Research Technical Completion Report

IMPACTS OF INDIVIDUAL ON-SITE SEWAGE DISPOSAL FACILITIES ON MOUNTAIN VALLEYS - PHASE II - WATER-QUALITY CONSIDERATIONS

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May, 1984

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CONTENTS

CONTENTS (cont)

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

A rapid increase in residential development utilizing primarily on-site sewage disposal systems is occurring in the Big Wood River valley in Idaho. This project evaluated the hydrologic characteristics of the Big Wood River and aquifer systems, addressing ground-water characteristics, ground-water/surface-water relationships, and water quality related to on-site sewage disposal systems.

Ground water is unconfined and often occurs close to land surface in unconsolidated valley-fill deposits, which range from less than 40 feet to more than 180 feet in thickness. Ground-water underflow at Hailey was calculated to be approximately 40,000 acre-feet per year.

A ground-water quality network of approximately 50 wells was established from which samples were collected in July-August, 1983. Approximately 20 wells were then selected from which samples were collected about every 6-8 weeks through March, 1984. The mean concentrations of nitrate-n, chloride, and orthophosphate were 0.53, 2.4, and .013 mg/L, respectively. Nitrate-n concentrations ranged from 0.1 to 2.2 mg/L, well below the USEPA recommended limit of 10 mg/L. The mean specific conductance was 371 micromhos/cm at 25^{o} C. Mean concentrations of nitrate-n, chloride, and orthophosphate from surface-water samples were 0.44, 1.8, and .015 mg/L, respectively.

Ground-water levels were measured in approximately 60 wells from which a water-table contour map and a ground-water/surface-water profile were constructed for July-August, 1983. The profile indicates hydraulic connection between ground water and surface water in much of the study area.

Discharge measurements made in the Big Wood River and tributaries indicate the river gained approximately 156 cfs between Ketchum and Hailey in September, 1983, and gained approximately 84 cfs within the same reach in March, 1984. The river lost approximately 57 cfs between Hailey and Glendale Bridge in September, 1983.

ACKNOWLEDGMENTS

The authors wish to thank the many individuals who allowed access to their wells and water-supply systems. This project would not have been possible without their cooperation. We wish to acknowledge the valuable assistance of personnel from Bellevue, Hailey, Ketchum, Sun Valley, and from Blaine county. We would also like to acknowledge the assistance of scientists from the U. S. Department of Agriculture, Kimberly, Idaho: we wish to name Dr. D. L. Carter, for his assistance with the orthophosphate analyses; Dr. T. W. Massee, for his assistance with the statistical analyses; Dr. C. W. Robbins, for his assistance with the chloride analyses; and Dr. D. T. Westermann, for his assistance with the nitrate analyses.

INTRODUCTION

Statement of the Problem

Rapid increases in residential development utilizing primarily on-site sewage disposal systems are occurring in the Big Wood River valley in Idaho. Ground water supplying private wells and small community water systems serves as the water supply for much of the population in the valley. Although conditions favor the potential contamination of ground-water supplies, the effects of on-site sewage-disposal systems on water resources in the Big Wood River valley have not previously been adequately assessed.

Blaine county and local city government planning personnel require knowledge of the hydrologic system and of current and future water quality conditions to aid in effective planning decisions. This knowledge can best be obtained by directed, comprehensive water-resources research programs.

Purpose and Objectives

The University of Idaho has evaluated potential effects of on-site sewage disposal systems on water quality in the Big Wood River valley. Phase I of this research was directed towards determining building densities and population trends, and predicting nutrient loads on the ground-water system. Phase II evaluated the hydrologic characteristics of the Big Wood River and aquifer systems, addressing ground-water flow system characteristics, ground-water/surface-water relationships, and water quality.

The objectives of this study were to:

1. Evaluate current or pontential water-quality problem areas based on results of Phase I.

2. Set up a ground-water quality monitoring network of existing wells from which water-quality samples could be taken.

3. Establish a ground-water quality data base.

4. Begin to evaluate the ground-water flow system, including construction of a water-table map.

5. Determine river/aquifer hydraulic relationships.

Location and Extent of Study Area

The study area is located within northern Blaine County (fig. 1), and includes primarily the valley areas of the Big Wood River and its tributaries between approximately North Fork Big Wood River and 3 miles south of Bellevue. The study area includes part or all of Townships 1 through 5 North, Ranges 17, 18, and 19 East. The cities of Ketchum, Sun Valley, Hailey, and Bellevue are located within the study area.

Previous Investigations

The water resources of the Big Wood River area were briefly discussed as sections of U. S. Geological Survey Water-Supply Papers 774 (Stearns et al., 1938) and 1654 (Mundorff et al., 1964). Smith (1959) and Castelin and Chapman (1972) described the water resources of the middle Big Wood River-Silver Creek area north to include Township 2 North. Castelin and Winner (1975) studied the effects of urbanization on the water resources of the area. Luttrell and Brockway (1982) determined current and projected building densities in the study area, and evaluated potential impacts of on-site sewage disposal systems on ground-water quality.

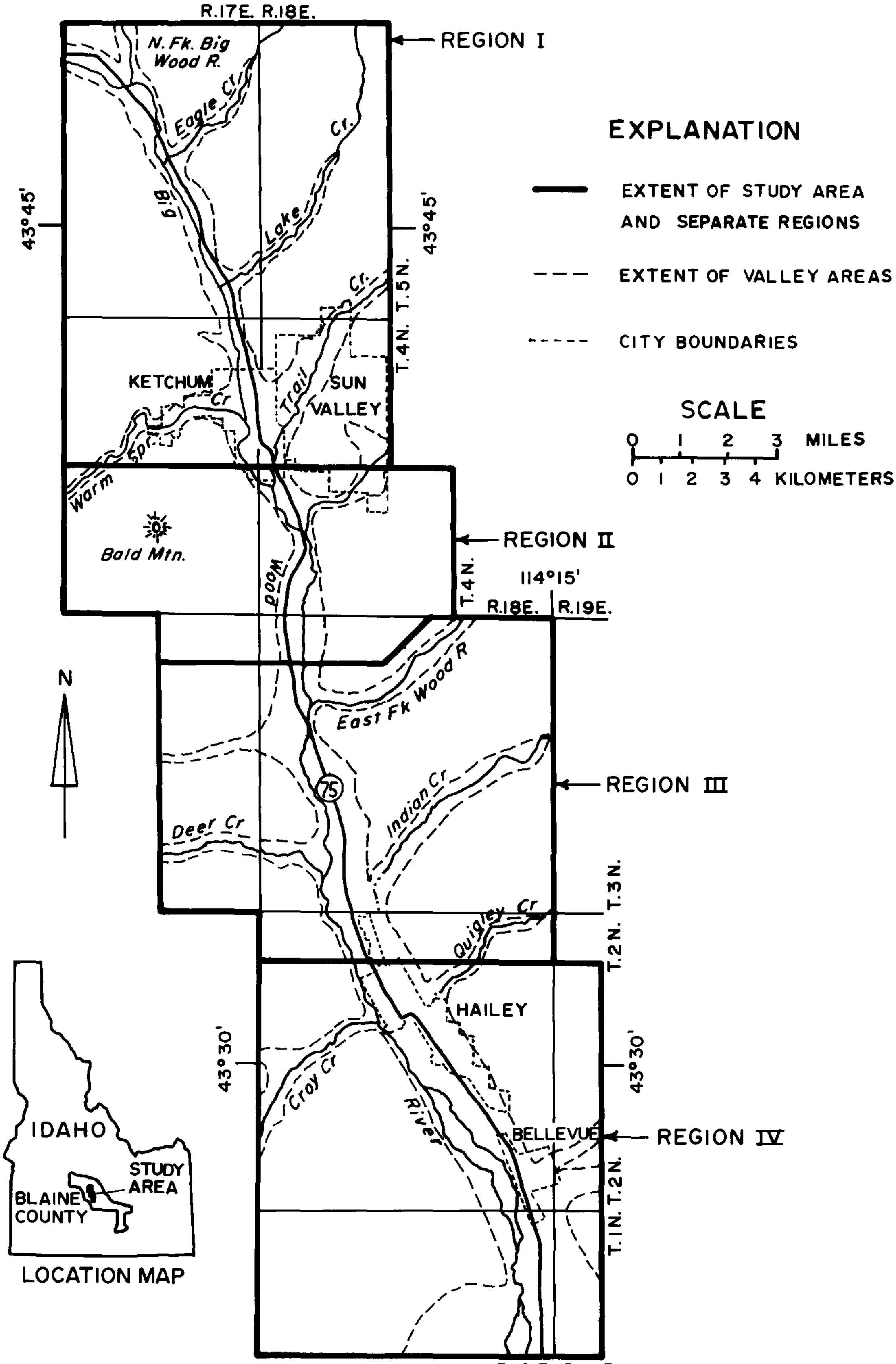


Figure 1.- Location and extent of study area and Region subareas.

PHYSICAL SETTING

Geographic Setting

Topography

Steep, rugged mountains, some with peaks exceeding 10,000 feet in altitude, rise sharply from the Big Wood River valley, which is relatively narrow and flat. The valley floor ranges in width from approximately one-quarter to one and one-half miles until it widens south of Bellevue. Tributary valley floors range in width from approximately one-eighth to one-half mile. The altitude of the valley floor is approximately 5,040 feet at the southern study boundary and approximately 6,240 feet at the mouth of North Fork Big Wood River.

Climate

The climate of the area is characterized by moderately cold winters and short, warm and dry summers. The average frost-free period is 95 days. Precipitation averages 17.3 inches annually at Sun Valley and slightly more than 15 inches annually at Hailey. The surrounding mountains receive considerably more precipitation, possibly more than 40 inches annually (Pacific Northwest River Basins Commission, 1969).

Economy

Prior to the mid-1960′s the economy of the study area depended primarily on agriculture and ranching. The economy is currently dependent on tourism and recreation, resulting in a large transient population. The resident population is employed largely in service-oriented occupations such as merchandising and construction. The total assessed valuation in Blaine county was approximately $7,440,000 in 1960, and $758,180,000 in 1982 (Blaine county assessor, 1982).

Land use and population

Agricultural land in much of the study area has been converted to residential development. The current area of irrigated agricultural land has not been recently determined, however the total area of valley floor above Hailey outside of platted subdivisions and city boundaries is about 7,500 acres. The area of irrigated agricultural land is probably much less than 7,500 acres (see Luttrell and Brockway, 1982).

The current Blaine county zoning ordinance was enacted in 1977. The ordinance accomplishes objectives of the Blaine County Comprehensive Plan (Blaine County Planning and Zoning Commission, 1975, p. 48) by containing current and future development within the middle and upper Big Wood River valley, and by reducing the former residential zoning densities. The current zoning districts are shown on figures 2 through 5. In 1982 there were about 85 approved subdivisions in the study area, with a planned build-out of 2,151 units. The 1982 build-out was 713 units, or 33 percent of those planned. The locations of the subdivisions and the 1982 building densities of the subdivisions are shown on figures 2 through 5.

As development increases on residentially-zoned lands, agricultural land use will necessarily decrease. In 1974, close to 100 percent of the property owners in the study area stated the intent to develop some degree of residential use over the following 20 years (Blaine County Planning and Zoning Commission, 1975, p. 47). Under the current zoning ordinance, 1,520 acres are designated productive agriculture, all of which lie south of Bellevue. Should residential development continue to its maximum under current zoning, it is possible that no land north of Bellevue would be under agricultural production.

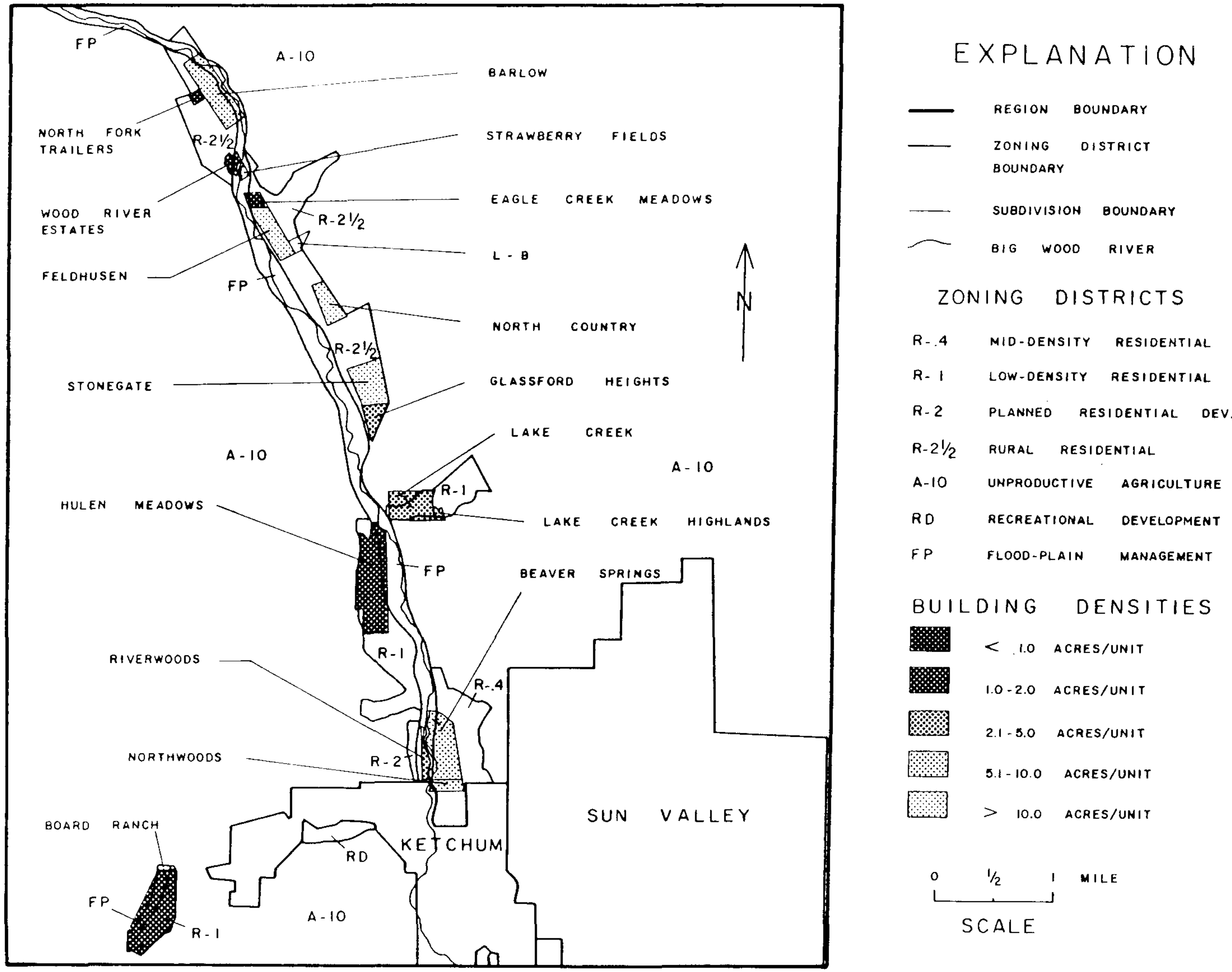


Figure 2.--Locations of current subdivisions and zoning districts, and 1982 building densities of non-sewered areas within Region I.

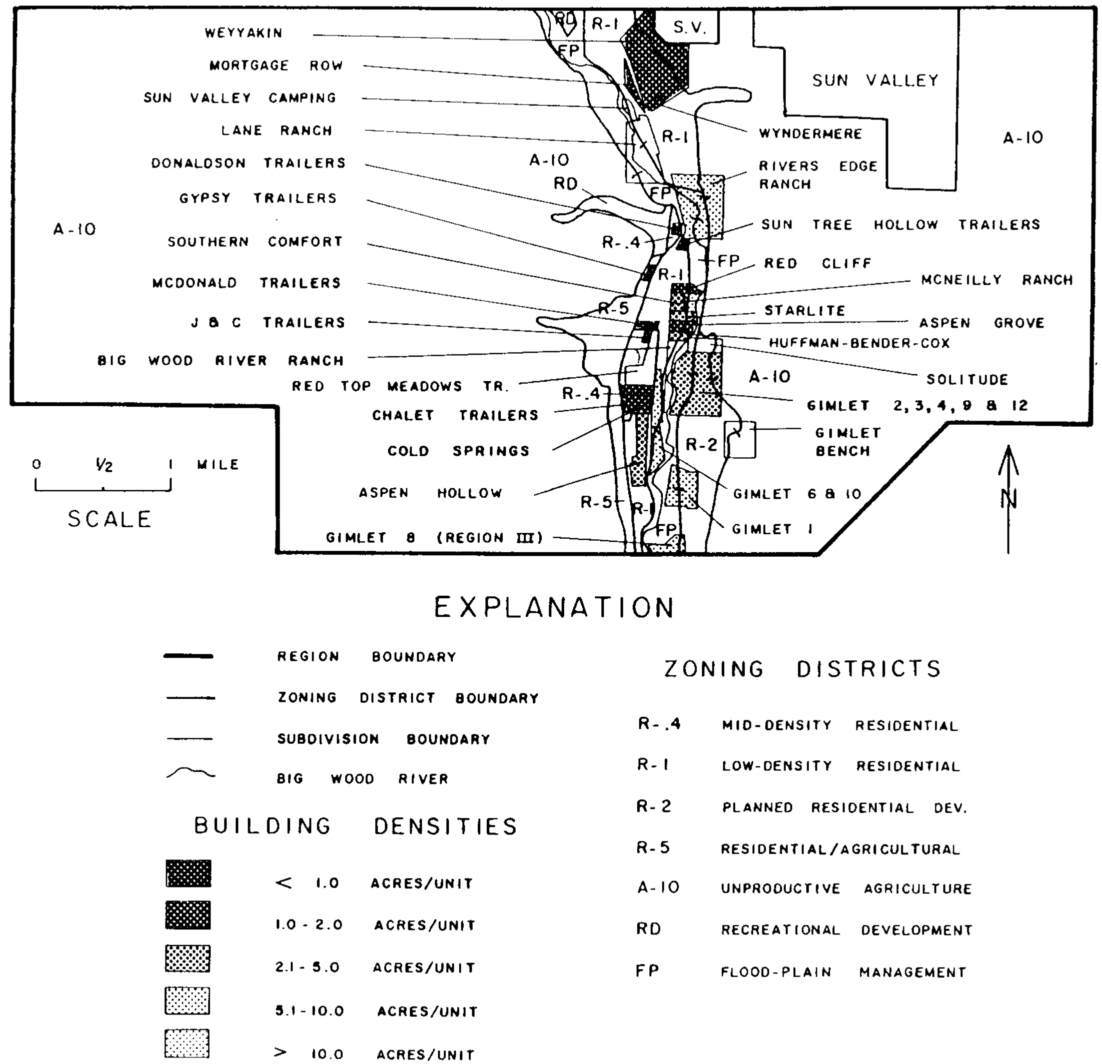


Figure 3.--Locations of current subdivisions and zoning districts, and 1982 building densities of non-sewered areas within Region II.

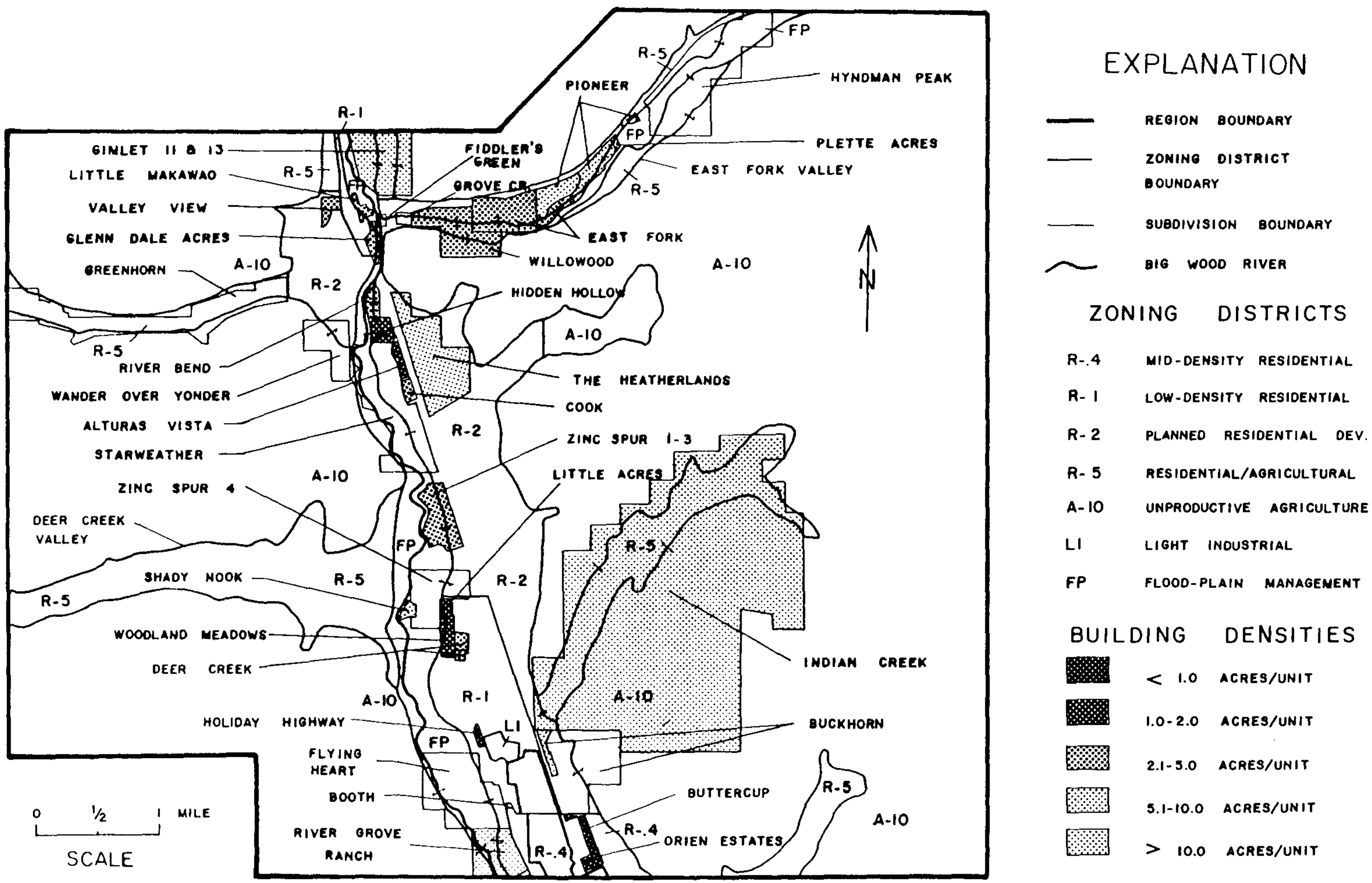


Figure 4.--Locations of current subdivisions and zoning districts, and 1982 building densities on non-sewered areas within Region III.

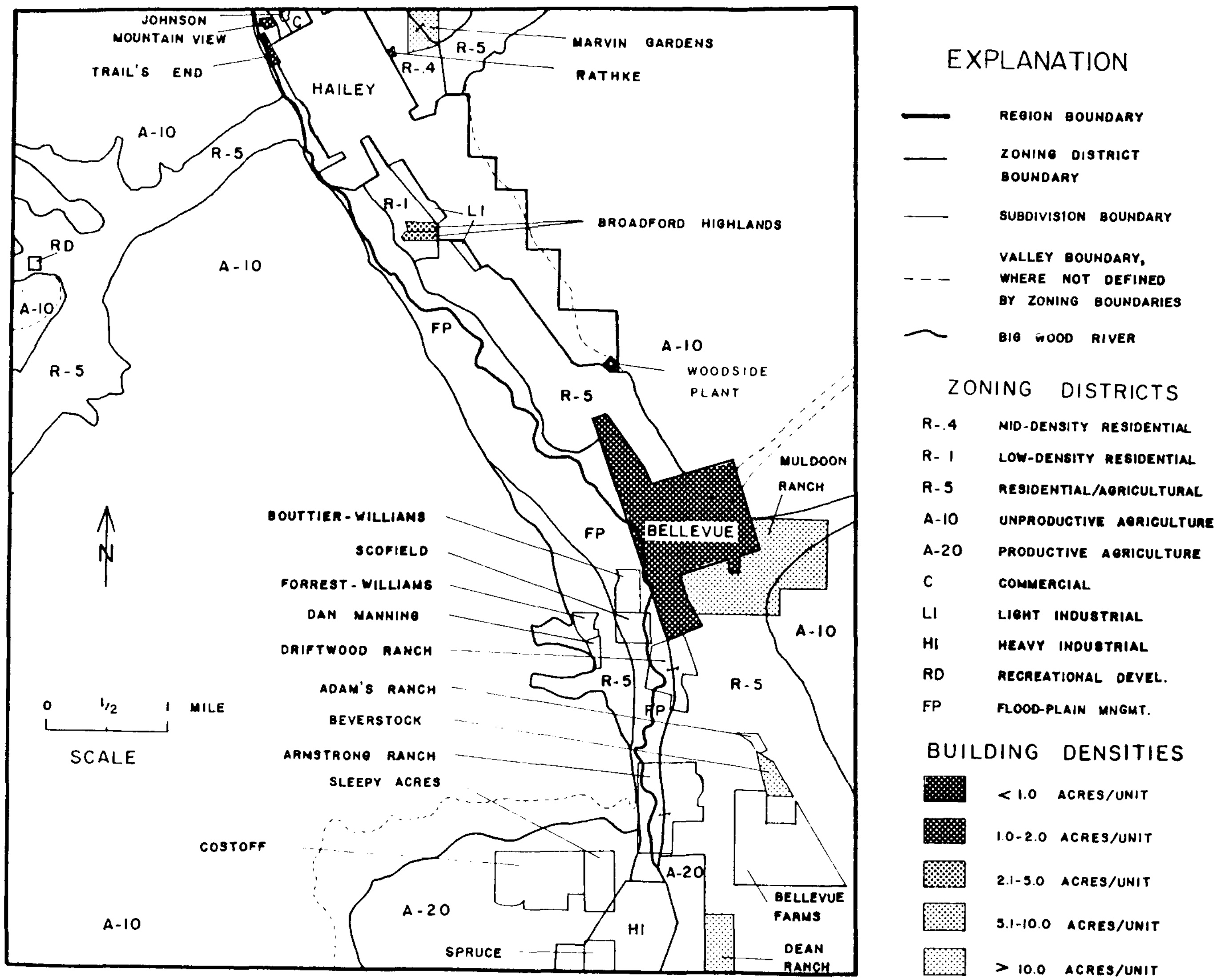


Figure 5.--Locations of current subdivisions and zoning districts, and 1982 building densities of non-sewered areas within Region IV.

Future residential development and population growth will depend largely on the national economy and recreational development trends. Population trends related to a recreational economy are difficult to predict. The 1990 projection of population for the study area is estimated to be about 15,000, and the maximum projected permanent population is estimated to be about 21,680 (Luttrell and Brockway, 1982, p. 26, 27). The maximum projected permanent population for non-sewered areas in the study area is estimated to be about 15,030.

Geologic Formations and Their Water-Bearing Characteristics

A detailed discussion of the geology of the Big Wood River region is included in Geological Survey Bulletin 814 (see Umpleby et al., 1930). Rocks within the study area can be grouped into two general categories: 1) consolidated sedimentary and igneous rocks; and 2) unconsolidated fluvioglacial and alluvial material. A generalized geologic map including the study is presented in figures 6 and 7.

Consolidated rocks

Consolidated rocks generally compose the mountains in the area, which surround the valley floors. These rocks underlie the unconsolidated valley-fill deposits, generally at a shallow depth. Sedimentary rocks include sandstone, limestone, and shale of predominantly Pennsylvanian and Mississippian age. Igneous rocks include extrusive lava flows of latite, andesite, and basalt of Tertiary age, and some granite and diorite of Cretaceous age. Extensive faulting and folding have occurred in the area resulting in complex stratigraphy and structure.

The consolidated rocks generally have very low hydraulic conductivity, and may serve as the impermeable boundaries of major

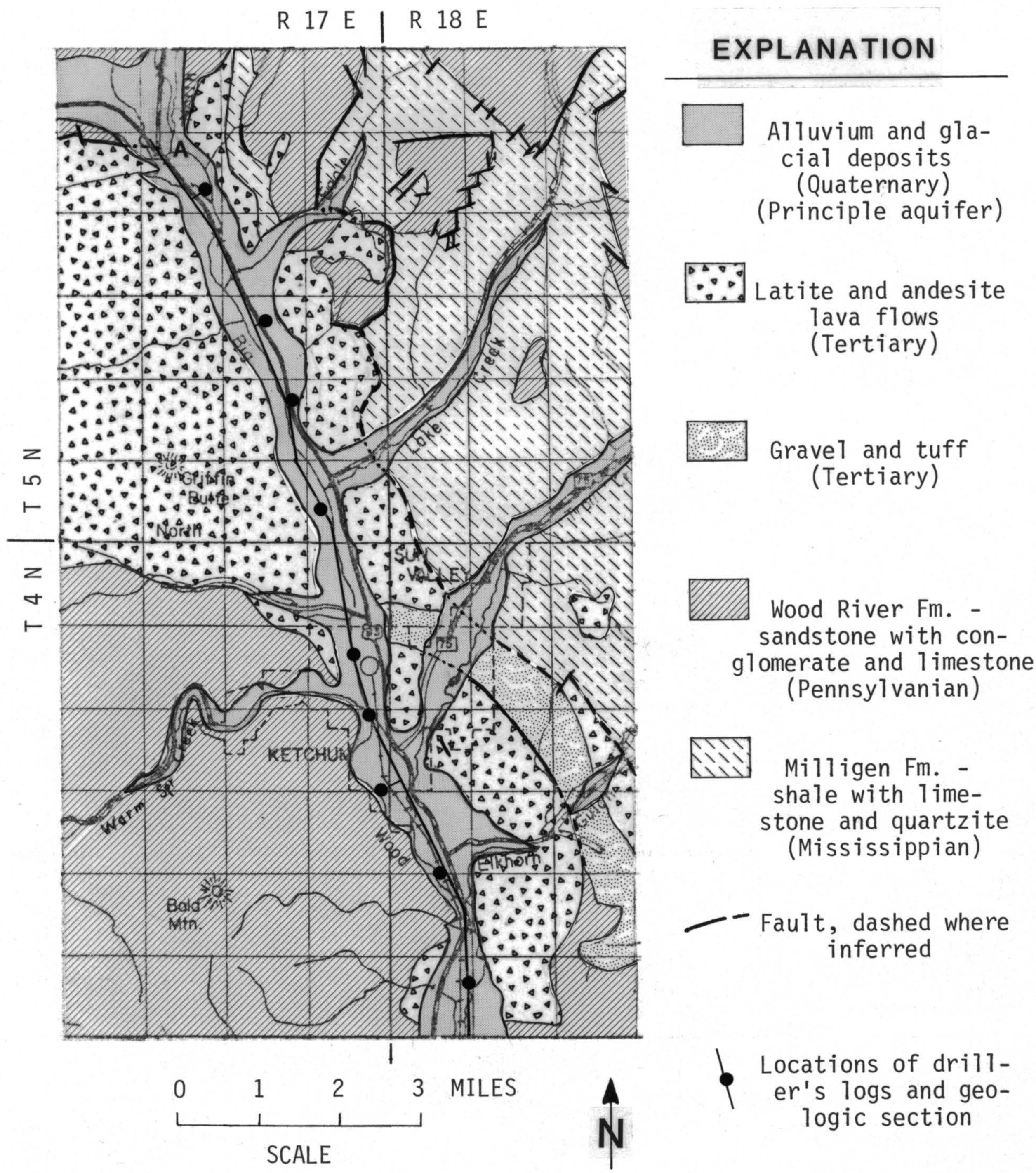


Figure 6.- Geologic map including the northern part of the study area (after Umpleby and others, 1930).

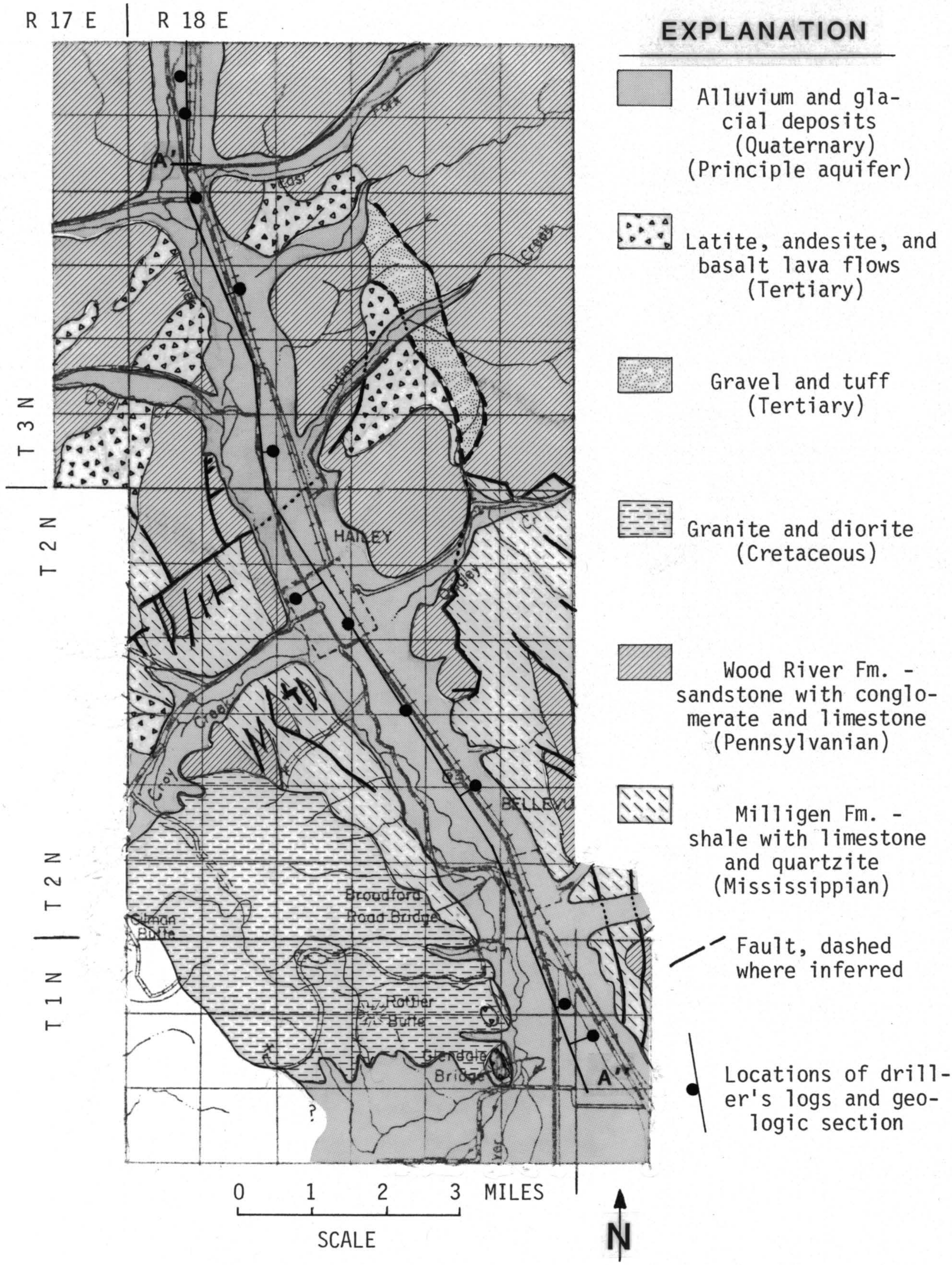


Figure 7.- Geologic map including the southern part of the study area (after Umpleby and others, 1930).

water-yielding zones. However, locally where jointed and fractured they may yield significant quantities of water. Several important springs, including geothermal, issue from these rocks in and near the study area.

Unconsolidated materials

Unconsolidated deposits make up the valley fill. These deposits include primarily coarse sand and gravel interfingered with clay and silt. The depth of the valley-fill deposits (as obtained from driller's logs) is shown on the geologic profiles in figures 8 and 9. These deposits range from a minimum thickness of approximately 30 feet in the vicinity of Ketchum, to a maximum thickness of greater than 180 feet north of Hailey. These profiles are considered preliminary due to the scarcity of wells which reach bedrock, and also due to questionable driller's logs.

The valley-fill deposits constitute the major aquifer in the study area, and well yields up to 2,000 gallons per minute from these deposits are known. Specific capacities range from a few to more than 200 gpm/ft. Smith (1959, p. 21) assumed the transmissivity of the aquifer in the Hailey vicinity to be approximately 950,000 gpd/ft based on aquifer tests at other locations.

Hydrologic Setting

Surface water

The Big Wood River and its tributaries drain the study area. Major tributaries of the Big Wood River include North Fork, Lake Creek, Warm Springs Creek, Trail Creek, East Fork, Deer Creek, and Croy Creek. Several smaller intermittent tributaries also contribute to the Big Wood River.

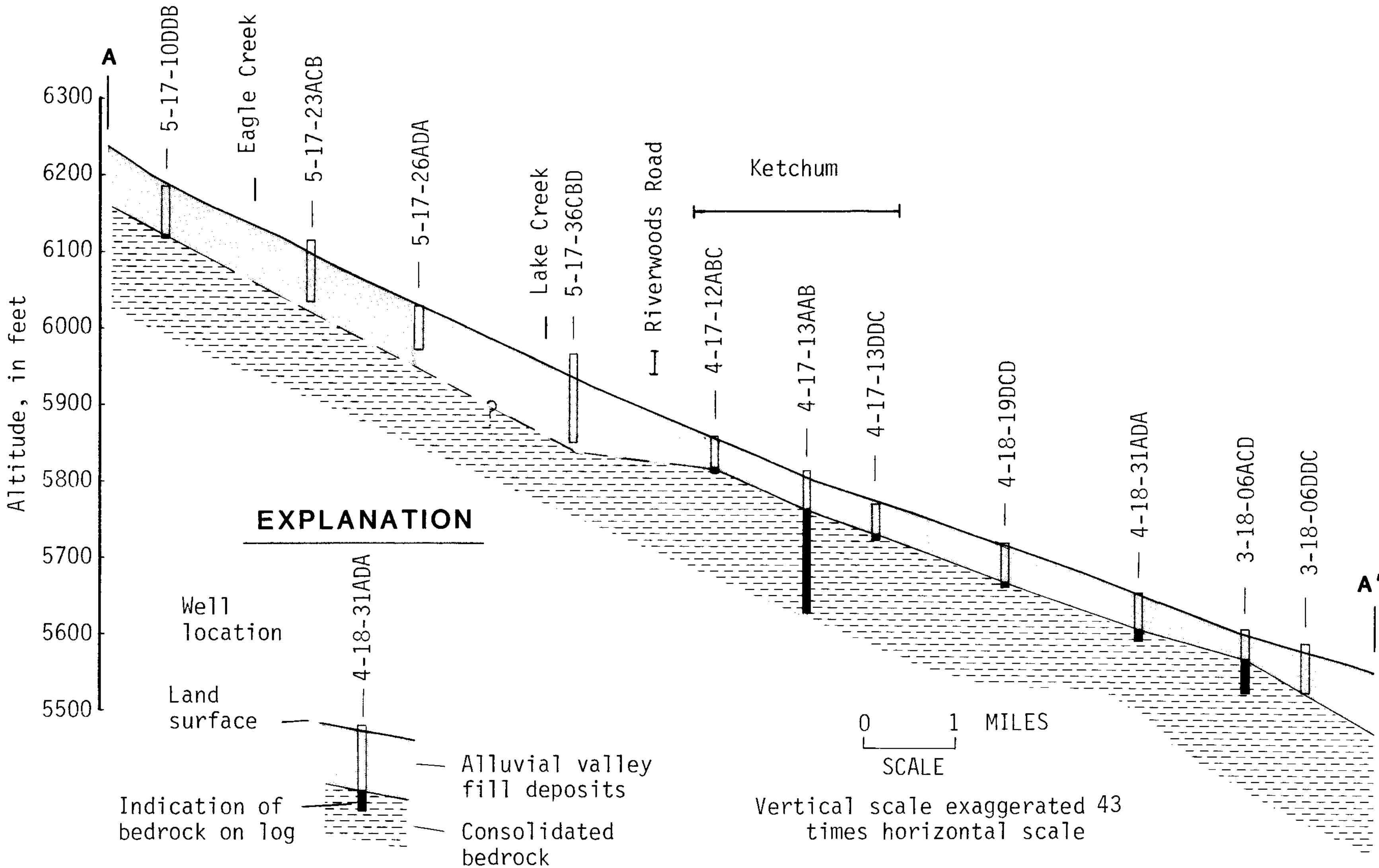


Figure 8.- Generalized geologic profile indicating the approximate maximum thickness of the unconsolidated valley-fill deposits in the northern part of the study area.

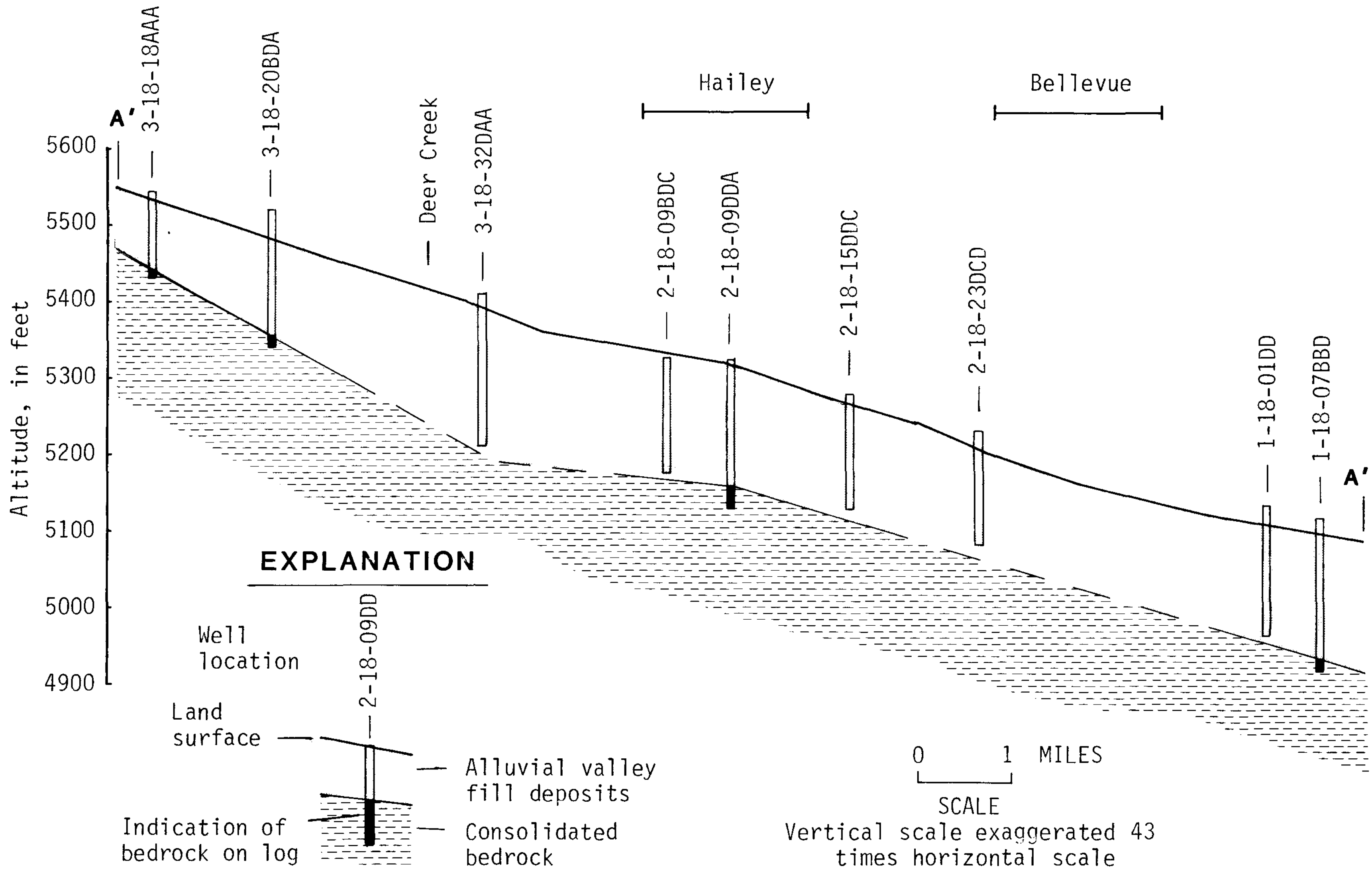


Figure 9.- Generalized geologic profile indicating the approximate maximum thickness of the unconsolidated valley-fill deposits in the southern part of the study area.

The 67-year average discharge of the Big Wood River at the Geological Survey stream-flow gaging station at Hailey is 451 cubic feet per second (cfs), or 326,700 acre-ft/yr (U. S. Geological Survey, 1982). Much of the flow of the Big Wood River is diverted for irrigation, and in many years the river bed is dry where it leaves the study area.

Ground water

Ground water is generally unconfined in the valley-fill deposits. Ground water occurs at very shallow depths in some parts of the flood plain, and at depths up to 100 feet below land surface on the river terraces or alluvial fans. The ground-water/surface-water systems are hydraulically connected in several reaches north of Bellevue. These relationships are examined and discussed in more detail later in this report. Smith (1959, p. 21) estimated the ground-water underflow past Hailey to be about 34,000 acre-ft/yr.

An analysis of available data indicates that a single, unconfined aquifer exists in the alluvial and fluvioglacial deposits. Many layers of clay are present in these deposits, but they are not laterally extensive so they do not act as major confining beds. The hydraulic potential within this aquifer does not vary significantly with depth, therefore ground-water flow in this system is essentially horizontal. Recharge to the aquifer is primarily from precipitation infiltration and percolation, tributary valley underflow, and stream and canal seepage losses. Discharge is both man-induced, by well pumping; and natural, by discharge into the Big Wood River and by evapotranspiration where the water table is close to or at ground surface.

Ground-water flow systems also exist within the consolidated rocks, however they are probably limited to fracture or fault zones. Some of these systems discharge water in the form of springs, such as Guyer Hot Springs and the cold springs which supply water to Hailey and Bellevue. These flow systems may also discharge into the aquifer system within the alluvial deposits, thus affecting aquifer water quality.

METHODS OF STUDY

Well- and Site-Numbering System

The well- and site-numbering system is that used by the U. S. Geological Survey (USGS). The first two segments of the number designate the township and range, with reference to the Boise base line and meridian. (All locations in this report are North and East of the Boise base line and meridian, respectively, so N and E designations are often omitted). The third segment indicates the section number, followed by three letters and (usually) a numeral. The letters and numeral represent the quarter section, the 40-acre tract, the 10-acre tract, and the serial number of the well within the tract, respectively. Quarter sections are lettered A, B, C, and D in counter-clockwise order from the northeast quarter. 40-acre and 10-acre tracts within the quarter are lettered in the same manner (see figure 10). Well 9-18-34DDA1 is in the NE1/4, SE1/4, SE1/4, sec. 34, T.9N., R.18E., and was the first well inventoried in that tract. Surface-water sites are designated by the letter `S´ rather than the serial number following the last letter.

Overall Approach

The results in this study are intended to be used especially by Blaine county and local city government personnel in making planning decisions. The overall approach taken for this study therefore utilized land-use and sewage-disposal information obtained from Phase I (see Luttrell and Brockway, 1982) in conjunction with hydrogeologic and well data compiled in the preliminary stages of this study.

Ground-Water Well Network

The general hydrogeologic framework was conceptualized as an

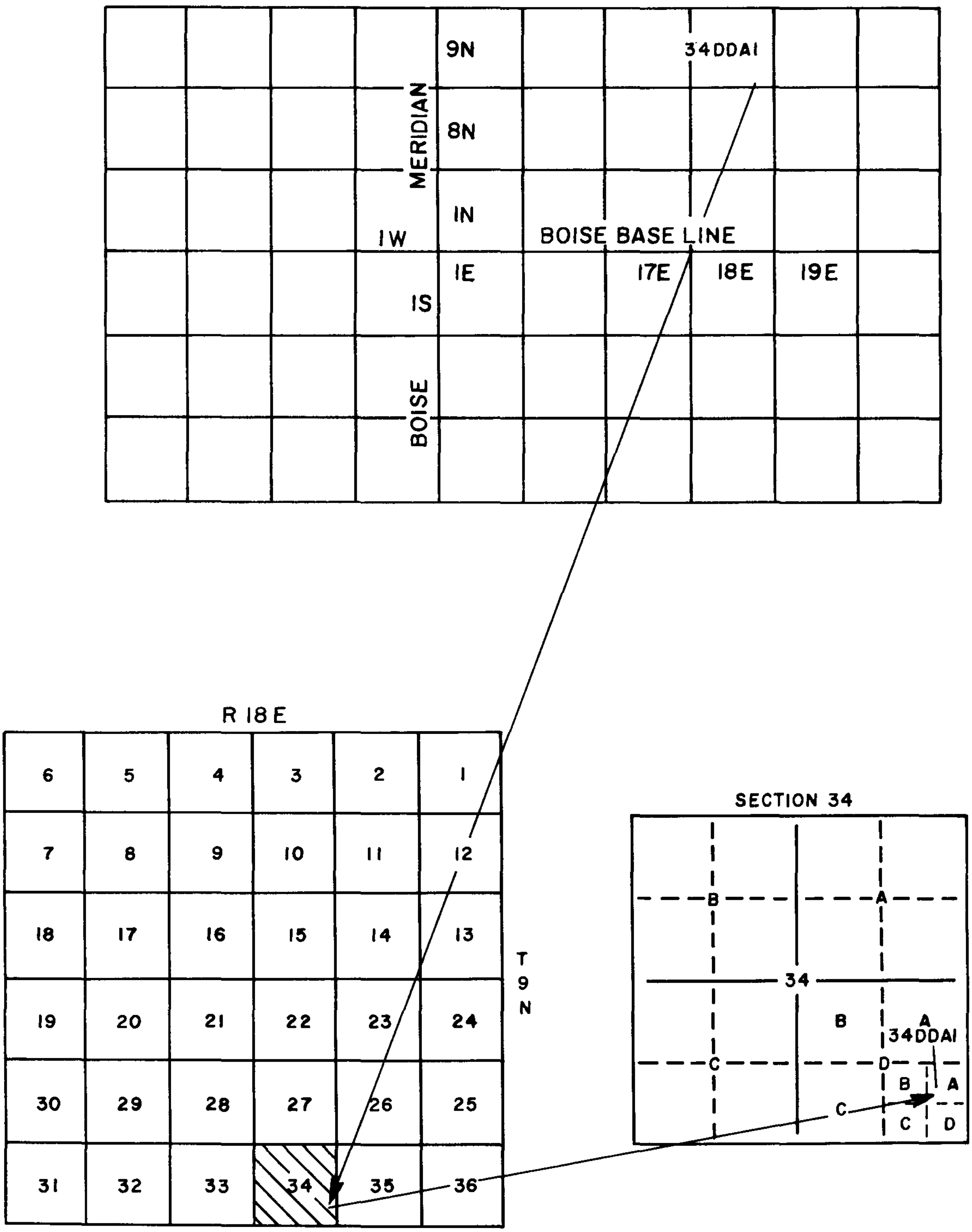


Figure 10.- Well-numbering and location system.

initial step in designing the ground-water monitoring network. Water-quality samples were collected, and depth-to-water measurements were made at selected wells. The locations of the wells are shown on figures 11 through 14.

Ground-water quality network

Primary criteria for consideration of sites to be included in the ground-water quality network consisted of the following:

1. Land-use and sewage disposal considerations -- Several areas were indicated in Phase I as being areas of pontential contamination of ground water based on density of building, type of water supply system, and types of sewage disposal systems utilized.

2. Hydrogeologic setting -- The relations of network site locations to potential sources of contamination in terms of direction of ground-water gradient was evaluated.

3. Well construction -- The total depths of wells, open intervals of wells, and depths-to-water were evaluated from driller`s logs and previous reports. This information is important in order to understand from where in the hydrogeologic setting water samples would be taken. Well data are listed in Appendix A.

4. Well use -- Wells serving subdivisions and communities were considered priority sites in the network. Irrigation wells were avoided because sample collection would not be possible during the non-irrigation season.

5. Historical data -- Water-quality data provided by the Idaho Department of Health and Welfare, South Central Health District, and Idaho Department of Water Resources were evaluated to determine background water quality and previous water-quality problem areas.

Samples were collected for analysis from approximately 50 sites as an overall reconnaissance effort. A network of approximately 20 wells was then selected from the original 50 sites from which samples were collected on a regular basis about every 6-8 weeks. Wells from which water-quality samples were collected are listed in Appendix B.

Ground-water level network

Depth-to-water measurements were made at approximately 60 wells in

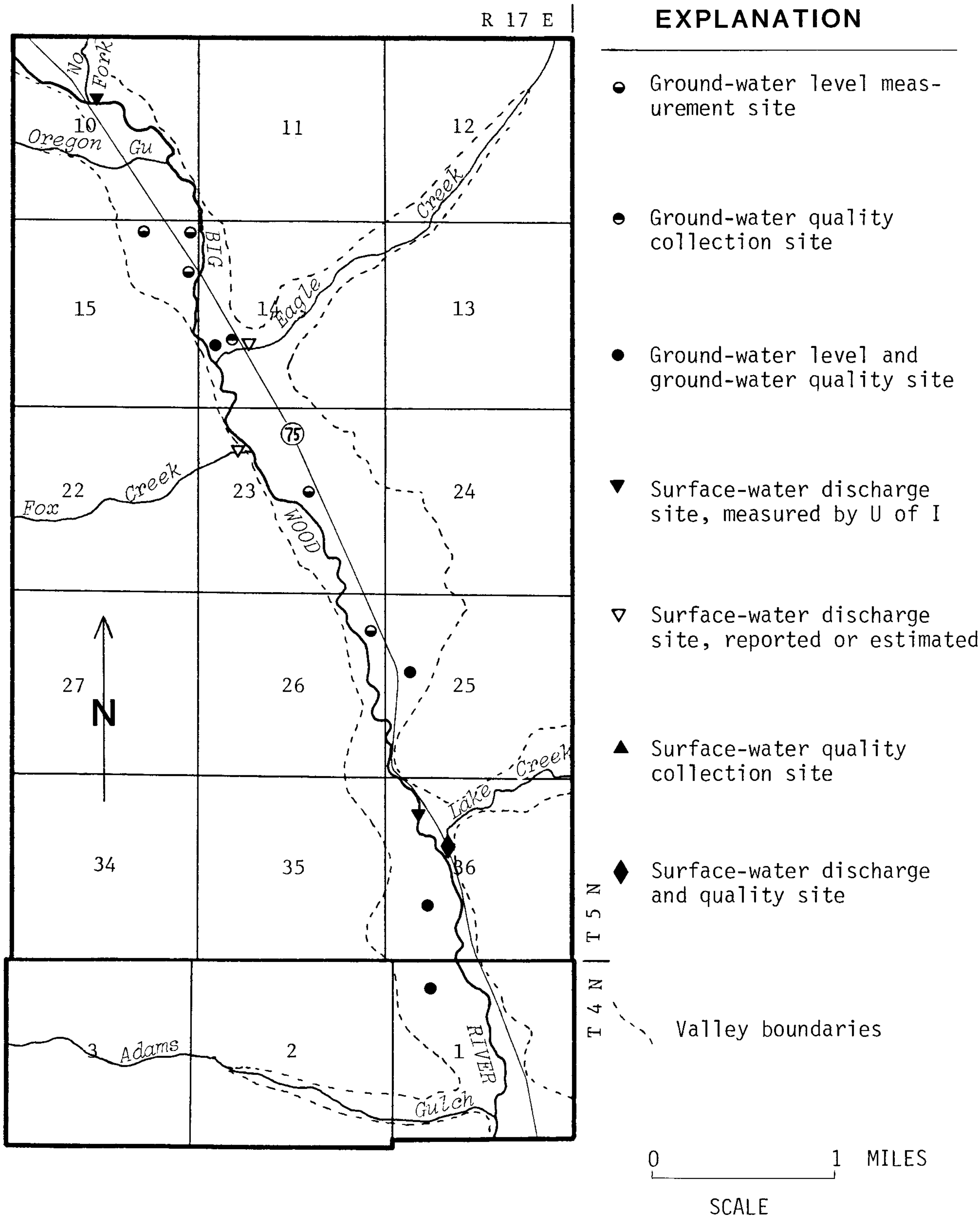


Figure 11.- Location and type of hydrologic data collection sites in the northern part of the study area.

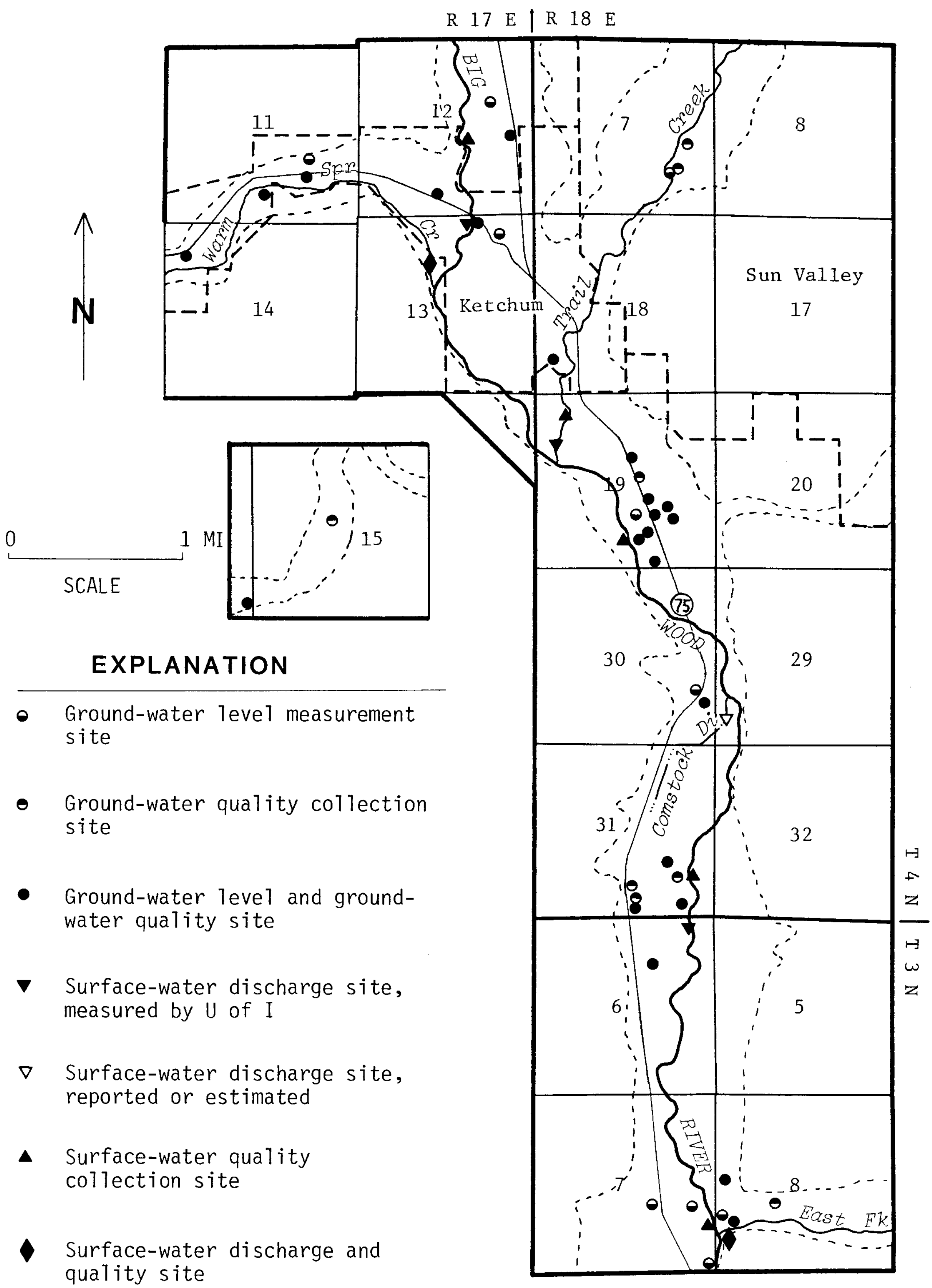


Figure 12.- Location and type of hydrologic data collection sites in the north-central part of the study area.

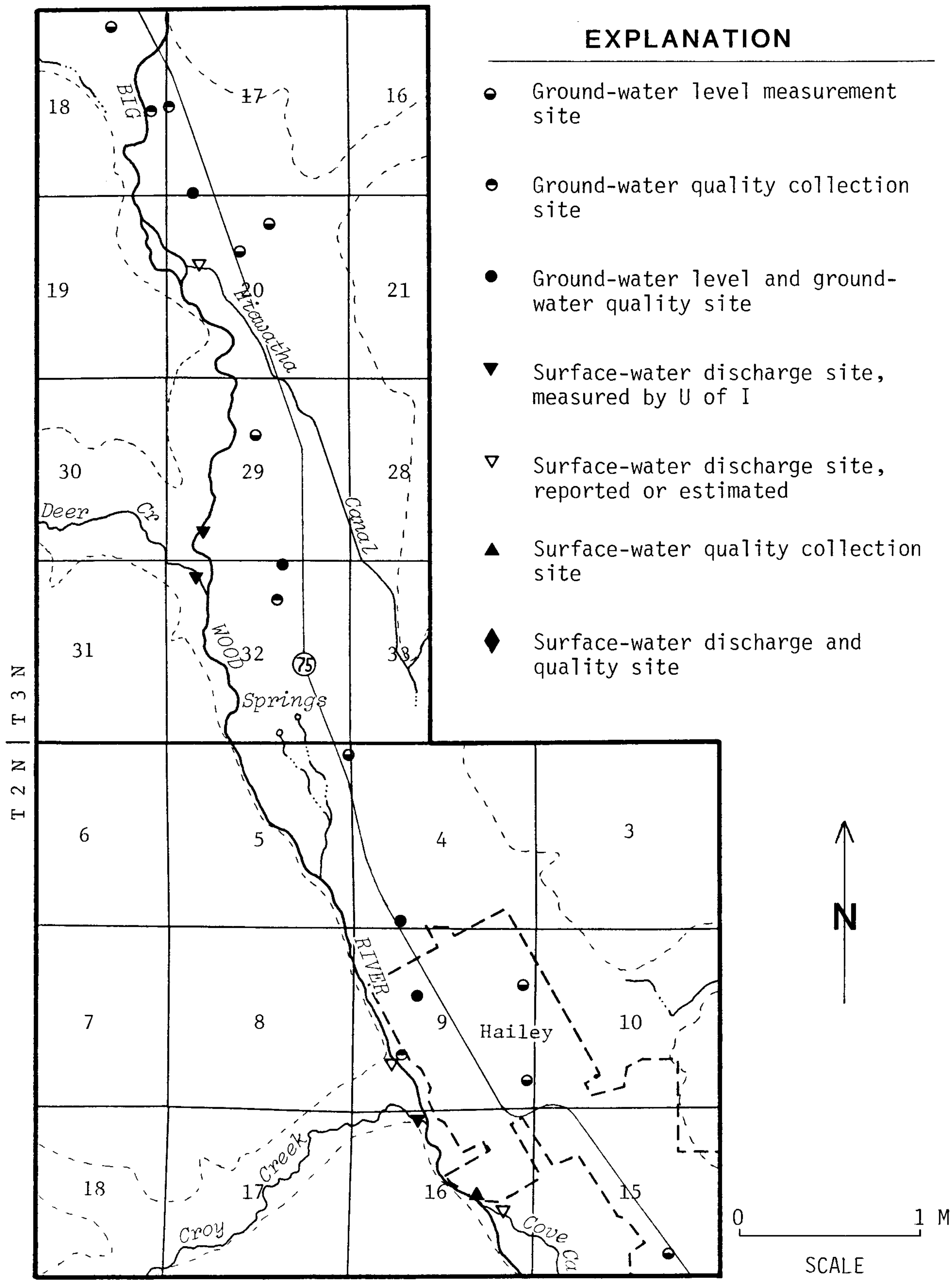


Figure 13.- Location and type of hydrologic data collection sites in the south-central part of the study area.

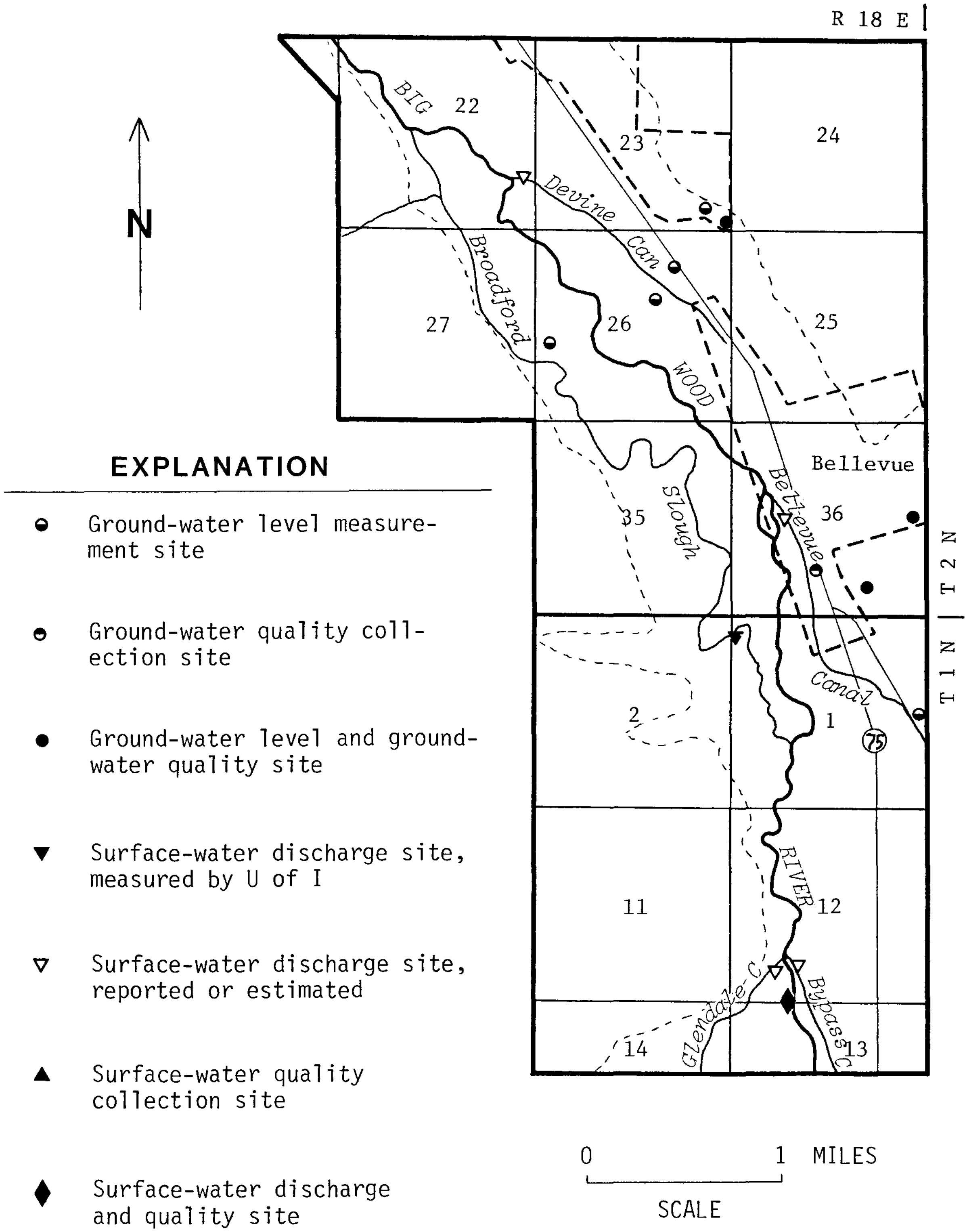


Figure 14.- Location and type of hydrologic data collection sites in the southern part of the study area.

July and August, 1983. These sites were selected primarily on well construction information, location (to provide adequate areal distribution), accessibility and owner consent. Two wells maintained by the USGS are equipped with continuous recorders. The July-August measurements were used to construct a ground-water table map and ground-water/surface-water profiles. Measurements were also made on several wells in November, 1983 and March, 1984 to be used to indicate water-level fluctuations.

Depth-to-water measurements were subtracted from land-surface altitudes to determine ground-water altitudes. Land-surface altitudes of the wells were determined from Idaho State Department of Transportation maps, by altimetry methods, and from previously reported altitudes. Wells on which water-level measurements were made, and the corresponding measurements, are listed in Appendix D.

Surface-Water Sites

Surface-water quality sites

Water-quality samples were collected at 10 sites in early October and 8 sites in late March; 6 sites are on the Big Wood River, and 4 sites are on major tributaries to the Big Wood River. Locations of surface-water quality sites are shown on figures 11 through 14. The sites are listed in Appendix C.

Surface-water discharge sites

Surface-water discharge was measured at 6 sites on the Big Wood River for the purpose of calculating reach gains and/or losses. The USGS streamflow gaging station at Hailey was utilized as a seventh discharge site. Discharge in tributaries to the Big Wood River was also measured or estimated, and diversions by irrigation canals were obtained from the water district. These measurements and records were made on or obtained for September 12-14, 1983. The locations of the measured, estimated and reported discharge sites are shown on figures 11 through 14.

Discharge measurements were made again March 12-14, 1984 at 2 sites on the Big Wood River, and were again taken from the USGS streamflow gaging station at Hailey. Tributaries between these sites were also measured or estimated. All the sites and the measured discharge values are listed in Appendix E and in tables 4 through 6.

Ground-Water Quality Sampling Techniques

Sample collection

Water-quality samples were collected as near to the well in the water system as reasonably possible. Water systems utilizing water softeners or filters were avoided. The water was turned on and allowed to run for at least 5 minutes, or until the pump in the well was known to turn on. Systems which had not been used for a long period were allowed to run for a longer time in order to eliminate stagnant water.

Temperature and pH were measured on-site during favorable weather. Temperature measurements assisted in determining when the sample should be collected; when temperature had stabilized it was assumed that water was coming directly from the well. During the winter months access could not be made to many of the original sample collection points, such as outside spigots, so samples had to be collected from any convenient location, including inside taps. Water from these sources often passes through a large pressure tank and it was undesirable to inconvenience well owners by running water inside for long times; therefore because pressure tanks often were not completely emptied, temperature and pH measurements were found not to be representative of the well water.

Sample preparation and preservation

Samples were filtered on-site through a 0.45 micron membrane filter if the samples could not be returned to the lab for analysis within 2 days. Samples collected for nitrate analyses were preserved with concentrated sulfuric acid. All samples were placed in a cooler at or below 4^{o} centigrade (C) immediately after collection.

Water-Quality Analyses

Samples were analyzed to determine concentrations of nitrate-nitrogen, chloride, and, initially, dissolved phosphate. Specific conductance was also determined. Nitrate-nitrogen concentrations were determined with an ion-specific electrode (Milham et al., 1970). Chloride concentrations were determined by the argentometric method (112 A.), (American Public Health Association, 1971). Dissolved phosphorus concentrations were determined by the ascorbic acid-spectrophotometer method (223 F.), and were discontinued after two series of sample collections. Specific conductance was measured with a Beckman conductivity bridge, and corrected to 25^{o} C.

Water-Yield and Underflow Determinations

The surface-water yield for the Big Wood River basin above Hailey averages 326,700 acre-feet per year (U. S. Geological Survey, 1982). Underflow at Hailey was calculated by Smith (1959, p. 21) to be approximately 34,000 acre-feet. A method devised by the USGS and documented by Johnson (1982, p. 23) to estimate average annual total water yield was applied to the Big Wood River basin above Hailey.

Underflow was then determined to be the difference between average annual total water yield and average annual surface discharge. Underflow was also re-evaluated using current ground-water gradient determinations, all available geologic data, and transmissivity values used by Smith (1959, p. 21).

RESULTS

Ground-Water Quality

Wells from which water-quality samples were collected are located on figures 11 through 14, and are listed with corresponding water-quality parameters in Appendix B. Drinking-water standards proposed by the U. S. Environmental Protection Agency (USEPA) (1977a and 1977b) are used as a reference for water quality.

Nitrate

Nitrate concentration was used as the primary indicator of contamination of ground water from on-site sewage disposal facilities. The USEPA (1977a) has established the maximum recommended nitrate concentration in public drinking-water supplies at 10 milligrams/liter (mg/L) nitrate-nitrogen (nitrate). Concentrations of nitrate above this limit may cause methemoglobinemia in infants under 6 months of age.

None of the wells sampled exceeded the 10 mg/L nitrate primary drinking-water standard. Fifteen percent of the wells sampled exceeded 1 mg/L nitrate at least once. Concentrations of nitrate ranged from 0.1 mg/L to 2.2 mg/L. The mean concentration was 0.53 mg/L. An analysis-of-variance test performed on 20 wells confirmed that nitrate concentrations vary significantly between wells and also with sample date. Mean concentrations of all sample dates are shown for each well on figures 15 through 18.

Nitrate concentrations in samples from 6 selected wells at 5 sample dates are plotted on figure 19 and are listed in table 1. These wells are most strategically located to represent ground-water quality while having been sampled at each of the 5 sample dates. An analysis-of-variance test was also conducted on these sample analyses,

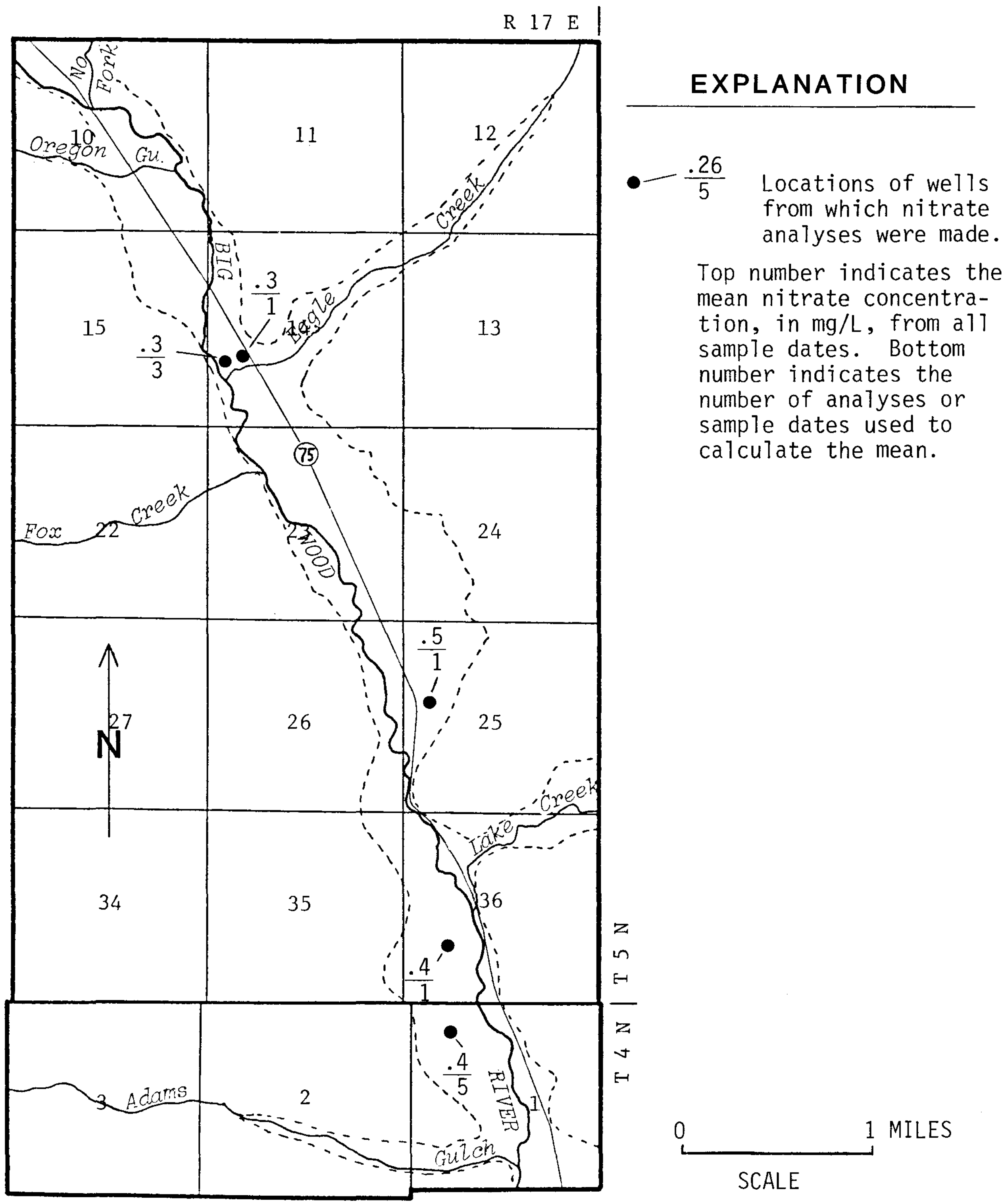


Figure 15.- Mean nitrate concentrations, in mg/L, of wells from which samples were analyzed in the northern part of the study area.

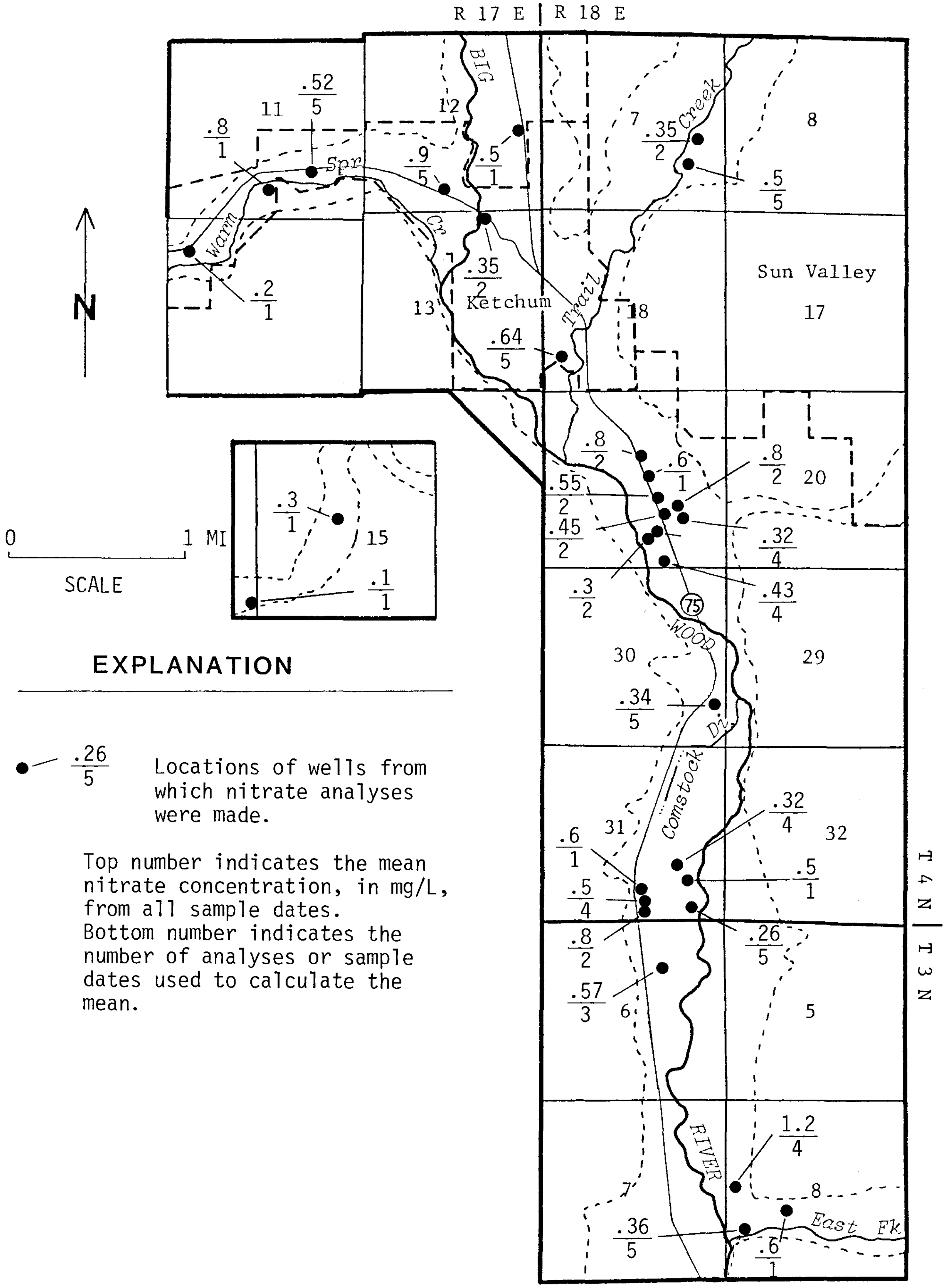


Figure 16.- Mean nitrate concentrations, in mg/L, of wells from which samples were analyzed in the north-central part of the study area.

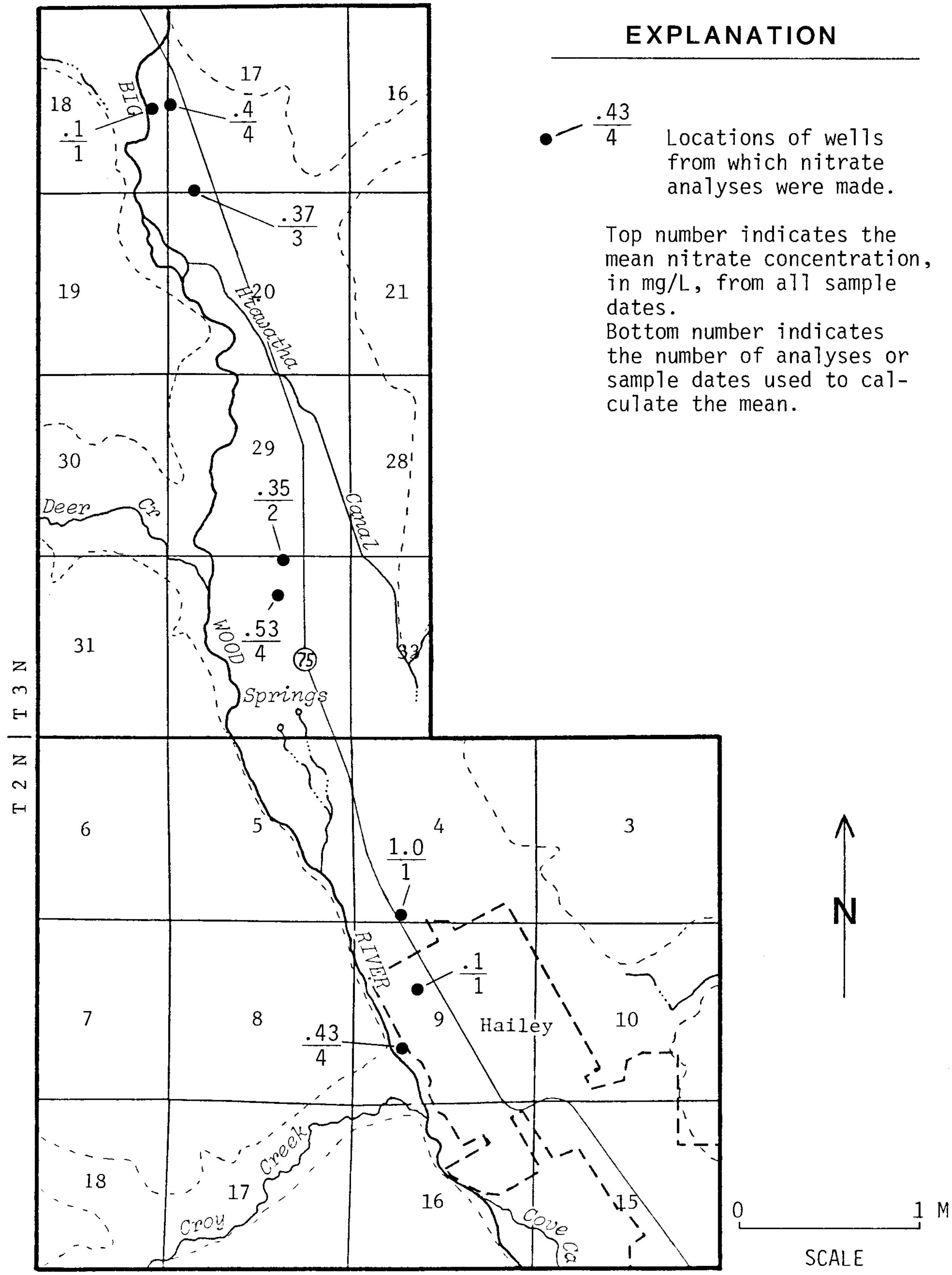


Figure 17.- Mean nitrate concentrations, in mg/L, of wells from which samples were analyzed in the south-central part of the study area.

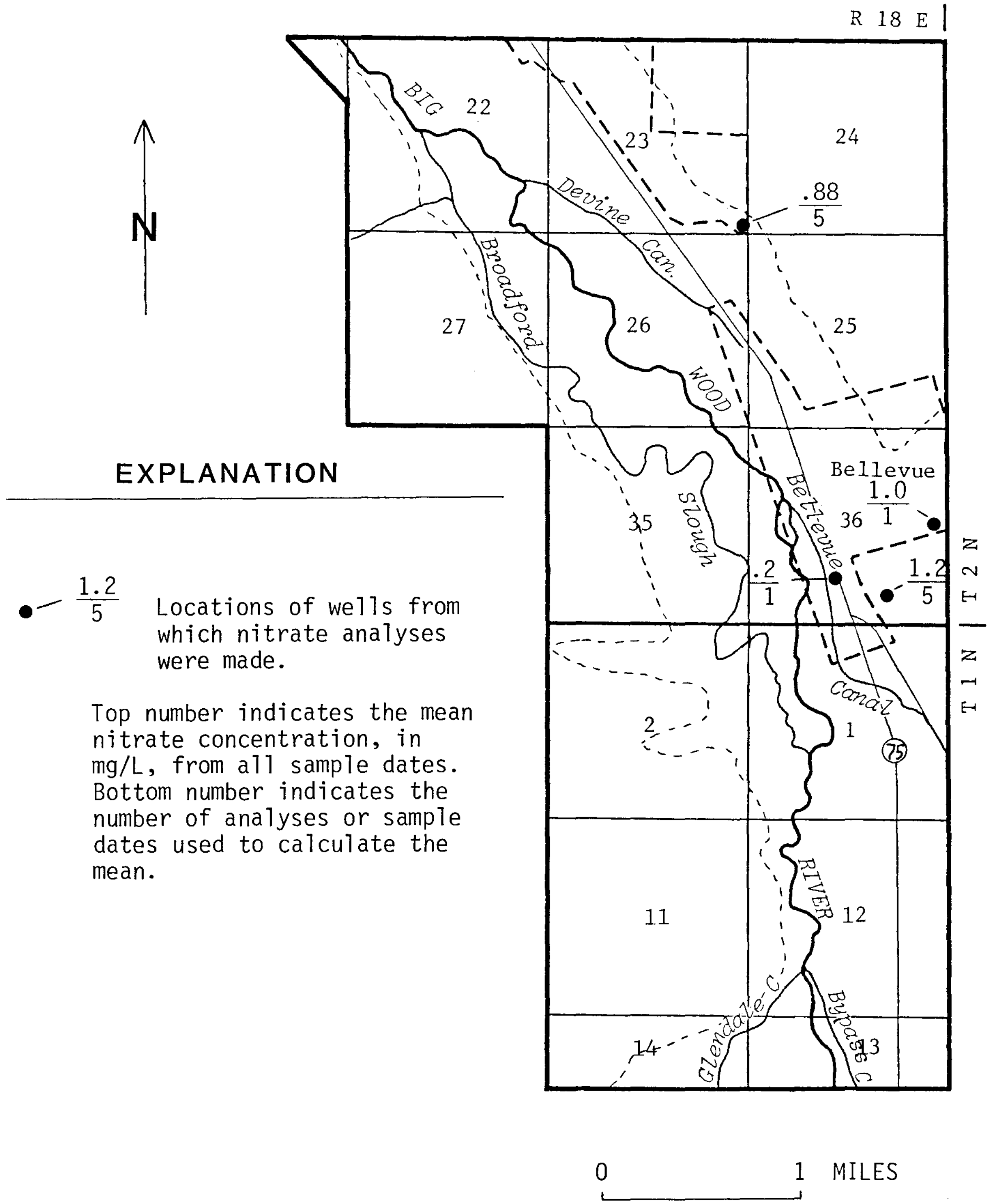


Figure 18.- Mean nitrate concentrations, in mg/L, of wells from which samples were analyzed in the southern part of the study area.

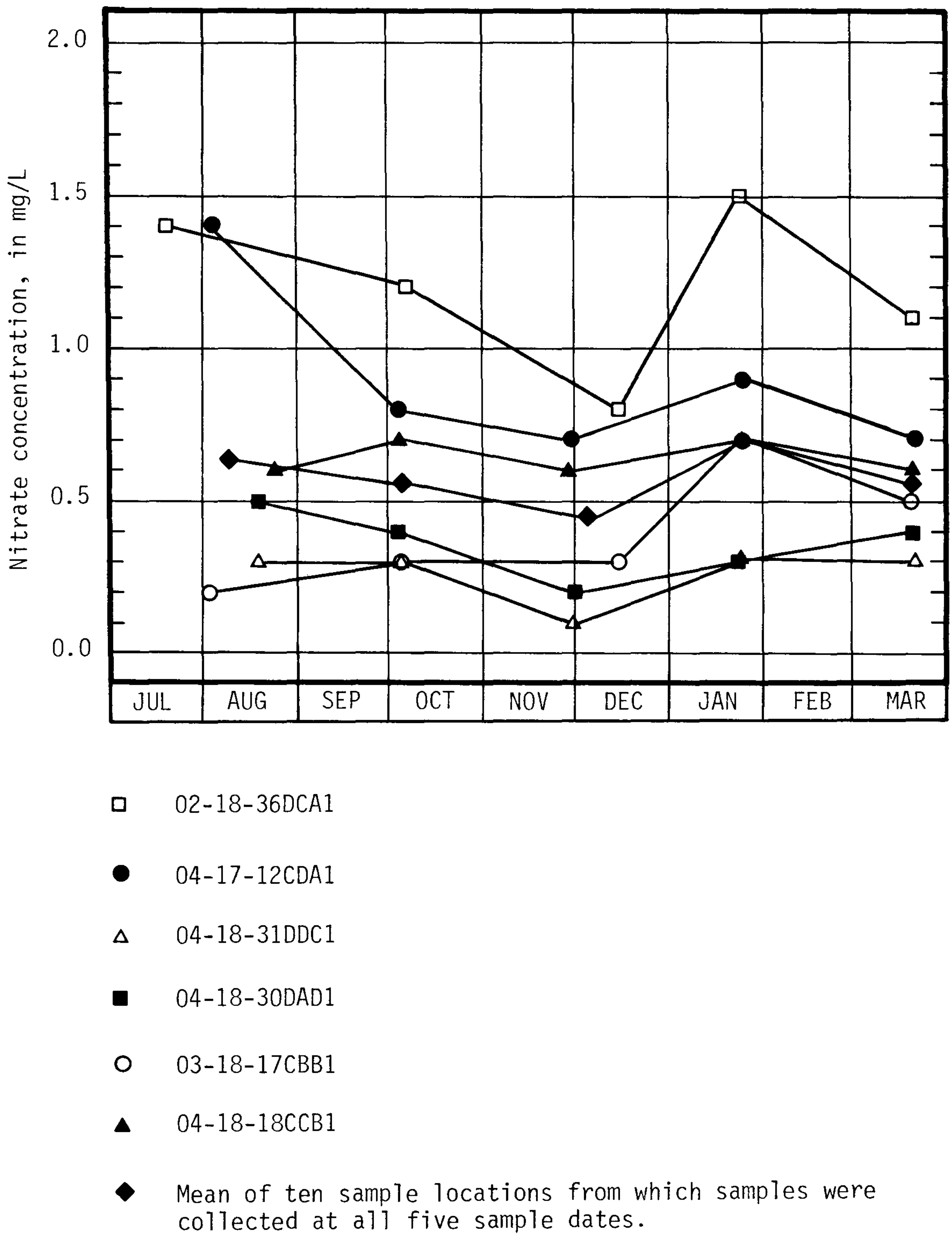


Figure 19.- Nitrate concentration, in mg/L, versus time of year, in six selected wells, and averaged in ten wells.

Table 1.-- Concentrations of nitrate-nitrogen, in mg/L, from samples in six selected wells at five sample dates. (These data are used in analysis-of-variance and Duncan's multiple range tests).

Well Location	Well Owner	Date of Sample Collection				
		07/08-1983	10-1983	11/12-1983	01-1984	03-1984
02-18-36DCA1	Christiansen	1.4	1.2	0.8	1.5	1.1
03-18-17CBB1	Hamlin	0.2	0.3	0.3	0.7	0.5
04-17-12CDA1	Ketchum #1	1.4	0.8	0.7	0.9	0.7
04-18-18CCB1	Tyrolean Ldg	0.6	0.7	0.6	0.7	0.6
04-18-30DAD1	Edwards	0.5	0.4	0.2	0.3	0.4
04-18-31DDC1	Wister	0.3	0.3	0.1	0.3	0.3
Means of Sample Dates		0.733	0.617	0.45	0.733	0.60

and the results indicate a significant difference in the mean nitrate concentrations between wells and at different sample dates. These results warranted a Duncan's multiple-range test (Duncan, 1955) to test each mean sample date or location against all other mean sample dates or locations (see table 2). The small letters beside the sample mean concentrations indicate the relationships between the concentrations. Numbers in columns not followed by the same letter are significantly different at less than 5 percentage points. Using the mean of sample dates as an example, there is no significant difference between the mean concentrations of the top 4 samples (those indicated by the letter `a'). Also, there is no significant difference between the mean nitrate concentrations of the samples indicated by the letter `b.' A significant difference in mean concentration does exist between the 2 top and the 1 bottom samples.

The analysis of differences of mean concentrations between wells indicates significant differences in mean concentration between the 4 top samples. No significant differences exist between the 3 bottom samples in table 2.

Although significant differences exist in mean nitrate concentrations of samples collected at different dates, no absolute reasons for these differences are proposed here. However, it is possible that concentrations were lower in November-December, 1983 because of lower population associated with the `slack' season between summer and winter recreation periods.

The differences of mean nitrate concentrations between wells seem to be attributable to well locations. It is assumed that the higher concentrations in the well located at 02-18-36DCA1 are a result of on-site sewage disposal in the city of Bellevue. The cause of the

Table 2.-- Results of Duncan's multiple-range test for mean nitrate-nitrogen concentrations in samples from six selected wells at five sample dates. Concentrations are in mg/L. See text for further explanation.

Duncan's multiple range test for difference between sample dates, with a mean of six well locations.

Date	Mean nitrate conc., and rank	
07/08-1983	0.733	a
01-1984	0.733	a
10-1983	0.617	a b
03-1984	0.600	a b
11/12-1983	0.450	b

Duncan's multiple range test for difference between sample well locations, with a mean of five sample dates.

Location	Mean nitrate conc., and rank	
02-18-36DCA1	1.2	a
04-17-12CDA1	0.9	b
04-18-18CCB1	0.64	c
03-18-17CBB1	0.4	d
04-18-30DAD1	0.36	d
04-18-31DDC1	0.26	d

higher-than-average concentrations in the samples from the well at 04-17-12CDA1 cannot be explained, since the well is within the city of Ketchum, which is sewered. The significantly lower concentrations in the samples from the wells at 03-18-17CBB1, 04-18-30DAD1, and 04-18-31DDC1 are probably a result of the wells′ close proximity to the Big Wood River, which may aid in dilution of nitrate and other constituents.

Regression analyses were made in an attempt to determine if relationships exist between nitrate concentrations and depth of well, depth to first open interval, or the difference between depth to water and depth to first open interval. No relationships were found between any of these pairs.

Chloride and orthophosphate

Concentrations of chloride in samples from all the wells sampled were far below the recommended limit for public drinking-water supplies of 250 mg/L (USEPA, 1977b). Concentrations ranged from approximately 0.3 mg/L to approximately 7.0 mg/L. The mean for all samples was 2.4 mg/L.

The concentration of orthophosphate (dissolved phosphate) in every sample was very low (less than 0.065 mg/L). The mean concentration in samples collected in July-August, 1983 and October, 1983 was approximately 0.013 mg/L. Orthophosphate is adsorbed by soil materials within and very near the effluent disposal field, resulting in low concentrations in ground water. No relationships could be found between the orthophosphate concentrations and other factors.

Specific conductance and pH

Specific conductance is the measure of the capacity of the water to conduct a current of electricity; the more minerals in solution the larger the specific conductance. Specific conductance in samples from all wells ranged from approximately 240 to 540 micromhos/cm at 25° C. The mean value of specific conductance was 371 micromhos/cm. It should be noted that the first series of measurements (July-August, 1983) are as much as 40% low, since temperature compensations were not considered at the time of analysis. Therefore, these measurements are not included in the calculation of means or in statistical calculations.

The mean specific conductance of 19 wells for October, 1983, November-December, 1983, January, 1984, and March, 1984 are 364, 363, 381, and 383 micromhos/cm, respectively. The two lower values are significantly different than the two higher values.

A pH of 7.0 indicates neutrality of water or other solutions. Values higher than 7.0 denote alkalinity; values lower than 7.0 indicate acidity. Recommended levels for public water supplies range from 6.5 to 8.5 (USEPA, 1977a). The pH of samples measured in July-August, 1983, and October, 1983 ranged from 6.9 to 7.7. The mean pH of samples on these dates was approximately 7.3. Means and ranges of values for all constituents in both ground-water and surface-water samples are given in table 3.

Surface-Water Quality

Nitrate

Locations of surface-water quality sites are shown on figures 11 through 14, and the locations and corresponding contituent values are listed in Appendix C. Concentrations of nitrate ranged from 0.3 mg/L to 0.7 mg/L. The mean concentration of nitrate in October, 1983 was 0.40 mg/L. The mean concentration in March, 1984 was 0.48 mg/L, which is not

Table 3.-- Mean and range of values of water-quality characteristics in the Big Wood River study area, July, 1983 to March, 1984.

Water-quality characteristic	Ground water		Surface water	
	Range	Mean	Range	Mean
Nitrate (NO_3 mg/L as N)	0.1-2.2	0.53	0.3-0.7	0.44
Chloride (mg/L Cl)	0.3-7.0	2.4	1.0-3.0	1.8
Orthophosphate (mg/L P)	.002-.063	.013	.004-.064	.015
Specific conductance (micromhos/cm at 25 C)	240-540	371	205-484	312
pH	6.9-7.7	7.3	7.5-8.3	8.0
Temperature (degrees C)	7.0-21.0	9.3	5.5-11.5	9.0

a statistically significant difference from the October mean. The highest concentrations of nitrate were found in samples collected from Lake Creek and from the Big Wood River below the Ketchum water treatment plant. Sawyer (1947), as cited in Castelin and Winner (1975) indicated the critical concentration of nitrogen below which algal growths are not troublesome is 0.30 mg/L, providing phosphorus is below 0.015 mg/L, however the literature is not consistent on these figures. The nitrate concentrations found in the Big Wood River may be a cause for concern and further study.

Chloride, specific conductance, pH, and orthophosphate

Chloride concentrations measured in surface water samples ranged from approximately 1.0 mg/L to 3.0 mg/L. Specific conductance ranged from 205 to 394 micromhos/cm in October, 1983 and from 224 to 484 micromhos/cm in March, 1984. The mean specific conductance in October, 1983 was 300 micromhos/cm, and in March, 1984 was 344 micromhos/cm. This is a statistically significant difference. The pH of surface-water samples measured in October, 1983 ranged from 7.5 to 8.3. The mean pH in October was approximately 8.0.

Orthophosphate concentrations in October, 1983 ranged from 0.004 to 0.064 mg/L, and the mean concentration in October, 1983 was 0.015 mg/L. The deviation is very high due to much larger concentrations below Hailey and Ketchum and at Lake Creek. The mean concentration excluding these sites is 0.006 mg/L.

Ground-Water/Surface-Water Relationships

Ground-water table configuration

The altitude of the ground-water surface is shown in figures 20 through 23 by contour lines and is based on water-level measurements made in the wells located on the same figures. Ground water moves approximately at right angles to the contour lines. Physical well data are listed in Appendix A, and water-level data are listed in Appendix D.

Ground-water fluctuations

Ground-water level measurements made in July-August, 1983, November-December, 1983, and March, 1984, and measurements from continuous recorders maintained by the USGS, give an indication of ground-water fluctuations in the study area. Hydrographs of water levels in 8 wells are shown in figure 24. The highest water levels appear to have occurred prior to or in July, and the lowest water levels generally occurred in about March. Historic hydrographs from the well at 04-17-13AAB1 indicate that ground-water levels in that well closely reflect discharge in the Big Wood River. Hydrographs from the the well at 01-18-01DAA1 indicate that ground-water levels in that well also reflect discharge in the Big Wood River, but with a slight time lag. The maximum ground-water fluctuation of approximately 8 feet occurred in the well located at 01-18-01DAA1, and the minimum fluctuation of less than 1 foot occurred in the well located at 04-18-31DDC1.

The greatest fluctuations appear to occur in wells located farther from the river, and the least fluctuations appear to occur in wells close to the river. The water level in the well at 01-18-01DAA1 responds to pumping from nearby irrigation wells in July, August, and September.

Ground-water/surface-water relationships

A profile of the ground-water surface and the Big Wood River channel bottom was constructed from water-level measurements and U. S.

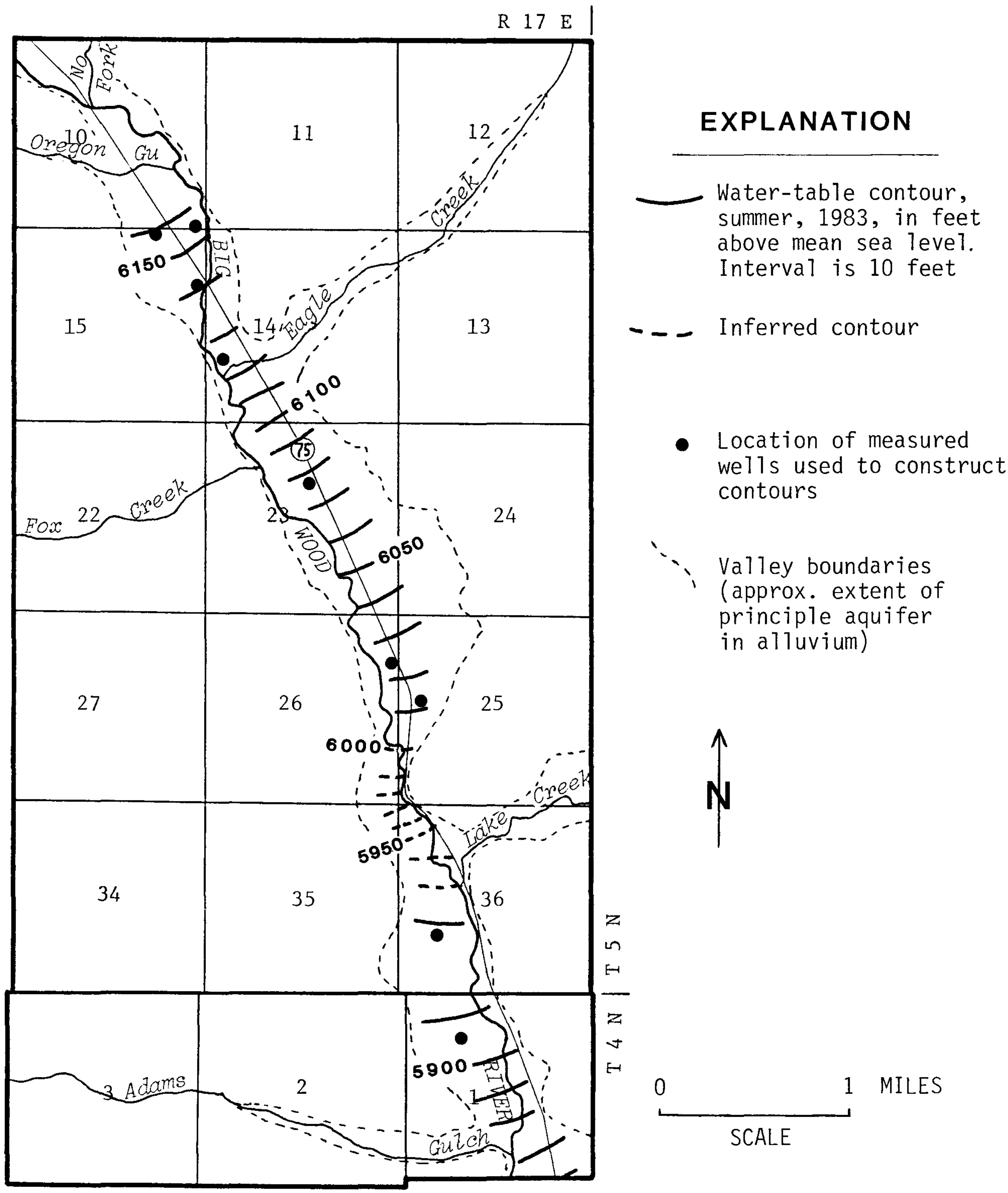


Figure 20.- Water-table contours, July-August, 1983, in the northern part of the study area.

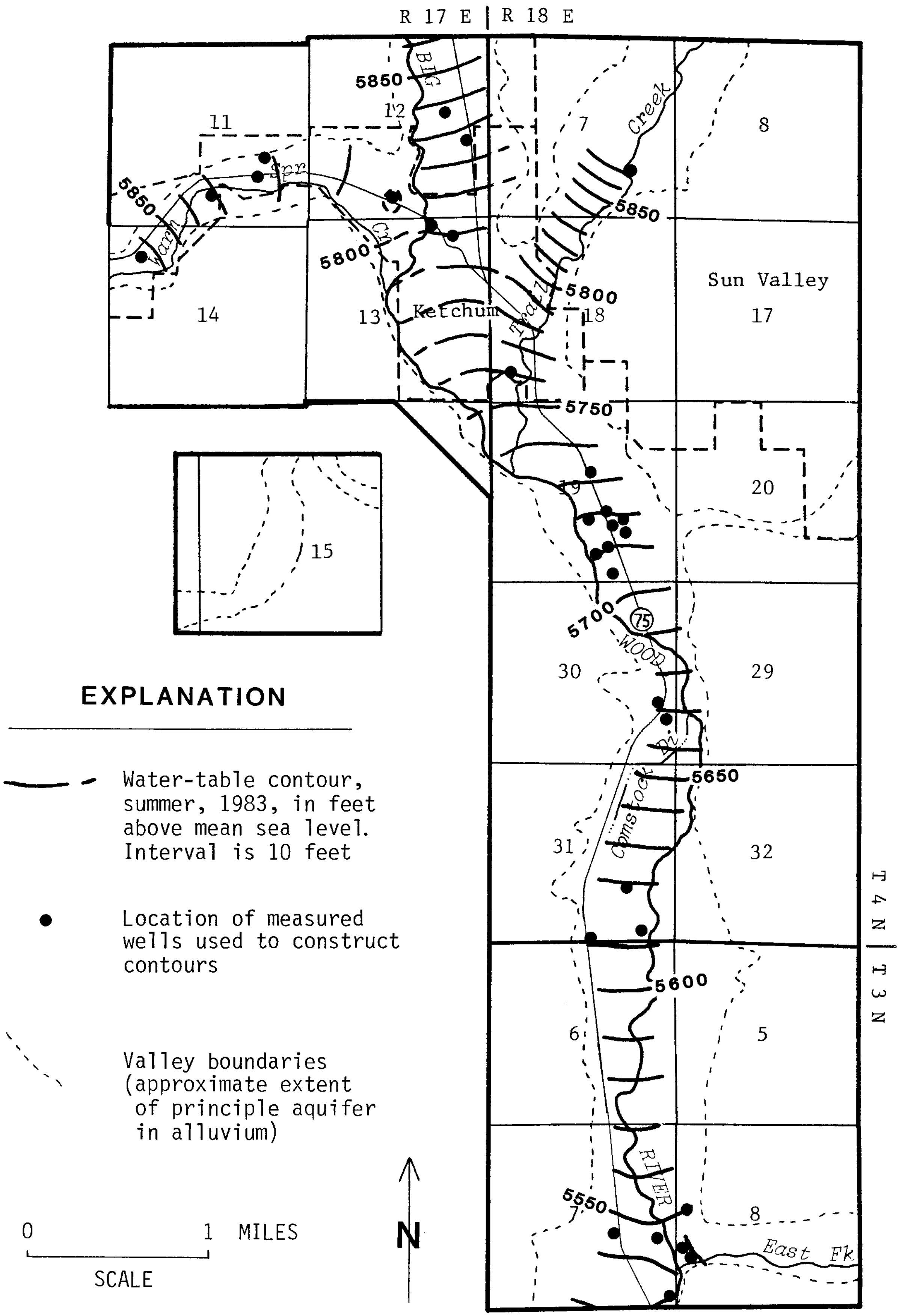


Figure 21.- Water-table contours, July-August, 1983, in the north-central part of the study area.

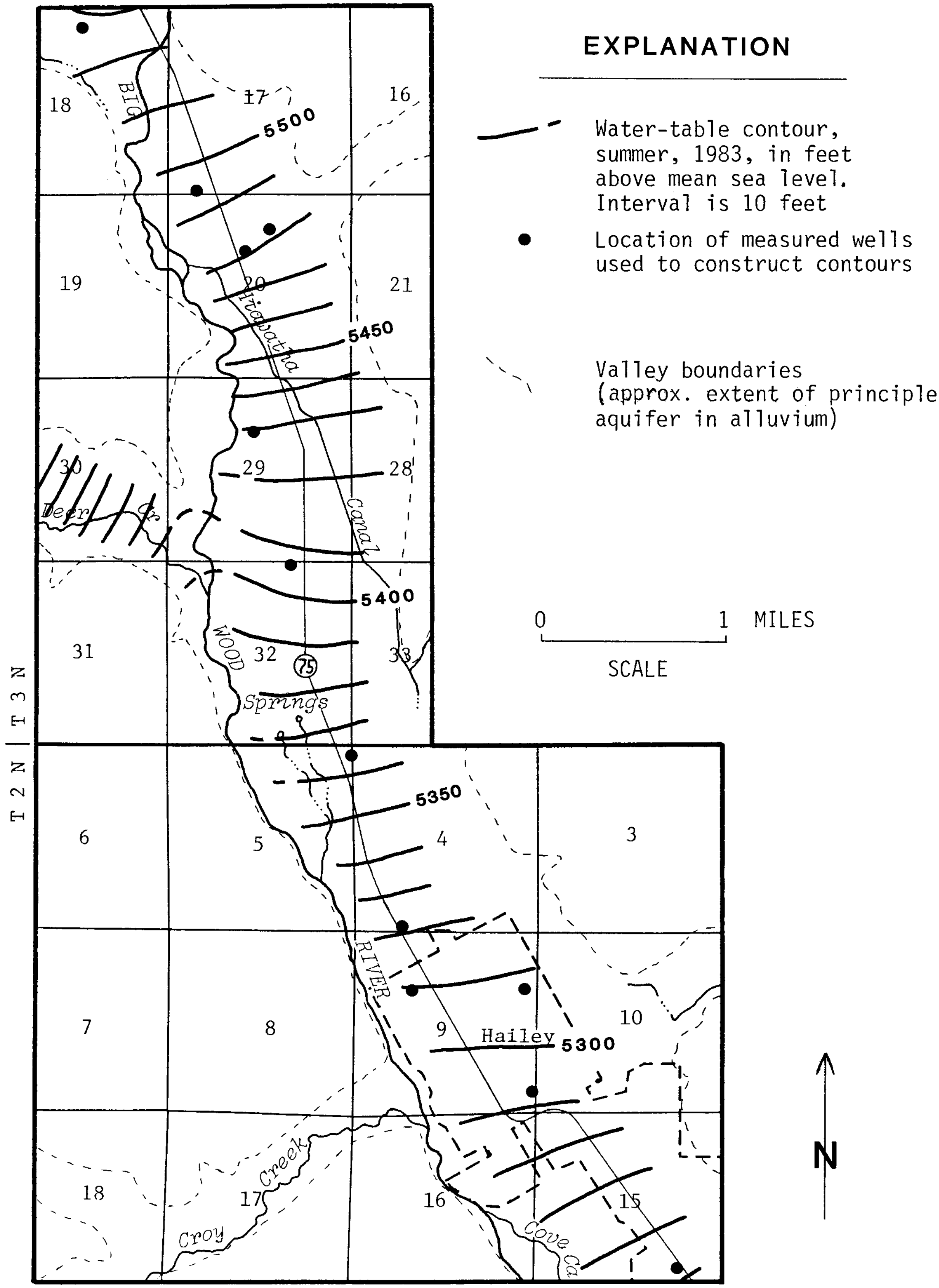


Figure 22.- Water-table contours, July-August, 1983, in the south-central part of the study area.

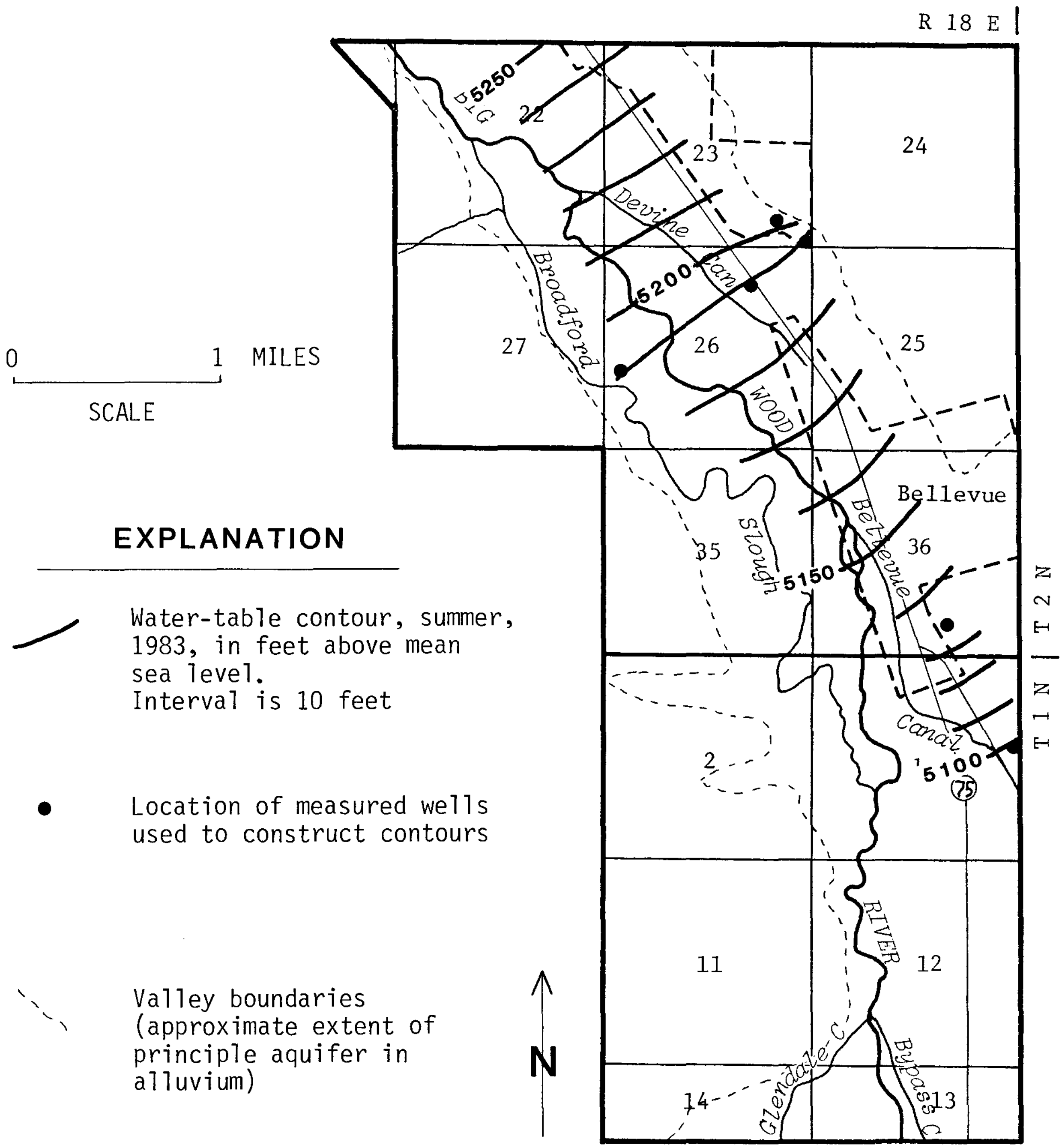


Figure 23.- Water-table contours, July-August, 1983, in the southern part of the study area.

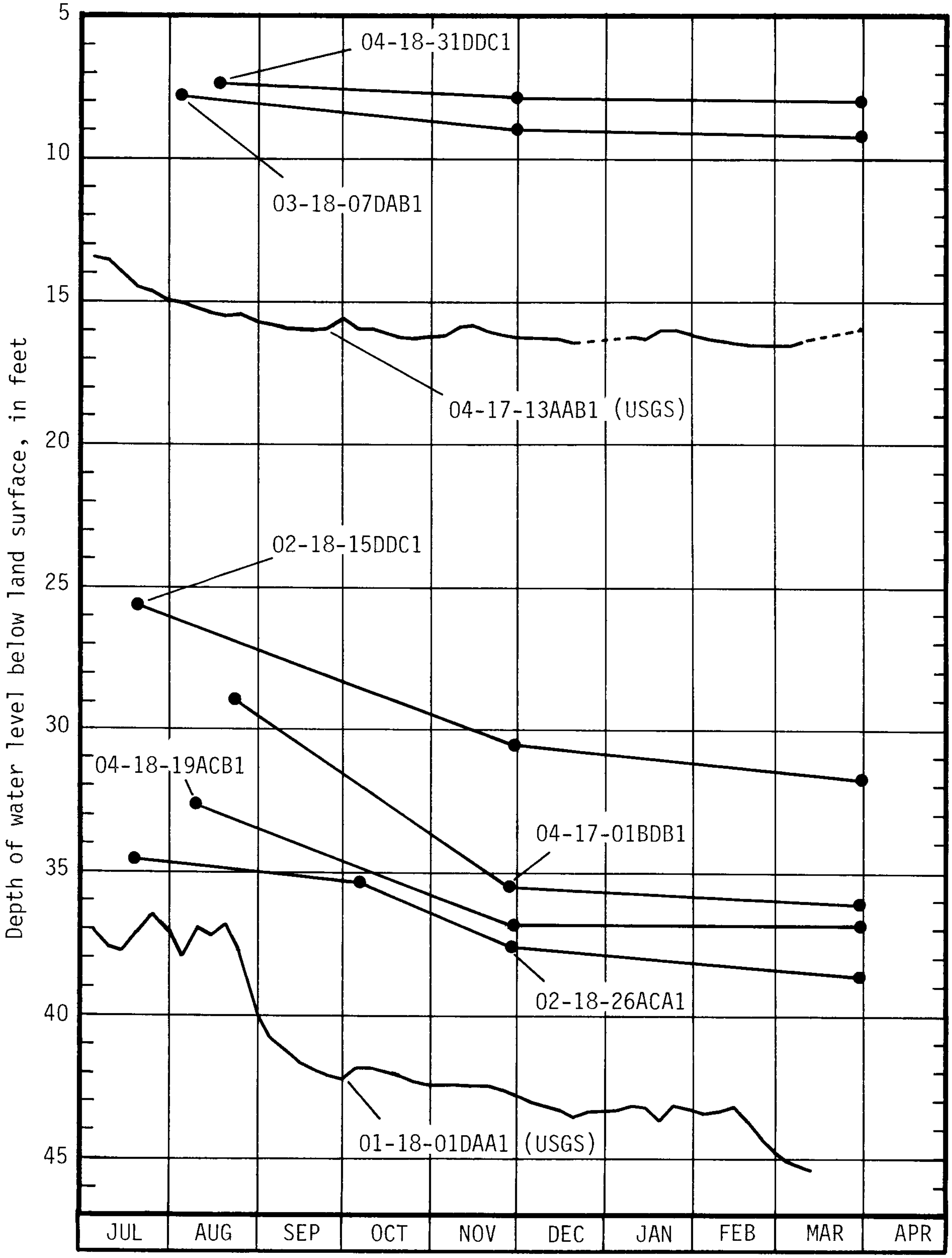


Figure 24.- Hydrographs of selected wells in the study area from July, 1983 to April, 1984.

Corps of Engineers (1970 and 1971) river profiles, and is shown on figures 27 through 30. The locations of the profile and wells from which water levels were used are shown on figures 25 and 26. The wells used are located closest to the river and within the valley floor.

The hydraulic relationships between the river and ground-water system in July-August, 1983 are apparent from the profile. The two systems seem to be hydraulically connected through most of the reaches. Two exceptions are a section in the vicinity of Hulen Meadows (figure 27), and a section south of Bellevue (figure 30).

The river would be expected to gain water from the ground-water system where ground-water level is higher in altitude than the river level, and the river would lose water where the river level is higher in altitude than the ground-water level.

Discharge measurements made in September, 1983 and in March, 1984 support the relationships indicated in the profile. The measured and reported discharge values and calculated reach gains or losses are given in tables 4 through 6. The small river gain between North Fork and Lake Creek, and the small river loss between Lake Creek and Ketchum are insignificant in light of possible measuring errors. The river gains in the 3 reaches between Ketchum and Hailey are significant, as is the loss between Hailey and Glendale Bridge. These figures in most part correspond to the ground-water/surface-water relationships indicated on the profile.

It would be expected that the ground-water/surface-water relationships change with time as a result of changes in ground-water levels and river discharge. Discharge measurements made in March, 1984 (table 6) indicate that the reach gain between Ketchum and Hailey had decreased from approximately 156 cfs in September, 1983 to approximately

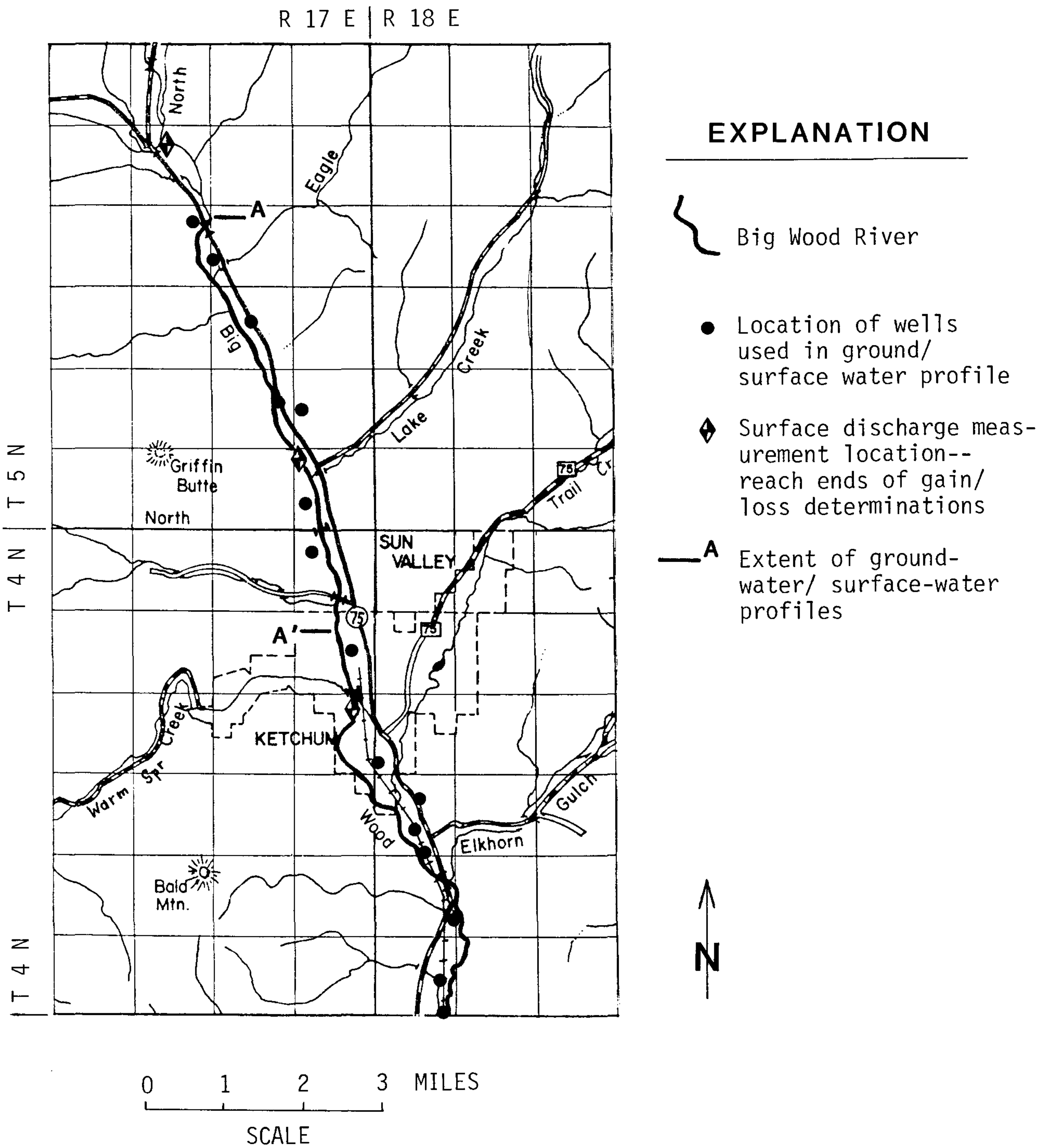


Figure 25.- Map showing location of Big Wood River channel and ground-water level measurement sites used in constructing the ground-water/ surface-water profile in the northern part of the study area.

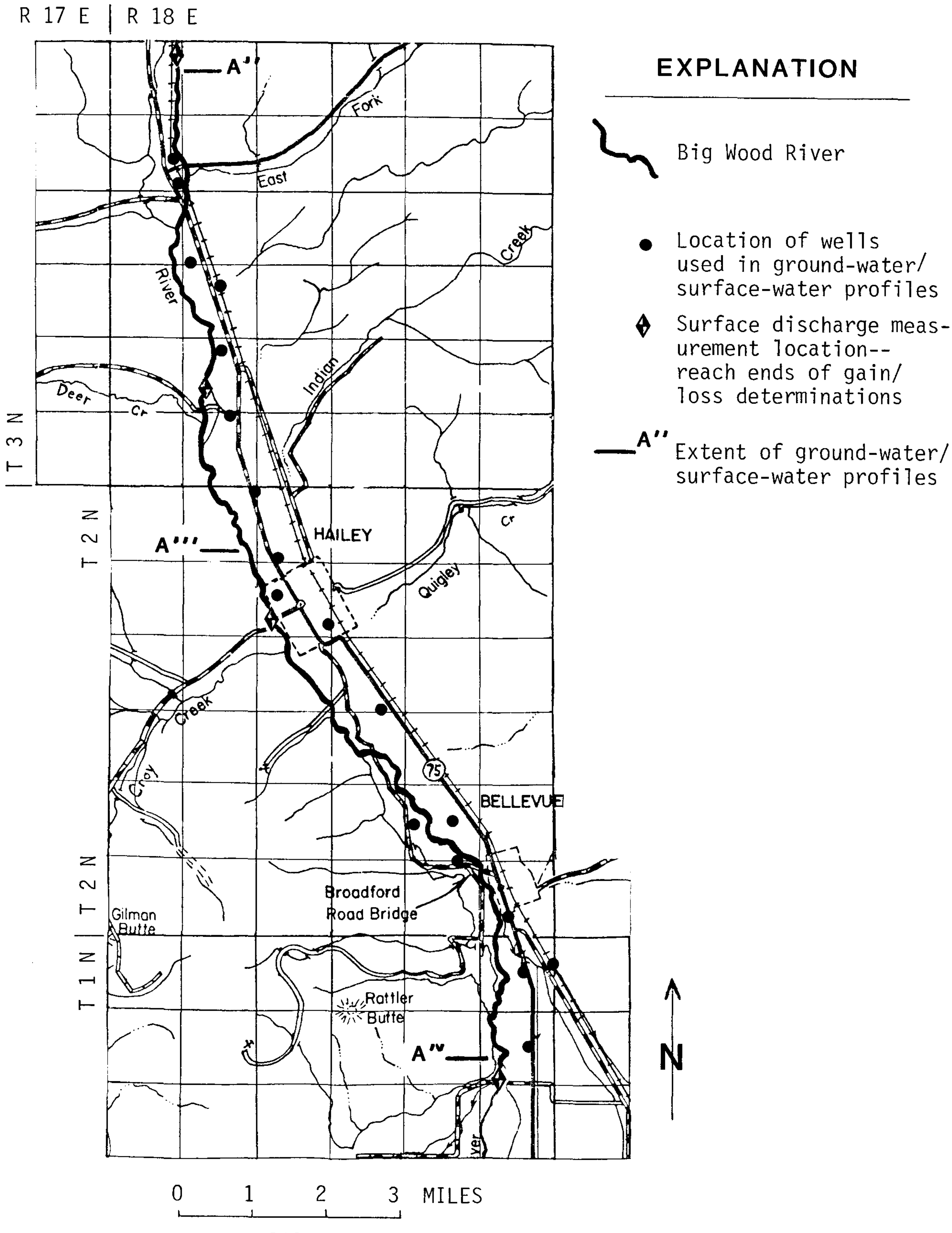


Figure 26.- Map showing location of Big Wood River channel and ground-water level measurement sites used in constructing the ground-water/ surface-water profile in the southern part of the study area.

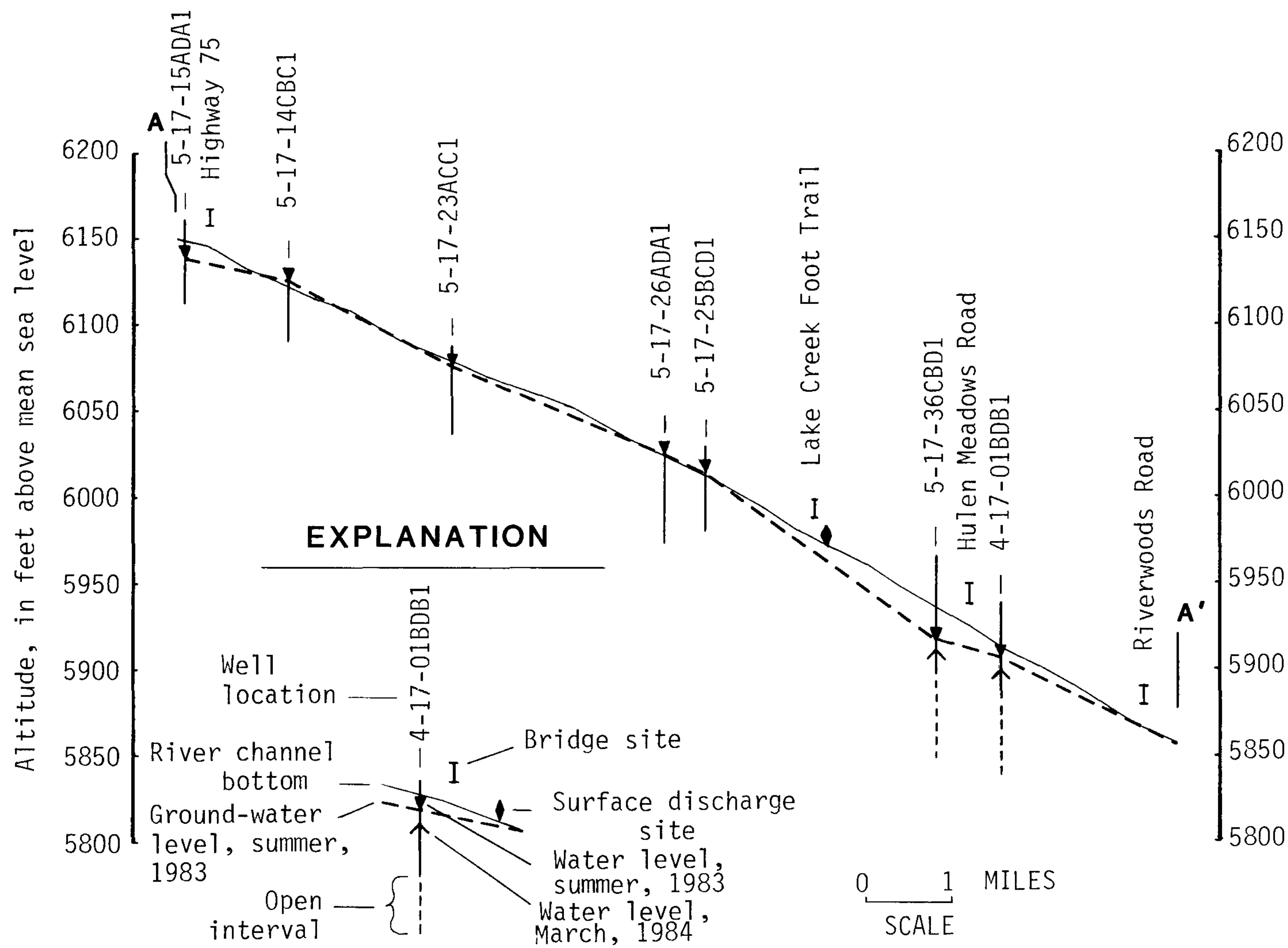


Figure 27.- Profile A-A' of ground-water level, July-August, 1983, and the channel bottom of the Big Wood River.

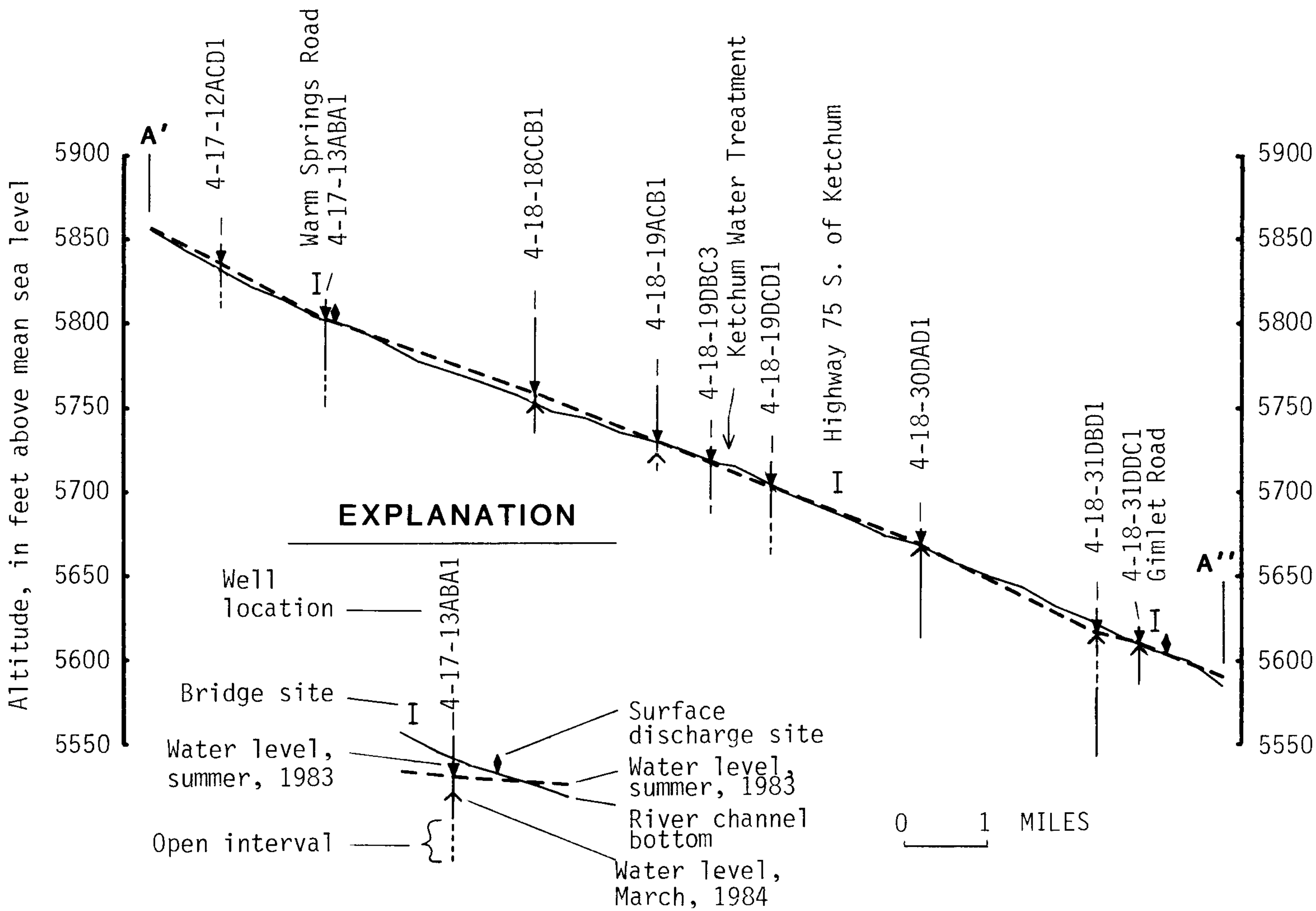


Figure 28.- Profile A'-A'' of ground-water level, July-August, 1983, and the channel bottom of the Big Wood River.

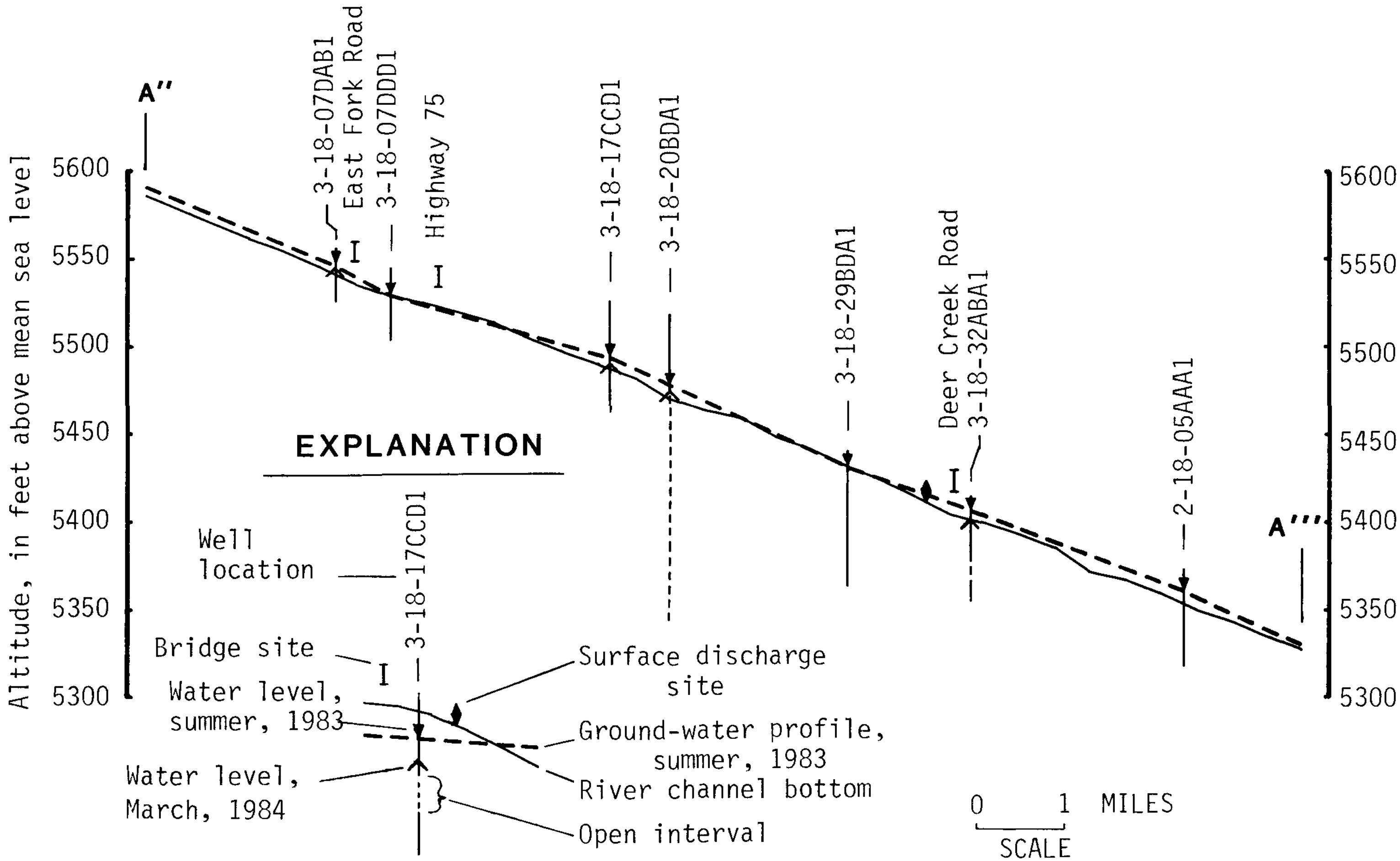
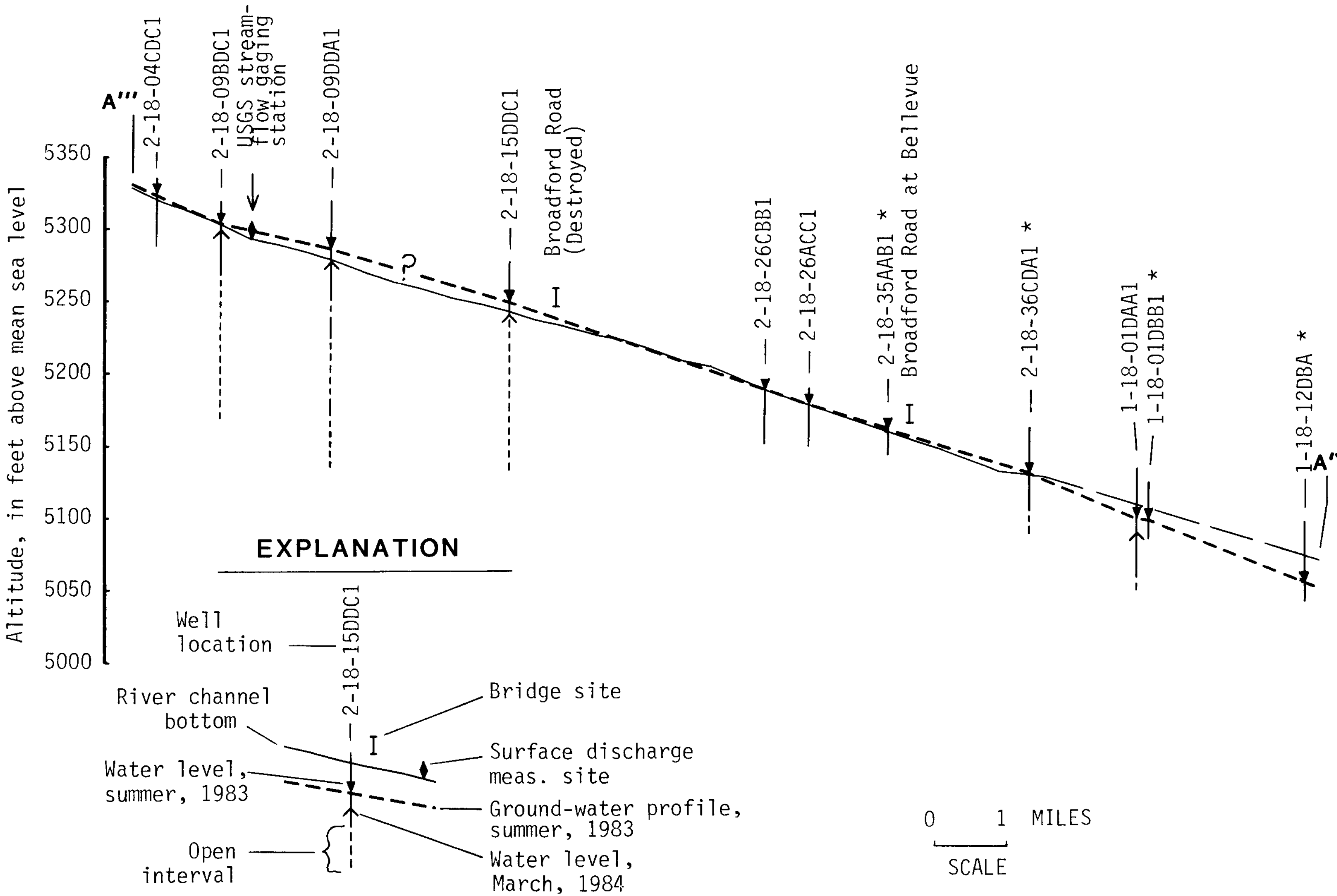


Figure 29.- Profile A''-A''' of ground-water level, July-August, 1983, and the channel bottom of the Big Wood River.



* Water levels obtained from previously recorded data; not measured in 1983.

Figure 30.- Profile A'''-A'ᵛ of ground-water level, July-August, 1983, and the channel bottom of the Big Wood River.

Table 4.- Big Wood River reach gain/loss determinations, September 12-14, 1983, and measured and reported discharge values.

Discharge measurement location	Inflows (-) (in cfs)	Outflows (+) (in cfs)	Reach loss (-) or gain (+) (in cfs)
	Big Wood R between North Fork and Lake Creek		
Big Wood near North Fork	171	-	
Eagle and Fox Creeks (est)	7*	-	
Big Wood near Lake Creek	-	182	
Total	178	182	+ 4
	Big Wood R between Lake Creek and Ketchum		
Big Wood near Lake Creek	182	-	
Lake Creek	10	-	
Misc. tributaries (est)	4*	-	
Big Wood at Ketchum	-	193	
Total	196	193	- 3
	Big Wood River between Ketchum and Gimlet		
Big Wood at Ketchum	193	-	
Warm Springs Creek	60	-	
Trail Creek	31	-	
Ketchum Treatment Plant	2	-	
Big Wood near Gimlet	-	327	
Comstock Ditch	-	6*	
Total	286	333	+ 47

* Values estimated (est) or reported from the water district or USGS.

Table 5.- Big Wood River reach gain/loss determinations, September 12-14, 1983, and measured and reported discharge values.

Discharge measurement location	Inflows (-) (in cfs)	Outflows (+) (in cfs)	Reach loss (-) or gain (+) (in cfs)
	Big Wood River between Gimlet and Deer Creek		
Big Wood near Gimlet	327	-	
East Fork	37	-	
Big Wood above Deer Creek	-	318	
Hiawatha Canal	-	69*	
Total	364	387	+ 23
	Big Wood River between Deer Creek and Hailey		
Big Wood above Deer Creek	318	-	
Deer Creek	6	-	
Big Wood at Hailey (USGS)	-	410*	
Total	324	410	+ 86
	Big Wood R between Hailey and Glendale Br		
Big Wood at Hailey (USGS)	402*	-	
Croy Creek	13	-	
Broadford Slough combined	8	-	
Big Wood at Glendale Br.	-	135	
Cove Canal	-	8*	
Devine Canal	-	4*	
Bellevue Canal	-	118*	
Bypass Canal	-	71*	
Glendale Canal	-	30*	
Total	423	366	- 57

* Values estimated (est) or reported from the water district or USGS.

Table 6.- Big Wood River reach gain/loss determinations, March 12-14, 1984, and measured and reported discharge values.

Discharge measurement location	Inflows (-) (in cfs)	Outflows (+) (in cfs)	Reach loss (-) or gain (+) (in cfs)
	Big Wood R between North Fork and Ketchum		
Big Wood near North Fork	94	-	
Lake and Fox Creeks (est)	10*	-	
Big Wood at Ketchum	-	120	
Total	104	120	+ 16
	Big Wood River between Ketchum and Hailey		
Big Wood near Ketchum	120	-	
Warm Springs Creek	51	-	
Trail Creek	33	-	
East Fork	24	-	
Deer Creek	13	-	
Big Wood at Hailey (USGS)	-	325*	
Total	241	325	+ 84

* Values are estimated (est) or are reported from the USGS.

84 cfs in March, 1984. This decrease is reasonable, since ground-water levels were lower in March than in September.

Water-Yield and Underflow Determinations

The USGS water-yield equation is expressed as:

$$Q = .000903\ (A^{0.90})\ (P^{1.83})\ (F^{0.29})$$

where Q is in cfs; A is the area of the drainage basin or watershed, in square miles; P is the average annual precipitation for the watershed, in inches, and F is the percent of watershed forested. Above the Hailey stream gaging station A is 640 mi^2 (U. S. Geological Survey, 1982); P is 32.7 inches (Warnick and others, 1981); and F is 37 percent, determined from USGS 7.5-minute topographic maps. The average annual water yield is approximately 510 cfs, or approximately 369,000 acre-feet. The average annual surface-water discharge is approximately 327,000 acre-feet. The difference, which makes up average annual underflow, is approximately 42,000 acre-feet.

Underflow was also calculated to be approximately 38,000 acre-feet per year using Darcy's Law with the July-August, 1983 ground-water gradient. The difference between the two methods is 10 percent, therefore an average annual underflow of approximately 40,000 acre-feet at Hailey appears to be reasonable.

SUMMARY AND CONCLUSIONS

Summary

A ground-water quality network of approximately 50 wells was initially established. Samples were collected from these wells in July-August, 1983 for analysis of nitrate, chloride, and orthophosphate, and determinations of specific conductance. Approximately 20 wells were selected from which samples were collected and analyzed about every 6-8 weeks through March, 1984.

The mean concentration of nitrate from all ground-water samples was 0.53 mg/L, and concentrations ranged from 0.1 to 2.2 mg/L. These values are below the USEPA maximum recommended value of 10 mg/L. The mean chloride concentration was 2.4 mg/L, and concentrations ranged from 0.3 to 7.0 mg/L. The USEPA recommended limit is 250 mg/L. The mean orthophosphate concentration of samples collected in July-August, 1983, and October, 1983 was .013 mg/L. Orthophosphate concentrations ranged from .002 to .063 mg/L. Specific conductance averaged 371 micromhos/cm at 25° C, and ranged from 240 to 540 micromhos/cm at 25° C.

Surface-water samples were collected and analyzed from 6 sites on the Big Wood River and 4 sites on tributaries to the Big Wood River. Mean concentrations of nitrate, chloride, and orthophosphate were 0.4, 1.8, and .015 mg/L, respectively. The mean specific conductance was 312 micromhos/cm at 25° C.

Ground-water levels were measured in approximately 60 wells in July-August, 1983, and in several wells again in November, 1983 and March, 1984. A water-table contour map for July-August, 1983 was constructed. Seasonal water-level fluctuations in individual wells ranged from less than 1 foot to more than 8 feet. A ground-water/surface-water profile was constructed; the profile indicates hydraulic connection between the two systems in much of the study area.

Discharge measurements were made in the Big Wood River and tributaries to determine reach gains or losses. The Big Wood River gained a significant amount from ground water between Ketchum and Hailey in September, 1983, and a lesser but still significant amount in March, 1984. The river lost a significant amount between Hailey and Glendale Bridge in September, 1983.

Water-budget analyses affirmed that the average annual underflow at Hailey is approximately 40,000 acre-feet.

Conclusions

No case of local or regional ground-water contamination exceeding USEPA standards was found in any well or surface-water sample. Individual wells close to the Big Wood River generally had lower-than-average nitrate concentrations. The highest nitrate concentrations occurred in a well located near an effluent disposal field serving several homes (03-18-08BCC1), and in a well located just south of Bellevue (02-18-36DCA1).

An adequate network of wells was established to determine regional water-quality characteristics and trends as related to potential contamination . Mean nitrate concentrations were significantly less in November, 1983 than on other sample dates. Mean nitrate concentrations do not seem to vary within the study area except as affected by local conditions. No relationships were found between physical well characteristics or depths-to-water and nitrate concentrations.

Nitrate concentrations of surface-water samples were great enough in some instances to be of some concern in regards to eutrophication. The greatest concentrations of nitrate occurred in the Big Wood River below the Ketchum water treatment plant and in Lake Creek.

The close hydraulic connection between the surface-water and ground-water systems was verified. Since the river gains water from the ground-water system in much of the study area, both regional and local ground-water quality conditions will affect surface-water quality. This is especially true in the region between Ketchum and Hailey, where the river was found to gain a large amount of water both in September, 1983 and in March, 1984.

Recommendations

It is recommended that the data presented in this report be utilized as a base for any future water-resources studies or water-quality projections, and that Blaine county planning personnel utilize the data and results with the assistance of professional water-resources personnel.

It is also recommended that samples be collected and analyzed particularly for nitrate on an annual or semi-annual basis from some of the wells included in the monitoring network established for this study; this action would identify water-quality trends and potential ground-water contamination. Sites should be selected based on planning needs.

It is further recommended that samples be collected and analyzed for nitrate and orthophosphate from the Big Wood River on a regular basis, since nitrate concentrations found in this study were a possible cause of concern in regards to eutrophication.

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Appendix A.- Locations and physical descriptions of wells visited during the study period.

(1). Well use codes:
- O - Observation or monitor well
- H - Domestic well
- I - Irrrigation well
- P - Public supply well
- S - Stock well
- U - Unused well

(2). Geology codes:
- SDGL - Sand and gravel
- GRVL - Gravel
- LMSN - Limestone

A dash (-) indicates the data are unknown.

Well location (T.- R.- Sec.)	Latitude-longitude	Well owner	Land ele-vation (feet)	Well depth (ft)	Cas-ing depth	1st per-fora-tion	Well dia-meter (in)	Well use (1)	Year drilled	Log avail-able?	Geo-logy (2)
01N-18E-01DAA1	432657-1141448	U S G S	5137	86	86	78	6	O	1954	N	SDGL
02N-18E-04CDC1	433140-1141915	Sahaka	5336	48	48	48	6	H	-	N	SDGL
05AAA1	433230-1141935	Richmond T	5374	55	55	55	6	I	1980	Y	GRVL
09ADA1	433153-1141825	Gorman J A	5340	84	84	60	6	H	1971	Y	GRVL
09BDC1	433119-1141906	Hailey #2	5324	150	147	50	16	P	1967	Y	GRVL
09CBD1	433103-1141912	Robertson C	5310	50	50	39	6	H	1966	Y	GRVL
09CBD2	433103-1141912	Robertson C	5310	30	-	-	2	H	-	N	-
09DDA1	433055-1141822	Hailey #3	5324	198	167	65	20	P	1965	Y	SDGL
15DDC1	433003-1141727	Eccles S	5278	152	151	40	12	I	1966	Y	GRVL
23DDB1	432910-1141615	Woodside Ctl	5242	-	-	-	6	O	-	N	-
23DDD1	432910-1141605	Woodside #1	5233	50	-	-	6	O	-	N	-
26ACA1	432855-1141620	Woodside #2	5224	65	65	-	6	O	1976	Y	GRVL
26ACC1	432840-1141620	Eccles S	5190	39	39	39	6	S	1971	Y	GRVL
26CBB1	432830-1141705	Forstmann C	5197	46	46	46	6	H	1971	Y	GRVL
36CAD1	432730-1141530	Fields E	5165	69	69	59	6	S	1960	Y	GRVL
36DAB1	432745-1141455	Bellevue #1	5211	200	200	95	12	P	1978	Y	SDGL
36DCA1	432725-1141510	Christiansen	5173	70	70	70	6	H	1973	Y	GRVL
03N-17E-25ADC1	433357-1142210	Schmidt	5520	95	95	95	16	U	1956	Y	SDGL
03N-18E-06ACB1	433730-1142110	Aspen Hollow	5620	59	38	25	12	P	1977	Y	GRVL
07DAB1	433622-1142053	Rickbeil C	5556	31	31	31	6	H	1979	Y	GRVL
07DBA1	433623-1142107	Potter M	5592	88	88	55	6	H	1974	Y	GRVL
07DDD1	433603-1142043	Dawson J	5546	44	44	44	6	H	1970	Y	-
08BCC1	433628-1142040	Haleen B	5566	50	50	40	8	H	1981	Y	LMSN
08CAA1	433621-1142015	Tenney S	5620	105	92	92	8	H	1980	Y	LMSN
08CBC1	433615-1142035	Zweifel C	5560	45	45	45	6	H	1970	N	-
08CBC2	433617-1142040	Wise A	5556	45	22	22	8	H	1982	Y	LMSN
17CBB1	433533-1142042	Hamlin E	5520	25	25	25	6	H	-	N	-
17CCD1	433510-1142032	Tucker L	5527	64	64	64	6	H	1979	Y	GRVL
18BAB1	433556-1142103	Greenhorn #2	5543	113	107	45	10	P	1982	Y	GRVL
18DAA1	433533-1142049	McIntyre	5515	22	22	22	6	H	1968	Y	SDGL
20ABC1	433501-1142002	Heatherlands	5520	97	97	75	12	P	1980	Y	SDGL
20BDA1	433451-1142011	Bliechman	5519	180	174	41	20	I	1959	Y	GRVL
29BDA1	433359-1142009	Hansen D	5440	77	77	77	6	H	1977	Y	SDGL
32ABA1	433322-1141957	Butler B	5416	61	61	38	6	H	1981	Y	SDGL
32ABC1	433313-1142000	Haynes D	5405	20	20	15	2	H	-	N	-
04N-17E-01BDB1	434248-1142250	Hulen Mdw #3	5938	101	101	47	12	P	1966	Y	GRVL
11CDA2	434121-1142344	Mattson R	5854	48	48	48	6	H	1973	Y	SDGL
11DAB1	434133-1142325	McShane R	5867	71	66	66	6	H	1968	Y	LMSN
11DBD1	434127-1142323	Limelight	5860	80	80	60	6	P	1972	Y	GRVL
12ACD1	434147-1142212	Sarchett L	5849	42	42	30	6	S	1978	Y	SDGL
12CDA1	434122-1144237	Ketchum #1	5848	110	75	75	20	P	1978	Y	SDGL
12DAB1	434137-1144220	Ketchum Spr.	5845	300	51	25	16	P	1970	Y	SDGL

Appendix A.- Locations and physical descriptions of wells visited during the study period.

(1). Well use codes: H - Domestic well
P - Public supply well
I - Irrigation well
O - Observation or monitor well

(2). Geology codes: SDGL - Sand and gravel
GRVL - Gravel

A dash (-) indicates the data are unknown.

Well location (T.- R.- Sec.)	Latitude-longitude	Well owner	Land elevation (feet)	Well depth (ft)	Casing depth	1st perforation	Well diameter (in)	Well use (1)	Year drilled	Log available?	Geology (2)
04N-17E-13AAB1	434108-1142210	U S G S	5813	187	54	54	12	O	1946	Y	SDGL
13ABA1	434114-1142218	Ketchum #2	5815	60	60	40	14	P	1981	Y	SDGL
14BBD1	434104-1142413	Greyhawk #1	5904	50	48	48	8	H	1974	Y	GRVL
15BDD1	434048-1142504	Caldwell W	5955	50	-	-	-	H	-	N	-
16DDD1	434027-1142537	Holt C	5980	-	-	-	-	H	-	N	-
04N-18E-07DAB1	434137-1142056	SunValley #5	5915	104	99	32	13	P	1966	Y	GRVL
07DBD1	434128-1142102	Ketchum Spr.	5880	58	52	10	13	P	1954	Y	GRVL
07DBD2	434128-1142102	Ketchum Spr.	5880	54	54	16	12	P	1954	Y	GRVL
18CCB1	434032-1142148	Tyrolean Ldg	5805	70	70	70	6	P	1971	Y	GRVL
19ACB1	434002-1142117	Weyyakin Ctl	5764	51	51	35	6	O	1981	Y	GRVL
19DBB1	433955-1142113	Weyyakin #1	5760	36	36	19	6	O	1980	Y	GRVL
19DBC1	433946-1142108	Weyyakin #3	5732	35	35	18	6	O	1980	Y	GRVL
19DBC2	433950-1142110	Weyyakin #2	5738	35	35	18	6	O	1980	Y	GRVL
19DBC3	433948-1142116	S.ValleyCmp.	5727	42	42	30	6	H	1968	Y	SDGL
19DBD1	433944-1142104	Pothier C	5734	51	48	48	6	H	1969	Y	GRVL
04N-18E-19DBD2	433947-1142104	Weyyakin #4	5740	35	35	18	6	O	1980	Y	GRVL
19DCB1	433938-1142112	S.Valley #7	5722	49	35	35	16	P	1972	Y	SDGL
19DCB2	433940-1142109	Lane Rch.Obs	5728	70	70	59	6	O	1969	N	-
19DCD1	433933-1142107	S.Valley #11	5718	55	31	31	16	P	1977	Y	SDGL
30DAD1	433852-1142047	Edwards E	5678	65	-	-	6	P	-	N	-
30DAD2	433854-1142050	Harmon J	5682	-	-	-	-	H	-	N	-
31DBD1	433759-1142102	Red Top Trl.	5632	88	88	24	16	P	1971	N	-
31DCB1	433752-1142117	Edwards E	5654	80	80	80	6	P	1965	Y	GRVL
31DCC1	433748-1142117	Odmark L	5650	80	-	-	6	I	-	N	-
31DCC2	433750-1142115	Edwards E	5651	220	-	-	8	P	-	N	-
31DDB1	433755-1142057	Dondero J	5625	35	35	35	8	H	1976	N	SDGL
31DDC1	433748-1142057	Wister C	5620	35	35	35	8	H	1975	N	SDGL
05N-17E-10DCD1	434627-1142442	Poe H	6188	66	66	66	6	H	1978	Y	SDGL
10DDD1	434630-1142424	Adkins L	6161	43	40	40	7	H	1973	N	-
14CBC1	434554-1142417	Rosa J	6129	39	39	39	6	H	1965	N	-
14CBD1	434555-1142409	Stansberry J	6130	40	40	40	6	H	1978	Y	SDGL
15ADA1	434613-1142427	Gerlits F	6161	48	48	48	6	H	1982	Y	SDGL
23ACC1	434512-1142339	Kennedy J	6087	51	51	30	8	H	1968	Y	SDGL
25BCD1	434421-1142300	Wilson D	6029	50	-	-	6	H	1964	N	-
26ADA1	434430-1142313	Baker R	6028	56	56	56	6	H	1980	Y	SDGL
36CBD1	434248-1142251	Hulen Md. #2	5965	117	117	65	16	P	1968	Y	SDGL

Appendix B.- Locations and corresponding water-quality data for ground-water quality sites within the study area, and for the duration of the study period.

(1). Concentrations of nitrate, chloride, and orthophosphate are in micrograms per liter. (Values shown are milligrams per liter x 1000).

A dash (-) indicates the values were not determined for that date.

Well location (T.- R.- Sec.)	Latitude-longitude	Sample date	Nitrate conc. (1)	Chloride conc. (1)	Temp. deg. C	E.C.	pH	Orthophosphate conc. (1)
02N-18E-04CDC1	433140-1141915	83/07/20	1000	4800	9.0	358	-	3
09BDC1	433119-1141906	83/12/14	100	2300	-	370	-	-
09CBD1	433103-1141912	83/08/11	500	1600	9.0	330	-	11
		83/12/14	300	2900	7.0	340	-	-
		84/01/23	400	1600	7.0	330	-	-
		84/03/20	500	1500	-	335	-	-
09CBD2	433103-1141912	83/10/05	200	3300	9.0	398	7.1	3
23DDD1	432910-1141605	83/07/19	1100	5500	13.0	450	7.4	13
		83/10/06	800	5700	15.0	453	7.4	12
		83/12/14	700	4800	-	477	-	-
		84/01/25	1000	3200	-	479	-	-
		84/03/20	800	3200	-	460	-	-
36CAD1	432730-1141530	83/10/06	200	1600	13.0	329	7.5	10
36DAB1	432745-1141455	83/07/22	1000	6500	9.5	500	-	22
36DCA1	432725-1141510	83/07/19	1400	4300	10.0	396	7.3	17
		83/10/06	1200	3300	-	437	-	15
		83/12/14	800	3200	-	430	-	-
		84/01/23	1500	1600	-	433	-	-
		84/03/20	1100	2400	-	402	-	-
03N-18E-06ACB1	433730-1142110	83/10/05	500	3300	-	387	-	4
		83/11/29	400	2400	8.0	374	7.5	8
		84/01/23	800	2300	-	391	-	-
08BCC1	433628-1142040	83/08/18	2200	7000	8.5	430	7.1	7
		83/10/05	800	2000	9.0	418	7.4	3
		84/01/24	1200	4700	-	433	-	-
		84/03/30	800	4400	-	445	-	-
08CAA1	433621-1142015	83/08/23	600	2700	9.0	360	7.2	6
08CBC1	433615-1142035	83/07/21	600	3000	8.0	266	-	2
		83/10/05	200	1600	-	374	7.0	3
		83/11/29	300	1600	8.0	374	7.0	11
		84/01/23	500	1300	-	433	-	-
		84/03/20	200	1100	-	420	-	-
17CBB1	433533-1142042	83/08/02	200	1600	9.5	242	6.9	24
		83/10/05	300	1600	-	284	7.2	19
		83/12/14	300	1600	-	300	-	-
		84/01/23	700	1500	-	309	-	-
		84/03/20	500	1900	-	320	-	-
17CCD1	433510-1142032	83/08/02	300	3200	9.5	315	7.6	11
		83/12/14	300	2300	-	327	-	-
		84/01/25	500	2300	-	330	-	-
18DAA1	433533-1142049	83/08/11	100	1600	7.0	275	7.3	14
32ABA1	433322-1141957	83/12/14	300	1900	-	351	-	-
		84/01/23	400	1900	-	350	-	-
32ABC1	433313-1142000	83/08/01	500	3200	10.0	358	7.1	11

Appendix B.- Locations and corresponding water-quality data for ground-water quality sites within the study area, and for the duration of the study period.

(1). Concentrations of nitrate, chloride, and orthophosphate are in micrograms per liter. (Values shown are milligrams per liter x 1000).

A dash (-) indicates the values were not determined for that date.

Well location (T.- R.- Sec.)	Latitude-longitude	Sample date	Nitrate conc. (1)	Chloride conc. (1)	Temp. deg. C	E.C.	pH	Orthophosphate conc. (1)
03N-18E-32ABC1	433313-1142000	83/10/05	400	2000	10.5	336	7.3	7
		84/01/24	700	2300	-	361	-	-
		84/03/20	500	1800	-	360	-	-
04N-17E-01BDB1	434248-1142250	83/08/23	300	1600	7.5	205	7.4	12
		83/10/03	400	1600	8.5	239	7.2	7
		83/11/28	400	1300	8.5	246	7.2	23
		84/01/24	500	1100	-	273	-	-
		84/03/20	400	1100	-	275	-	-
11CDA2	434121-1142344	83/08/23	800	4800	11.0	307	7.6	15
11DBD1	434127-1142323	83/08/19	300	1600	9.5	222	7.3	25
		83/10/03	500	3300	10.0	266	7.1	21
		83/11/29	500	1900	12.0	276	7.6	23
		84/01/24	600	1900	-	294	-	-
		84/03/28	700	3100	-	303	-	-
12CDA1	434122-1142237	83/08/03	1400	5400	13.0	365	7.6	24
		83/10/03	800	3300	13.5	313	7.3	22
		83/11/29	700	2500	12.0	302	7.3	25
		84/01/24	900	3200	-	319	-	-
		84/03/21	700	3400	-	328	-	-
12DAB1	434137-1142205	83/08/19	500	1300	8.0	220	7.5	63
13ABA1	434114-1142218	83/08/03	200	1600	7.5	205	7.3	18
		84/01/24	500	400	-	232	-	-
14BBD1	434104-1142413	83/08/19	200	6200	21.0	385	7.7	10
15BDD1	434048-1142504	83/08/24	300	2200	-	258	7.5	7
16DDD1	434027-1142537	83/08/24	100	2200	11.0	287	7.3	12
04N-18E-07DAB1	434137-1142056	83/08/10	200	1600	9.5	375	7.4	16
		84/01/24	500	1500	-	453	-	-
07DBD1	434128-1142102	83/08/24	300	1100	8.0	369	7.1	12
		83/10/03	700	3300	8.5	506	7.1	10
		83/11/28	400	1600	8.5	463	7.1	11
		84/01/24	600	2300	-	572	-	-
		84/03/20	500	3200	-	542	-	-
18CCB1	434032-1142148	83/08/24	600	3800	8.5	428	7.3	16
		83/10/03	700	4100	8.5	458	7.1	12
		83/11/28	600	2800	8.0	437	7.3	14
		84/01/24	700	3100	-	458	-	-
		84/03/20	600	2900	-	465	-	-
19ACB1	434002-1142117	83/08/10	1100	3200	8.0	445	7.3	24
		83/10/04	500	1600	8.5	431	7.2	19
19DBB1	433955-1142113	83/10/04	600	1600	8.0	427	7.3	13
19DBC1	433946-1142108	83/08/10	600	1900	9.0	405	7.5	20
		83/10/04	300	1600	9.0	427	7.4	16
19DBC2	433950-1142110	83/08/10	700	1600	8.0	418	7.3	16
		83/10/04	400	1600	8.5	414	7.3	15

Appendix B.- Locations and corresponding water-quality data for ground-water quality sites within the study area, and for the duration of the study period.

(1). Concentrations of nitrate, chloride, and orthophosphate are in micrograms per liter. (Values shown are milligrams per liter x 1000).

A dash (-) indicates the values were not determined for that date.

Well location (T.- R.- Sec.)	Latitude-longitude	Sample date	Nitrate conc. (1)	Chloride conc. (1)	Temp. deg. C	E.C.	pH	Orthophosphate conc. (1)
04N-18E-19DBD1	433944-1142104	83/08/04	800	2800	10.5	403	7.2	21
		83/11/29	500	1900	9.0	416	7.4	17
		84/01/24	500	2300	-	438	-	-
		84/03/20	500	1900	-	452	-	-
19DBD2	433947-1142104	83/08/10	700	1300	7.0	380	7.3	23
		83/10/04	900	2600	10.0	473	7.4	22
19DCB1	433938-1142112	83/08/10	300	1600	9.0	288	7.3	20
		83/11/29	300	1600	7.5	364	7.4	14
19DCB2	433940-1142109	83/10/04	500	1600	9.0	416	7.4	9
19DCD1	433933-1142107	83/08/24	300	1100	11.0	278	7.5	13
		83/10/03	500	1300	-	321	-	6
		84/01/24	500	1500	-	309	-	-
		84/03/21	400	1300	-	335	-	-
30DAD1	433852-1142047	83/08/18	400	1300	8.0	300	7.4	10
		83/10/03	400	2600	8.5	317	7.1	6
		83/11/30	200	1600	-	324	-	8
		84/01/23	300	1900	-	340	-	-
		84/03/20	400	1900	-	350	-	-
31DBD1	433759-1142102	83/08/13	500	1600	7.0	322	7.2	9
		83/11/20	200	2200	9.0	338	7.3	8
		84/01/23	300	1800	-	350	-	-
		84/03/21	300	2700	-	360	-	-
31DCB1	433752-1142117	83/08/03	600	3200	10.0	385	7.2	18
31DCC1	433748-1142117	83/08/02	1100	3800	11.0	395	7.2	6
		83/10/04	500	2600	9.0	402	7.2	6
31DCC2	433750-1142115	83/08/03	800	4300	10.5	382	7.4	6
		83/12/14	300	3200	-	417	-	-
		84/01/23	600	3100	-	412	-	-
		84/03/20	300	3200	-	412	-	-
31DDB1	433755-1142057	83/08/03	500	1100	8.5	284	7.2	9
31DDC1	433748-1142057	83/08/18	300	1600	8.0	270	7.5	10
		83/10/04	300	1600	9.5	299	7.7	9
		83/11/29	100	1600	7.5	307	7.4	9
		84/01/23	300	1300	-	314	-	-
		84/03/21	300	1800	-	320	-	-
05N-17E-14CBC1	434554-1142417	83/08/25	200	1600	7.0	246	7.3	6
		84/01/24	300	500	-	275	-	-
		84/03/20	400	300	-	278	-	-
14CBD1	434555-1142409	83/10/03	300	1000	8.0	246	-	7
25BCD1	434421-1142300	83/08/25	500	1600	10.0	307	7.5	16
36CBD1	434248-1142251	83/08/19	400	1600	7.0	270	7.4	12

Appendix C.- Locations and corresponding water-quality data for surface-water quality sites within the study area, and for the duration of the study period.

(1). Concentrations of nitrate, chloride, and orthophosphate are in micrograms per liter. (Values shown are milligrams per liter x 1000).

A dash (-) indicates the values were not determined for that date.

Site location (T.- R.- Sec.)	Latitude-longitude	General site description	Sample date	Nitrate conc. (1)	Chloride conc. (1)	Temp. deg. C	E.C.	pH	Orthophosphate conc. (1)
01N-18E-12CDCS	432534-1141539	Big Wood at Glendale Br.	83/10/06	400	1600	9.0	299	8.1	7
		Big Wood at Glendale Br.	84/03/30	400	1900	-	320	-	-
02N-18E-16ACDS	433023-1141846	Big Wood below Hailey	83/10/05	500	1000	10.0	288	8.2	64
03N-18E-07DADS	433617-1142043	Big Wood at East Fork	83/10/04	400	1000	11.5	266	8.2	6
08CCBS	433613-1142037	East Fork nr. Mouth	83/08/02	500	1100	11.0	230	8.3	8
		East Fork nr. Mouth	83/10/05	300	1000	5.5	354	8.1	4
		East Fork nr. Mouth	84/03/30	400	2700	-	473	-	-
04N-17E-12DBCS	434136-1142224	Big Wood above Ketchum	83/10/03	300	1000	8.0	205	7.8	3
		Big Wood above Ketchum	84/03/30	500	1000	-	224	-	-
13BADS	434058-1142237	Warm Spr. Cr. nr. Mouth	83/10/03	300	1300	12.0	233	-	6
		Warm Spr. Cr. nr. Mouth	84/03/30	500	2400	-	241	-	-
04N-18E-19BBDS	434014-1142143	Trail Cr. above Mouth	83/10/03	300	1300	9.0	394	8.3	7
		Trail Cr. above Mouth	84/03/30	400	2400	-	484	-	-
19DCBS	433939-1142116	Big Wood below Ketchum	83/10/04	700	3000	7.0	275	7.8	21
		Big Wood below Ketchum	84/03/30	600	2600	-	303	-	-
31DDBS	433726-1142052	Big Wood at Dondero's	83/10/05	500	1300	7.0	266	8.2	9
		Big Wood at Dondero's	84/03/30	400	2400	-	299	-	-
05N-17E-36BDBS	434335-1142248	Lake Creek at Highway	83/10/03	400	1600	8.5	376	7.5	24
		Lake Creek at Highway	84/03/30	600	2900	-	407	-	-

Appendix D.- Locations and water-level data for water-level measurement sites within the study area, and for the duration of the study period.

(1). Status codes: NP - Well not being pumped at time of measurement.
P - Well being pumped at time of measurement.
R - Well was recently pumped before measurement.

Agency column indicates which agency personnel made the measurement.

Well location (T.- R.- Sec.)	Latitude-longitude	Date of measure-ment	Agency	Status (1)	Well ele-vation (feet)	Depth to water (feet)	Water-level elev. (feet)
01N-18E-01DAA1	432657-1141448	83/07/19	USGS	NP	5137	37.30	5099.3
		83/11/08	USGS	NP	5137	42.43	5094.2
		84/03/13	USGS	NP	5137	45.37	5091.2
02N-18E-04CDC1	433140-1141915	83/07/20	UofI	P	5336	13.70	5322.3
05AAA1	433220-1141935	83/07/21	UofI	NP	5374	9.54	5364.5
09ADA1	433153-1141825	83/07/21	UofI	NP	5340	31.97	5308.0
09BDC1	433119-1141906	83/07/20	UofI	NP	5324	14.57	5309.4
		83/12/14	UofI	NP	5324	19.31	5304.7
		84/03/29	UofI	NP	5324	19.32	5304.7
09DDA1	433055-1141822	83/07/20	UofI	P	5324	36.50	5287.5
		83/08/18	UofI	NP	5324	32.12	5291.9
		83/12/14	UofI	NP	5324	38.78	5285.2
		84/03/29	UofI	NP	5324	39.17	5284.8
15DDC1	433003-1141727	83/07/20	UofI	NP	5278	25.63	5252.4
		83/11/28	UofI	NP	5278	30.66	5247.3
		84/03/29	UofI	NP	5278	31.76	5246.2
23DDB1	432910-1141615	83/07/19	UofI	NP	5242	38.61	5203.4
		83/10/06	UofI	NP	5242	39.45	5202.5
		83/11/28	UofI	NP	5242	40.86	5201.1
23DDD1	432910-1141605	83/07/19	UofI	NP	5233	43.75	5189.3
		83/10/06	UofI	NP	5233	44.77	5188.2
		83/11/28	UofI	NP	5233	46.66	5186.3
26ACA1	432855-1141620	83/07/19	UofI	NP	5224	34.55	5189.5
		83/10/06	UofI	NP	5224	35.33	5188.7
		83/11/28	UofI	NP	5224	37.61	5186.4
		84/03/29	UofI	NP	5224	38.58	5185.4
26ACC1	432840-1141620	83/07/20	UofI	NP	5190	8.89	5181.1
26CBB1	432830-1141705	83/07/20	UofI	NP	5197	6.29	5190.7
36DAB1	432745-1141455	83/07/22	UofI	R	5211	73.13	5137.9
36DCA1	432725-1141510	83/07/19	UofI	NP	5173	37.52	5135.5
		84/03/29	UofI	NP	5173	44.09	5128.9
03N-17E-25ADC1	433357-1142210	83/07/21	UofI	NP	5520	2.22	5517.8
03N-18E-06ACB1	433730-1142110	83/11/29	UofI	P	5620	8.87	5611.1
07DAB1	433622-1142053	83/08/04	UofI	R	5556	7.79	5548.2
		83/11/30	UofI	NP	5556	9.02	5547.0
		84/03/29	UofI	NP	5556	9.22	5546.8
07DBA1	433623-1142107	83/08/10	UofI	P	5592	46.38	5545.6
07DDD1	433603-1142043	83/08/02	UofI	NP	5546	16.42	5529.6
08BCC1	433628-1142040	83/08/18	UofI	NP	5566	16.34	5549.7
08CBC1	433615-1142035	83/07/21	UofI	NP	5560	11.08	5548.9
08CBC2	433617-1142040	83/07/21	UofI	NP	5556	7.09	5548.9
		83/11/29	UofI	NP	5556	10.37	5545.6
17CCD1	433510-1142032	83/08/02	UofI	NP	5527	32.18	5494.8
		84/03/29	UofI	NP	5527	33.95	5493.0

Appendix D.- Locations and water-level data for water-level measurement sites within the study area, and for the duration of the study period.

(1). Status codes: NP - Well not being pumped at time of measurement.
P - Well being pumped at time of measurement.
R - Well was recently pumped before measurement.
S - Nearby well pumping at time of measurement.

Agency column indicates which agency personnel made the measurement.

Well location (T.- R.- Sec.)	Latitude-longitude	Date of measure-ment	Agency	Status (1)	Well ele-vation (feet)	Depth to water (feet)	Water-level elev. (feet)
03N-18E-18BAB1	433556-1142103	83/07/21	UofI	NP	5543	16.31	5526.7
		83/11/30	UofI	NP	5543	20.53	5522.5
20ABC1	433501-1142002	83/08/02	UofI	P	5520	37.94	5482.1
20BDA1	433451-1142011	83/07/21	UofI	NP	5519	37.61	5481.4
		84/03/29	UofI	NP	5519	40.00	5479.0
29BDA1	433359-1142009	83/07/22	UofI	P	5440	10.73	5429.3
		83/11/30	UofI	NP	5440	12.39	5427.6
32ABA1	433222-1141957	83/07/21	UofI	NP	5416	6.83	5409.2
		84/03/30	UofI	NP	5416	11.49	5404.5
04N-17E-01BDB1	434248-1142250	83/08/23	UofI	NP	5938	28.95	5909.0
		83/11/28	UofI	NP	5938	35.54	5902.5
		84/03/29	UofI	NP	5938	36.05	5902.0
11CDA2	434121-1142344	83/08/23	UofI	NP	5854	23.17	5830.8
11DAB1	434133-1142325	83/08/23	UofI	NP	5867	44.78	5822.2
11DBD1	434127-1142323	83/08/19	UofI	R	5860	37.22	5822.8
		83/11/29	UofI	R	5860	45.05	5815.0
12ACD1	434147-1142212	83/08/24	UofI	R	5849	11.80	5837.2
		83/11/29	UofI	NP	5849	12.57	5836.4
12CDA1	434122-1142237	83/08/03	UofI	NP	5848	49.84	5798.2
		83/11/29	UofI	R	5848	53.03	5795.0
		84/03/29	UofI	R	5848	52.20	5795.8
12DAB1	434137-1142205	83/08/19	UofI	P	5845	19.56	5825.4
13AAB1	434108-1142210	83/07/18	USGS	NP	5813	14.27	5798.8
		83/11/18	USGS	NP	5813	16.02	5797.1
		84/03/24	UofI	NP	5813	15.94	5797.1
13ABA1	434114-1142218	83/08/03	UofI	NP	5815	11.10	5803.9
14BBD1	434104-1142413	83/08/19	UofI	R	5904	39.05	5865.0
16DDD1	434027-1142537	83/08/24	UofI	NP	5980	0.20	5979.8
04N-18E-07DBD2	434128-1142102	83/08/24	UofI	P	5880	7.93	5872.1
		83/11/28	UofI	S	5880	15.37	5864.6
18CCB1	434032-1142148	83/08/24	UofI	R	5805	45.60	5759.4
		83/11/28	UofI	NP	5805	47.82	5757.2
		84/03/29	UofI	NP	5805	48.55	5756.5
19ACB1	434002-1142117	83/08/10	UofI	NP	5764	32.65	5731.3
		83/11/29	UofI	NP	5764	36.91	5727.1
		84/03/29	UofI	NP	5764	36.92	5727.1
19DBC1	433946-1142108	83/08/10	UofI	NP	5732	17.02	5715.0
		83/08/24	UofI	NP	5732	17.14	5714.9
		83/11/29	UofI	NP	5732	19.15	5712.8
		84/03/29	UofI	NP	5732	18.98	5713.0
19DBC2	433950-1142110	83/08/10	UofI	NP	5738	18.14	5719.9
19DBC3	433948-1142116	83/08/04	UofI	R	5727	8.40	5718.6
19DBD1	433944-1142104	83/08/04	UofI	NP	5734	21.38	5712.6
19DBD2	433947-1142104	83/08/10	UofI	NP	5740	22.88	5717.1

Appendix D.- Locations and water-level data for water-level measurement sites within the study area, and for the duration of the study period.

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Agency column indicates which agency personnel made the measurement.

Well location (T.- R.- Sec.)	Latitude-longitude	Date of measurement	Agency	Status (1)	Well elevation (feet)	Depth to water (feet)	Water-level elev. (feet)
04N-18E-19DBD2	433947-1142104	83/11/29	UofI	NP	5740	25.57	5714.4
19DCB1	433938-1142112	83/08/10	UofI	NP	5722	9.99	5712.0
19DCB2	433940-1142109	83/08/24	UofI	NP	5728	18.30	5709.7
		83/11/29	UofI	NP	5728	19.50	5708.5
19DCD1	433933-1142107	83/08/24	UofI	NP	5718	12.45	5705.5
		83/11/29	UofI	R	5718	13.11	5704.9
30DAD1	433852-1142047	83/08/18	UofI	R	5678	8.07	5669.9
		83/11/30	UofI	NP	5678	9.17	5668.8
		84/03/29	UofI	NP	5678	9.07	5668.9
31DBD1	433759-1142102	83/08/03	UofI	R	5632	13.78	5618.2
		83/11/30	UofI	R	5632	15.07	5616.9
		84/03/29	UofI	R	5632	13.85	5618.2
31DCC1	433748-1142117	83/08/02	UofI	P	5650	38.25	5611.8
31DDC1	433748-1142057	83/08/18	UofI	NP	5620	7.25	5612.8
		83/11/29	UofI	NP	5620	7.90	5612.1
		84/03/29	UofI	NP	5620	8.02	5612.0
05N-17E-10DCD1	434627-1142442	83/08/25	UofI	NP	6188	28.70	6159.3
		83/11/28	UofI	NP	6188	31.45	6156.5
10DDD1	434630-1142424	83/08/25	UofI	NP	6161	7.70	6153.3
14CBC1	434554-1142417	83/08/25	UofI	NP	6129	2.33	6126.7
15ADA1	434613-1142427	83/08/25	UofI	NP	6161	20.15	6140.8
23ACC1	434512-1142339	83/08/25	UofI	NP	6087	11.02	6076.0
25BCD1	434421-1142300	83/08/25	UofI	NP	6029	15.54	6013.5
26ADA1	434430-1142313	83/08/25	UofI	NP	6028	3.57	6024.4
36CBD1	434248-1142251	83/08/19	UofI	NP	5965	46.80	5918.2
		84/03/29	UofI	NP	5965	51.64	5913.4

Appendix E.- Locations of measured surface-water discharge sites, and corresponding values, in cubic feet per second (cfs).

Site location (T.- R.- Sec.)	Latitude-longitude	General site description	Measurement date	Measurement time	Agency	Discharge (cfs)
01N-18E-01BBBS	432716114160 0	Broadford Slough	83/09/14	12:30	UofI	8
12CDCS	432534114153 9	Big Wood at Glendale Br.	83/09/14	14:00	UofI	135
02N-18E-16BABS	432619114190 8	Croy Creek nr. Mouth	83/09/14	11:00	UofI	13
03N-18E-06AABS	433712114205 2	Big Wood at Gimlet	83/09/13	12:30	UofI	327
08CCBS	433613114203 7	East Fork nr. Mouth	83/09/13	15:30	UofI	37
		East Fork nr. Mouth	84/03/13	12:30	UofI	24
29CCAS	433333114203 0	Big Wood above Deer Cr.	83/09/13	17:00	UofI	318
32BBAS	433322114203 3	Deer Creek nr. Mouth	83/09/13	18:00	UofI	6
		Deer Creek nr. Mouth	84/03/14	10:00	UofI	13
04N-17E-13ABAS	434114114222 0	Big Wood at Ketchum	83/09/12	18:30	UofI	193
		Big Wood at Ketchum	84/03/12	16:30	UofI	120
13BADS	434058114223 7	Warm Spr. Cr. abv.Mouth	83/09/13	09:30	UofI	60
		Warm Spr. Cr. nr. Mouth	84/03/13	09:30	UofI	51
04N-18E-19BCBS	434005114214 7	Trail Creek nr. Mouth	83/09/13	11:00	UofI	31
		Trail Creek abv.Mouth	84/03/13	11:00	UofI	33
05N-17E-03CDDS	434702114250 3	Big Wood Below No. Fork	83/09/12	11:00	UofI	171
		Big Wood Below No. Fork	84/03/12	11:00	UofI	94
36BBDS	434342114225 6	Big Wood nr. Lake Creek	83/09/12	16:30	UofI	182
36BDBS	434335114224 8	Lake Creek nr. Mouth	83/09/12	17:30	UofI	10