-02	43.00	3158120	1028	80020
83-06-02	49.00	3159014	1028	80020
83-06-02	82.00	3159015	1028	80020
83-03-14	1110	--	80020	80020
83-07-26	1110	3222029	1028	80020
82-09-01	450	--	80020	80020
83-03-10	450	3076023	1028	80020
83-07-22	450	3213079	1028	80020
82-08-31	652	--	80020	80020
83-03-10	652	3075040	1028	80020
83-07-21	652	3213086	1028	80020
82-09-02	380	--	80020	80020
83-03-10	380	--	1028	1028
83-03-10	380	3075037	1028	1028
82-08-31	300	--	80020	80020
83-05-18	300	3147138	1028	80020
83-07-21	300	3213076	1028	80020
82-09-02	220	--	80020	80020
83-05-20	220	3160045	1028	80020
83-07-21	220	3213093	1028	80020
82-09-01	940	--	80020	80020
83-05-20	940	3160039	1028	80020
83-08-03	940	3242008	1028	80020
82-08-31	420	--	80020	80020
83-03-10	420	3075063	1028	80020
83-07-27	420	3221081	1028	80020
82-09-02	320	--	80020	80020
83-03-11	320	3207026	1028	80020
83-07-27	320	3222045	1028	80020
82-08-31	433	--	80020	80020
83-03-14	433	3252162	1028	80020
83-07-26	433	3222017	1028	80020
82-08-11	445	--	80020	80020
83-03-16	445	--	1028	80020
83-07-26	445	3222050	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — MULTIPLE STATION LISTING — PROCESS DATE 01/24/86

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
464412119115401	82-08-31	1130	19.0	560	565	5.8	8.2	8.3	1.9	4.0	220
	83-03-15	0900	14.0	557	592	8.4	7.8	8.0	4.9	4.1	240
	83-07-26	1645	18.5	580	573	8.2	8.3	8.1	1.6	4.4	220
464415119575301	82-08-10	0900	15.5	787	795	7.6	7.7	8.3	6.8	12	360
	83-03-14	1155	14.5	790	789	8.0	7.4	7.9	13	9.2	360
	83-07-27	1230	15.5	788	762	7.8	7.7	8.0	7.0	12	360
464420119383401	82-08-19	1630	20.0	310	311	3.4	7.8	8.1	3.9	.81	110
	83-03-15	1300	16.5	300	314	3.5	7.8	8.0	4.4	.10	110
	83-07-26	1850	20.0	305	305	--	7.9	7.9	3.1	.76	110
464507118175501	82-09-08	1015	20.0	410	444	.1	7.7	7.8	8.9	<.10	150
	83-05-24	1200	20.0	435	454	--	7.4	7.8	17	.14	150
	83-08-26	1430	20.0	445	447	--	7.7	7.7	8.8	<.10	150
464518118185201	82-08-06	1745	16.5	520	566	--	8.0	8.1	4.8	3.2	190
	83-05-24	1320	17.0	520	528	--	7.9	8.0	5.9	1.6	160
	83-08-22	1530	16.0	602	621	--	8.0	7.9	5.3	4.2	230
464650118401401	82-08-07	1600	17.0	565	667	7.3	8.1	8.1	1.9	25	260
	83-03-16	0915	16.0	527	557	9.8	7.7	8.1	5.0	12	230
	83-08-01	1430	17.0	785	748	9.2	8.0	8.0	2.6	35	340
464727118560501	83-05-26	1000	28.5	372	390	.5	9.1	8.8	.2	<.10	14
464752118500801	83-05-20	1130	25.5	348	348	1.0	8.3	8.2	1.4	.18	43
	83-08-02	0945	25.5	336	345	.8	8.4	8.4	1.0	<.10	43
464753119573901	82-08-10	1045	23.0	390	395	3.3	8.8	8.8	.4	<.10	45
	83-05-19	1330	23.0	400	399	.4	8.8	8.7	.4	<.10	44
	83-07-29	1400	25.0	379	378	.7	8.7	8.8	.5	<.10	33
464759118563301	83-05-26	1100	22.5	389	403	--	7.8	7.9	4.2	<.10	63
464802118495501	82-08-09	1200	26.0	320	330	E2.4	8.6	8.6	.7	.26	44
464830118595901	83-05-19	1230	17.5	362	362	1.8	8.6	8.4	.5	1.3	82
	83-07-29	1145	19.0	352	356	--	8.7	8.6	.4	1.1	75
464903118571601	83-05-27	1650	19.0	397	413	1.9	8.0	8.0	2.6	.34	99
	83-08-01	1230	19.5	392	393	--	8.0	8.2	2.6	.29	90
464923118234501	82-08-07	1030	15.0	301	301	3.8	8.1	8.3	2.2	.48	96
	83-05-24	1015	14.5	291	305	5.1	8.2	8.1	1.8	1.2	92
	83-08-03	1045	15.0	293	300	5.1	8.1	8.2	2.2	.49	92
464924118374501	82-08-07	1400	17.0	318	318	4.3	8.4	8.3	1.0	1.5	130
	83-08-01	1545	19.0	336	340	.7	8.5	8.3	.8	2.1	120
464924118374502	83-03-16	1150	17.0	318	341	4.5	8.6	8.5	.6	1.6	110
464928119103201	82-08-10	1500	26.5	440	446	.8	9.3	9.4	.1	.36	21
	83-03-15	1355	26.0	432	467	1.4	9.3	9.2	.1	.58	30
	83-07-27	0835	26.5	419	438	.9	9.1	9.0	.2	.34	19
464940118273001	83-05-27	0945	16.5	262	282	7.9	7.6	7.9	6.1	.76	120

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/85
MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
82-08-31	63	63	38	30	32	1	24	5.9	149	190	.000	32
83-0 .5	78	78	41	33	34	1	23	6.0	161	196	.000	32
83-07-26	59	59	37	32	32	1	23	6.0	162	202	.000	34
82-08-10	190	187	74	43	18	.4	10	4.4	176	214	.000	48
83-03-14	190	191	73	43	18	.4	10	4.1	176	206	.000	48
83-07-27	180	181	74	43	18	.4	10	4.0	164	221	.000	49
82-08-19	0	0	27	11	18	.8	25	4.6	118	153	.000	7.1
83-03-15	0	0	27	11	18	.8	25	4.4	126	176	.000	7.1
83-07-26	0	0	26	11	18	.8	25	4.5	127	157	.000	7.1
82-09-08	0	0	29	19	40	1	35	7.1	226	281	.000	6.1
83-05-24	0	0	28	19	39	1	35	7.7	224	275	.000	6.3
83-08-26	0	0	28	19	39	1	35	7.7	225	279	.000	6.2
82-08-05	0	0	44	20	47	2	34	8.5	250	304	.000	16
83-05-24	0	0	35	17	53	2	41	9.2	237	293	.000	12
83-08-22	0	0	53	24	42	1	27	8.7	270	331	.000	19
82-08-07	140	140	68	23	15	.4	11	3.9	128	153	.000	46
83-03-16	99	99	58	20	14	.4	12	3.6	133	157	.000	36
83-08-01	210	208	90	29	16	.4	9	4.6	132	161	.000	58
83-05-26	0	0	3.7	1.1	78	9	87	8.6	151	164	8.0	11
83-05-20	0	0	9.3	4.9	57	4	70	7.0	142	172	.000	9.8
83-08-02	0	0	9.5	4.8	57	4	70	7.1	146	164	4.0	9.1
82-08-10	0	0	9.5	5.2	65	4	71	10	150	167	8.0	10
83-05-19	0	0	9.6	4.9	69	5	72	11	150	172	8.0	11
83-07-29	0	0	7.0	3.7	68	5	76	10	149	155	12	13
83-05-26	0	0	14	6.9	54	3	60	13	135	168	.000	11
82-08-09	0	0	10	4.6	50	3	66	8.6	139	164	.000	8.8
83-05-19	0	0	13	12	42	2	50	6.4	116	137	4.0	15
83-07-29	0	0	12	11	46	2	54	7.0	127	137	7.0	17
83-05-27	0	0	20	12	41	2	44	9.7	141	166	.000	19
83-08-01	0	0	18	11	45	2	49	10	147	165	.000	19
82-08-07	0	0	17	13	25	1	34	7.1	146	177	.000	4.2
83-05-24	0	0	17	12	26	1	36	7.1	144	176	.000	4.1
83-08-03	0	0	17	12	27	1	37	7.2	149	177	.000	4.1
82-08-07	0	0	31	12	16	.6	21	3.7	130	156	.000	11
83-09-01	0	0	30	12	20	.8	25	4.2	127	151	3.0	16
83-03-16	0	0	27	9.6	27	1	34	4.8	128	147	4.0	15
82-08-10	0	0	4.9	2.2	88	9	86	8.3	158	151	20	14
83-03-15	0	0	6.7	3.3	89	7	83	8.3	165	155	21	[illegible]
83-07-27	0	0	4.2	2.0	89	9	87	8.5	162	179	17	18
83-05-27	0	0	28	11	13	.5	19	3.1	127	152	.000	5.3

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
82-08-31	76	.50	57	370	.50	--	3	2	380	--	11	1100.00
83-03-15	80	.70	59	380	.52	30	<3	1	--	--	--	1100.00
83-07-26	80	.60	56	380	.51	20	<3	<1	--	--	--	1100.00
82-08-10	120	.40	45	460	.62	--	3	2	590	--	9	1115.00
83-03-14	130	.40	45	460	.63	20	7	7	--	--	--	1115.00
83-07-27	130	.40	44	470	.64	20	4	<1	--	--	--	1115.00
82-08-19	23	.30	62	230	.31	--	<3	18	170	--	6	700.00
83-03-15	22	.30	62	240	.32	10	4	<1	--	--	--	720.00
83-07-26	23	.30	48	220	.29	10	5	3	--	--	--	720.00
82-09-08	11	.80	76	330	.44	--	8	80	75	--	26	1030.00
83-05-24	10	.90	76	320	.44	20	21	74	--	--	--	1030.00
83-08-26	11	.90	73	320	.44	20	10	80	--	50	--	1030.00
82-08-05	23	.50	52	360	.49	--	<3	2	180	--	33	1012.00
83-05-24	19	.60	53	340	.47	20	9	4	--	--	--	1012.00
83-08-22	25	.50	50	380	.52	20	21	5	--	40	--	1012.00
82-08-07	26	.20	41	300	.41	--	<3	14	330	--	7	1420.00
83-03-16	22	.30	43	270	.37	20	7	1	--	--	--	1420.00
83-08-01	33	.20	40	350	.47	10	6	<1	--	--	--	1420.00
83-05-26	21	2.8	83	310	.42	50	26	2	--	--	--	1270.00
83-05-20	18	1.8	66	260	.35	50	12	<1	--	--	--	1300.00
83-08-02	13	1.8	65	260	.35	50	3	1	--	40	--	1300.00
82-08-10	23	2.3	63	290	.40	--	<3	<1	58	--	14	1220.00
83-05-19	29	2.3	65	300	.41	50	20	<10	--	--	--	1220.00
83-07-29	24	3.0	67	300	.40	60	11	1	--	50	--	1220.00
83-05-26	42	1.7	60	290	.39	40	480	55	--	--	--	1275.00
82-08-09	17	1.7	66	250	.34	--	<3	2	52	--	10	1309.00
83-05-19	32	1.0	53	250	.34	20	20	<10	--	--	--	1242.00
83-07-29	26	1.3	57	260	.35	30	4	<1	--	40	--	1242.00
83-05-27	31	.70	48	260	.36	20	<3	3	--	--	--	1260.00
83-08-01	32	.60	48	260	.36	20	<3	<1	--	50	--	1260.00
82-08-07	7.0	.40	44	200	.28	--	<3	9	79	--	14	1710.00
83-05-24	7.7	.40	44	200	.28	30	17	9	--	--	--	1710.00
83-08-03	8.0	.40	42	200	.28	30	6	9	--	--	--	1710.00
82-08-03	14	.30	44	210	.28	--	<3	<1	150	--	4	1495.00
83-08-01	18	.50	48	230	.31	20	<3	<1	--	40	--	1495.00
83-03-16	16	.90	56	240	.32	20	<3	3	--	--	--	1495.00
82-08-10	31	4.3	84	350	.48	--	35	2	31	--	13	1053.00
83-03-15	34	4.8	87	370	.50	90	36	2	--	--	--	1053.00
83-07-27	31	4.4	83	360	.49	90	40	<1	--	30	--	1053.00
83-05-27	7.5	.30	49	190	.26	20	13	<1	--	--	--	1583.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
82-08-31	305	--	80020	80020
83-03-15	305	3083061	1028	80020
83-07-26	305	3222020	1028	80020
82-08-10	304	--	80020	80020
83-03-14	304	--	1028	80020
83-07-27	304	3222037	1028	80020
82-08-19	420	--	80020	80020
83-03-15	420	3249816	1028	80020
83-07-26	420	3222046	1028	80020
82-09-08	510	--	80020	80020
83-05-24	510	3160047	1028	80020
83-08-26	510	3249190	1028	80020
82-08-06	380	--	80020	80020
83-05-24	380	3160041	1028	80020
83-08-22	380	3250132	1028	80020
82-08-07	480	--	80020	80020
83-03-16	480	--	1028	80020
83-08-01	480	3242011	1028	80020
83-05-26	1410	3160051	1028	80020
83-05-20	1890	3160044	1028	80020
83-08-02	1890	3227008	1028	80020
82-08-10	1030	--	80020	80020
83-05-19	1030	3147118	1028	80020
83-07-29	1030	3227017	1028	80020
83-05-26	1210	3160038	1028	80020
82-08-09	1980	--	80020	80020
83-05-19	1370	3147121	1028	80020
83-07-29	1370	3227015	1028	80020
83-05-27	1330	3160017	1028	80020
83-08-01	1330	3227016	1028	80020
82-08-07	342	--	80020	80020
83-05-24	342	3160046	1028	80020
83-08-03	342	3227010	1028	80020
82-08-07	830	--	80020	80020
83-08-01	830	3242012	1028	80020
83-03-16	1200	3083027	1028	80020
82-08-10	1210	--	80020	80020
83-03-15	1210	3083059	1028	80020
83-07-27	1210	3222053	1028	80020
83-05-27	1100	3168035	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPERATURE (DEG C) (00010)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	SPECIFIC CONDUCTANCE LAB (UMHOS) (90095)	OXYGEN, DISSOLVED (MG/L) (00300)	PH (STANDARD UNITS) (00400)	PH LAB (STANDARD UNITS) (00403)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	HARDNESS (MG/L AS CACO3) (00900)
464940118273001	83-09-06	1630	16.5	260	272	8.1	7.9	7.8	3.0	.70	120
465020117102301	83-05-27	1500	24.5	385	407	.3	8.3	8.4	1.7	.17	7
	83-08-22	1300	25.0	368	395	--	8.5	8.4	.9	<.10	6
465022118282001	82-08-07	0815	16.0	266	266	8.8	7.9	8.1	3.0	.56	110
	83-05-24	0900	16.0	261	271	8.2	7.4	7.9	9.5	1.8	110
	83-08-30	1400	16.0	255	264	8.4	7.9	8.0	3.1	.54	110
465100119001601	82-08-10	1200	29.5	350	356	.1	9.0	9.1	.2	<.10	5
	83-05-19	1000	21.5	371	384	5.3	9.0	8.8	.3	.25	28
	83-08-30	1200	30.0	342	354	1.2	9.0	8.8	.3	<.10	6
465152118383801	82-08-31	1130	20.5	560	557	3.0	7.6	8.1	11	2.0	220
	83-03-10	1430	20.0	525	538	3.2	7.6	7.7	11	2.2	220
	83-07-21	1430	20.5	545	538	3.1	7.5	7.8	11	2.3	230
465206118524401	82-09-09	1345	25.5	320	324	.3	8.6	8.8	.7	.74	24
	83-05-24	0910	26.0	317	327	.2	8.5	8.3	.9	.26	26
	83-05-24	1901	--	--	--	--	--	--	--	--	--
465212118212401	82-08-09	0940	17.5	210	246	--	7.8	8.2	3.6	.27	100
	83-05-24	1510	16.0	231	241	--	8.3	8.0	1.2	.33	100
	83-08-02	1245	17.5	231	240	--	8.0	8.2	2.3	.34	100
465227118502201	83-05-26	1530	26.0	375	376	.5	9.4	9.0	.0	<.10	12
	83-08-03	1030	26.0	355	369	.7	9.2	9.1	.2	.10	12
465245118461201	83-05-27	1200	24.5	392	406	.3	8.3	8.0	1.4	.24	62
465253119420202	82-08-09	1700	19.5	287	292	6.9	8.0	8.1	2.7	.50	110
	83-03-17	1250	12.5	277	299	7.4	7.9	8.2	3.4	.37	110
	83-08-02	1115	20.0	279	285	--	7.8	8.2	4.3	.51	110
465317118461001	82-08-09	0930	23.5	311	312	.2	8.1	8.4	2.0	.35	43
	83-05-19	1530	23.0	300	325	.9	8.2	8.2	1.6	.57	51
	83-08-02	1625	23.0	300	316	.7	8.3	8.2	1.3	.77	47
465332118145401	82-08-05	1155	14.0	340	346	7.3	7.8	8.2	4.1	3.6	160
	83-05-25	1245	14.5	348	362	8.9	8.2	8.0	1.7	4.0	160
	83-08-02	1600	14.0	337	344	9.3	7.6	8.2	6.7	3.5	160
465347118521301	82-09-08	1555	20.0	370	359	4.4	7.9	8.2	3.5	.35	100
	83-03-15	1115	14.5	341	366	4.4	7.7	8.0	5.5	.32	110
	83-07-28	0915	20.0	353	359	5.1	7.9	8.0	3.6	.68	100
465353119203301	83-03-15	1705	15.0	695	719	8.0	7.8	7.9	6.7	5.9	280
	83-07-28	1030	17.0	668	654	7.1	7.9	8.0	4.8	6.9	230
465357119373701	82-08-17	1100	21.0	510	515	.6	7.9	8.2	4.0	.31	140
	83-03-15	1015	18.5	530	308	3.8	7.7	7.9	6.4	2.4	200
	83-07-27	1600	20.5	529	505	.5	8.0	8.1	3.2	1.3	160
465425119250001	82-08-11	1500	17.5	750	763	6.0	7.6	8.1	8.9	7.0	300
	83-03-11	1400	17.0	735	749	6.4	7.4	7.8	13	6.4	280

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-09-06	0	0	28	11	12	.5	18	3.3	126	150	.000	6.1
83-05-27	0	0	1.8	.52	81	14	89	12	147	209	.000	14
83-09-22	0	0	1.6	.37	77	15	89	12	143	174	3.0	12
82-08-07	0	0	26	10	12	.5	19	2.9	126	148	.000	4.7
83-05-24	0	0	26	11	12	.5	19	2.9	125	150	.000	4.8
83-08-30	0	0	27	11	12	.5	18	2.7	125	155	.000	4.9
82-08-10	0	0	2.0	.10	75	15	91	8.5	150	153	13	9.9
83-05-19	0	0	6.8	2.6	68	6	78	11	148	172	6.0	11
83-08-30	0	0	1.9	.20	75	14	91	8.1	150	159	8.0	11
82-08-31	0	0	53	22	25	.8	19	7.3	206	278	.000	19
83-03-10	0	0	52	21	24	.7	19	6.7	226	276	.000	18
83-07-21	0	0	55	21	26	.8	19	7.2	232	283	.000	21
82-09-09	0	0	6.7	1.7	62	6	79	9.2	133	163	4.0	7.6
83-05-24	0	0	7.1	1.9	60	5	78	9.5	140	172	2.0	6.8
83-05-24	--	--	--	--	--	--	--	--	--	--	--	--
82-08-09	0	0	25	9.1	9.6	.4	17	3.6	122	142	.000	2.2
83-05-24	0	0	25	9.3	9.1	.4	16	3.4	118	145	.000	2.1
83-08-02	0	0	25	9.4	9.6	.4	17	3.5	123	147	.000	2.2
83-05-26	0	0	2.9	1.1	78	10	89	7.2	155	158	21	11
83-08-03	0	0	2.9	1.1	77	10	89	7.4	158	166	8.5	12
83-05-27	0	0	17	4.8	57	3	62	11	135	178	.000	18
82-08-09	0	0	23	13	20	.8	27	3.5	141	169	.000	2.8
83-03-17	0	0	23	13	20	.8	27	3.4	144	172	.000	2.0
83-08-02	0	0	22	13	20	.9	28	3.5	144	169	.000	3.0
82-08-09	0	0	12	3.1	47	3	66	8.7	133	[illegible]	.000	8.8
83-05-19	0	0	14	3.9	50	3	64	7.8	130	156	.000	10
83-08-02	0	0	13	3.5	46	3	64	8.3	134	161	.000	9.7
82-08-05	23	23	43	12	8.2	.3	10	2.5	135	163	.000	13
83-05-25	10	18	43	13	8.5	.3	10	2.6	140	174	.000	11
83-08-02	27	27	44	13	8.3	.3	10	2.7	139	167	.000	13
82-09-08	0	0	22	12	31	1	37	[illegible]	141	174	.000	12
83-03-15	0	0	23	12	32	1	37	9.1	147	174	.000	10
83-07-28	0	0	22	12	32	1	37	9.2	147	180	.000	12
83-03-15	64	64	52	37	44	1	25	9.2	221	266	.000	21
83-07-28	32	32	44	29	50	1	31	11	200	241	.000	23
82-08-17	0	0	32	15	45	2	38	12	154	201	.000	18
83-03-15	34	34	42	23	38	1	28	8.6	176	202	.000	21
83-07-27	0	0	36	18	41	[illegible]	33	11	167	202	.000	21
82-08-11	120	122	62	36	40	1	22	9.1	184	222	.000	30
83-03-11	110	108	62	30	37	1	22	11	171	208	.000	39

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-09-06	7.6	.30	49	190	.26	20	5	5	--	80	--	1583.00
83-05-27	25	2.5	64	300	.41	50	23	14		--	--	1080.00
83-08-22	26	2.6	62	290	.39	50	18	4	--	--	--	1080.00
82-08-07	5.0	.30	47	180	.25	--	3	<1	130	--	4	1575.00
83-05-24	6.2	.30	47	180	.25	20	9	<1	--	--	--	1575.00
83-08-30	6.3	.30	47	190	.25	20	4	<1	--	30	--	1575.00
82-08-10	15	2.4	93	310	.42	--	13	5	7	--	19	1365.00
83-05-19	22	1.8	79	300	.41	50	56	2	--	--	--	1365.00
83-08-30	14	2.5	91	300	.41	60	16	<1	--	30	--	1365.00
82-08-31	32	.30	54	350	.48	--	<3	2	270	--	19	860.00
83-03-10	30	.45	54	340	.46	30	<3	2	--	--	--	860.00
83-07-21	31	.30	54	360	.49	--	4	3	--	40	--	850.00
82-09-09	15	1.6	72	260	.36	--	16	3	25	--	16	1415.00
83-05-24	13	1.7	72	260	.35	40	11	5	--	--	--	1415.00
83-05-24	--	--	--	--	--	--	--	--	--	--	--	1415.00
82-08-09	<5.0	.20	47	--	--	--	<3	1	140	--	10	1695.00
83-05-24	3.6	.20	45	170	.24	20	7	<1	--	--	--	1695.00
83-08-02	5.0	.20	49	--	--	20	5	2	--	--	--	1695.00
83-05-26	14	3.7	93	330	.45	70	34	<1	--	--	--	1580.00
83-08-03	12	2.8	89	300	.41	70	28	<1	--	50	--	1580.00
83-05-27	31	1.5	66	290	.40	40	<3	2	--	--	--	1378.00
82-08-09	10	.40	48	200	.28	--	<3	<1	130	--	5	1655.00
83-03-17	8.3	.50	48	200	.28	20	5	1	--	--	--	1655.00
83-08-02	9.0	.40	46	200	.27	20	3	<1	--	--	--	1655.00
82-08-09	13	1.5	69	240	.33	--	<3	<1	46	--	15	1475.00
83-05-19	13	1.5	68	250	.34	40	30	<10	--	--	--	1475.00
83-08-02	12	1.5	64	240	.32	40	4	<1	--	50	--	1475.00
82-08-05	13	.20	36	210	.28	--	<3	6	170	--	4	1560.00
83-05-25	14	.20	36	210	.29	10	13	<1	--	--	--	1560.00
83-08-02	12	.20	35	210	.29	10	3	<1	--	--	--	1560.00
82-09-08	26	.50	57	260	.35	--	24	3	120	--	12	1300.00
83-03-15	24	.60	59	260	.35	30	34	4	--	--	--	1300.00
83-07-28	25	.50	61	260	.36	20	6	<1	--	--	--	1300.00
83-03-15	110	.70	56	460	.63	30	16	2	--	--	--	1000.00
83-07-28	100	.60	53	430	.58	20	26	[illegible]	--	--	--	1000.00
82-08-17	70	.60	50	340	.46	--	<3	3	220	--	29	1030.00
83-03-15	72	.50	53	360	.49	10	<3	3	--	--	--	1030.00
83-07-27	71	.60	59	350	.47	20	18	1	--	40	--	1030.00
82-08-11	150	.60	60	500	.68	--	13	3	560	--	18	940.00
83-03-11	120	.60	66	470	.64	20	18	2	--	--	--	940.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNI.ED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99,98)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-09-06	1100	3253089	1028	80020
83-05-27	1040	3160082	1028	80020
83-08-22	1040	3250139	1028	80020
82-08-07	620	--	80020	80020
83-05-21	620	3160034	1028	80020
83-08-30	620	3252174	1028	80020
82-08-19	1050	--	80020	80020
83-05-19	1050	3147120	1028	80020
83-08-30	1050	3252161	1028	80020
82-08-31	1320	--	80020	80020
83-03-10	1320	3076024	1028	80020
83-07-21	1320	3213073	1028	80020
82-09-09	1340	--	80020	80020
83-05-24	1340	3160018	1028	80020
83-05-24	1340	--	1028	1028
82-08-09	400	--	80020	80020
83-05-24	400	3160042	1028	80020
83-08-02	400	3227013	1028	80020
83-05-26	1540	3160049	1028	80020
83-08-03	1540	3224010	1028	80020
83-05-27	1310	3160016	1028	80020
82-08-09	600	--	80020	80020
83-03-17	600	3083060	1028	1028
83-08-02	600	3227009	1028	80020
82-08-09	1400	--	80020	80020
83-05-19	1400	3147119	1028	80020
83-08-02	1400	3227025	1028	80020
82-08-05	20[illegible]	--	80020	80020
[illegible]-25	200	3160022	1028	80020
83-08-02	200	3227011	1028	80020
82-09-08	540	--	80020	80020
83-03-15	540	3083062	1028	80020
83-07-28	540	3223041	1028	80020
83-03-15	290	--	80020	80020
83-07-28	290	37[illegible]2019	1028	80020
82-08-17	907	--	80020	80020
83-03-15	907	3228035	1028	80020
83-07-27	907	3222022	1028	80020
82-08-11	250	--	80020	80020
83-93-11	250	--	1028	80020

Table A.5

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
465425119250001	83-07-27	1800	17.5	760	747	5.3	7.7	8.0	7.4	6.7	300
465433118210501	82-08-05	[illegible]	17.0	381	390	8.3	7.8	8.0	3.5	6.4	160
	83-05-25	1100	15.0	389	403	--	8.0	7.9	2.2	6.6	160
	83-08-02	1430	17.5	372	382	8.8	7.6	8.0	5.5	6.1	160
465440119183001	82-08-1[illegible]	0730	15.0	71[illegible]	722	7.8	7.7	8.2	11	9.3	320
	83-03-15	1715	15.0	860	774	8.0	7.4	8.0	21	5.7	320
	83-07-28	0900	16.0	750	735	7.8	7.7	8.0	11	8.0	310
465447119021301	82-08-06	0915	15.0	790	806	7.6	7.6	8.2	12	6.1	340
	83-08-30	1115	16.0	740	710	1.4	7.9	8.0	5.5	3.7	270
465501119031401	82-08-11	1130	21.[illegible]	700	724	.3	7.4	7.3	14	23	180
	83-03-16	1510	16.5	676	720	.1	7.7	7.6	7.8	21	200
	83-07-28	1115	16.5	790	786	.1	8.6	7.2	4.1	35	220
465531119292001	82-08-18	1415	21.0	580	564	3.4	7.8	8.0	5.3	1.5	170
	83-03-11	1200	17.5	495	564	2.6	7.5	7.9	9.7	2.1	180
	83-07-28	1145	16.5	472	469	8.4	7.8	8.0	4.9	4.9	180
465704118301501	82-08-10	0845	14.5	780	800	5.7	7.7	7.9	5.6	8.1	320
	83-05-24	1630	14.0	1020	1100	8.1	7.8	7.8	6.3	14	420
	83-08-03	1730	14.0	1170	1110	6.5	7.6	7.9	9.3	12	460
465713118092901	82-08-05	1600	19.5	257	265	--	8.6	8.6	.6	.30	37
	83-08-04	1645	18.5	266	270	2.7	8.4	8.4	1.0	.58	52
465717119064201	82-08-11	1415	16.5	590	594	7.7	7.8	8.3	5.7	5.5	94
465800119360801	82-08-18	1545	16.5	790	811	.7	7.4	8.0	20	<.10	260
465814118524101	83-05-20	1105	18.5	372	384	4.5	8.1	8.0	2.2	2.4	87
	83-08-02	1430	18.0	370	384	5.2	8.1	8.1	2.1	2.6	90
465840118584601	82-08-11	1600	15.0	976	1020	6.2	7.6	8.0	13	22	390
	83-03-17	0855	14.5	62[illegible]	653	7.7	7.7	8.0	9.1	8.8	240
	83-08-01	150[illegible]	15.0	710	682	6.9	7.9	8.1	5.7	12	27[illegible]
4658521182155[illegible]1	82-08-06	12[illegible]	15.5	350	348	7.8	7.7	8.2	6.0	1.6	[illegible]
	83-05-25	14[illegible]0	14.5	243	258	--	7.7	8.0	4.8	1.1	100
	83-08-30	1630	[illegible]	262	256	8.0	7.7	7.9	4.8	1.1	100
465853118365101	82-08-10	1050	19.0	300	309	.6	7.8	8.4	4.0	.22	32
	83-03-17	1445	19.0	295	319	1.0	8.2	8.3	1.6	.35	34
	83-08-02	0940	19.0	300	[illegible]	1.0	8.3	8.3	1.3	.24	31
465900118522701	82-08-10	[illegible]	27.5	29[illegible]	[illegible]	.1	8.2	8.4	1.6	.18	39
	83-05-24	1125	[illegible]	293	303	.1	8.3	8.2	1.4	<.10	39
	83-07-[illegible]	1245	27.5	290	295	--	8.0	8.2	2.6	.10	47
465935117592801	[illegible]-04	1750	12.0	418	417	4.1	7.3	7.8	12	10	180
	83-05-24	1630	12.0	565	564	4.8	7.3	7.5	14	14	230
	83-08-03	1515	12.5	395	405	5.0	7.1	7.9	19	9.0	160
465947119433301	83-05-25	1020	26.5	273	290	1.3	8.0	8.2	2.6	.15	44

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-07-27	110	110	59	37	39	1	21	8.8	187	232	.000	33
82-08-05	46	46	39	15	14	.5	16	3.2	115	139	.000	23
83-05-25	49	49	39	16	12	.4	14	3.1	114	139	.000	26
83-08-02	49	49	40	15	13	.5	15	3.3	116	137	.000	27
82-08-12	41	41	62	39	29	.7	15	8.4	270	336	.000	12
83-03-15	43	43	64	39	33	.8	18	13	283	339	.000	18
83-07-28	31	31	63	38	33	.8	18	13	273	345	.000	20
82-08-06	200	193	75	38	34	.8	18	3.6	248	294	.000	55
83-08-30	43	43	58	30	47	1	27	6.2	218	275	.000	54
82-08-11	6	6	33	24	68	2	43	11	182	214	.000	26
83-03-16	0	0	35	28	67	2	41	8.6	207	247	.000	18
83-07-28	7	7	37	31	73	2	41	9.6	204	260	.000	21
82-08-10	0	0	37	18	46	2	35	13	172	211	.000	34
83-03-11	18	18	38	20	36	1	29	8.7	164	194	.000	16
83-07-28	16	16	36	21	28	.9	25	5.6	165	196	.000	15
82-08-10	170	173	74	32	32	.8	18	6.9	153	176	.000	79
83-05-24	220	216	95	45	62	1	24	7.3	202	252	.000	110
83-08-03	270	273	110	46	62	1	22	7.2	195	234	.000	130
82-08-05	[illegible]	0	9.5	3.3	42	3	66	7.0	121	144	.000	3.5
83-08-04	0	0	12	5.4	36	2	56	6.8	126	--	--	4.1
82-08-11	0	0	13	15	86	4	64	7.4	182	226	.000	22
82-08-18	6	6	48	35	72	2	36	8.9	251	315	.000	37
83-05-20	0	0	22	7.7	43	2	49	8.8	134	176	.000	11
83-08-02	0	0	23	7.9	42	2	47	8.9	136	163	.000	13
82-08-11	130	128	76	48	48	1	21	3.4	260	318	.000	61
83-03-17	5	5	47	30	43	1	27	5.3	232	288	.000	12
83-08-01	32	32	51	34	45	1	26	4.8	236	287	.000	31
82-08-06	0	0	31	16	15	.6	18	3.4	157	190	.000	7.0
83-05-25	0	0	22	11	13	.6	21	3.2	120	150	.000	3.4
83-08-30	0	0	22	11	13	.6	21	3.1	120	150	.000	3.7
82-08-10	0	0	9.0	2.2	52	4	73	7.5	134	160	.000	10
83-03-17	0	0	9.5	2.4	55	4	73	7.5	134	163	.000	10
83-08-02	0	0	8.8	2.3	52	4	73	7.7	136	167	.000	10
82-08-10	0	0	11	2.9	45	3	67	7.5	137	155	.000	12
83-05-24	0	0	11	2.9	50	4	69	7.8	137	174	.000	6.5
83-07-29	0	0	13	3.5	45	3	63	7.5	137	163	.000	6.3
82-08-04	51	51	42	17	16	.5	16	2.2	131	152	.000	17
83-05-24	81	81	54	23	21	.6	16	2.4	135	182	.000	32
83-08-03	40	40	38	17	17	.6	18	2.0	126	153	.000	14
83-05-25	0	0	12	3.3	41	3	63	7.4	130	162	.000	5.6

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-07-27	150	.80	55	500	.68	20	19	3	--	--	--	940.00
82-08-05	19	.30	45	230	.31	--	<3	3	170	--	9	1685.00
83-05-25	19	.30	45	230	.31	10	12	<1	--	--	--	1685.00
83-08-02	17	.30	44	230	.31	10	4	<1	--	20	--	1685.00
82-08-12	60	.40	54	430	.58	--	<3	4	590	--	10	1020.00
83-03-15	83	.30	53	470	.64	20	12	1	--	--	--	1020.00
83-07-28	80	.30	52	470	.64	10	<3	<1	--	--	--	1020.00
82-08-06	80	.30	44	470	.65	--	4	2	460	--	16	1630.00
83-08-30	80	.40	38	450	.61	20	7	3	--	--	--	1630.00
82-08-11	54	.50	44	370	.50	--	16	150	200	--	29	1344.00
83-03-16	45	.50	44	370	.50	30	14	69	--	--	--	1344.00
83-07-28	46	.40	56	400	.55	30	14	<1	--	30	--	1344.00
82-08-18	57	.50	56	370	.50	--	4	93	230	--	28	1170.00
83-03-11	68	.60	57	340	.46	10	6	2	--	--	--	1170.00
83-07-28	48	.60	59	310	.42	20	4	<1	--	40	--	1170.00
82-08-10	110	.30	46	470	.63	--	<3	<1	340	--	20	1505.00
83-05-24	180	.30	45	670	.91	30	8	<1	--	--	--	1505.00
83-08-03	200	.30	45	720	.97	20	4	<1	--	--	--	1505.00
82-08-05	10	.80	60	210	.28	--	<3	1	47	--	27	1620.00
83-08-04	9.0	.90	55	200	.28	20	4	1	--	30	--	1620.00
82-08-11	67	.50	47	370	.50	--	<3	3	84	--	13	1270.00
82-08-13	120	.60	55	530	.72	--	140	160	430	--	19	1187.00
83-05-20	30	1.1	59	270	.37	30	<3	2	--	--	--	1215.00
83-08-02	27	1.1	57	260	.35	30	4	1	--	40	--	1215.00
82-08-11	50	.40	43	490	.66	--	<3	<1	520	--	18	1260.00
83-03-17	53	.40	47	380	.52	30	<3	2	--	--	--	1260.00
83-08-01	53	.40	44	400	.55	30	<3	<1	--	--	--	1260.00
82-08-05	11	.30	46	220	.30	--	<3	<1	15	--	5	1645.00
83-05-25	5.3	.40	47	180	.24	10	7	1	--	--	--	1645.00
83-08-30	5.5	.40	46	180	.24	10	4	4	--	--	--	1645.00
82-08-10	7.0	1.9	66	230	.32	--	<3	2	29	--	30	1540.00
83-03-17	7.7	.50	68	240	.33	50	<3	<1	--	--	--	1540.00
83-08-02	7.3	2.1	63	240	.32	50	3	<1	--	30	--	1540.00
82-08-10	9.0	1.5	67	230	.32	--	<3	<1	44	--	23	1260.00
83-05-24	9.2	1.5	70	240	.33	40	5	<1	--	--	--	1260.00
83-07-29	9.0	1.4	67	230	.32	30	6	<1	--	120	--	1260.00
82-08-04	20	.20	40	230	.31	--	5	4	220	--	13	1635.00
83-05-24	28	.20	39	290	.39	10	16	<1	--	--	--	1620.00
83-08-03	22	.20	39	220	.31	10	8	6	--	--	--	1620.00
83-05-25	5.9	1.7	65	220	.30	40	19	4	--	--	--	1830.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-07-27	250	3222025	1028	80020
82-08-05	560	--	80020	80020
83-05-25	560	3160037	1028	80020
83-08-02	560	3227012	1028	80020
82-08-12	179	--	80020	80020
83-03-15	179	3221084	1028	80020
83-07-28	179	3222028	1028	80020
82-08-06	300	--	80020	80020
83-08-30	300	3252181	1028	80020
82-08-11	1000	--	80020	80020
83-03-16	1000	--	1028	80020
83-07-28	1000	3222040	1028	80020
82-08-18	810	--	80020	80020
83-03-11	810	3167034	1028	80020
83-07-28	810	3222026	1028	80020
82-08-10	165	--	80020	80020
83-05-24	165	3160040	1028	80020
83-08-03	165	3242009	1028	80020
82-08-05	755	--	80020	80020
83-08-04	755	3227034	1028	80020
82-08-11	210	--	80020	80020
82-08-18	310	--	80020	80020
83-05-20	1130	3147103	1028	80020
83-08-02	1130	3227039	1028	80020
82-08-11	126	--	80020	80020
83-03-17	126	3083064	1028	80020
83-08-01	126	3227023	1028	80020
82-08-06	349	--	80020	80020
83-05-25	349	3160043	1028	80020
83-08-30	349	3252166	1028	80020
82-08-10	1020	--	80020	80020
83-03-17	1020	3083063	1028	80020
83-08-02	1020	3227030	1028	80020
82-08-10	1950	--	80020	80020
83-05-24	1950	3160072	1028	80020
83-07-29	1950	3227019	1028	80020
82-08-04	140	--	80020	80020
83-05-24	140	3160027	1028	80020
83-08-03	140	3242010	1028	80020
83-05-25	1200	3160056	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPERATURE (DEG C) (00010)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	SPECIFIC CONDUCTANCE LAB (UMHOS) (90095)	OXYGEN, DISSOLVED (MG/L) (00300)	PH (STANDARD UNITS) (00400)	PH LAB (STANDARD UNITS) (00403)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	HARDNESS (MG/L AS CACO3) (00900)
465947118433301	83-08-02	1155	26.5	283	282	1.5	8.2	8.2	1.6	.15	46
465953118542001	83-05-24	131·	23.5	301	313	8.3	8.3	8.1	1.4	<.10	35
465950118562401	82-08-11	6	21.0	330	336	.4	7.9	8.2	3.4	<.10	68
	83-05-19	1/5[illegible]	19.5	360	375	.2	8.0	8.1	2.8	.19	79
	83-07-29	1120	21.0	323	342	--	8.1	8.1	2.2	.13	72
470018119323301	83-05-18	1345	21.0	815	816	.0	7.8	7.9	6.1	<.10	280
470048118561701	83-05-19	1905	36.5	400	410	.0	9.3	9.2	.1	<.10	5
	83-08-01	1615	36.5	385	402	.2	9.2	9.2	.2	<.10	6
470050119352301	82-08-17	1830	20.0	580	533	.5	7.6	7.9	11	2.6	220
	83-05-20	1545	20.5	540	573	.2	7.6	8.4	11	3.2	230
	83-08-01	0845	20.0	559	549	.2	7.6	8.0	11	2.8	230
470102118023901	83-08-04	1130	13.0	216	229	7.2	8.0	8.0	1.8	2.8	94
	83-08-30	1345	13.5	212	210	--	7.3	7.7	8.4	2.2	85
470140119161901	82-08-12	1100	22.5	432	447	.7	8.5	8.5	1.0	.42	17
	83-05-17	1745	22.0	440	449	.3	8.4	8.4	1.2	.21	18
	83-07-28	1600	22.5	442	442	.4	8.5	8.3	1.0	.39	17
470147118034601	82-08-10	1300	13.5	213	225	--	7.7	8.2	3.7	2.9	97
470236119024101	82-08-12	1330	15.0	1100	1090	6.3	7.7	8.2	5.9	26	450
	83-03-18	1320	15.0	1090	1130	7.6	7.6	7.9	6.6	19	460
	83-07-28	1300	15.0	1080	1030	6.9	7.8	7.9	4.7	24	470
470309118522401	83-05-24	1450	19.5	362	374	.3	8.2	8.0	1.8	.11	56
	83-08-31	1005	19.5	365	365	2.4	8.1	8.0	2.2	<.10	59
470323118473101	82-08-10	1705	18.5	303	364	.1	8.3	7.1	1.3	<.10	26
	83-03-17	1045	17.5	341	359	.4	8.3	8.3	1.3	<.10	52
	83-08-01	1315	18.0	340	319	.7	8.4	8.3	1.1	<.10	35
470341118205501	83-05-25	1730	14.[illegible]	790	742	2.4	7.8	8.0	6.7	30	350
	83-09-06	1515	15.[illegible]	755	749	6.0	7.9	7.9	5.2	29	320
470355118592601	82-08-12	1030	21.5	372	382	.2	8.3	8.6	1.6	<.10	21
	83-05-19	1455	20.5	348	365	.1	8.4	8.3	1.1	<.10	23
	83-08-03	1410	21.5	380	370	.3	8.5	8.4	.9	<.10	21
470356118221901	82-08-09	1800	18.5	320	319	2.5	8.2	8.2	1.6	3.7	81
	83-05-20	1330	18.5	305	314	2.6	8.2	8.2	1.6	2.0	70
	83-08-03	1130	15.5	318	326	5.5	8.3	8.1	1.3	3.4	110
470415118354801	82-08-11	0825	17.5	325	327	5.7	8.0	7.7	2.4	3.2	94
	83-03-17	1630	17.5	321	345	4.1	8.0	8.1	2.3	3.9	110
	83-08-04	1230	18.0	558	356	5.5	8.[illegible]	8.1	1.6	5.1	120
470433118094501	82-09-09	1630	15.0	335	331	8.4	7.[illegible]	8.0	3.6	2.6	150
470505117393601	82-08-04	1700	15.0	358	352	8.5	7.3	7.8	14	5.0	160
	83-03-23	1430	15.0	344	359	8.6	7.3	7.7	14	4.5	160
	83-08-25	1105	16.5	362	374	6.5	7.4	7.5	12	8.3	190

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-08-02	0	0	13	3.4	42	3	62	7.4	133	161	.000	5.6
83-05-24	0	0	9.2	3.0	52	4	72	7.4	136	180	.000	6.8
82-08-11	0	0	16	6.9	43	2	54	9.1	141	171	.000	9.1
83-05-19	0	0	18	8.3	43	2	50	9.9	145	178	.000	12
83-07-29	0	0	17	7.2	43	2	53	8.7	144	171	.000	9.6
83-05-18	76	76	56	33	48	1	26	12	190	244	.000	120
83-05-17	0	0	1.8	.13	89	18	93	7.1	171	172	22	13
83-08-01	0	0	1.9	.33	87	16	93	6.8	176	163	24	13
82-08-12	0	0	45	26	30	.9	22	8.3	217	278	.000	18
83-05-20	0	0	46	27	31	.9	22	8.0	224	279	.000	21
83-08-01	0	0	47	27	31	.9	22	8.2	229	279	.000	22
83-08-04	3	3	23	8.8	8.8	.4	17	2.5	96	111	.000	3.5
83-08-30	0	0	20	8.4	9.2	.4	19	2.1	87	--	--	3.7
82-08-12	0	0	4.1	1.7	84	9	84	13	159	192	.000	18
83-05-17	0	0	4.2	1.9	84	9	84	12	156	193	.000	16
83-07-28	0	0	3.9	1.8	86	9	85	12	161	195	.000	18
82-08-10	2	2	24	8.9	8.9	.4	16	2.4	93	116	.000	3.5
82-08-12	300	297	89	55	44	.9	17	4.5	150	187	.000	93
83-03-18	320	324	87	59	46	1	18	4.2	140	166	.000	100
83-07-28	320	319	92	59	45	.9	17	4.2	153	188	.000	97
83-05-24	0	0	12	6.4	55	3	64	8.4	150	176	.000	12
83-08-31	0	0	13	6.5	58	3	65	8.0	151	176	.000	13
82-08-10	0	0	6.9	2.1	53	5	75	9.5	98	164	.000	6.9
83-03-17	0	0	13	4.8	48	3	60	14	137	166	.000	10
83-08-01	0	0	9.0	3.0	54	4	71	10	138	169	.000	8.2
83-05-25	130	129	85	33	25	.6	13	4.3	207	268	.000	30
83-09-06	110	109	76	32	27	.7	15	4.6	213	260	.000	29
82-08-12	0	0	5.8	1.6	67	7	82	8.7	141	206	.000	10
83-05-19	0	0	6.1	1.8	67	6	81	8.2	129	170	.000	8.7
83-08-03	0	0	5.8	1.7	70	7	83	8.3	140	170	.000	11
82-08-09	0	0	17	9.3	36	2	47	5.7	132	164	.000	8.5
83-05-20	9	0	14	8.4	38	2	52	5.6	131	164	.000	7.3
83-08-03	0	0	21	13	26	1	33	5.1	134	165	.000	10
82-08-11	0	0	21	10	27	1	36	9.1	124	148	.000	6.1
83-03-17	0	0	24	11	25	1	32	7.8	123	145	.000	7.6
83-08-04	0	0	26	13	22	.9	27	7.4	124	155	.000	8.1
82-07-09	0	0	34	15	15	.6	18	2.1	142	179	.000	7.8
82-08-04	8	8	44	11	9.6	.3	12	2.2	148	180	.000	7.5
83-03-23	17	17	44	12	9.7	.3	12	2.4	150	174	.000	10
83-08-25	34	34	54	14	11	.4	11	2.5	151	193	.000	21

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-08-02	6.0	1.6	63	220	.30	40	3	<1	--	30	--	1830.00
83-05-24	12	1.6	63	240	.33	40	11	<1	--	--	--	1418.00
82-08-11	19	1.3	62	250	.34	--	7	5	69	--	14	1340.00
83-05-19	28	1.0	55	260	.36	30	3	4	--	--	--	1340.00
83-07-29	20	1.2	69	250	.37	30	5	4	--	40	--	1340.00
83-05-18	41	.40	57	490	.66	30	59	97	--	--	--	1125.00
83-05-19	12	4.1	110	370	.50	70	62	<1	--	--	--	1420.00
83-08-01	11	3.0	100	350	.48	70	70	2	--	60	--	1420.00
82-08-17	33	.40	62	360	.49	--	<3	9	440	--	15	1130.00
83-05-20	37	.40	60	370	.50	20	<3	<1	--	--	--	1130.00
83-08-01	36	.50	62	370	.50	20	4	<1	--	--	--	1130.00
83-08-04	8.0	.20	43	150	.21	<10	7	3	--	--	--	1685.00
83-08-30	7.3	.20	41	140	.20	<10	11	4	--	--	--	1685.00
82-08-12	37	1.7	55	310	.42	--	9	1	23	--	30	1110.00
83-05-17	35	1.8	54	300	.41	40	16	6	--	--	--	1110.00
83-07-28	36	1.8	55	310	.42	40	8	<1	--	40	--	1110.00
82-08-10	8.0	.20	45	160	.21	--	<3	<1	96	--	<4	1655.00
82-08-12	180	.50	54	610	.83	--	<3	1	760	--	26	1206.00
83-03-18	200	.50	54	630	.86	30	16	<1	--	--	--	1206.00
83-07-28	200	.50	50	640	.87	30	11	<1	--	--	--	1206.00
83-05-24	21	1.6	57	260	.35	30	<3	6	--	--	--	1385.00
83-08-31	19	1.5	60	270	.36	30	12	7	--	80	--	1385.00
82-08-10	13	1.3	62	240	.32	--	<3	<1	24	--	28	1420.00
83-03-17	25	.60	49	250	.33	20	5	1	--	--	--	1420.00
83-08-01	15	1.1	58	240	.33	30	4	1	--	--	--	1420.00
83-05-25	40	.50	37	390	.53	10	15	2	--	--	--	1789.00
83-09-06	39	.40	36	370	.51	10	7	19	--	60	--	1789.00
82-08-12	29	1.5	65	290	.40	--	<3	4	19	--	38	1355.00
83-05-19	32	1.5	64	270	.37	30	<3	3	--	--	--	1355.00
83-08-03	31	1.4	64	280	.38	30	4	2	--	40	--	1355.00
82-08-09	12	1.2	55	230	.31	--	<3	<1	79	--	13	1840.00
83-05-20	9.2	1.4	55	220	.30	60	<3	1	--	--	--	1840.00
83-08-03	13	.70	48	220	.30	40	7	1	--	40	--	1840.00
82-08-11	22	.50	47	220	.29	--	<3	2	110	--	21	1820.00
83-03-17	25	.50	46	220	.30	20	5	3	--	--	--	1820.00
83-08-04	25	.40	47	230	.31	10	5	<1	--	--	--	1820.00
82-09-09	10	.20	46	220	.30	--	3	2	170	--	<4	1755.00
82-08-04	<5.0	.20	50	--	--	--	<3	<1	190	--	9	2035.00
83-03-23	5.8	.20	48	220	.30	<10	4	10	--	--	--	2030.00
83-08-25	14	.30	49	260	.35	--	11	4	--	--	--	2030.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-08-02	1200	3227022	1028	80020
83-05-24	1360	3160052	1028	80020
82-08-11	1260	--	80020	80020
83-05-19	1260	3147100	1028	80020
83-07-29	1260	3222039	1028	80020
83-05-18	66.00	3147132	1028	80020
83-05-19	2400	3147141	1028	80020
83-08-01	2400	3227029	1028	80020
82-08-17	450	--	80020	80020
83-05-20	450	3147134	1028	80020
83-08-01	450	3227020	1028	80020
83-08-04	155	3227032	1028	80020
83-08-30	155	3252180	1028	80020
82-08-12	801	--	80020	80020
83-05-17	801	3147140	1028	80020
83-07-28	801	3222038	1028	80020
82-08-10	125	2235041	1028	80020
82-08-12	185	--	80020	80020
83-03-18	185	3083057	1028	80020
83-07-28	185	3222042	1028	80020
83-05-24	982	3160076	1028	80020
83-08-31	982	3253047	1028	80020
82-08-10	280	--	80020	80020
83-03-17	280	3253047	1028	80020
83-08-01	280	3227021	1028	80020
83-05-25	256	3159083	1028	80020
83-09-06	256	3253093	1028	80020
82-08-12	1160	--	80020	80020
83-05-19	1160	3147109	1028	80020
83-08-03	1160	3227035	1028	80020
82-08-09	747	--	80020	80020
83-05-20	747	3147110	1028	80020
83-08-03	747	3227047	1028	80020
82-08-11	500	--	80020	80020
83-03-17	500	3227047	1028	80020
83-08-04	500	3227046	1028	80020
82-09-09	294	--	80020	80020
82-08-04	119	--	80020	80020
83-03-23	119	3094052	1028	80020
83-08-25	119	3252093	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
470508119062701	83-05-18	1040	16.0	460	462	5.5	7.9	8.0	3.8	3.1	130
	83-07-29	0930	16.0	345	356	--	8.1	8.1	2.0	1.2	85
470510119075201	82-08-13	0830	14.5	398	407	8.5	7.7	8.2	6.0	2.1	66
	83-03-17	0920	13.5	415	445	9.6	7.8	8.1	4.3	2.5	69
	83-07-28	1415	14.5	458	462	8.8	8.0	8.0	3.4	3.5	63
470512118245101	82-08-09	1700	14.0	231	236	6.8	8.0	8.2	1.6	2.2	87
	83-05-19	1630	13.0	271	278	--	7.9	8.0	2.1	4.9	110
	83-08-03	1300	14.5	247	242	6.0	8.2	8.1	1.1	2.2	89
470553119030301	83-07-14	1400	15.0	--	345	--	8.2	7.9	1.8	.43	110
470559119302601	82-08-13	1700	20.0	417	426	.4	7.5	8.0	11	2.0	140
	83-08-29	1400	20.0	412	412	.4	7.7	7.9	7.0	2.2	140
470620119292001	82-08-13	1420	19.5	453	462	5.0	7.6	8.0	8.3	4.0	170
	83-05-16	1800	19.0	497	486	7.2	7.7	7.9	6.9	5.5	180
470637118540901	83-05-23	1730	26.0	361	375	.1	8.6	8.5	.7	<.10	12
470659118511501	83-05-19	1120	19.5	470	492	.4	8.9	8.5	.3	.28	42
	83-07-30	1615	19.0	455	474	.3	8.6	8.7	.8	.27	38
470703118413701	83-05-26	1000	30.0	398	411	.1	9.3	9.2	.1	<.10	3
	83-07-30	1140	32.5	405	411	.3	9.4	9.2	.1	<.10	2
470733119214501	83-03-16	1615	13.5	850	874	8.5	7.2	7.6	47	4.9	300
470752118181802	82-08-09	0830	26.5	273	278	.1	8.4	8.4	1.0	<.10	29
	83-05-20	1130	20.5	271	283	.1	8.3	8.2	1.3	<.10	29
	83-08-03	1006	20.5	271	282	.1	8.2	8.1	1.6	.22	29
470752118385701	82-08-11	1130	22.0	295	299	.2	8.9	8.9	.3	<.10	15
	83-05-19	1445	21.0	295	301	.3	9.0	8.6	.3	<.10	18
	83-08-04	1030	22.5	295	301	.3	8.9	8.6	.3	<.10	12
470754119304101	83-05-19	1000	17.5	318	325	10.2	7.9	8.1	3.8	.21	110
470758118173502	83-05-26	0830	22.5	291	299	.3	8.3	8.2	1.4	<.10	35
470814119020201	82-08-14	0815	23.5	410	400	.4	8.9	9.1	.3	<.10	14
	83-05-17	1545	24.0	393	403	.0	9.0	8.7	.2	<.10	3
470831118524403	82-08-14	1245	18.0	750	720	6.3	7.9	8.0	3.0	3.1	240
470836117590301	82-08-09	1045	12.5	440	437	--	7.6	8.0	9.4	.72	170
470844118423001	83-05-25	1245	24.5	310	328	.2	8.8	8.4	.4	<.10	18
	83-08-03	1600	23.5	322	315	.4	8.8	8.5	.5	<.10	26
470849118413801	82-08-13	0845	31.5	320	318	.2	8.9	9.3	.3	<.10	4
	83-05-25	1430	31.5	312	325	.1	9.0	8.7	.3	<.10	7
	82-08-30	1005	31.5	299	316	.1	8.9	8.7	.3	<.10	7
470857119122001	82-08-12	1300	15.0	362	366	6.1	7.7	8.4	5.9	2.0	110
	83-05-26	1545	15.0	326	342	6.0	7.7	8.0	5.5	1.6	110
	83-07-29	1425	15.0	348	345	--	8.0	8.0	2.9	1.8	120
470915119061501	83-05-23	1645	23.0	360	380	.2	9.0	8.5	.2	<.10	4

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-05-18	0	0	25	16	47	2	43	5.8	155	190	.000	14
83-07-29	0	0	16	11	42	2	50	6.1	133	157	.000	6.8
82-08-11	0	0	11	9.3	60	3	65	2.6	154	190	.000	7.7
83-03-17	0	0	11	10	67	4	67	3.0	142	170	.000	12
83-07-28	0	0	9.5	9.5	79	4	72	2.2	172	215	.000	13
82-08-09	5	5	24	6.6	12	.6	22	2.5	85	100	.000	9.4
83-05-19	20	20	31	7.4	9.1	.4	15	2.0	86	107	.000	12
83-08-03	2	2	24	7.1	12	.6	22	2.6	90	106	.000	9.6
83-07-14	0	0	23	12	30	1	36	7.8	146	--	--	6.9
82-08-13	0	0	30	15	36	1	35	9.3	182	222	.000	6.9
83-08-29	0	0	30	15	34	1	33	8.5	180	222	.000	6.5
82-08-13	0	0	36	19	32	1	29	5.0	175	208	.000	8.0
83-05-16	2	2	38	21	33	1	28	4.6	168	219	.000	10
83-05-23	0	0	3.9	.49	76	10	88	8.0	147	174	4.0	13
83-05-19	0	0	10	4.1	84	6	78	7.5	144	168	7.0	25
83-07-30	0	0	9.4	3.5	83	6	79	8.3	145	192	.000	30
83-05-26	0	0	1.0	.05	89	25	95	6.6	177	164	28	11
83-07-30	0	0	.95	.03	90	26	95	6.6	178	168	28	12
83-03-16	0	0	52	41	71	2	32	19	391	470	.000	14
82-08-09	0	0	7.3	2.6	50	4	74	6.7	130	156	.000	3.6
83-05-20	0	0	7.3	2.7	50	4	74	6.5	128	160	.000	3.4
83-08-03	0	0	7.1	2.7	49	4	74	6.8	132	155	.000	3.6
82-08-11	0	0	4.0	1.1	60	7	84	7.6	136	156	8.0	5.2
83-05-19	0	0	4.6	1.5	58	6	82	7.2	139	158	13	5.0
83-08-04	0	0	3.4	.82	62	8	86	7.6	145	161	8.0	5.5
83-05-19	0	0	30	7.8	24	1	31	6.0	150	191	.000	2.2
83-05-26	0	0	8.1	3.6	51	4	72	6.2	134	172	.000	4.7
82-08-14	0	0	4.0	.90	79	10	88	8.0	127	151	9.0	17
83-05-17	0	0	1.2	.12	84	20	94	5.7	137	154	8.0	16
82-08-14	120	123	58	24	50	1	30	9.1	109	148	.000	79
82-08-09	0	0	42	16	27	.9	25	3.8	195	235	.000	8.3
83-05-25	0	0	4.4	1.7	62	7	83	8.0	144	172	5.0	6.8
83-08-03	0	0	6.4	2.5	57	5	77	9.0	144	193	3.0	7.2
82-08-13	0	0	1.7	.02	69	15	92	7.2	145	156	13	6.1
83-05-25	0	0	2.1	.53	67	11	90	6.9	149	168	8.0	6.1
83-08-30	0	0	2.1	.41	69	12	91	6.6	148	159	10	6.6
82-08-12	0	0	24	13	28	1	34	3.9	150	185	.000	4.3
83-05-26	0	0	22	13	28	1	35	3.4	131	174	.000	3.8
83-07-29	0	0	24	14	29	1	34	3.5	150	181	.000	4.0
83-05-23	0	0	1.3	.30	79	17	93	6.6	136	152	9.0	18

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-05-18	47	.40	42	290	.40	30	10	10	--	--	--	1270.00
83-07-29	36	.40	40	240	.32	20	3	<1	--	--	--	1270.00
82-08-13	33	.60	52	270	.37	--	<3	<1	120	--	10	1250.00
83-03-17	52	.70	56	290	.39	30	9	4	--	--	--	1256.00
83-07-28	42	.60	58	320	.43	40	3	<1	--	--	--	1250.00
82-08-09	12	.30	33	150	.20	--	<3	<1	91	--	9	1745.00
83-05-19	16	.10	30	160	.22	20	<3	1	--	--	--	1745.00
83-08-03	11	.30	32	150	.21	10	4	<1	--	--	--	1745.00
83-07-14	29	.50	44	240	.33	--	56	47	--	--	--	1270.00
82-08-13	26	.50	61	290	.40	--	<3	6	230	--	14	1230.00
83-08-29	23	.50	61	290	.39	20	<3	6	--	--	--	1230.00
82-08-13	43	.50	62	310	.42	--	<3	<1	330	--	8	1220.00
83-05-16	51	.50	60	330	.44	20	13	5	--	--	--	1220.00
83-05-23	21	1.9	73	290	.40	30	5	2	--	--	--	1475.00
83-05-19	45	2.1	63	340	.46	30	25	4	--	--	--	1473.00
83-07-30	45	2.2	60	340	.46	30	19	5	--	50	--	1473.00
83-05-26	5.1	4.6	110	370	.50	90	65	1	--	--	--	1700.00
83-07-30	5.0	4.9	100	360	.49	90	100	1	--	50	--	1700.00
83-03-16	51	.70	33	510	.70	40	4	2	--	--	--	1065.00
82-08-09	10	1.2	59	220	.30	--	<3	5	22	--	26	1864.00
83-05-20	12	1.2	58	220	.30	20	6	1	--	--	--	1864.00
83-08-03	10	1.1	56	210	.29	20	5	<1	--	70	--	1864.00
82-08-11	<5.0	2.4	73	--	--	--	11	3	15	--	27	1855.00
83-05-19	5.5	2.0	67	250	.35	40	12	<1	--	--	--	1855.00
83-08-04	<5.0	2.6	74	--	--	50	8	<1	--	50	--	1855.00
83-05-19	16	.40	45	230	.31	10	<3	<1	--	--	--	1225.00
83-05-26	11	1.2	59	230	.31	20	17	3	--	--	--	1830.00
82-08-14	30	2.1	72	310	.42	--	28	24	12	--	32	1442.00
83-05-17	27	2.4	73	300	.41	40	36	5	--	--	--	1442.00
82-08-14	110	.50	47	450	.61	--	20	5	290	--	16	1430.00
82-08-09	25	.30	44	280	.38	--	<3	2	180	--	7	1785.00
83-05-25	7.8	2.6	66	250	.35	40	17	1	--	--	--	1790.00
83-08-03	9.0	2.4	64	260	.35	40	6	4	--	50	--	1790.00
82-08-13	<5.0	3.1	82	--	--	--	11	8	3	--	24	1840.00
83-05-25	2.2	3.2	80	270	.36	50	17	1	--	--	--	1840.00
83-08-30	<.2	2.9	83	--	--	60	15	3	--	230	--	1840.00
82-08-12	25	.60	50	240	.33	--	<3	2	170	--	14	1220.00
83-05-26	24	.70	50	230	.31	20	9	4	--	--	--	1220.00
83-07-29	25	.60	56	250	.33	20	19	24	--	--	--	1220.00
83-05-23	23	2.3	72	300	.40	40	58	1	--	--	--	1415.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL-LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA-LYZING SAMPLE (CODE NUMBER) (00028)
83-05-18	865	3147125	1028	80020
83-07-29	865	3227014	1028	80020
82-08-13	270	--	80020	80020
83-03-17	270	3084003	1028	80020
83-07-28	270	3222043	1028	80020
82-08-09	180	--	80020	80020
83-05-19	180	3147124	1028	80020
83-08-03	180	3227043	1028	80020
83-07-14	245	3214045	1028	80020
82-08-13	515	--	80020	80020
83-08-29	515	3252179	1028	80020
82-08-13	460	--	80020	80020
83-05-16	460	3147104	1028	80020
83-05-23	1410	3160073	1028	80020
83-05-19	1060	3147133	1028	80020
83-07-30	1060	3227024	1028	80020
83-05-26	2240	3160081	1028	80020
83-07-30	2240	3227026	1028	80020
83-03-16	96.00	--	80020	80020
82-08-09	1020	--	80020	80020
83-05-20	1020	3147123	1028	80020
83-08-03	1020	3227045	1028	80020
82-08-11	1120	--	80020	80020
83-05-19	1120	3147136	1028	80020
83-08-04	1120	3224009	1028	80020
83-05-19	140	3160025	1028	80020
83-05-26	1280	3160030	1028	80020
82-08-14	1170	--	80020	80020
83-05-17	1170	3147127	1028	80020
82-08-14	630	--	80020	80020
82-08-09	200	--	80020	80020
83-05-25	1720	3160077	1028	80020
83-08-03	1720	3227031	1028	80020
82-08-13	2430	--	80020	80020
83-05-25	2430	3160020	1028	80020
83-08-30	2430	3253049	1028	80020
82-08-12	273	--	80020	80020
83-05-26	273	3160058	1028	80020
83-07-29	273	3222047	1028	80020
83-05-23	930	3160074	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
470915119061501	83-09-06	1415	23.0	362	370	.2	9.1	8.7	.2	<.10	12
470959119021801	83-05-26	1415	21.5	385	401	.0	9.2	8.8	.2	.22	17
	83-07-30	1810	21.0	395	388	.2	9.2	8.9	.2	.10	15
471913118515601	83-05-24	1715	17.0	360	376	4.4	8.1	8.0	2.0	.41	110
	83-08-30	1425	17.0	382	369	2.3	7.6	7.9	6.3	.47	110
471023119092501	82-08-14	1000	22.5	333	337	.2	8.8	9.1	.4	<.10	7
	83-05-27	0840	22.0	335	352	.1	8.8	8.5	.4	<.10	14
	83-07-29	1536	22.5	340	348	--	8.8	8.5	.4	<.10	9
471032118183001	82-08-09	1500	12.5	804	792	6.9	7.4	7.6	18	10	260
	83-05-20	1000	11.5	795	786	7.1	7.3	7.5	24	7.4	270
	83-08-02	1430	12.0	785	752	9.5	7.5	7.6	15	9.0	250
471033119102801	83-07-13	1530	16.0	435	430	--	7.8	8.1	4.0	2.1	150
471039117435601	82-08-06	0930	19.5	280	287	.2	8.0	8.1	2.9	<.10	82
	83-03-23	1200	19.5	366	327	.1	7.4	7.8	11	.12	110
	83-08-22	1545	19.5	258	284	.1	8.0	7.9	2.8	<.10	82
471039118242201	83-05-25	1200	12.5	421	429	9.0	7.6	7.8	8.0	7.2	180
	83-08-03	1500	15.0	425	420	8.7	7.8	7.9	3.5	7.4	180
471050119191501	82-08-13	1100	21.0	335	343	1.4	8.0	8.3	2.5	.60	86
	83-03-17	1100	21.5	320	332	2.8	7.7	8.1	4.9	.28	76
	83-07-29	1430	21.5	334	337	2.2	8.1	8.0	2.0	.54	83
471111118574001	82-08-11	1525	18.5	347	348	4.3	8.3	8.5	1.2	.17	79
	83-03-18	1140	16.0	326	347	7.8	8.1	8.1	1.9	.34	100
	83-08-05	1145	17.5	335	351	4.5	8.2	8.2	1.5	.32	80
471122117551701	82-08-06	1210	16.0	399	399	1.0	8.2	8.2	2.3	<.10	130
	83-08-25	1250	16.5	332	359	.6	8.2	8.0	2.2	<.10	110
471126118113101	82-08-09	1255	14.0	308	311	E9.2	7.9	8.1	3.6	1.9	150
	83-05-24	1330	13.0	512	514	8.9	7.8	7.9	5.5	11	220
	83-08-02	1300	13.5	370	362	10.6	8.0	8.0	3.0	4.5	160
471158118234001	82-09-09	0910	21.0	285	294	2.4	8.4	8.3	1.0	.30	48
	83-05-24	0800	21.5	291	303	1.6	8.2	8.2	1.8	.26	45
	83-08-31	1100	22.0	284	297	1.4	8.1	8.2	2.0	.17	41
471300117334201	82-08-05	0915	12.0	279	293	5.0	6.8	7.4	29	5.6	120
	83-03-24	1450	11.0	269	285	3.2	6.7	7.1	35	3.5	110
	83-08-24	1600	12.0	280	308	6.8	6.9	6.9	26	4.6	130
471315118282201	82-08-10	0925	15.5	598	584	3.6	8.0	8.2	3.3	6.0	180
	83-05-24	1030	14.0	612	616	3.5	8.0	8.0	3.7	5.9	180
	83-08-04	0900	15.0	598	576	4.7	8.1	8.1	2.8	5.3	180
471330118455802	83-05-26	1230	20.5	320	334	.8	8.4	8.2	1.0	.20	39
	83-08-30	1530	21.0	332	330	.8	--	8.1	--	.19	37
471347118410103	83-07-19	2030	14.5	352	358	--	8.0	8.2	2.6	.33	78

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-09-06	0	0	3.3	1.0	77	10	89	6.9	137	168	9.5	16
83-05-26	0	0	4.3	1.4	80	9	88	6.4	143	154	13	20
83-07-30	0	0	3.9	1.2	78	9	88	6.5	147	161	12	19
83-05-24	0	0	26	10	32	1	38	6.5	135	159	.000	14
83-08-30	0	0	26	11	34	1	38	6.4	132	159	.000	15
82-08-14	0	0	2.4	.30	68	11	89	8.9	127	145	8.0	14
83-05-27	0	0	4.0	.89	66	8	85	9.5	134	160	5.0	17
83-07-29	0	0	2.8	.51	68	10	88	9.0	134	145	10	16
82-08-09	27	27	63	25	69	2	36	3.5	235	285	.000	49
83-05-20	24	24	61	28	64	2	34	4.0	238	297	.000	52
83-08-02	7	7	57	26	67	2	36	3.7	238	296	.000	49
83-07-13	23	23	29	20	29	1	28	5.5	132	--	--	19
82-08-06	0	0	19	8.4	29	1	42	4.1	146	180	.000	3.1
83-03-23	0	0	24	11	27	1	35	4.7	139	176	.000	2.8
83-08-22	0	0	19	8.4	28	1	41	4.0	145	178	.000	3.0
83-05-25	14	14	42	18	12	.4	13	1.9	113	201	.000	26
83-08-03	65	65	42	18	11	.4	12	1.8	115	139	.000	29
82-08-13	0	0	20	8.8	37	2	45	8.7	130	155	.000	12
83-03-17	0	0	17	8.1	38	2	49	8.8	128	153	.000	11
83-07-29	0	0	19	8.7	37	2	46	9.0	130	159	.000	11
82-08-11	0	0	20	7.1	38	2	48	9.3	115	145	.000	13
83-03-18	0	0	25	10	27	1	34	8.5	130	151	.000	11
83-08-05	0	0	20	7.4	38	2	47	9.0	121	150	.000	16
82-08-06	0	0	29	13	36	1	37	7.8	185	227	.000	5.7
83-08-25	0	0	26	12	31	1	35	7.5	174	219	.000	4.6
82-08-09	0	0	35	14	10	.4	13	1.6	143	182	.000	5.9
83-05-24	42	42	54	21	19	.6	16	1.9	169	219	.000	27
83-08-02	7	7	39	15	13	.5	15	1.6	154	186	.000	13
82-07-09	0	0	11	5.0	45	3	64	5.2	124	160	.000	7.1
83-05-24	0	0	10	4.8	46	3	66	5.6	132	184	.000	7.0
83-08-31	0	0	9.7	4.1	48	3	68	5.6	133	161	.000	7.2
82-08-05	23	23	30	10	9.8	.4	15	3.1	89	114	.000	9.3
83-03-24	24	24	29	9.9	10	.4	16	3.3	98	109	.000	6.2
83-08-24	20	20	33	11	10	.4	14	3.5	111	131	.000	8.7
82-08-10	9	9	34	23	51	2	37	8.2	171	209	.000	49
83-05-24	0	6	34	24	51	2	36	8.7	173	234	.000	53
83-08-04	0	0	34	23	52	2	37	8.8	181	218	.000	53
83-05-26	0	0	9.6	3.6	54	4	71	7.0	128	160	.000	12
83-08-30	0	0	9.3	3.4	56	4	73	6.6	130	--	--	11
83-07-19	0	0	21	6.1	43	2	52	6.5	134	--	--	14

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-09-06	22	2.0	69	300	.41	40	41	3	--	90	--	1415.00
83-05-26	22	3.1	74	310	.43	50	4	1	--	--	--	1415.00
83-07-30	15	2.8	72	300	.41	50	28	1	--	50	--	1415.00
83-05-24	31	.60	46	240	.33	10	31	9	--	--	--	1620.00
83-08-30	33	.50	47	250	.34	20	6	1	--	50	--	1620.00
82-03-14	11	2.2	69	260	.35	--	13	21	6	--	32	1355.00
83-05-27	12	2.2	64	260	.36	40	19	4	--	--	--	1355.00
83-07-29	10	2.3	36	240	.32	40	26	16	--	--	--	1355.00
82-08-09	70	.30	39	460	.62	--	<3	<1	270	--	11	1850.00
83-05-20	74	.30	39	470	.64	30	17	1	--	--	--	1850.00
83-08-02	67	.30	39	450	.62	20	5	<1	--	--	--	1850.00
83-07-13	61	.30	35	280	.38	--	6	<1	--	--	--	1280.00
82-08-06	<5.0	.70	62	--	--	--	19	23	60	--	33	2075.00
83-03-23	26	.60	54	240	.32	10	39	130	--	--	--	2075.00
83-08-22	3.3	.80	61	220	.29	--	41	25	--	--	--	2075.00
83-05-25	28	.30	39	270	.36	10	15	<1	--	--	--	1931.00
83-08-03	29	.30	36	240	.32	10	5	1	--	--	--	1931.00
82-08-13	26	.60	49	240	.32	--	<3	<1	98	--	9	1187.00
83-03-17	26	.70	47	230	.32	20	6	1	--	--	--	1187.00
83-07-29	26	.70	47	240	.32	20	3	<1	--	30	--	1187.00
82-08-11	35	.60	46	240	.33	--	3	1	58	--	19	1440.00
83-03-18	31	.50	43	230	.31	10	6	<1	--	--	--	1440.00
83-08-05	34	.60	44	240	.33	10	5	<1	--	40	--	1440.00
82-08-05	20	.40	44	270	.36	--	4	10	98	--	31	1940.00
83-06-25	2'	.50	44	250	.35	--	11	12	--	--	--	1940.00
82-08-09	6.0	.40	47	210	.28	--	<3	2	170	--	<4	2000.00
83-05-24	13	.40	45	290	.39	10	29	1	--	--	--	2000.00
83-08-02	9.0	.40	45	230	.31	<10	8	<1	--	--	--	2000.00
82-09-09	8.0	1.6	55	220	.29	--	29	2	51	--	22	2000.00
83-05-24	8.9	1.9	56	230	.31	30	17	1	--	--	--	2000.00
83-08-31	9.0	1.9	57	220	.30	30	11	<1	--	40	--	2000.00
82-08-05	19	.20	42	180	.24	--	<3	5	120	--	11	2025.00
83-03-24	24	.20	42	180	.24	<10	9	5	--	--	--	2025.00
83-08-24	17	.20	43	190	.26	--	6	1	--	--	--	2025.00
82-08-10	34	.50	41	340	.47	--	<3	11	190	--	17	1930.00
83-05-24	24	.60	40	350	.48	20	4	13	--	--	--	1930.00
83-08-04	37	.50	39	350	.48	20	6	7	--	--	--	1930.00
83-05-26	18	2.3	55	240	.3_	20	<3	1	--	--	--	1711.00
83-08-30	16	2.3	56	240	.32	30	5	<1	--	70	--	1711.00
83-07-19	29	.30	33	230	.32	--	12	<1	--	--	--	1670.00

Table A.5

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TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 06/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-09-06	930	3253095	1028	80020
83-05-26	1100	3160080	1028	80020
83-07-30	1100	3227033	1028	80020
83-05-24	710	3160057	1028	80020
83-08-30	710	3253048	1028	80020
82-08-14	1200	--	80020	80020
83-05-27	1200	3160075	1028	80020
83-07-29	1200	3222056	1028	80020
82-08-09	155	--	80020	80020
83-05-20	155	3147111	1028	80020
83-08-02	155	3227050	1028	80020
83-07-13	112	3214054	1028	80020
82-08-06	421	--	80020	80020
83-03-23	421	--	80020	80020
83-08-22	421	3252086	1028	80020
83-05-25	320	3160026	1028	80020
83-08-03	320	3227027	1028	80020
82-08-13	712	--	80020	80020
83-03-17	712	--	1028	80020
83-07-29	712	3221082	1028	80020
82-08-11	620	--	80020	80020
83-03-18	620	3221082	1028	80020
83-08-05	620	3227040	1028	80020
82-08-06	363	--	80020	80020
83-08-25	363	3252088	1028	80020
82-08-09	180	--	80020	80020
83-05-24	180	3160032	1028	80020
83-08-02	180	3227028	1028	80020
82-09-09	1260	--	80020	80020
83-05-24	1260	3160023	1028	80020
83-08-31	1260	3252176	1028	80020
82-08-05	241	--	80020	80020
83-03-24	241	3094046	1028	80020
83-08-24	241	3252092	1028	80020
82-08-10	340	--	80020	80020
83-05-24	340	3160021	1028	80020
83-08-04	340	3227051	1028	80020
83-05-26	1040	3160079	1028	80020
83-08-30	1040	3253043	1028	80020
83-07-19	310	3214056	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPERATURE (DEG C) (00010)	SPECIFIC CONDUCTANCE (UMHOS) (00095)	SPECIFIC CONDUCTANCE LAB (UMHOS) (90095)	OXYGEN, DISSOLVED (MG/L) (00300)	PH (STANDARD UNITS) (00400)	PH LAB (STANDARD UNITS) (00403)	CARBON DIOXIDE DISSOLVED (MG/L AS CO2) (00405)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	HARDNESS (MG/L AS CACO3) (00900)
471347118410105	83-07-20	1245	17.0	340	362	--	8.0	9.3	2.6	<.10	11
471337118410106	83-07-19	2100	15.5	320	336	--	8.1	8.4	2.2	<.10	28
471347118471701	82-08-13	1300	14.5	353	363	6.6	8.2	8.2	1.5	.46	140
	83-03-18	0930	12.0	368	392	1.9	8.0	8.1	2.4	.52	150
	83-07-30	1420	14.0	440	431	7.3	8.1	8.1	2.0	1.9	170
471402119154001	82-08-18	0950	16.5	422	426	8.1	7.7	7.9	8.1	1.0	190
471416117510501	82-08-05	1610	14.0	214	233	4.1	7.7	8.0	4.5	.46	90
	83-03-23	1015	6.0	252	257	4.2	7.4	7.8	10	.43	97
	83-08-25	1345	15.5	205	231	3.9	7.7	7.5	4.6	.45	88
471421119573702	83-05-19	1300	19.0	488	486	2.5	8.0	8.1	2.8	2.4	130
471542119062701	82-08-12	0930	18.0	355	359	.2	8.0	8.4	2.5	<.10	84
	83-05-17	1400	18.0	361	363	.3	8.0	8.1	2.6	<.10	84
471606119142901	82-07-26	*330	15.5	200	211	8.3	7.1	7.6	14	.56	90
	83-03-18	0900	15.0	200	213	8.4	7.4	7.9	6.6	.78	90
	83-07-29	1630	14.5	200	207	8.1	7.3	7.5	8.9	.49	87
471625118503701	83-06-03	1440	20.0	430	431	.6	8.1	8.0	2.0	<.10	110
	83-09-07	1530	20.0	412	410	7.4	8.2	8.0	1.6	.17	110
471630118292501	82-07-23	0915	15.0	405	407	--	8.0	8.1	3.0	4.5	150
	83-05-26	1100	15.5	398	409	--	8.0	8.0	3.1	4.5	140
	83-08-04	0915	15.0	396	371	--	7.8	8.0	4.6	3.4	130
471633117441501	82-07-21	1029	17.5	260	267	.1	8.1	8.3	2.1	<.10	88
471647118155101	82-07-22	1150	15.0	326	336	.2	8.1	8.3	2.1	.16	110
	83-05-31	1500	14.5	372	347	.4	7.9	8.0	3.4	.21	110
	83-08-10	1030	14.5	632	351	.1	8.0	8.0	2.7	.16	110
471737118322001	82-07-23	1030	20.0	520	525	.7	8.0	8.1	4.2	.84	190
	83-05-27	1015	20.0	465	474	.2	8.0	8.0	4.5	<.10	170
	83-08-04	1045	21.0	513	520	.3	7.8	8.0	6.7	1.0	200
471731117590201	82-07-21	1210	21.5	248	255	.1	8.4	8.4	.9	.22	52
	83-06-20	1200	21.0	250	257	.2	8.1	8.1	2.0	.22	50
	83-08-02	1030	21.0	249	250	.1	8.4	8.3	1.0	<.10	51
471809118360801	82-07-23	00	13.5	1140	1750	7.2	7.3	7.7	20	21	640
	83-05-26	300	13.5	1750	1770	6.9	7.3	7.7	22	19	610
	83-08-04	1200	14.0	1970	1930	--	7.1	7.8	36	24	760
471812119000001	82-09-08	1000	23.0	372	372	--	8.6	8.7	.5	<.10	50
	83-05-18	1200	23.5	373	380	.4	8.7	8.4	.5	<.10	47
	83-09-01	1015	23.0	378	371	7.8	8.6	8.4	.5	<.10	47
471835117582101	82-07-21	1440	16.0	372	368	.7	8.2	8.3	1.5	.20	130
	83-06-02	1050	15.0	391	--	.8	7.9	7.8	3.1	.57	75
	83-08-02	0830	15.5	351	347	1.5	8.2	8.2	1.6	.16	130
471837118300001	83-06-03	1830	14.0	860	825	4.6	7.2	7.1	18	7.8	360

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 04/24/86

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-07-26	0	0	4.1	.09	75	11	91	5.1	134	--	--	12
83-07-19	0	0	9.2	1.1	62	5	78	7.4	142	--	--	11
82-08-13	27	17	37	12	19	.7	22	3.8	118	153	.000	17
83-03-18	31	31	40	13	19	.7	21	3.7	125	149	.000	22
83-07-30	39	39	44	14	20	.7	20	4.3	129	157	.000	32
82-08-18	0	0	45	18	19	.6	18	2.3	198	256	.000	1.8
82-09-05	0	0	23	8.0	13	.6	23	2.4	117	143	.000	2.0
83-03-23	0	0	23	9.6	13	.6	22	2.9	121	158	.000	2.5
83-04-25	0	0	22	8.1	13	.6	24	2.6	116	144	.000	1.9
83-05-19	0	0	29	15	44	2	40	8.6	134	176	.000	33
82-08-12	0	0	19	8.8	39	2	47	9.0	133	159	.000	12
83-05-17	0	0	19	8.9	40	2	48	8.3	132	166	.000	12
82-07-26	0	0	23	7.9	7.8	.4	15	3.4	99	114	.000	1.8
83-03-18	5	5	22	8.5	5.0	.2	10	3.5	90	104	.000	2.2
83-07-29	0	0	22	7.7	8.1	.4	16	3.1	92	112	.000	1.7
83-06-03	0	0	25	11	44	2	44	9.7	129	156	.000	14
83-09-07	0	0	24	11	45	2	45	10	126	155	.000	15
82-07-23	0	0	27	19	27	1	28	3.5	157	190	.000	19
83-05-26	0	0	25	18	29	1	31	3.6	153	197	.000	13
83-08-04	0	0	24	17	27	1	30	3.5	152	183	.000	13
82-07-21	0	0	17	11	23	1	35	3.0	139	167	.000	2.2
82-07-22	0	0	23	1[illegible]	29	1	35	3.9	150	169	.000	9.0
83-05-31	0	0	22	1[illegible]	29	1	35	3.7	139	170	.000	11
83-08-10	0	0	22	14	29	1	35	3.7	138	167	.000	10
82-07-23	0	0	47	18	38	1	29	5.8	213	267	.000	18
83-05-27	0	0	40	16	39	1	33	5.7	227	285	.000	7.9
83-08-04	0	0	48	19	38	1	29	6.0	224	267	.000	21
82-07-21	0	0	15	3.6	34	2	56	5.0	126	145	3.0	3.0
83-05-20	0	0	14	3.7	33	2	56	4.9	128	156	.000	3.0
83-08-02	0	0	14	3.8	35	2	57	5.2	127	157	.000	3.1
82-07-23	430	431	150	64	110	2	27	6.7	225	254	.000	250
83-05-25	390	392	140	64	110	2	28	7.1	214	270	.000	260
83-08-04	530	527	180	75	120	2	25	7.2	236	283	.000	300
82-09-08	0	0	16	2.4	55	4	65	11	115	130	3.0	20
83-05-18	0	0	15	2.4	57	4	67	11	122	147	7.0	20
83-09-01	0	0	15	2.4	56	4	67	10	122	137	.000	18
82-07-21	7	7	26	16	21	.8	25	5.9	123	151	.000	32
83-06-02	0	0	15	9.0	8.9	.5	20	2.9	85	156	.000	2.8
83-08-02	0	0	25	16	21	.8	25	5.4	128	157	.000	29
83-06-03	210	214	84	36	33	.8	16	9.5	142	176	.069	18

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-07-20	25	1.1	28	230	.31	30	130	2	--	--	--	1670.00
83-07-19	19	1.5	35	230	.31	--	220	12	--	--	--	1670.00
82-08-13	31	.40	45	240	.33	--	<3	4	150	--	14	1595.00
83-03-18	35	.40	45	250	.34	20	22	8	--	--	--	1595.00
83-07-30	42	.40	42	280	.38	20	9	2	--	--	--	1595.00
82-09-18	19	.40	47	280	.38	--	<3	48	410	--	11	1250.00
82-08-05	<5.0	.20	44	--	--	--	<3	2	89	--	10	2110.00
83-03-23	8.4	.30	41	180	.24	10	<3	9	--	--	--	2110.00
83-08-25	3.7	.30	43	170	.23	--	22	2	--	--	--	2110.00
83-05-19	49	.80	54	320	.43	20	<3	<1	--	--	--	1585.00
82-08-12	30	.60	46	240	.33	--	7	18	86	--	12	1462.00
83-05-17	28	.60	46	240	.33	20	10	11	--	--	--	1462.00
82-07-26	14	.20	23	140	.19	--	6	2	110	--	10	1280.00
83-03-18	15	.20	22	130	.18	<10	5	1	--	--	--	1280.00
83-07-29	13	.20	23	130	.18	<10	4	<1	--	--	--	1280.00
83-06-03	63	.60	47	290	.40	<10	<3	<1	--	--	--	1813.00
83-09-07	56	.50	47	280	.39	<10	<3	3	--	40	--	1813.00
82-07-23	17	.40	50	260	.35	--	<3	<1	200	--	11	1975.00
83-05-26	18	.50	49	250	.34	20	<3	<1	--	--	--	1975.00
83-08-04	13	.50	48	240	.32	20	5	<1	--	--	--	1975.00
82-07-21	<5.0	.60	56	--	--	--	8	9	57	--	24	2180.00
82-07-22	22	.70	46	230	.31	--	6	7	76	--	31	1915.00
83-05-31	24	.80	45	230	.32	10	<3	8	--	--	--	1915.00
83-08-10	22	.80	44	230	.31	10	68	24	--	--	--	1915.00
82-07-23	29	.50	47	330	.46	--	5	7	160	--	30	1940.00
83-05-27	17	.60	46	315	.42	10	13	14	--	--	--	1940.00
83-08-04	28	.50	45	340	.46	10	5	11	--	40	--	1940.00
82-07-21	<5.0	.90	63	--	--	--	11	6	38	--	32	1910.00
83-06-20	3.0	.90	58	200	.27	10	7	5	--	--	--	1910.00
83-08-02	<5.0	1.1	62	--	--	10	9	6	--	--	--	1910.00
82-07-23	250	.30	39	1000	1.4	--	10	2	650	--	27	1665.00
83-05-26	240	.30	38	990	1.3	30	19	<1	--	--	--	1665.00
83-08-04	290	.30	37	1100	1.6	30	11	3	--	--	--	1665.00
82-09-08	35	.90	68	280	.38	--	8	7	46	--	32	1680.00
83-05-18	34	1.1	67	290	.40	20	7	5	--	--	--	1680.00
83-09-01	33	1.1	69	270	.37	20	10	5	--	50	--	1680.00
82-07-21	16	.40	42	230	.32	--	26	9	92	--	23	2020.00
83-06-02	7.8	.30	44	170	.23	<10	11	2	--	--	--	2020.00
83-08-02	12	.40	41	230	.31	<10	28	9	--	--	--	2020.00
83-06-03	250	.30	41	560	.76	20	5	<1	--	--	--	1620.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-07-20	616	3272043	1028	80020
83-07-19	704	3214055	1028	80020
82-08-13	220	--	80020	80020
83-03-18	220	3083058	1028	80020
83-07-30	220	3227038	1028	80020
82-08-18	110	--	80020	80020
82-08-05	284	--	80020	80020
83-03-23	284	--	80020	80020
83-08-25	284	3252091	1028	80020
83-05-19	800	3147107	1028	80020
82-08-12	1360	--	80020	80020
83-05-17	1360	3147129	1028	80020
82-07-26	138	--	80020	80020
83-03-18	138	3147129	1028	80020
83-07-29	138	3221078	1028	80020
83-06-03	744	3160084	1028	80020
83-09-07	744	3253094	1028	80020
82-07-23	337	--	80020	80020
83-05-26	337	3160029	1028	80020
83-08-04	337	3227052	1028	80020
82-07-21	400	--	80020	80020
82-07-22	200	--	80020	80020
83-05-31	200	3160086	1028	80020
83-08-10	200	3243070	1028	80020
82-07-23	737	--	80020	80020
83-05-27	737	3160048	1028	80020
83-08-04	737	3227048	1028	80020
82-07-21	502	--	80020	80020
83-06-20	502	3187045	1028	80020
83-08-02	502	3227018	1028	80020
82-07-23	120	--	80020	80020
83-05-26	120	3159085	1028	80020
83-08-04	120	3227044	1028	80020
82-09-08	1330	--	80020	80020
83-05-18	1330	3147139	1028	80020
83-09-01	1330	3253044	1028	80020
82-07-21	178	--	80020	80020
83-06-02	178	3171018	1028	80020
83-08-02	178	3227042	1028	80020
83-06-03	150	3160060	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 05/24/84

MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
471901117592001	83-09-08	1000	14.5	425	448	9.0	7.9	7.9	4.3	3.9	180
471926118432302	82-07-22	1815	14.0	380	398	3.?	7.9	8.2	4.1	1.3	150
	83-05-27	1300	14.0	455	465	3.8	7.8	7.8	5.9	2.1	180
	83-09-04	1530	13.5	535	531	4.8	7.9	7.9	5.0	3.6	22?
471928116412501	82-07-26	0810	16.0	410	410	.4	8.2	8.3	2.2	<.10	100
	83-05-26	1445	16.0	410	410	.1	8.2	7.9	2.3	<.10	100
	83-08-05	0900	15.5	404	413	.1	8.1	8.1	2.8	<.10	110
471938117251001	82-07-19	1450	13.0	205	211	5.7	7.4	7.7	7.8	1.2	85
	83-03-22	1140	11.0	195	213	5.8	7.1	7.6	15	1.3	82
	83-08-09	1100	12.5	200	214	5.4	7.5	7.6	6.3	1.5	83
472002117352201	82-07-19	1630	19.0	350	353	.6	8.0	8.2	3.5	<.10	130
472008119021501	82-09-08	1230	23.0	405	400	1.2	8.2	8.3	1.3	.11	72
	83-05-18	1430	23.0	410	418	.2	8.3	8.1	1.2	.15	66
	83-09-01	1145	22.5	405	403	4.0	8.2	8.0	1.3	.11	72
472119117493101	82-07-20	1600	14.5	190	196	6.8	7.7	7.9	3.7	<.10	79
	83-06-02	1340	14.0	194	--	3.2	7.3	7.5	7.0	.24	140
	83-08-09	1400	14.0	198	196	3.4	7.6	7.8	4.6	<.10	77
472220118583801	83-06-03	1645	19.0	310	325	.6	8.2	8.1	1.8	<.10	89
	83-08-08	1345	18.5	320	324	.2	--	8.0	--	<.10	90
472307118224002	82-07-22	1450	13.0	330	334	6.0	7.6	7.9	6.4	1.3	150
	83-06-01	1205	11.0	340	349	5.2	7.7	7.6	5.0	1.7	130
	83-08-11	0855	12.0	345	338	4.7	7.6	7.8	7.5	1.5	120
472330118174001	83-09-07	1600	13.0	308	324	9.2	7.8	7.7	3.6	2.1	150
472336117404001	82-07-21	0850	12.5	610	616	.1	7.8	8.0	5.2	<.10	290
	83-03-22	1100	10.5	625	653	.1	7.4	7.7	15	<.10	320
472347118414401	83-06-03	1300	22.0	325	338	--	8.1	8.2	2.2	<.10	43
	83-08-05	1230	21.5	324	335	.1	8.5	8.2	.9	<.10	42
472407118200201	82-07-22	1325	12.5	880	873	.3	7.6	7.7	15	<.10	180
	83-06-01	1015	12.0	860	869	1.0	7.5	7.6	19	<.?0	180
	83-08-10	1440	12.0	912	866	.2	7.7	7.6	7.0	1.6	180
472408118350501	82-07-23	1340	12.5	380	390	3.9	7.0	7.3	18	1.7	140
	83-06-01	1000	13.0	371	390	5.7	7.2	7.4	13	1.3	130
	83-08-05	1045	12.0	429	433	4.9	7.2	7.5	13	1.2	160
472420118573301	82-07-26	1015	14.5	560	533	--	7.5	7.8	15	.13	200
	83-05-31	1700	15.0	550	541	--	7.7	7.8	9.8	.17	200
	83-08-05	0910	14.0	510	519	--	7.9	8.1	6.1	.13	190
47251[illegible]8053501	82-07-22	1000	15.5	325	333	2.5	8.0	8.3	3.0	.55	99
	83-06-01	1500	15.5	315	323	1.4	8.1	7.9	2.4	.32	92
	83-08-06	1400	17.0	319	328	2.2	7.9	7.9	3.9	.56	99
472538118371901	82-07-25	1850	13.0	453	452	19.9	7.9	7.9	3.2	11	170

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-09-08	5	5	39	20	20	.7	19	4.9	172	213	.000	12
82-07-22	0	0	36	14	22	.8	24	4.9	158	204	.000	12
83-05-27	0	0	44	18	23	.8	21	5.1	184	234	.000	15
83-08-04	15	15	52	22	24	.7	19	5.8	209	251	.000	21
82-07-26	0	0	24	10	48	2	49	6.3	178	217	.000	10
83-05-26	0	0	24	10	48	2	49	5.9	179	225	.000	10
83-08-05	0	0	24	11	49	2	49	5.4	179	220	.000	11
82-07-19	0	0	21	7.8	9.9	.5	20	2.4	110	124	.000	2.2
83-03-22	0	0	20	7.8	10	.3	20	2.0	99	119	.000	2.0
83-08-09	0	0	20	8.1	10	.5	20	2.2	99	125	.000	2.2
82-07-19	6	0	21	18	27	1	31	3.1	197	222	.000	2.4
82-09-08	0	0	22	4.2	48	3	55	10	105	132	.000	24
83-05-18	0	0	20	3.9	53	3	59	10	110	145	.000	25
83-09-01	0	0	22	4.1	51	3	56	12	112	133	.000	23
82-07-20	0	0	16	9.4	9.6	.5	20	2.8	104	116	.000	1.6
83-06-02	65	65	27	17	21	.8	24	5.8	128	88	.000	38
83-08-09	0	0	15	9.6	9.8	.5	21	2.7	95	116	.000	1.7
83-06-03	0	0	21	8.8	33	2	43	5.6	142	176	.000	6.8
83-05-08	0	0	21	9.1	34	2	43	5.3	145	[illegible]	[illegible]	6.4
82-07-22	14	14	37	13	20	.7	22	3.5	142	161	.000	12
83-06-01	9	0	29	13	19	.8	24	3.4	130	158	.000	15
83-08-11	0	0	28	13	19	.8	24	3.7	128	188	.000	12
83-09-07	28	28	37	13	11	.4	14	2.0	131	144	.000	12
82-07-21	130	126	60	35	15	.4	10	2.5	188	206	.000	7.5
83-03-22	120	118	61	40	16	.4	10	2.5	191	243	.000	7.6
83-06-03	0	0	11	3.7	54	4	70	6.4	142	176	.000	8.6
83-08-05	0	0	11	3.6	54	4	70	6.6	142	171	.000	8.6
82-07-22	0	0	42	19	120	4	58	6.4	310	378	.000	47
83-03-01	0	0	40	19	120	4	58	6.4	306	381	.000	49
83-08-10	3	3	41	20	130	4	59	6.4	300	222	.000	50
82-07-23	41	41	28	16	24	.9	27	4.0	103	116	.000	17
83-06-01	25	25	26	16	23	.9	27	3.9	103	129	.000	20
83-08-05	52	52	31	20	26	.9	26	4.3	106	131	.000	19
82-07-26	0	0	49	20	37	1	27	7.4	267	301	.000	11
83-05-31	0	0	47	20	37	1	28	7.1	249	308	.000	12
83-08-05	0	0	46	19	36	1	28	7.7	252	306	.000	14
82-07-27	0	0	20	12	33	1	41	3.9	158	190	.000	5.1
83-06-01	0	0	17	12	33	2	43	3.8	155	190	.000	5.1
83-08-05	0	0	20	12	33	1	41	3.5	157	195	.000	5.0
82-07-25	39	39	43	15	22	.8	22	3.8	178	159	.000	24

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/85

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-09-08	24	.40	46	270	.37	<10	4	3	--	--	--	2180.00
82-07-22	19	.30	40	250	.34	--	3	<1	130	--	21	1535.00
83-05-27	26	.30	40	290	.39	10	13	<1	--	--	--	1535.00
83-08-04	35	.30	39	320	.44	<10	6	<1	--	40	--	1535.00
82-07-26	20	.90	44	270	.37	--	66	24	65	--	34	1692.00
83-05-26	21	1.0	44	270	.37	10	71	23	--	--	--	1692.00
83-08-0[illegible]	20	.90	44	270	.37	10	60	24	--	40	--	1692.00
82-07-1[illegible]	<5.0	.30	57	--	--	-	<3	1	91	--	10	2540.00
83-03-22	2.3	.30	56	160	.22	<10	<3	3	--	--	--	2540.00
83-08-09	2.5	.30	54	160	.22	--	3	<1	--	--	--	2540.00
82-07-19	8.0	.40	45	230	.32	--	6	7	76	--	33	2280.00
82-09-08	49	.60	60	280	.[illegible]8	--	6	5	62	--	31	1670.00
83-05-18	48	.90	60	290	.40	<10	<3	3	--	--	--	1670.00
83-09-01	50	.70	61	290	.39	10	14	4	--	40	--	1670.00
82-07-20	<5.0	.30	43	--	--	--	7	10	55	--	14	2050.00
83-06-02	15	.40	41	210	.28	<10	54	13	--	--	--	2050.00
83-08-09	5.0	.30	42	140	.19	<10	12	8	--	--	--	2050.00
83-06-03	16	.70	48	230	.31	10	<3	2	--	--	--	1668.00
83-08-08	15	.60	48	230	.31	10	3	3	--	--	--	1668.00
82-07-22	20	.40	42	230	.31	--	27	13	130	--	10	1918.00
83-06-01	22	.40	39	220	.30	<10	5	4	--	--	--	1918.00
83-08-11	19	.40	37	220	.31	<10	8	<1	--	90	--	1918.00
83-09-07	14	.30	46	210	.28	<10	5	1	--	60	--	2175.00
82-07-21	140	.30	49	410	.56	--	660	590	250	--	26	2260.00
83-03-22	160	.30	49	460	.62	10	1100	680	--	--	--	2260.00
83-06-03	17	.90	53	240	.33	20	18	2	--	--	--	1925.00
83-08-05	15	.80	50	230	.32	10	6	2	--	60	--	1925.00
82-07-22	85	.60	47	550	.75	--	320	880	200	--	18	1992.00
83-06-01	78	.70	45	550	.74	10	390	860	--	--	--	1992.00
83-08-10	89	.60	45	490	.67	<10	360	890	--	--	--	1992.00
82-07-23	66	.30	45	260	.35	--	31	32	92	--	14	1785.00
83-06-01	53	.30	43	250	.34	10	<3	3	--	--	--	1785.00
83-08-05	74	.30	43	280	.38	<10	33	13	--	--	--	1785.00
82-07-26	25	.50	49	350	.47	--	<3	5	180	--	30	1330.00
83-05-31	24	.50	47	350	.47	20	<3	9	--	--	--	1330.00
83-08-05	21	.50	44	340	.46	10	5	2	--	40	--	1330.00
82-07-22	11	.60	44	220	.30	--	7	6	76	--	29	2190.00
83-06-01	8.9	.60	44	220	.30	<10	12	6	--	--	--	2190.00
83-08-06	11	.60	43	220	.30	<10	8	3	--	40	--	2190.00
82-07-25	25	.30	45	260	.35	--	5	4	220	--	12	1925.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-09-08	353	3259010	1028	80020
82-07-22	225	--	80020	80020
83-05-27	225	3160033	1028	80020
83-08-04	225	3227041	1028	80020
82-07-26	595	--	80020	80020
83-05-26	595	3160031	1028	80020
83-08-05	595	3243068	1028	80020
82-07-19	[illegible]	--	80020	80020
83-03-22	225	3090025	1028	80020
83-08-09	225	3243062	1028	80020
82-07-19	450	--	80020	80020
82-09-08	1340	--	80020	80020
83-05-18	1340	3147135	1028	80020
83-09-01	1340	3253045	1028	80020
82-07-20	154	--	80020	80020
83-06-02	154	3171041	1028	80020
83-08-09	154	3243077	1028	80020
83-06-03	505	3160085	1028	80020
83-08-08	505	3249189	1028	80020
82-07-22	346	--	80020	80020
83-06-01	346	3160089	1028	80020
83-08-11	346	3243048	1028	80020
83-09-07	400	3253068	1028	80020
82-07-21	196	--	80020	80020
83-03-22	196	--	1028	80020
83-06-03	615	3160067	1028	80020
83-08-05	615	3243047	1028	80020
82-07-22	67.00	--	80020	80020
83-06-01	67.00	3160070	1028	80020
83-08-10	67.00	3243046	1028	80020
82-07-23	45.00	--	80020	80020
83-06-01	45.00	3168050	1028	80020
83-08-05	45.00	3243073	1028	80020
82-07-26	100	--	80020	80020
83-05-31	100	3168049	1028	80020
83-08-05	100	3227037	1028	80020
82-07-22	510	--	80020	80020
83-06-01	510	3168045	1028	80020
83-08-06	510	3243075	1028	80020
82-07-25	165	--	80020	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
47[illegible]38118371901	83-06-02	0830	13.0	465	476	8.0	7.7	7.7	5.6	9.8	180
	83-09-08	1330	13.0	482	478	8.6	7.6	7.7	6.3	11	190
472542117225501	82-07-20	1200	18.0	232	249	1.2	8.0	8.1	2.4	.57	77
	83-08-26	1500	18.0	245	243	1.4	7.8	8.1	3.8	1.1	81
472605117592501	82-07-21	1350	13.0	315	330	10.1	7.7	8.0	4.9	4.7	140
472609117461201	82-07-20	1505	11.5	285	296	4.0	6.7	7.0	20	6.0	99
	83-03-22	0900	9.5	218	234	5.5	6.5	6.9	27	5.5	75
	83-08-09	1055	13.0	247	251	4.6	6.7	7.2	23	4.5	84
472638118560101	82-09-08	1500	19.5	315	313	3.3	8.9	8.8	.3	.11	38
	83-06-02	1140	19.5	310	325	3.0	8.7	8.[illegible]	.5	<.10	34
	83-08-12	1130	19.5	372	317	2.8	8.7	8.4	.5	<.10	36
472702117245801	82-07-20	0950	14.5	265	259	--	8.1	8.2	1.9	<.10	100
472728118081501	82-07-22	1020	13.0	350	358	5.5	7.6	7.9	7.1	2.5	130
	83-06-02	1000	12.0	310	367	4.2	7.7	7.8	5.8	2.1	120
	83-08-10	1500	13.0	329	340	4.9	7.5	7.7	9.1	2.7	130
472737118271401	82-07-23	1315	12.5	485	497	9.1	7.5	7.9	8.9	8.2	220
	83-06-02	1320	14.0	581	591	5.0	7.8	7.7	4.4	14	250
	83-08-11	1145	14.0	472	460	8.8	7.6	7.8	7.1	7.3	200
472758117344001	82-07-20	1720	14.5	481	505	.6	7.7	8.0	11	.10	230
	83-03-22	1400	14.0	455	489	.3	7.7	7.7	10	<.10	220
	83-08-09	1430	15.5	421	465	.6	8.0	8.0	5.4	<.10	190
472828117283901	82-07-19	1015	10.0	198	198	4.8	6.1	6.7	103	.85	71
	83-03-22	1510	9.5	174	188	6.7	6.3	6.4	67	1.2	65
	83-08-09	1600	10.0	180	188	4.1	6.6	6.7	36	.73	68
472846118133801	82-07-22	1[illegible]30	12.0	490	511	8.0	7.6	7.9	7.1	8.4	210
	83-06-02	1130	12.0	490	502	7.4	7.8	7.7	4.3	10	200
472848118195901	82-07-22	1200	11.5	530	553	--	7.4	7.8	13	4.3	240
	83-06-01	0845	12.5	520	534	6.8	7.4	7.6	13	4.4	240
	83-08-10	1330	12.0	462	429	7.4	7.5	8.1	9.2	3.6	190
473025117570701	82-07-21	1720	12.5	275	283	.2	8.0	8.1	2.6	<.10	100
	83-06-20	1500	12.5	279	287	.4	8.0	7.9	2.7	<.10	100
	83-08-06	1230	12.5	268	278	.3	8.0	7.9	2.6	<.10	100
473052118224201	82-07-23	1005	14.0	380	398	2.8	8.2	8.3	2.0	.16	110
	83-06-01	1735	13.5	400	399	3.8	8.3	8.1	1.6	.19	110
	83-08-11	1300	14.5	370	350	2.0	8.2	7.9	1.8	<.10	100
473057117251001	82-07-19	0855	12.0	196	214	7.7	7.4	7.8	7.3	2.2	100
	83-03-22	1630	9.5	197	216	7.7	7.1	7.4	15	2.3	90
	83-08-10	0930	11.5	201	213	8.2	7.5	7.7	6.0	2.3	88
473103117382801	82-07-20	1120	13.0	190	200	7.2	7.5	7.9	5.3	1.8	81
	83-03-22	0900	11.5	184	198	--	7.4	7.5	6.9	1.7	79

Table A.5

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TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY — PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-06-02	38	38	45	17	23	.8	21	3.5	136	176	.000	23
83-09-08	57	57	47	17	23	.8	21	3.7	131	159	.000	27
82-07-20	0	0	15	9.6	22	1	37	2.6	127	153	.000	2.2
83-08-26	0	0	16	9.9	23	1	37	2.3	123	150	.000	3.2
82-07-21	10	10	37	11	14	.5	18	2.3	143	156	.000	6.1
82-07-20	47	47	24	9.4	14	.6	22	5.0	59	63	.000	22
83-03-22	32	32	18	7.3	10	.5	21	4.1	45	53	.000	13
83-08-09	26	26	20	8.2	13	.6	24	4.6	59	71	.000	13
82-09-09	0	0	9.0	3.7	56	4	73	5.6	133	151	8.0	8.0
83-06-02	0	0	8.2	3.3	56	4	75	5.7	144	170	4.0	8.1
83-08-12	0	0	8.7	3.5	55	4	73	5.5	140	157	3.0	7.9
82-07-20	0	0	21	12	15	.7	24	1.8	127	153	.000	1.8
82-07-22	0	0	26	15	21	.8	26	2.4	150	177	.000	7.7
83-06-02	0	0	24	15	21	.8	27	2.1	142	182	.000	6.7
83-08-10	0	0	27	14	21	.8	26	2.4	146	181	.000	7.5
82-07-23	74	74	53	21	16	.5	14	2.6	157	177	.000	35
83-06-02	100	104	58	25	17	.5	13	2.7	141	176	.000	45
83-08-11	52	52	46	20	15	.5	14	2.5	141	177	.000	30
82-07-20	0	0	48	26	22	.7	17	2.5	272	336	.000	2.4
83-03-22	0	0	46	26	21	.6	17	2.4	266	329	.000	2.4
83-08-09	0	0	38	22	17	.6	16	2.6	258	339	.000	2.1
82-07-19	4	4	17	7.0	8.0	.4	18	5.5	75	82	.000	5.9
83-03-22	0	0	15	6.6	7.0	.4	18	5.4	68	84	.000	4.6
83-08-09	0	0	16	6.8	7.5	.4	18	5.4	72	90	.000	4.3
82-07-22	68	68	54	19	21	.6	17	2.9	162	177	.000	32
83-06-02	64	64	54	17	17	.5	15	2.6	14[illegible]	172	.000	26
82-07-22	72	72	60	22	18	.5	14	2.5	187	206	.000	29
83-06-01	61	61	58	22	18	.5	14	2.4	165	213	.000	27
83-08-10	36	36	45	18	17	.6	16	2.5	149	184	.000	18
82-07-21	0	0	23	11	18	.8	27	3.2	135	161	.000	3.3
83-06-20	0	0	23	11	18	.8	27	3.1	137	168	.000	3.1
83-08-06	0	0	23	11	18	.8	27	3.3	133	166	.000	3.1
82-07-23	0	0	17	16	37	2	40	11	166	204	.000	13
83-06-01	0	0	18	16	36	2	39	11	163	203	.000	11
83-08-11	0	0	19	13	30	1	37	6.9	146	183	.000	7.4
82-07-19	8	8	30	6.7	9.1	.4	14	1.4	104	116	.000	1.1
83-03-22	0	0	25	6.8	8.1	.4	16	1.3	97	119	.000	1.1
83-08-10	0	0	24	6.7	8.0	.4	16	1.4	96	119	.000	1.1
82-07-20	0	0	22	6.3	8.3	.4	18	1.5	94	106	.000	2.6
83-03-22	0	0	21	6.4	7.9	.4	18	1.[illegible]	87	109	.000	3.4

Table A.5

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-06-02	28	.30	44	270	.37	<10	10	2	--	--	--	1925.00
93-09-08	26	.20	44	270	.36	<10	6	2	--	60	--	1925.00
82-07-20	5.0	.60	51	--	--	--	4	2	63	--	23	2410.00
83-08-26	2.5	.60	51	180	.25	--	6	<1	--	--	--	2410.00
82-07-21	11	.30	47	210	.28	--	7	2	160	--	13	2260.00
82-07-20	30	.10	46	180	.25	--	24	3	100	--	12	2290.00
83-03-22	23	.10	42	140	.20	60	83	2	--	--	--	2290.00
83-08-09	24	.20	45	160	.22	--	36	2	--	--	--	2290.00
82-09-08	12	1.2	59	250	.33	--	6	<1	33	--	14	1715.00
83-06-02	12	1.4	57	240	.33	30	3	<1	--	--	--	1715.00
83-08-12	12	1.3	56	230	.32	20	<3	<1	--	50	--	1715.00
82-07-20	10	.40	51	190	.26	--	190	15	76	--	18	2390.00
82-07-22	11	.30	41	210	.29	--	7	7	110	--	18	2175.00
83-06-02	11	.30	40	210	.29	<10	13	3	--	--	--	2175.00
83-08-10	10	.30	39	210	.29	10	10	2	--	--	--	2175.00
82-07-23	25	.30	50	290	.39	--	12	3	250	--	15	2110.00
83-06-02	31	.30	47	310	.43	<10	<3	1	--	--	--	2110.00
83-08-11	22	.30	49	270	.37	<10	17	1	--	--	--	2110.00
82-07-26	<5.0	.30	51	--	--	--	94	44	200	--	25	2300.00
83-03-22	4.6	.20	48	310	.42	<10	110	29	--	--	--	2290.00
83-08-09	3.9	.30	47	300	.41	<10	34	18	--	--	--	2290.00
82-07-19	16	.10	55	150	.21	--	10	1	75	--	8	2340.00
83-03-22	13	.10	51	140	.20	<10	26	5	--	--	--	2340.00
83-08-09	14	.10	51	150	.20	--	28	<1	--	--	--	2340.00
82-07-22	32	.30	46	290	.40	--	3	1	250	--	18	2295.00
83-06-02	31	.30	46	280	.38	10	<3	<1	--	--	--	2295.00
82-07-22	52	.30	44	330	.45	--	10	5	280	--	18	2040.00
83-06-01	51	.30	43	330	.44	<10	13	2	--	--	--	2040.00
83-08-10	31	.30	42	260	.36	<10	6	4	--	80	--	2040.00
82-07-21	11	.50	39	190	.26	--	220	25	96	--	19	2340.00
83-06-20	10	.50	35	190	.25	<10	200	23	--	--	--	2340.00
83-08-06	11	.50	37	190	.26	<10	180	22	--	--	--	2340.00
82-07-23	24	.50	38	260	.35	--	7	5	74	--	33	2315.00
83-06-01	24	.50	37	250	.34	<10	14	2	--	--	--	2315.00
83-08-11	16	.40	37	220	.30	<10	15	3	--	40	--	2315.00
82-07-19	<5.0	.30	51	--	--	--	4	5	120	--	8	2410.00
83-03-22	3.1	.30	50	150	.21	20	11	9	--	--	--	2410.00
83-08-10	2.9	.30	48	150	.21	--	5	<1	--	--	--	2410.00
82-07-20	<5.0	.20	53	--	--	--	5	1	100	--	11	2410.00
83-03-22	4.2	.20	49	150	.20	<10	10	5	--	--	--	2390.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROC'SS DATE 01/24/86

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL-LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA-LYZING SAMPLE (CODE NUMBER) (00028)
83-06-02	135	3168047	1028	80020
83-09-08	165	3259008	1028	80020
82-07-20	566	--	80020	80020
83-08-26	566	3252173	1028	80020
82-07-21	300	--	80020	80020
82-07-20	160	--	80020	80020
83-03-22	160	3094061	1028	80020
83-08-09	160	3249181	1028	80020
82-09-08	685	--	80020	80020
83-06-02	685	3164012	1028	80020
83-08-12	685	3243071	1028	80020
82-07-20	360	--	80020	80020
82-07-22	213	--	80020	80020
83-06-02	213	3168044	1028	80020
83-08-10	213	3243057	1028	80020
82-07-23	240	--	80020	80020
83-06-02	240	3168025	1028	80020
83-08-11	240	3243074	1028	80020
82-07-20	300	--	80020	80020
83-03-22	300	3094060	1028	80020
83-08-09	300	3249193	1028	80020
82-07-19	52.00	--	80020	80020
83-03-22	52.00	3094056	1028	80020
83-08-09	52.00	3251148	1028	80020
82-07-22	247	--	80020	80020
83-06-02	247	3168026	1028	80020
82-07-22	212	--	80020	80020
83-06-01	212	3168046	1028	80020
83-08-10	212	3243045	1028	80020
82-07-21	100	--	80020	80020
83-06-20	100	3187034	1028	80020
83-08-06	100	3243051	1028	80020
82-07-23	445	--	80020	80020
83-06-01	445	3160066	1028	80020
83-08-11	445	3243044	1028	80020
82-07-19	125	--	80020	80020
83-03-22	125	--	80020	80020
83-08-10	125	3243049	1028	80020
82-07-20	100	--	80020	80020
83-03-22	100	--	80020	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY　　PROCESS DATE 01/24/86

MULTIPLE STATION LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (90900)
473103117382801	83 09-07	1230	12.5	193	196	7.6	7.2	7.4	10	1.8	83
473103117533901	82-07-21	0910	11.0	280	28[illegible]	--	7.7	7.9	4.0	4.4	110
473117118110901	82-07-21	1700	9.5	235	255	6.6	6.5	7.1	67	1.4	88
	83-06-01	1245	9.0	243	247	--	6.8	7.0	29	2.2	83
	83-08-11	1145	9.5	233	240	--	6.8	7.8	27	1.6	79
473227118341001	82-07-27	1315	1[illegible].0	265	265	--	8.0	8.0	2.1	1.5	94
473230117460301	82-07-20	1345	11.5	280	294	E.5	7.4	8.6	12	<.10	130
	83-06-02	1630	11.5	292	300	2.8	7.3	7.7	15	.15	120
	83-08-10	1130	11.5	2[illegible]8	287	3.5	7.6	7.7	7.1	<.10	120
473427118420001	83-09-08	1600	15.0	245	246	2.2	7.9	7.9	2.8	.[illegible]4	88
4[illegible]17362201	82-07-19	1600	15.5	213	221	.4	7.7	8.3	4.3	<.10	82
	83-03-22	1030	15.0	201	223	.1	8.0	7.9	1.9	<.10	77
	83-08-09	1315	16.0	211	219	.1	7.9	7.9	2.6	<.10	77
473442118162202	83-07-16	1900	12.0	297	302	--	8.5	8.5	.5	5.3	120
473442118162203	83-07-16	2030	12.0	225	235	--	9.6	9.3	.0	.65	87
473442118162204	83-07-18	191[illegible]	18.0	203	215	--	8.0	8.7	1.7	<.10	65
473442118162205	83-07-19	1000	14.0	295	245	--	9.4	9.6	.0	<.10	56
473442118162207	83-07-17	2000	14.0	400	333	--	11.0	10.5	.0	<.10	78
473442118162208	83-07-18	1730	15.5	241	253	--	8.1	8.9	2.0	<.10	36
473413118531501	82-07-23	1445	15.0	278	281	6.3	8.2	8.4	1.8	<.10	75
	83-06-03	0930	14.5	268	282	.9	8.2	8.1	1.6	<.10	75
	83-08-11	0900	15.0	260	278	.4	8.2	8.0	1.5	<.10	75
473454117302001	82-07-20	0925	11.5	330	320	7.9	7.6	7.9	7.5	1.4	160
	83-03-23	1020	11.5	318	336	10.2	7.6	7.7	7.4	1.7	160
	83-08-09	1730	12.0	322	327	9.2	7.7	7.7	6.2	1.4	160
473547117461701	82-07-20	1205	10.5	360	350	5.3	7.4	7.9	12	1.2	130
	83-03-22	1335	7.5	342	367	5.0	7.7	7.6	5.1	.72	130
	83-08-09	1030	10.5	410	406	6.7	7.5	7.7	12	.90	150
473612117335001	82-07-19	1410	9.5	372	383	2.7	6.9	7.4	36	1.9	140
	83-03-23	1155	9.0	370	391	1.8	6.9	7.2	34	1.8	140
	83-08-09	1545	10.5	402	394	1.5	6.9	7.3	37	1.3	140
473614117282101	82-07-19	0845	11.0	332	335	4.5	7.2	7.3	17	3.7	130
	83-03-22	1605	10.0	416	434	--	7.3	7.5	15	6.0	140
	83-08-10	1030	11.0	350	345	4.8	7.5	7.7	8.6	4.2	130
473625117592401	82-07-20	1535	9.5	430	432	8.3	7.2	7.6	18	7.6	140
473644118161701	82-07-21	1330	12.5	182	186	5.0	7.6	7.9	3.5	2.3	65
	83-06-01	1100	12.0	181	186	6.3	7.3	7.8	6.2	3.3	63
	83-08-11	1315	11.5	180	196	5.9	7.4	7.7	4.8	3.0	63
473648118452301	82-09-09	0800	21.5	270	272	.6	8.2	8.3	1.5	<.10	52
	83-06-04	1100	21.5	268	279	.1	8.2	8.2	1.6	.21	50

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-09-07	0	0	22	6.7	8.3	.4	18	1.5	88	103	.000	2.3
82-07-21	4	4	27	9.9	15	.6	23	1.7	115	127	.000	6.8
82-07-21	0	0	24	6.8	17	.8	29	3.7	107	133	.000	5.9
83-06-01	0	0	22	6.7	15	.7	27	3.7	90	117	.000	7.7
83-08-11	0	0	21	6.4	15	.8	28	4.1	91	109	.000	6.1
82-07-27	0	0	21	10	14	.6	24	3.3	96	130	.000	5.1
82-07-20	0	0	31	12	11	.4	16	2.9	145	185	.000	5.4
83-06-02	0	0	30	12	13	.5	18	3.3	148	184	.000	4.0
83-08-10	0	0	28	12	12	.5	18	2.9	143	179	.000	3.5
83-09-08	0	0	17	11	18	.9	30	4.6	113	142	.000	3.9
82-07-19	0	0	19	8.4	17	.8	30	3.1	116	136	.000	2.0
83-03-22	0	0	17	8.3	16	.8	30	3.1	108	121	.000	2.0
83-08-09	0	0	17	8.4	16	.8	30	2.8	103	129	.000	1.9
83-07-16	36	36	34	8.0	12	.5	18	2.9	82	--	--	14
83-07-16	0	0	24	6.5	14	.7	25	4.4	87	--	--	7.3
83-07-18	0	0	20	3.7	17	1	35	3.7	90	--	--	3.5
83-07-19	0	0	22	.14	38	2	57	4.5	70	--	--	3.7
83-07-17	20	20	31	.22	34	2	46	6.5	58	--	--	5.2
83-07-18	0	0	11	2.0	40	3	68	4.0	129	--	--	2.9
82-07-23	0	0	12	11	29	1	43	7.5	111	177	.000	7.0
83-05-03	0	0	12	11	27	1	41	[illegible]	119	157	.000	5.0
83-08-11	0	0	12	11	27	1	41	6.8	119	148	.000	4.9
82-07-20	4	4	45	11	4.2	.2	5	2.8	160	188	.000	2.3
83-03-23	12	12	46	12	4.1	.1	5	2.7	162	185	.000	2.7
83-08-09	0	0	43	12	4.2	.2	5	3.0	156	194	.000	2.4
82-07-20	0	0	31	12	23	.9	28	3.3	160	196	.000	5.5
83-03-22	0	0	33	12	24	.9	28	3.6	165	192	.000	6.1
83-08-09	0	0	37	14	26	1	27	4.4	193	235	.000	6.1
82-07-19	0	0	38	11	25	1	27	3.1	156	180	.000	15
83-03-23	0	0	37	11	24	.9	27	3.2	142	168	.000	17
83-08-09	0	0	38	12	24	.9	26	3.3	146	186	.000	17
82-07-19	0	0	34	11	21	.8	26	2.4	140	169	.000	4.3
83-03-22	0	0	38	12	32	1	32	2.4	166	194	.000	7.0
83-08-10	0	0	33	11	20	.8	25	2.4	140	172	--	5.0
82-07-20	0	0	38	12	26	1	28	2.9	130	177	.000	15
82-07-21	0	0	15	6.7	9.9	.6	23	4.3	77	87	.000	3.3
83-05-01	0	0	15	6.2	8.7	.5	22	4.5	65	78	.000	3.6
83-08-11	1	1	15	6.3	8.9	.5	22	4.3	64	76	.000	3.8
82-09-09	0	0	12	5.3	39	2	59	4.8	123	151	.000	4.6
83-06-04	0	0	11	5.4	39	2	60	5.0	129	163	.000	4.7

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS- SOLVED (MG/L AS SO4) (00945)	FLUO- RIDE, DIS- SOLVED (MG/L AS F) (00950)	SILICA, DIS- SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI- TUENTS, DIS- SOLVED (MG/L) (70301)	SOLIDS, DIS- SOLVED (TONS PER AC-FT) (70303)	BORON, DIS- SOLVED (UG/L AS B) (01020)	IRON, DIS- SOLVED (UG/L AS FE) (01046)	MANGA- NESE, DIS- SOLVED (UG/L AS MN) (01056)	STRON- TIUM, DIS- SOLVED (UG/L AS SR) (01080)	ALUM- INUM, TOTAL RECOV- ERABLE (UG/L AS AL) (01105)	LITHIUM DIS- SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-09-07	4.2	.20	52	150	.20	<10	<3	20	--	--	--	2390.00
82-07-21	12	.30	41	180	.24	--	13	3	120	--	14	2395.00
82-07-21	13	.20	47	180	.25	--	25	2	130	--	10	2365.00
83-06-01	15	.20	45	170	.24	<10	48	1	--	--	--	2365.00
83-08-11	14	.20	44	160	.22	<10	37	3	--	--	--	2365.00
82-07-27	17	.30	46	180	.25	--	<3	<1	110	--	5	2219.00
82-07-20	5.0	.30	46	200	.28	--	27	23	130	--	16	2440.00
83-06-02	7.0	.30	43	200	.28	<10	20	20	--	--	--	2140.00
83-08-10	4.7	.30	41	190	.26	<10	17	17	--	--	--	2140.00
83-09-08	8.1	.40	46	180	.24	<10	3	2	--	60	--	1985.00
82-07-19	8.0	.40	50	170	.24	--	91	13	110	--	12	2410.00
83-03-22	8.6	.40	48	160	.22	<10	92	10	--	--	--	2410.00
83-08-09	8.2	.40	49	170	.23	<10	96	12	--	--	--	2410.00
83-07-16	26	.20	38	180	.25	--	6	1	--	--	--	2372.00
83-07-16	21	.40	33	160	.22	<10	5	2	--	--	--	2372.00
83-07-18	18	.50	32	150	.21	--	17	3	--	--	--	2372.00
83-07-19	28	.70	11	150	.20	--	8	<1	--	--	--	2732.00
83-07-17	39	.50	39	190	.26	<10	3	<1	--	--	--	2372.00
83-07-18	3.6	1.2	50	190	.26	<10	21	3	--	--	--	2372.00
82-07-23	18	.70	37	210	.28	--	10	18	47	--	17	1995.00
83-06-03	17	.70	36	190	.26	10	15	14	--	--	--	1995.00
83-08-11	16	.70	36	190	.25	<10	9	14	--	--	--	1995.00
82-07-20	10	.10	38	210	.28	--	3	4	150	--	12	2350.00
83-03-23	10	.10	36	210	.28	<10	4	4	--	--	--	2350.00
83-08-09	11	.10	35	210	.28	<10	<3	1	--	--	--	2350.00
82-07-20	15	.30	37	220	.30	--	10	6	160	--	17	2400.00
83-03-22	19	.20	31	220	.30	<10	10	2	--	--	--	2400.00
83-08-09	14	.20	34	250	.34	<10	<3	2	--	--	--	2400.00
82-07-19	24	.20	39	240	.33	--	7	1	170	--	17	2390.00
83-03-23	23	.20	37	240	.32	10	41	5	--	--	--	2390.00
83-08-09	25	.20	38	250	.34	10	42	<1	--	--	--	2390.00
82-07-19	17	.30	51	220	.30	--	5	<1	150	--	11	2324.00
83-03-22	25	.40	47	260	.35	<10	6	<1	--	--	--	2324.00
83-08-10	17	.40	48	220	.30	<10	<3	5	--	--	--	2324.00
82-07-20	28	.20	38	250	.34	--	20	7	190	--	16	2400.00
82-07-21	9.0	.20	45	140	.19	--	6	3	71	--	15	2380.00
83-06-01	9.7	.20	48	130	.18	<10	9	<1	--	--	--	2380.00
83-08-11	9.2	.30	45	130	.18	<10	<3	2	--	--	--	2380.00
82-09-09	7.0	.80	57	200	.28	--	21	6	36	--	32	2135.00
83-06-04	7.7	1.0	58	210	.29	<10	26	8	--	--	--	2135.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-09-07	100	3253090	1028	80020
82-07-21	300	--	80020	80020
82-07-21	165	--	80020	80020
83-06-01	165	3171032	1028	80020
83-08-11	165	3243059	1028	80020
82-07-27	596	--	80020	80020
82-07-20	100	--	80020	80020
83-06-02	100	3171029	1028	80020
83-08-10	100	3243064	1028	80020
83-09-08	350	3259009	1028	80020
82-07-19	775	--	80020	80020
83-03-22	775	3094053	1028	80020
83-08-09	775	3243067	1028	80020
83-07-16	160	3214052	1028	80020
83-07-16	224	3272044	1028	80020
83-07-18	261	3214050	1028	80020
83-07-19	365	3214057	1028	80020
83-07-17	635	3272045	1028	80020
83-07-18	750	3214058	1028	80020
82-07-23	250	--	80020	80020
83-06-03	250	3164014	1028	80020
83-08-11	250	3243076	1028	80020
82-07-20	325	--	80020	80020
83-03-23	325	3094048	1028	80020
83-08-09	325	3243058	1028	80020
82-07-20	50.00	--	80020	80020
83-03-22	50.00	3094049	1028	80020
83-08-09	50.00	3243060	1028	80020
82-07-19	60.00	--	80020	80020
83-03-23	60.00	3094050	1028	80020
83-08-09	60.00	3243056	1028	80020
82-07-19	100	--	80020	80020
83-03-22	100	3094055	1028	80020
83-08-10	100	3243053	1028	80020
82-07-20	85.00	--	80020	80020
82-07-21	125	--	80020	80020
83-06-01	125	3171031	1028	80020
83-08-11	125	3249179	1028	80020
82-09-09	1130	--	80020	80020
83-06-04	1130	3164013	1028	80020

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY   PROCESS DATE 01/24/86
MULTIPLE STAT N LISTING

STATION NUMBER	DATE OF SAMPLE	TIME	TEMPER-ATURE (DEG C) (00010)	SPE-CIFIC CON-DUCT-ANCE (UMHOS) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (UMHOS) (90095)	OXYGEN, DIS-SOLVED (MG/L) (00300)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	HARD-NESS (MG/L AS CACO3) (00900)
473648118452301	83-08-31	1100	21.5	268	273	.1	8.2	8.0	1.6	<.10	51
473751118152001	82-07-21	1445	12.5	185	190	5.7	7.2	7.7	8.4	3.2	68
	83-06-01	0900	11.5	262	268	5.6	7.1	7.5	16	4.8	99
473829118381901	83-06-03	1100	19.5	260	282	.3	7.9	8.0	3.2	<.10	80
473832118081801	82-07-21	0900	11.0	190	203	--	7.0	7.4	11	5.3	68
	83-05-31	1730	11.0	191	194	8.8	7.0	7.2	12	5.3	64
	83-08-11	0945	--	--	215	--	--	7.4	--	5.9	71
473848118091901	82-07-21	1030	22.5	288	300	.4	8.2	8.3	1.7	<.10	61
	83-06-01	1500	23.5	278	289	.1	8.4	8.1	1.2	<.10	40
	83-08-10	1345	24.0	288	286	.1	8.4	8.2	1.1	<.10	37
473913118261702	82-07-22	0955	14.5	232	237	2.8	7.4	7.9	8.6	.71	95
473913118193401	82-07-23	1320	14.0	349	353	7.7	7.3	7.8	12	4.3	140
473946118003701	82-07-20	1755	12.0	420	436	7.7	7.2	7.6	15	8.8	160
	83-06-02	1825	11.0	431	445	9.5	7.0	7.5	25	8.4	160
	83-08-10	1600	11.0	410	419	8.9	7.2	7.5	15	6.3	150
474142118235501	82-07-22	1105	11.5	400	406	6.2	6.7	7.2	48	12	140
	83-06-02	1525	12.0	410	418	4.7	6.6	7.0	60	11	150
	83-08-11	1600	11.5	409	406	5.1	7.0	7.2	24	10	140
474159118360101	82-07-22	1235	11.5	350	364	8.4	7.3	7.6	11	4.2	140
	83-06-03	1400	10.5	370	393	8.3	7.4	7.4	8.7	4.3	140
	83-08-31	1330	11.5	360	348	8.5	7.3	7.5	10	4.4	130
474215118355301	83-06-22	1300	13.5	260	269	2.4	7.8	7.0	3.0	1.9	94
	83-09-07	1315	13.0	258	230	1.6	7.9	7.9	2.5	1.2	86
474337118454201	82-07-23	1100	11.5	213	218	E1.1	8.2	8.0	1.3	.91	74
	83-06-04	0840	11.5	210	228	1.8	8.4	8.0	.8	<.10	74
	83-09-07	1045	11.5	210	214	.7	8.4	8.0	.8	<.10	75
474435118425401	83-06-04	1140	13.5	200	212	1.8	8.3	8.2	1.1	<.10	70
	83-08-11	1800	13.0	208	209	1.7	8.4	8.2	.8	<.10	70
474556118431101	82-07-23	0740	12.5	548	570	2.9	7.1	7.7	28	2.6	220
	83-06-21	1630	12.5	555	749	2.8	7.6	7.6	11	3.2	300
	83-08-11	1915	14.0	870	844	2.7	7.5	7.7	17	3.0	350
474748118381601	82-07-27	1005	18.0	850	847	8.3	7.6	7.8	6.1	20	340
	83-06-02	1415	14.5	843	911	10.2	7.7	7.6	5.4	24	400
	83-08-12	0930	14.0	848	874	10.1	7.4	8.0	9.4	24	390

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 01/24/86
MULTIPLE STATION LISTING

DATE OF SAMPLE	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)	HARD-NESS NONCAR-BONATE (MG/L AS CACO3) (95902)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	PERCENT SODIUM (00932)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	BICAR-BONATE IT-FLD (MG/L AS HCO3) (99440)	CAR-BONATE IT-FLD (MG/L AS CO3) (99445)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)
83-08-31	0	0	12	5.1	40	3	60	4.7	129	158	.000	4.7
82-07-21	0	0	18	5.6	9.8	.5	23	2.0	69	84	.000	3.2
83-06-01	0	0	26	8.3	13	.6	22	2.2	87	125	.000	5.4
83-06-03	0	0	16	9.8	28	1	42	3.1	128	160	.000	4.6
82-07-21	10	10	18	5.5	12	.7	27	3.3	64	71	.000	6.3
83-05-31	0	0	17	5.2	11	.6	26	3.2	56	78	.000	5.2
83-08-11	15	15	19	5.6	11	.6	24	3.3	56	--	--	7.4
82-07-21	0	0	15	5.8	40	2	56	4.8	129	174	.000	4.3
83-06-01	0	0	11	3.1	48	3	69	5.7	141	182	.000	3.6
83-08-10	0	0	10	2.9	48	4	70	5.5	140	168	.000	3.6
82-07-22	0	0	24	8.5	16	.7	26	3.2	120	136	.000	2.0
82-07-23	20	20	34	14	16	.6	19	3.0	132	150	.000	12
82-07-20	33	33	43	12	26	.9	26	2.0	137	152	.000	18
83-06-C.	32	32	43	13	27	1	26	2.0	131	158	.000	20
83-08-10	28	28	40	12	26	1	27	2.1	122	148	.000	21
82-07-22	15	15	37	11	23	.9	26	3.8	107	150	.000	13
83-06-02	24	24	39	12	24	.9	26	3.8	123	150	.000	11
83-08-11	20	20	38	12	24	.9	26	4.0	125	152	.000	14
82-07-22	31	31	36	12	18	.7	22	2.8	117	133	.000	18
83-06-03	25	25	35	12	22	.8	25	2.8	115	137	.000	18
83-08-31	26	26	34	11	17	.7	22	2.5	101	127	.000	19
83-06-22	0	0	21	10	16	.7	26	4.1	103	121	.000	7.3
83-09-07	0	0	18	10	16	.8	28	4.4	98	125	.000	6.2
82-07-23	0	0	14	9.4	18	.9	34	3.0	100	128	.000	2.5
83-05-04	0	0	14	9.5	17	.9	32	3.2	103	125	3.0	2.4
83-09-07	0	0	14	9.7	17	.9	32	2.9	104	131	4.0	2.4
83-06-04	0	0	13	9.0	15	.8	31	3.3	99	141	.000	2.3
83-08-11	0	0	13	9.2	15	.8	31	3.0	100	123	.000	2.5
82-07-23	41	41	50	24	29	.9	22	4.4	193	223	.000	25
83-06-21	71	71	66	33	38	1	21	5.4	255	281	.000	35
83-08-11	69	69	78	38	43	1	21	5.2	283	345	.000	42
82-07-27	210	211	85	30	23	.6	13	4.9	127	153	.000	91
83-06-02	260	257	99	36	22	.5	11	4.9	131	170	.000	120
83-08-12	270	266	96	36	24	.5	12	4.3	126	149	.000	110

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	ALUM-INUM, TOTAL RECOV-ERABLE (UG/L AS AL) (01105)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)
83-08-31	7.5	.90	58	210	.29	<10	18	7	--	--	--	2135.00
82-07-21	12	.20	49	140	.19	--	4	19	88	--	13	2368.00
83-06-01	17	.20	48	180	.25	<10	11	<1	--	--	--	2368.00
83-06-03	11	.70	47	200	.27	<10	27	12	--	--	--	2320.00
82-07-21	12	.20	50	140	.19	--	<3	<1	83	--	12	2420.00
83-05-31	12	.20	49	140	.19	<10	12	<1	--	--	--	2420.00
83-08-11	13	.20	47	140	.19	<10	4	<1	--	--	--	2420.00
82-07-21	11	.90	50	220	.30	--	18	7	68	--	39	2410.00
83-06-01	4.3	1.2	53	220	.30	<10	30	4	--	--	--	2410.00
83-08-10	4.0	1.3	51	210	.28	<10	13	4	--	--	--	2410.00
82-07-22	10	.40	44	180	.24	--	10	300	140	--	<10	2250.00
82-07-23	22	.20	45	220	.39	--	5	2	150	--	17	2060.00
82-07-20	30	.20	48	250	.35	--	3	3	200	--	12	2480.00
83-06-02	33	.20	47	260	.36	<10	16	<1	--	--	--	2480.00
83-08-10	32	.30	46	250	.34	<10	7	3	--	--	--	2480.00
82-07-22	19	.20	48	230	.31	--	6	15	210	--	13	2345.00
83-06-02	19	.20	48	230	.31	<10	15	2	--	--	--	2345.00
83-08-11	17	.20	46	230	.31	10	6	2	--	--	--	2315.00
82-07-22	31	.20	45	230	.31	--	8	8	170	--	13	2280.00
83-06-03	33	.30	43	230	.32	<10	15	2	--	--	--	2280.00
83-08-31	30	.30	43	220	.30	<10	8	1	--	--	--	2280.00
83-06-22	16	.40	37	170	.23	<10	19	10	--	--	--	2035.00
83-09-07	15	.40	37	170	.23	<10	7	7	--	--	--	2035.00
82-07-23	6.0	.50	39	160	.21	--	83	17	50	--	20	2060.00
83-06-04	6.7	.50	37	160	.21	<10	77	15	--	--	--	2060.00
83-09-07	6.3	.50	37	160	.22	<10	36	17	--	--	--	2060.00
83-06-04	6.2	.50	37	160	.21	<10	33	11	--	--	--	2175.00
83-08-11	6.0	.50	37	150	.20	<10	26	20	--	--	--	2175.00
82-07-23	59	.30	46	350	.47	--	12	<1	240	--	19	2160.00
83-06-21	90	.30	43	450	.61	40	10	<1	--	--	--	2160.00
83-08-11	110	.30	44	530	.72	40	5	<1	--	--	--	2160.00
82-07-27	64	.30	47	420	.57	--	48	2	390	--	19	2080.00
83-06-02	80	.30	45	490	.67	10	32	4	--	--	--	2080.00
83-08-12	78	.30	45	470	.63	10	25	2	--	--	--	2080.00

TABLE A.5

WATER-QUALITY DATA, USGS REGIONAL STUDY (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
MULTIPLE STATION LISTING

PROCESS DATE 01/24/86

DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	LAB ID NUMBER (UNITS) (99998)	AGENCY COL- LECTING SAMPLE (CODE NUMBER) (00027)	AGENCY ANA- LYZING SAMPLE (CODE NUMBER) (00028)
83-08-31	1130	3252171	1028	80020
82-07-21	324	--	80020	80020
83-06-01	324	3171030	1028	80020
83-06-03	865	3164011	1028	80020
82-07-21	100	--	80020	80020
83-05-31	100	3171020	1028	80020
83-08-11	100	3243054	1028	80020
82-07-21	975	--	80020	80020
83-06-01	975	3171019	1028	80020
83-08-10	975	3243050	1028	80020
82-07-22	410	--	80020	80020
82-07-23	300	--	80020	80020
82-07-20	121	--	80020	80020
83-06-02	121	3171035	1028	80020
83-08-10	121	3249180	1028	80020
82-07-22	200	--	80020	80020
83-06-02	200	3160090	1028	80020
83-08-11	200	3243055	1028	80020
82-07-22	60.00	--	80020	80020
83-06-03	60.00	3160065	1028	80020
83-08-31	60.00	3252165	1028	80020
83-06-22	185	3187036	1028	80020
83-09-07	185	3253091	1028	80020
82-07-23	166	--	80020	80020
83-06-04	166	3160088	1028	80020
83-09-07	166	3253092	1028	80020
83-06-04	233	3160069	1028	80020
83-08-11	233	3243079	1028	80020
82-07-23	154	--	80020	80020
83-06-21	154	3187032	1028	80020
83-08-11	154	3243065	1028	80020
82-07-27	146	--	80020	80020
83-06-02	146	3160063	1028	80020
83-08-12	146	3243072	1028	80020

TABLE A.6

SELECTED WATER-QUALITY DATA, WSU STUDY

Township/Range Section [1]	Owner Description	T (°F)	pH	TDS (mg/L)	DSA (mg/L)	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO_3 (meq/L)	CO_3 (meq/L)	SO_4 (meq/L)	Cl (meq/L)	F (meq/L)	NO_3 (meq/L)	PO_4 (meq/L)	SiO_2 (mg/L)	Map No. [1]	Reference [2]
13/31-24A1	C.W. McLean	52	7.8	—	213	1.10	1.00	1.17	0.16	2.75	0.00	0.35	0.15	0.03	.06	--	42.0	71	1
13/32-1J1	Connell Sand & Gravel	57	7.8	—	239	1.60	0.82	1.17	0.12	[illegible]	0.00	0.29	0.23	0.03	--	0.01	37.0	70	1
13/34	Kahlotus Lake	75	9.1	302	--	1.55	2.05	2.90	0.40	[illegible]	1.86	0.56	0.89	--	--	—	7.3	66	2
13/34	Herron & Hiltz	—	7.8	559	--	10.16	—	4.22	0.41	6.48	0.00	3.55	4.15	--	--	--	14.0	67	2
14/31	Connell well #2	66	8.7	252	--	0.96	1.04	1.39	0.10	2.36	0.26	0.37	0.35	--	--	--	2.0	64	2
14/31-36Q2	Connell well #1	60	8.3	—	208	1.50	1.23	0.55	0.06	2.47	0.00	0.29	0.14	0.02	0.23	--	38.0	69	1
14/32-31D1	Connell well #3	65	7.9	--	226	1.30	0.99	0.78	0.14	2.26	0.00	0.46	0.28	0.03	0.14	--	48.0	68	1
15/32-1J1	George Pence	[illegible]	8.2	--	238	0.50	0.17	2.22	0.23	2.62	0.00	0.21	0.25	0.08	0.02	--	66.0	62	1
15/37	McGregor	66	7.6	375	—	1.20	1.36	0.76	0.13	3.42	0.00	0.08	0.26	--	--	--	--	89	2
15/37	H. Hilam	63	7.4	475	--	1.68	1.63	0.95	0.13	4.10	0.00	0.22	0.32	--	--	—	--	90	2
15/37	McGregor	66	7.5	460	—	1.64	1.52	0.87	0.13	3.70	0.00	0.16	0.30	--	—	--	--	91	2
16/32	Jack Damon	70	8.2	322	--	0.21	0.20	3.07	0.23	2.50	0.23	0.69	0.59	--	--	--	--	57	2
16/39	Robinette Crane	79	7.9	—	--	1.69	1.51	1.24	0.10	4.30	0.00	0.12	0.26	--	—	--	--	97	2
17/32-6J1	John Kulm	57	8.0	—	247	0.80	0.99	1.78	0.31	2.75	0.00	0.92	0.23	0.03	--	--	33.0	61	1
17/33	Town of Lind	61	7.3	865	—	3.90	4.70	3.22	0.19	3.35	0.00	0.21	5.75	--	--	--	0.77	54	2
17/33	Town of Lind	61	7.5	362	--	1.54	2.50	1.17	0.15	2.84	0.00	1.12	1.09	—	--	—	0.60	55	2
17/33	Town of Lind	61	7.6	233	--	1.10	0.94	0.87	0.09	2.23	0.00	0.38	0.52	—	—	—	1.13	56	2
17/41	Palouse River	77	7.7	--	--	0.62	0.46	0.40	0.06	1.42	0.00	0.11	0.18	—	--	--	--	98	2

TABLE A.6

SELECTED WATER-QUALITY DATA, WSU STUDY (continued)

Township/Range Section ID[1]	Owner Description	T °F	pH	TSS (mg/L)	DSR (mg/L)	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO_3 (meq/L)	CO_3 (meq/L)	SO_4 (meq/L)	Cl (meq/L)	F (meq/L)	NO_3 (meq/L)	PO_4 (meq/L)	SiO_2 (mg/L)	Map No.[1]	Reference[2]
19/40	Ferris	63	7.7	333	—	1.46	1.08	0.43	0.08	2.61	0.00	0.09	0.18	--	--	--	—	93	2
19/40	Ferris #2	—	6.4	277	—	2.86	—	0.87	0.16	2.90	0.00	0.91	0.17	--	--	—	51.8	99	2
19/40	Ferris #1	—	7.5	206	—	2.64	—	0.42	0.09	2.88	0.00	0.14	0.10	--	--	--	54.0	100	2
19/41	E.M. Smith	53	7.7	390	--	1.60	1.40	1.00	0.12	3.47	0.00	0.23	0.29	--	--	--	--	94	2
19/42	E.M. Smith	54	7.4	409	--	1.58	1.50	1.20	0.13	3.88	0.00	0.26	0.33	--	--	--	—	95	2
19/32-15[illegible]	C.F. Goss	58	8.0	—	223	1.10	0.90	1.44	0.21	2.88	0.00	0.52	0.25	0.04	--	--	40.0	60	1
19/35	Town of Ritzville	61	7.8	190	—	1.10	1.08	0.60	0.07	0.15	0.00	2.15	0.25	--	--	--	1.3	51	2
19/35	Town of Ritzville	61	7.7	230	--	1.15	1.15	1.02	0.20	2.44	0.04	0.33	0.57	—	--	--	1.47	52	2
19/35	Town of Ritzville	61	7.5	234	—	1.22	1.18	1.02	0.12	2.27	0.02	0.34	0.56	--	--	--	1.23	53	2
19/35-23C1	City of Ritzville	60	8.2 & 7.9	—	455	3.14	2.96	1.00	0.16	3.64	0.00	0.87	1.58	0.01	0.76	--	43.0	59	1
20/32-32[illegible]	USA Government	64	8.0	—	214	0.75	0.48	1.57	0.16	2.56	0.00	0.27	0.16	0.05	0.01	--	55.0	58	1
20/41	Rock Lake	46	7.4	194	--	1.01	0.63	0.61	0.12	1.76	0.10	0.31	0.12	--	--	--	0.73	96	2
21/33	Odessa Tractor & Imp. Co.	73	7.5	214	--	1.16	1.00	1.61	0.13	2.99	0.04	0.39	0.31	--	--	—	1.27	75	2
21/33	Ralph King (house well)	79	7.3	327	—	2.27	2.37	1.07	0.18	5.25	0.00	0.45	0.27	--	--	--	1.11	74	2
21/34	Ralph King (irrig. well)	79	7.8	312	--	1.77	1.71	1.38	0.15	4.58	0.00	0.49	0.45	--	—	--	34.5	73	2
21/38	Sprague Lake	64	8.2	1916	--	1.22	1.30	1.00	0.22	3.03	0.30	1.81	0.18	—	--	--	0.06	78	2
21/38	Deep well	59	7.8	208	—	0.92	1.00	0.48	0.08	1.94	0.14	0.44	0.18	—	—	—	1.60	76	2
21/38	Shallow well	59	7.7	161	—	1.21	0.87	0.61	0.10	2.23	0.00	0.23	0.11	--	—	—	0.60	77	2

TABLE A.6

SELECTED WATER-QUALITY DATA, WSU STUDY (continued)

Township/Range Section ID[1]	Owner Description	T °F	pH	S [illegible]	DSR (mg/L)	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	K (meq/L)	HCO_3 (meq/L)	CO_3 (meq/L)	SO_4 (meq/L)	Cl (meq/L)	F (meq/L)	NO_3 (meq/L)	PO_4 (meq/L)	SiO_2 (mg/L)	Na No.[1]	Reference[2]
24/40-22L1	US Government (USA, well 45-C)	54	8.0	--	197	1.45	0.91	0.70	0.07	2.51	0.00	0.40	[illegible]	0.02	--	--	43.0	64	1
24/40-3M1	State of Washington	56	7.8	--	178	1.15	0.80	0.79	0.04	2.44	0.00	0.23	0.08	0.03	--	--	45.0	85	1
24/41-3N	US Government (Fairchild AFB, well #2)	60	7.8	--	162	1.65	0.82	0.22	0.06	2.33	0.00	0.29	0.10	0.01	0.05	--	18.0	83	1
24/41-11N1	US Government (USA well 37-C & L)	50	7.9	--	107	0.65	0.35	0.26	0.03	[illegible]	0.00	0.14	0.06	0.01	0.15	--	35.0	62	1
25/40-34, NE 1/4	US Government (USA well 87-C, #2)	54	7.7	--	198	1.45	0.77	0.38	0.033	2.49	0.00	0.10	0.19	0.02	0.21	--	44.0	51	1
25/41-28	US Government (Fairchild AFB well #3)	54	7.8	--	203	1.50	0.90	.52	0.05	1.96	0.00	0.35	0.12	0.02	0.56	--	42.0	68	1
25/41-34 (C)	US Government (USAF)	54	8.0	--	229	1.60	0.61	0.65	0.036	1.48	0.00	0.31	0.27	0.02	0.69	--	42.0	97	1
25/42-29H1	City of Spokane	50	8.0	--	158	0.99	0.60	0.40	0.07	1.95	0.00	0.15	0.07	0.16	0.76	--	45.0	90	1
25/42-25, SW 1/4	US Government	50	7.7	--	177	2.05	1.15	0.135	0.144	2.85	0.00	0.33	0.059	--	0.58	--	14.0	66	1
26/31-32A	City of Almira, well #1	56	7.8 & 8.0	--	247	1.40	1.32	1.30	0.10	3.28	0.00	0.50	0.11	0.04	0.03	--	43.0	79	1
27/32-28, NE 1/4, NW 1/4	L. Sheffels & Son, Inc.	—	7.7	--	--	0.94	0.76	0.58	0.07	1.89	0.00	0.19	0.16	--	0.08	--	--	72	--
	City of Ritzville	—	7.7	457	--	2.22	3.44	1.18	0.35	3.91	0.68	0.66	1.41	--	--	--	1.43	50	2
	City of Connell	68	7.8	220	—	1.15	0.97	0.83	0.15	2.38	0.12	0.23	0.23	--	--	--	2.10	63	2
	L. Camp	64	8.0	285	—	1.17	0.91	0.35	0.80	2.10	0.00	0.06	0.27	--	--	--	--	92	2
	City of Connell	64	7.5	300	—	1.74	1.66	0.57	0.10	2.40	0.22	0.47	0.55	--	--	--	2.06	65	2

Source: Silar, 1969.
1) See Fig. 2.19. Locations are approximate where noted.
2) 1 - Van Denburgh and Santos, 1965; 2 - Adams, 1958.

TABLE A.7

WATER-QUALITY DATA,
STATE OF WASHINGTON DEPARTMENT OF SOCIAL & HEALTH SERVICES

18100N DAVENPORT WATER DIVISION Class:1 County:LINCOLN ABC:2/C
PO BOX 26 WFI printed:01/09/86

DAVENPORT, WA 99122

Next sample due - Frequency	
Bacti:	2/month
Inorg.chem:	5/tri-an

1: 5107217 06/18/84

Arsenic	<0.01	Iron	<0.05
Barium	<0.25	Manganese	0.014
Cadmium	<0.002	Sodium	40
Chromium	<0.01	Hardness	70
Lead	<0.01	Conductivity	330
Mercury	0.0005	Turbidity,ch	0.1
Selenium	<0.003	Color	<5
Silver	<0.01	Chloride	5
Fluoride	0.9		
Nitrate	<0.2		

Q, quit:

2: 5104711 08/24/81 2537E

Arsenic	<0.01	Iron	<0.05
Barium	<0.25	Manganese	<0.01
Cadmium	<0.002	Sodium	45
Chromium	<0.01	Hardness	100
Lead	<0.01	Conductivity	280
Mercury	0.0005	Turbidity,ch	0.2
Selenium	<0.005	Color	<5
Silver	<0.01		
Fluoride	1.4		

3: 3001622 01/16/80

Arsenic	<0.01	Iron	<0.01
Barium	0.5	Manganese	<0.003
Cadmium	<0.002	Hardness	59
Chromium	<0.005	Conductivity	258
Lead	<0.02	Turbidity,ch	0.2
Mercury	0.0002	Color	10
Selenium	<0.002		
Silver	<0.003		
Fluoride	1.1		
Nitrate	<0.1		

end of list:

Table A.7 Sheet 1 of 6

96800R WILBUR, TOWN OF
PO BOX 214

WILBUR, WA 99185

Class:1 County:LINCOLN ABC:1/0
WFI printed:01/09/86

Next sample due - Frequency
Bacti: 2/month
Inorg.chem: 3/tri-an

1: 5212348	11/08/85	Mercury	<0.0005		
2: 5108545	10/11/85	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	10
		Chromium	<0.01	Hardness	90
		Lead	<0.01	Conductivity	230
		Mercury	<0.001	Turbidity,ch	0.1
		Selenium	<0.003	Color	<5
		Silver	<0.01	Chloride	<5
		Fluoride	0.3		
		Nitrate	0.8		
3: 5108546	10/11/85	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	10
		Chromium	<0.01	Hardness	90
		Lead	<0.01	Conductivity	230
		Selenium	<0.003	Turbidity,ch	0.1
		Silver	<0.01	Color	<5
		Fluoride	0.3	Chloride	<5
		Nitrate	0.8		
4: 5106368	01/31/83	Arsenic	<0.01	Iron	0.06
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	23
		Chromium	<0.01	Hardness	140
		Lead	<0.01	Conductivity	380
		Mercury	0.0005	Turbidity,ch	0.2
		Selenium	<0.003	Color	<5
		Silver	<0.01	Chloride	15
		Fluoride	0.3		
		Nitrate	2.3		
5106369	01/31/83	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	10
		Chromium	<0.01	Hardness	90
		Lead	<0.01	Conductivity	220
		Mercury	0.0005	Turbidity,ch	0.1
		Selenium	<0.003	Color	<5
		Silver	<0.01	Chloride	5
		Fluoride	0.3		
6: 5103641	06/13/79	Arsenic	<0.01	Iron	<0.1
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Hardness	130
		Chromium	<0.01	Conductivity	220
		Lead	<0.01	Turbidity,ch	0.1
		Mercury	<0.001	Color	<5
		Selenium	<0.005		
		Silver	<0.01		
		Fluoride	0.3		
		Nitrate	0.6		

Table A.7

161500 CRESTON PUBLIC WTR Class:1 County:LINCOLN ABC:1/0
PO BOX 131 WFI printed:12/09/85

CRESTON, WA 99117

Next sample due - Frequency
Bacti: 1/month
Inorg.chem: 2/tri-an

1: 3000913	10/10/85	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	13
		Chromium	<0.01	Hardness	129
		Lead	<0.01	Conductivity	285
		Mercury	<0.001	Turbidity,ch	0.5
		Selenium	<0.005	Color	8
		Silver	<0.01	Chloride	12
		Fluoride	0.3		
		Nitrate	6.8		

Q, quit:

2: 3000607	06/00/82	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	12.2
		Chromium	<0.01	Hardness	120
		Lead	<0.01	Conductivity	290
		Mercury	0.001	Turbidity,ch	0.4
		Selenium	<0.005	Color	<5
		Silver	<0.01		
		Fluoride	0.3		
3: 8906103	06/06/79	Arsenic	0.001	Iron	0.04
		Barium	0.02	Manganese	0.002
		Cadmium	0.001	Hardness	110
		Chromium	0.003	Conductivity	243
		Lead	0.009	Turbidity,ch	0.1
		Mercury	0.0002	Color	1
		Selenium	0.003		
		Silver	0.001		
		Fluoride	0.2		
		Nitrate	5.6		

end of list:

Table A.7 Sheet 3 of 6

TABLE A.7

WATER-QUALITY DATA,
STATE OF WASHINGTON DEPARTMENT OF SOCIAL & HEALTH SERVICES
(continued)

715507 REARDAN, TOWN OF   Class:1   County:LINCOLN   ABC:1/0
PO BOX 220   TABLE II (Continued)   WFI printed:09/24/85

REARDAN, WA 99029

Next sample due - Frequency
Bacti: 1/month
Inorg.chem: 4/tri-an

1: 5107411	08/06/84	2539E	Arsenic	<0.01	Iron	<0.05
			Barium	<0.25	Manganese	0.016
			Cadmium	<0.002	Sodium	18
			Chromium	<0.01	Hardness	120
			Lead	<0.01	Conductivity	310
			Mercury	0.0005	Turbidity,ch	<0.1
			Selenium	<0.003	Color	<5
			Silver	<0.01	Chloride	5
			Fluoride	0.3		
			Nitrate	3.2		
2: 5105089	10/30/81		Arsenic	<0.01	Iron	0.05
			Barium	<0.25	Manganese	0.014
			Cadmium	<0.002	Sodium	15
			Chromium	<0.01	Conductivity	280
			Lead	<0.01	Turbidity,ch	0.1
			Mercury	0.0005	Color	<5
			Selenium	<0.005	Chloride	5
			Silver	<0.01		
			Fluoride	0.3		
			Nitrate	0.8		

end of list:

TABLE A.7

WATER-QUALITY DATA,
STATE OF WASHINGTON DEPARTMENT OF SOCIAL & HEALTH SERVICES
(continued)

63050N ODESSA
PO BOX 218

ODESSA, WA 99159

Class:1 County:LINCOLN ABC:1/0
WFI printed:01/09/86

Next sample due - Frequency
Bacti: (m) 1/month
Inorg.chem: 3/tri-an

1: 5106879	01/13/84	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	50
		Chromium	<0.01	Hardness	110
		Lead	<0.01	Conductivity	430
		Mercury	0.0005	Turbidity,ch	0.2
		Selenium	<0.003	Color	<5
		Silver	<0.01	Chloride	15
		Fluoride	0.8		
		Nitrate	<0.2		

2: 5104082	05/09/80	Arsenic	0.01	Iron	0.05
		Barium	0.25	Manganese	0.01
		Cadmium	0.002	Hardness	10
		Chromium	0.01	Conductivity	340
		Lead	0.01	Turbidity,ch	0.1
		Mercury	0.0005	Color	5
		Selenium	0.005		
		Silver	0.01		
		*Fluoride	3.1		
		Nitrate	0.2		

end of list:

31450Y HARRINGTON, CITY OF
BOX 492

HARRINGTON, WA 99134

Class:1 County:LINCOLN ABC:1/0
WFI printed:10/23/85

Next sample due - Frequency
Bacti: 1/month
Inorg.chem: 2/tri-an

1: 5108298	07/18/85	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	50
		Chromium	<0.01	Hardness	270
		Lead	<0.01	Conductivity	680
		Mercury	<0.0005	Turbidity,ch	0.1
		Selenium	<0.003	Color	<5
		Silver	<0.01	Chloride	35
		Fluoride	0.3	Sulfate	25
		Nitrate	8.2		
2: 5105919	08/27/82	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	40
		Chromium	<0.01	Hardness	260
		Lead	<0.01	Conductivity	670
		Mercury	0.0005	Turbidity,ch	0.1
		Selenium	<0.005	Color	<5
		Silver	<0.01	Chloride	50
		Fluoride	0.3		
3: 5103553	05/11/79	Arsenic	<0.01	Iron	<0.1
		Barium	<0.25	Manganese	0.037
		Cadmium	<0.002	Hardness	240
		Chromium	<0.01	Conductivity	530
		Lead	<0.01	Turbidity,ch	0.2
		Mercury	<0.001	Color	<5
		Selenium	<0.005		
		Silver	<0.01		
		Fluoride	0.4		
		Nitrate	5		
4: 5103267	09/18/78	Arsenic	<0.01	Iron	<0.05
		Barium	<0.25	Manganese	<0.01
		Cadmium	<0.002	Sodium	28
		Chromium	<0.01	Hardness	240
		Lead	<0.01	Conductivity	580
		Mercury	0.0015	Turbidity,ch	0.2
		Selenium	<0.003	Color	<5
		Silver	<0.01	Chloride	28
		Fluoride	<0.2	Sulfate	90
		Nitrate	4.7		

Table A.7

Sheet 6 of 6

TABLE A.8

AVAILABLE GEOPHYSICAL LOGS

Lincoln County

Township/Range Section ID	Owner	Elevation (ft MSL)	Depth (ft)	Log Type[1)]
21/31-10M1	Basalt Explorer #1	1610	4400	M
21/31-21B1	Bates, Don	1742	555	M
21/31-22L1	Bates, Don, #2	1750	1567	M
21/31-22L1	Bates, Don, #2	1750	1560	IM
21/31-25B1	Schibel, Don	1780	644	M
21/31-30L1	Kissler, Bob	1680	470	M
21/31-30R1	Kissler, Bob	1647	865	M
21/31-32D1	Kissler, Fred	1669	687	M
21/31-32D2	Kissler, Bob	1670	1180	N
21/32-23F1	Schafer, Jerry	1812	980	M
21/32-23F1	Schafer, Jerry	1812	980	IM
21/32-23F1	Schafer, Jerry	1812	980	IM
21/33-09E1	Odessa City	1610	652	M
21/34-33C1	Hardung, Joe	1920	880	M
23/32-04J1	Weishaar, Wallace, #1	1865	697	MT
23/32-10G1	Weishaar, Maurice	1885	430	M
23/32-17G1	Weishaar, Wallace, #2	1863	677	M
23/33-10J1	Zagelow, William F.	2115	750	M
23/33-14E1	Zagelow, Larry	2070	675	M
23/34-30C1	Null, Earl	2006	555	M
23/37-35A1	Bly, Dale, #1	2280	284	M
24/31-16E1	Almira Test Well (DOE)	1840	742	M

TABLE A.8

AVAILABLE GEOPHYSICAL LOGS (continued)

Lincoln County (Continued)

Township/Range Section ID	Owner	Elevation (ft MSL)	Depth (ft)	Log Type[1)]
24/33-23P1	Schmierer, Alvin	2090	1017	M
24/34-23F1	Bly, Dale, #2	2240	429	M
24/34-30P1	Nealey, Darwin	2115	759	M
25/33-07B1	Dreger, Bill	2150	375	N
25/34-29J1	Dreger, Richard	2282	1233	T
25/37-21L1	Davenport City #5	2410	490	M
25/37-21L2	Davenport City #6	2410	743	M
25/37-21L2	Davenport City #6	2410	525	IM
25/39-15D1	Reardan City	2500	851	M
26/32-10H1	Geib, Norman	2240	744	M
26/33-06J1	Wilbur Cemetery	2340	440	M
26/33-07L1	Wilbur City	2190	193	M
Spokane County				
23/41-01R1	Bell, Don	2390	90	IM
23/41-13C1	Cheney #1	2420	560	T
23/41-13C2	Cheney #2	2420	604	T
23/41-23B1	Cheney City Test Well	2370	607	M
23/41-23B1	Cheney City Test Well	2370	1003	N
23/41-23B1	Cheney City Test Well	2370	1120	IN
23/41-23B2	Cheney City #5	2370	2125	T
25/40-06N1	Carstens, George	2530	266	M
25/40-34H1	Jackman, H.	2340	332	M

TABLE A.8

AVAILABLE GEOPHYSICAL LOGS (continued)

Adams County

Township/Range Section ID	Owner	Elevation (ft MSL)	Depth (ft)	Log Type[1)]
19/31-10Q1	Kagele, James	1371	655	M
19/31-24G1	Kagele, Norman	1473	540	M
19/32-24K1	S & K Farms	1740	770	M
19/32-24N1	J & M Farms	1674	2245	M
19/33-08Q1	Hoefel, Paul	1842	730	M
19/33-08Q2	Hoefel, Paul, #2	1825	2433	M
19/34-20B1	Kagele, Melvin	1857	1124	M
19/35-14Q1	Ritzville City #2	1805	964	M
19/36-09K1	Gering, Gayle	1860	751	N
19/36-15A1	Gering, Gayle	1905	1241	M
19/36-21F1	Galbreath, Dale	1820	358	IM
19/36-22J1	Templin, Del	1864	292	M
19/36-22J1	Templin, Del	1864	650	M
19/36-34M1	Heinemann, Don	1769	450	M
19/36-34N1	Heinemann, Don, #2	1769	330	M
20/31-05C1	Kissler, Merlin	1645	561	M
20/33-16E1	Odessa Test Well (DOE)	1665	744	M
20/33-19B1	Schorzman, Ray	1775	777	M
20/34-02Q1	Weber, John	1950	653	M
20/34-10F1	Weizel, Leroy	1915	775	M

TABLE A.8

AVAILABLE GEOPHYSICAL LOGS (continued)

Adams County (Continued)

Township/Range Section ID	Owner	Elevation (ft MSL)	Depth (ft)	Log Type[1)]
20/34-25G1	Theil, Walter	1918	550	M
20/35-01M1	Franz, Harold	1930	790	M
20/35-17D1	Hardung, Lavine	1982	740	M
20/35-24D1	Ahern, Cliff	1945	516	M
20/35-27A1	Kagele, Richard	2005	757	IN
20/35-27A1	Kagele, Richard	2005	1200	IN
20/35-27A1	Kagele, Richard	2005	1193	M
20/36-08A1	Curtis, Bill	1909	475	M
20/37-04L1	Henning, C.H.	1888	410	M
Grant County				
19/27-02F1	Edwards, Robert	1140	265	M
19/27-31D1	Lauzier, Paul	1230	765	M
19/28-23D1	Moses Lake City #7	1065	920	M
19/28-23J1	Moses Lake City #5	1175	690	M
19/28-27C1	Moses Lake City #10	1057	660	M
19/28-28K1	Moses Lake City #4	1075	960	M
19/28-28K1	Moses Lake City #4	1075	960	M
19/28-29M1	Moses Lake City #31	1055	482	M
19/29-03F1	Fode, Roy	1330	526	IN
19/29-03F2	Fode, Roy, #2	1357	1054	M
19/29-03F2	Fode, Roy, #2	1357	714	IN

TABLE A.8

AVAILABLE GEOPHYSICAL LOGS (continued)

Grant County (Continued)

Township/Range Section ID	Owner	Elevation (ft MSL)	Depth (ft)	Log Type[1)]
19/29-04H1	Shinn, Frank, #2	1312	920	IM
19/29-09H1	Shinn, Frank, #1	1298	572	M
19/29-14J1	Jett-Aero #2	1350	320	M
19/29-14J1	Jett-Aero #2	1350	713	M
19/29-15A1	Masto Farms	1365	945	M
19/29-16N1	Carnation Company	1242	625	M
19/30-15L1	Radach, Jerry	1442	1178	M
19/30-16J1	Sparks, Dave (East)	1452	916	M
19/30-16M1	Sparks, Dave (West)	1440	952	M
19/30-17M1	Schmidt, Reuben	1420	729	M
19/30-20D1	Jett-Aero #1	1427	1020	M
19/30-28E1	Basin Produce	1378	697	M
20/29-07H1	Cole, E.B.	1295	700	M
20/29-15H1	Cole, Ivan	1365	522	M
20/29-25C1	Reinke Farms	1422	1326	M
20/29-35A1	Powers, Tom	1340	960	M
20/30-21G1	Claassen, Clint	1560	1164	M
20/30-21G1	Claassen, Clint	1560	1535	N
20/30-23A1	Franz, Herb, #2	1641	720	M
20/30-23E1	Franz, Herb, #1	1588	1103	M
20/30-28R1	Stucky, J. Jantz	1525	588	M

TABLE A.8

AVAILABLE GEOPHYSICAL LOGS (continued)

Grant County (Continued)

Township/Range Section ID	Owner	Elevation (ft MSL)	Depth (ft)	Log Type[1)]
20/30-32K1	Neibaur/West	1460	1252	M
21/24-25J1	Boruff, C.E.	1720	865	N
21/24-25J1	Boruff, C.E.	1720	1136	N
21/26-08N1	Ephrata City #5	1580	434	M
21/26-15H1	Ephrata City #10	1320	1856	T
22/28-25D1	Schafer, Jerry	1410	466	T
22/28-25Q1	Schafer, Jerry	1380	544	T
22/30-26G1	King, Bud	1673	787	M
22/30-26G1	King, Bud	1673	1565	MT
23/28-27E1	Schafer, Jerry	1700	643	T
23/29-23G1	Stevens, David	1650	582	T
24/28-11M1	Borst, Paul	1730	369	M
24/29-01A1	McPherson, Tom	1805	1044	M
25/28-13R1	Isaak, Larry, #3	1827	360	M
25/28-14P1	Isaak, Larry, #2	1667	440	M
25/28-24D1	Isaak, Larry	1824	342	M
25/28-24L1	Isaak, Larry, #1	1818	620	M
25/28-25B1	Dormaier, Lawrence	1820	570	M
25/28-26P1	Buob, Bill	1675	374	M
25/30-05[illegible]	[illegible]ormaier, George	1885	644	M

Source: [illegible] Washington State University (Ken Seymour, written [illegible] January 31, 1986).

1) [illegible] incomplete log suite, T= Translucent copy, [illegible] copy.

Table A.8 Sheet 6 of 6

TABLE A.9

RADIOCARBON AGE DATA, WSU STUDY

Field Sample #	W.S.U. Sample #	Well #	Owner, Town	Depth (feet)	Altitude land sur (ft)	Depth of Aquifer (ft)	Altitude Aquifer (ft MSL)	Temp. °F	Radiocarbon Age Yrs. B.P. 6)
1	894	15/37-34A1	Union Pacific R.R. Company, Hooper	184	1052 Alt.[1]	44-51 53-56 176-184	1000 999-996 876-863	59	4690 ± 280
2	896	15/39-2K1	City of LaCrosse	273	1564 Alt.	235-237	1329-1327	55	1600 ± 375
3	897	14/39-12F1	B. M. Stephenson, Hooper	81	1324 Alt.	~60-81	1264-1243	54	925 ± 275
4	899	15/36-28L	A. R. Sitko, Washtucna	130	1022 Alt.	~102-109	920-913	56	8700 ± 660
5	901	20/36-10E	R. C. Langenheder, Ritzville	176	1919 U.S.G.S. level.[2]	127-164	1783-1746	54	3030 ± 210
6				OMITTED					
7	902	20/34-23H	R. Miesner, Ritzville	98	1917 Alt.	60-90	1857-1827	52	4020 ± 160
8	903	18/35-25G	R. L. Plager, Ritzville	92	1617 Alt	63-92	1554-1525	51.5	Modern 101.7 ± 2.6%
9	904	19/36-11F	N. Krause, Ritzville	63	182 Alt.	49-54	1773-1738	52	6845 ± 320
10	907	18/37-29E	Union Pacific R.R., Marengo	260	1635 7.5' map[3]	(199-260)	1436-1365	54	4065 ± 250

Sheet 1 of 5

TABLE A.9

RADIOCARBON AGE DATA, WSU STUDY (continued)

Field Sample #	W.S.U. Sample #	Well #	Owner, Town	Depth (feet)	Altitude land sur. (ft)	Depth of Aquifer (ft)	Altitude Aquifer (ft MSL)	Temp. °F	Radiocarbon Age Yrs. B.P. 6)
11	913	19/32-4J	J. Greenwalt, Jr., Ritzville	290	1584 Alt.	187-205 229-248	1397-1379 1355-1336	58	8990 ± 275
12	912	18/36-4M	H. Teske, Ritzville	151	1778 U.S.G.S. level	128-149	1650-1629	55	4870 ± 380
13	935	20/35-12D1	H. Franz (G. Kubik), Ritzville	197	1952 Alt.	150-170	1760-1740	52.7	1065 ± 275
14	936	17/37-17R	R. Harder, Benge	214	1599 Alt.	194-214	1405-1385	56.2	5530 ± 280
15	937	15/34-30A1	L. Watson, Lind	245	1400 Alt.	181-196	1219-1204	55.7	1560 ± 265
16	938	14/34-33JK	W. G. Harder, Kahlotus	120	947 Alt.	80-120	867-827	56.2	4480 ± 250
17	934	23/41-1J1	W. E. Lee (Mr. Godwin), Cheney	89	2378 Alt.	(78-89)	2300-2289	47.2	1880 ± 200
18	939	24/41-7[illegible]	J. L. Eccles, Medical Lake	107	2413 Alt.	(95-107)	2318-2306	48.6	11,625 ± 750
19	940	24/42-22G1	T. Martensen, Marshall	124	2237 Alt.	(70-124) assum.	2167-2113	47.3	Modern 103 ± 2.17
20	941	23/36-15K2	Town of Harrington	300	2145 Alt.	262-300	1883-1845	55.3	5000 ± [illegible]

TABLE A.9

RADIOCARBON AGE DATA, WSU STUDY (continued)

Field Sample #	W.S.U. Sample #	Well #	Owner, Town	Depth (feet)	Altitude land sur. (ft)	Depth of Aquifer (ft)	Altitude Aquifer (ft MSL)	Temp. °F	Radiocarbon Age Yrs. B.P. 6)
21	942	19/40-25C1	J. P. Glorfield (R. Loomis), St. John (Ewan)	98	1741 Alt.	90-98	1651-1643	57.2	11,050 ± 690
22	943	18/40-2A2	E. M. Hays, Ewan	140	1849 Alt.	120-140	1729-1709	52.7	Modern 112 ± 2%
23	944	25/39-2P	Town of Reardan	300	2524 Alt.	(261-295)	2263-2229	51.8	1805 ± 200
24	9[illegible]5	23/38-12A	Great Northern R.R., Edwall	82	2329 Alt.	62-82	2347-2267	56.2	1[illegible],275 ± 1465
25	946	26/33-19D	A. McInroy, Wilbur	233	2159 Alt.	223-233	1936-1926	54.2	7225 ± 225
26	947	26/32-26D1	J. F. Rosman, Wilbur	166	2043 Alt.	153-164	1890-1872	51.8	10,900 ± 485
27	949	26/32-16F	Sheffels Co., Wilbur	233	2113 Alt.	171-176	1942-1937	53	5030 ± [illegible]65
28	952	23/37-29F	H. Armstrong, Harrington	213	2182 Alt.	185-213	1997-1969	52.7	2610 ± 2[illegible]5
29	948	21/33-24B	J. Scrupps, Odessa	120	1800 U.S. top. map*	~100	~ 1700	55.8	Modern 162 ± 2.67%
30	953	27/32-28B	J. Sheffels, Wilbur	212	2222	110-125 170-205	2112-2097 2052-2017	52.9	5340 ± 350

TABLE A.9

RADIOCARBON AGE DATA, WSU STUDY (continued)

Field Sample #	W.S.U. Sample #	Well #	Owner, Town	Depth (feet)	Altitude land sur. (ft)	Depth of Aquifer (ft)	Altitude Aquifer (ft MSL)	Temp. °F	Radiocarbon Age Yrs. B.P.[6]
31	954	20/39-28C1	Town of Lamont	202	1961 Alt.	162-198	1799-1763	53.3	3020 ± 280
32	955	25/42-33K	Starlite Motels Inc., Spokane	156	2340 7.5' map	154-156	2186-2184	51.5	Contamin. 856% ± 1.5%
33	958	19/35-26C1	M. Galbreath, Ritzville	200	1862 Alt.	185	1677	56.5	2840 ± 335
34	964	26/33-29Q	H. Eux, Wilbur	288	2208 Alt.	(120-130) (250-270) 280-288	2088-2078 1958-1938 1928-1920	55.2	4660 ± 350
35	976	23/33-10A	W. F. Zagelow, Odessa	146	2075 Alt.	(135-146)	1940-1924	56.8	5800 ± 400
36	959	18/38-21D	R. Spencer, Ser e	~118	1694 Alt.	(-100)	~1594	50.2	Modern 133.35 ± 2.6%
37	960	17/35-15Jr	J. D. Haase, Ritzville	74	1730 Alt.	(74)	1556	54	1086 ± 185
38	961	25/36-34M	P. H. Janett, Davenport	148	2389 Alt.	134-148	2256-2242	51	2120 ± 280
39	962	24/38-29D	E. E. Warwick, Davenport	150	2342 Alt.	147-150	2253-2250	52	2440 ± 270
40	977	22/33-2K1	A. Sackman, Odessa	165	1930 Alt.	(149-165)	1771-1755	55.8	2720 ± 300

TABLE A.9

RADIOCARBON AGE DATA, WSU STUDY (continued)

Field Sample #	W.S.U. Sample #	Well #	Owner, Town	Depth (feet)	Altitude land sur. (ft)	Depth of Aquifer (ft)	Altitude Aquifer (ft MSL)	Temp. °F	Radiocarbon Age Yrs. B.P.[6]
41	978	21/35-7A1	E. W. Iverson, Odessa	116	2000 U.S. top map	~100	1900	55.9	6250 ± 400
42	979	21/35-7G1	E. W. Iverson, Odessa	607	2020 U.S. top map	109-123 592-607	1911-1897 1428-1413	54	Modern 157% ± 2.5%
43	980	16/39-27 GHJK	J. S. Schlomer, Benge	156	1565 Alt.	132-156	1433-1409	58.5	5980 ± 390
44	981 982	25/35-4H1	State Highway Dept., Davenport	90	2339 Alt.	(21-90)	2318-2249	53.1	4680 ± 360 4660 ± 395
45	985	19/40-21N1	Clorfield Bros., Ewan	278	1821 7.5' map	194-278	1627-1543	50.7	5250 ± 350
46	989	17/40-26A1	C. S. Storment, Endicott	101	1640 15' map[5]	(62-101)	1578-1539	56.8	Modern 147% ± 2.4%

1 Altitudes measured with altimeter.
2 Altitudes established by the levelling of U.S. Geological Survey.
3 Altitudes established from 7.5' topographic maps.
4 Altitudes established from 1:250,000 topographic maps.
5 Altitudes established from 15' topographic maps.
6 See Fig. 2.22.

Source: Silar, 1969.

TABLE A.10

SELECTED ISOTOPIC DATA, USGS REGIONAL STUDY

USGS Station ID[1)]	Township/Range Section ID[3)]	Date of Sample	C^{13}/C^{12} Ratio (per M)	H^2/H^1 Ratio (per M)	O^{18}/O^{16} Ratio (per M)	C^{14} Percent Modern	USGS Map No.[2)]
473640119355601	24/26-06H01	07/27/82	-13.7	--	--	75.4	--
473443118531501	24/31-14E01	07/23/82	-12.8	--	-17.5	35.5	--
473443118531501	24/31-14E01	06/03/83	-12.7	-135.0	-17.6	35.8	--
473908120042.01	25/22-21H01D1	07/29/82	-13.4	--	-17.7	67.8	--
473648118452301	25/32-35P01	09/09/82	-12.8	--	-17.8	8.0	407
473648118452301	25/32-35P01	06/04/83	-11.6	-144.0	-17.9	5.8	407
473829118382901	25/33-27A02	06/03/83	--	-134.0	-17.0	--	409
474142118235501	25/35-03E01D1	06/02/83	-17.7	-121.0	-15.4	51.5	410
473848118091901	25/37-21L04	06/01/83	-13.0	-144.0	-18.6	5.0	413
473832118081801	25/37-27E01	05/31/83	—	-127.0	-16.3	—	414
474337118454201	26/32-26D01	07/23/82	-14.4	--	-16.6	38.0	--
474337118454201	26/32-26D01	06/04/83	-14.4	-130.0	-16.8	39.0	--

1) Source: USGS WATSTORE file retrieval (January 24, 1986). These stations represent a subset of those described on Table 2.3.

2) See Fig. 2.11.

3) Township(N)/Range(E)-Section with subsection designation.

NRC FORM 335 (2-84) NRCM 1102, 3201, 3202 — U.S. NUCLEAR REGULATORY COMMISSION

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12. SUPPLEMENTARY NOTES

13. ABSTRACT (200 words or less)

This report provides a general but comprehensive characterization of hydrogeologic and hydrogeochemical baseline conditions for the Creston area located along the northern rim of the Columbia Plateau physiographic province. Historical as well as recent data and other available information from previous studies and alternative sources have been considered in this baseline hydrological characterization. These include data and information on water levels, aquifer characteristics, and water quality for shallow basalt units comprising the Wanapum Formation and the Grande Ronde Formation in the Creston study area and for the general region surrounding this study area. The overall goal of this hydrologic characterization was to provide useful information leading to the selection of the Roza Member of the Wanapum Formation as the study's basalt horizon and for other related, subsequent study components of In-Situ's research project.

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