GROUND WATER RESOURCES IN A PORTION OF PAYETTE COUNTY, IDAHO

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ABSTRACT

This study was conducted to provide ground water resource information for Payette County, Idaho. The study area is located in the western edge of a large sediment filled basin, the western Snake River Plain, which consists of over 4,000 feet of lacusterine and fluvial deposits of mostly clay, sand and gravel. Lithologic correlation between wells and aquifer identification are difficult because of the discontinuous and variable nature of the sediments.

Four water quality types were identified from 42 ground water analyses. Four flow systems are suggested when the four water types are correlated with the subsurface geology.

Well hydrographs indicate that the dominate source of recharge is surface water irrigation in much of the study area. Long-term water level trends are stable in the surface water irrigated areas. Multi-year hydrographs are not available to determine long-term trends in the ground water irrigated areas. One irrigation well has experienced over 4 ft/year of water level decline.

Most of the ground water enters the study area from the southeast with a small quantity entering from the northeast. Most ground water discharge is to the Snake and Payette Rivers.

Drinking water standards for sulfate, iron, manganese, nitrates and total dissolved solids are exceeded for water quality samples from some wells. The south edge of Clay Peak is identified as a potential problem area for future housing development because of the low well yields expected. The short well life problem for the City of Payette is possibly because of bacteria indigenous to the subsurface.

ACKNOWLEDGMENTS

This project was funded by the Payette County Planning and Zoning Commission. The field vehicle made available by the Commission was a valuable asset to the project, and was greatly appreciated.

Stewart Edwards is acknowledged for his time and efforts directed toward this project. Bob Himes of the U.S. Soil Conservation Service is gratefully acknowledged for providing office space, along with technical and moral support during the 1984 field season. University of Idaho graduate students Tom Lachmar and Charles Gruenenfelder are acknowledged for field work completed during the fall and spring water level measurements.

A special thanks to Sue Line and Lisa Scarano for their patience during the many changes and many drafts needed for this report.

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CHAPTER 1

INTRODUCTION

Statement of the Problem

Payette County needs a ground water information base in order to understand present ground water resource problems and to predict impacts from possible future use. Reported ground water problems include: water level declines in areas irrigated by ground water, decreasing yields from City of Payette municipal wells, poor natural water quality in some areas, and water quality problems due to land use practices.

Purpose and Objectives

The purpose of this study is to provide a guide for the continued utilization and development of the ground water resources of Payette County. The general objective of this study is to prepare a report describing the general hydrogeology of the southwestern half of Payette County to be used by the county as a basis for land use planning. The specific objectives of this study are to:

1) review existing well data, hydrogeologic information and other appropriate ground water information on the Payette County study area,
2) conduct a water level measurement and water quality sampling program using existing wells,
3) present and evaluate physical and chemical characteristics of the ground water resources in the study area based on the hydrogeologic, hydrologic, and chemical water quality data collected,

4) prepare a report of findings for use as a resource document for land use planning within Payette County.

Method of Study

A literature review was conducted to evaluate the existing available data. Agencies contacted include the United States Geological Survey (USGS), Idaho Department of Water Resources (IDWR), and the Idaho Department of Health and Welfare (IDHW). Field data were collected intermittently during the period of May, 1984 to August, 1985. Water level measurements were taken in the first three field trips: Summer, 1984; November, 1984; and April, 1985. Chemical water quality sampling took place in June, 1985.

Description of the Study Area

Payette County is located in southwestern Idaho (figure 1). The Snake River separates Payette County from the State of Oregon to the west. Canyon County lies to the south, while Gem and Washington Counties form the eastern and northern borders. Payette County includes 403 square miles of land area.

The southwestern half of the county was selected as the study area for this investigation (figure 1). The study area outlined in figure 1 contains about 235 square miles. Relatively few wells exist in the county outside the study area. The majority of the county's population and farms are located within the study area boundary. The major population centers are Payette, population 5,448; Fruitland, population 2,559; and New Plymouth, population 1,186 (U.S. Bureau of Census, 1982).

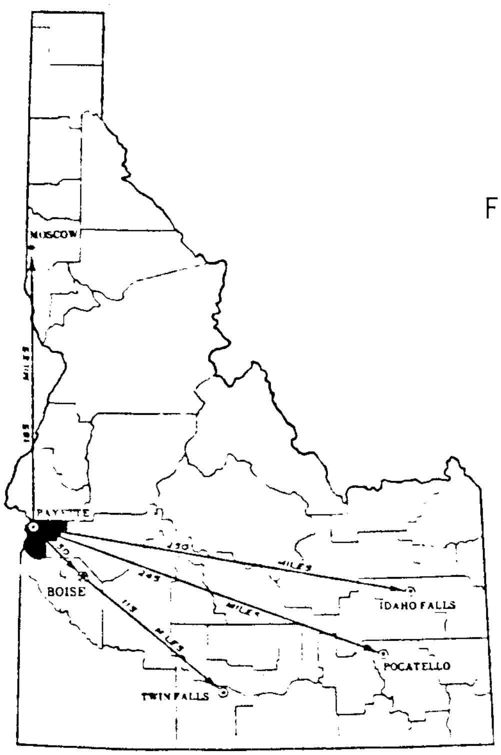
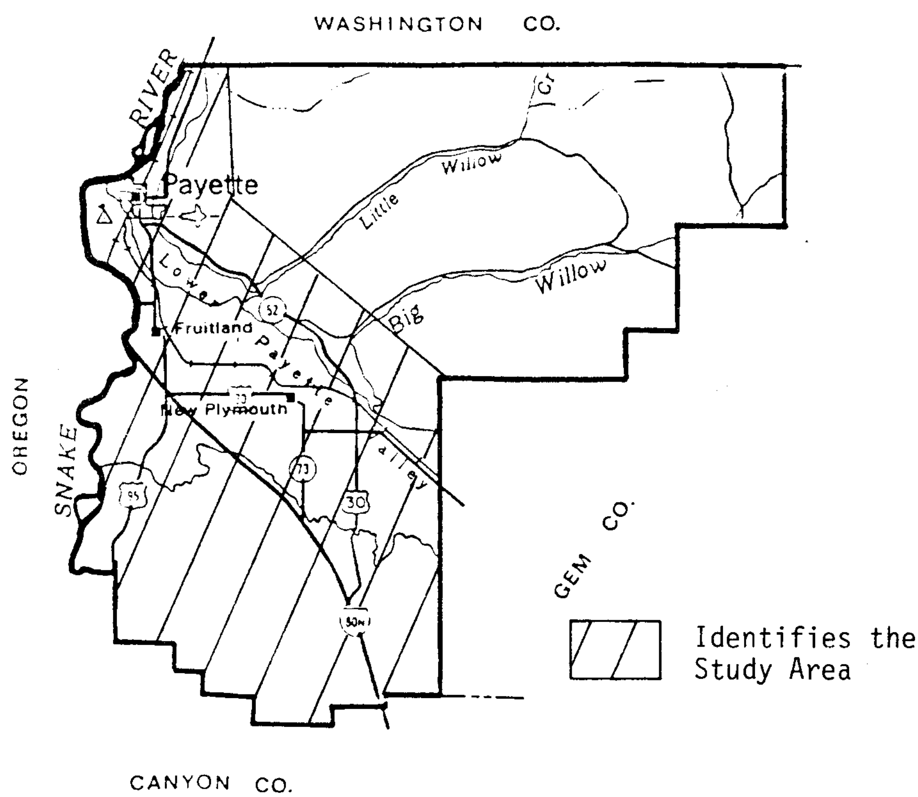


Figure 1. Location map of Payette County, Idaho, with study area outlined.



All of these cities use ground water for their water supplies. Each city has several wells. The County's total population is about 15,825.

Most of the Payette County study area is located within the lower portion of the Payette River Basin. The southwestern portion of the study area drains directly to the Snake River. The study area is composed of relatively flat river bottom lands bounded by a series of semi-rounded terraces. Most of the area is used for irrigated agriculture with much of the water supplied by canals from the Payette River. Portions of the southern and northern part of the county are irrigated by ground water.

The climate of Payette County can be classified as semiarid. Average annual rainfall and temperature near the City of Payette are 10.9 inches and 50.5 degrees Fahrenheit. The U.S. Soil Conservation Service (1976) reports that the northeastern portion of the county, east of the study area, receives the most precipitation, up to 16 inches annually. The southern portion of the county is hotter and drier, averaging 50.9 degrees Fahrenheit and 8.6 inches of precipitation annually at the University of Idaho research station, two miles south of the county border. A detailed description of the climate is contained in the Soil Survey of Payette County, Idaho, published by the U.S. Soil Conservation Service (1976).

The Payette River is the dominant water source for crop irrigation in Payette County. Figure 2 shows the major canals. In general, water flows from east to west through mostly unlined ditches. There are lined canals in some localized areas. Water loss from the canals probably is a significant source of ground water recharge.

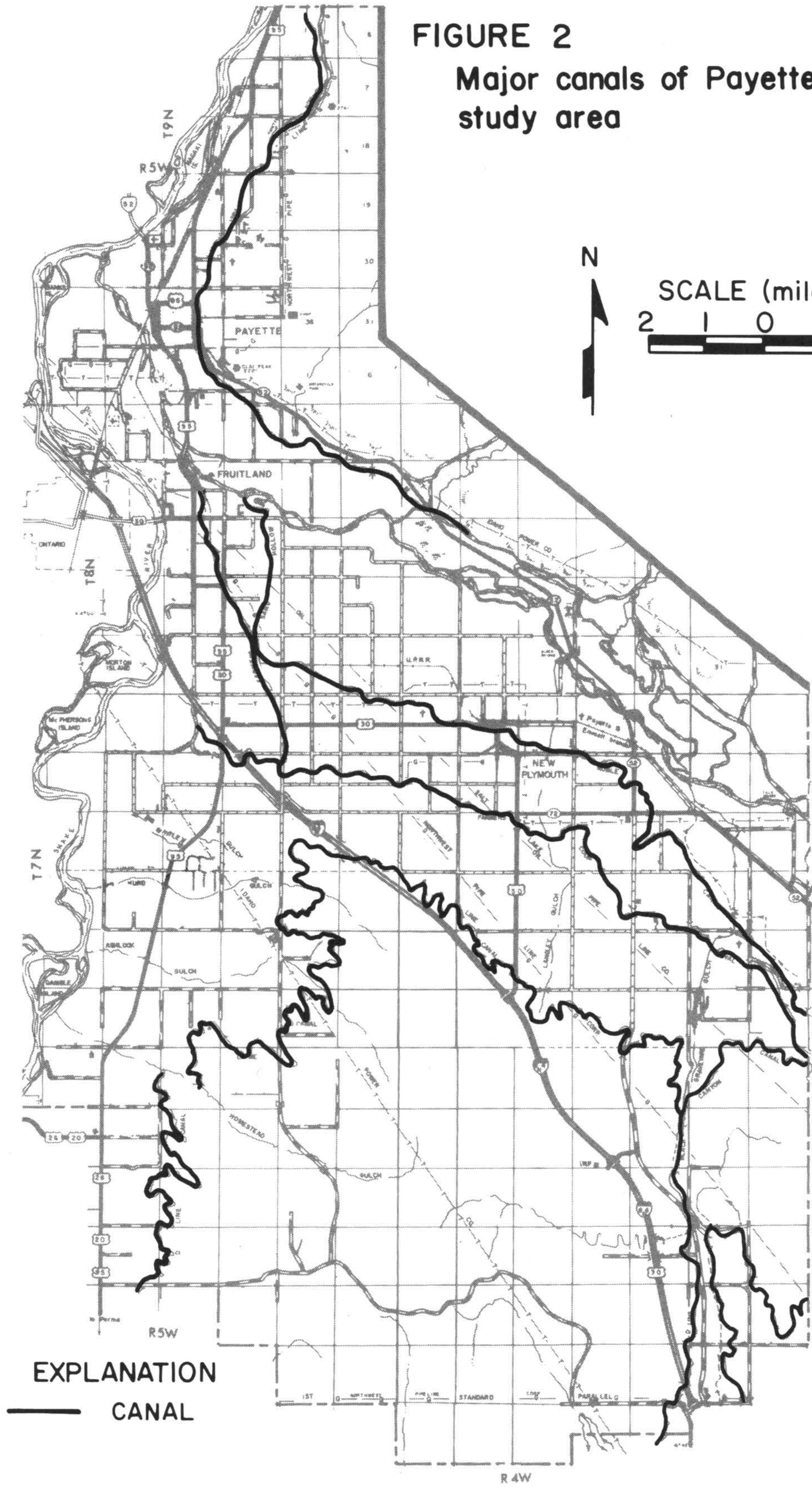


FIGURE 2
Major canals of Payette County study area

County wide land use is predominantly farming and ranching. The Soil Conservation Service (1967) reports 56,000 acres of cropland with about 98% of this land irrigated. Most of this irrigation occurs within the study area.

Previous Investigations

The geology of the Payette County region has been presented in previous reports: Lindgren (1898a and 1898b), Kirkham (1930, 1931a, 1931b, 1931c, and 1935), and Youngquist and Kiilsgaard (1951). The report Geology and Mineral Resources of Ada and Canyon Counties by Savage (1958) includes a fairly complete geologic history of southwestern Idaho. Savage (1961) describes the geology of Payette County in a similar report called Geology and Mineral Resources of Gem and Payette Counties. Subsurface geologic data are available primarily in the form of drillers' logs within the files of the Idaho Department of Water Resources. Wood and Anderson (1981) wrote on the geology of the Nampa and Caldwell area southeast of Payette County. They adapted the name Idaho Group after Malde and Powers (1962) instead of the previously used name of Idaho Formation; they subdivided the Idaho Group into the Upper Idaho Group (Glenns Ferry Formation) and the Lower Idaho Group (Chalk Creek and Poison Creek Formations undifferentiated). Blakley Engineering (1976) conducted a subsurface study using drillers' logs in the vicinity of the City of Payette in order to determine locations for future municipal wells.

Information on the regional hydrogeology and ground water levels was obtained from a series of reports from the United States Geologic Survey

(USGS). Specific references include: Bassick (1985), Bigelow, Goodell and Newton (1984), Lindholm and Goodell (1984), Young and Norvitch (1984), and Sisco (1976). Wood and Anderson (1981) discuss the hydrologic units they have identified in the Caldwell and Nampa area. Water quality data were obtained from the STORET data retrieval system operated by the United States Environmental Protection Agency (EPA).

Well-Numbering System

The well-numbering system used in this report is the same as used by the USGS in Idaho, and indicates the well location within the official rectangular subdivision of public lands, with reference to the Boise base line and meridian (figure 3). The first two segments of the number designate the township and range. The third segment gives the section number, which is followed by three letters and a numeral to indicate the 1/4 section (160-acre tract), the 1/4-1/4 section (40-acre tract), the 1/4-1/4-1/4 section (10-acre tract), and the serial number of the well within the tract respectively.

Quarter sections are lettered A, B, C and D in counterclock wise order from the northeast quarter of each section. Within the quarter sections, 40-acre and 10-acre tracts are lettered in the same manner. For example, well 8N4W31DAD1 is in the SE1/4NE1/4SW1/4 sec. 31, T.8N., R.4W., and is the first well inventoried in that tract.

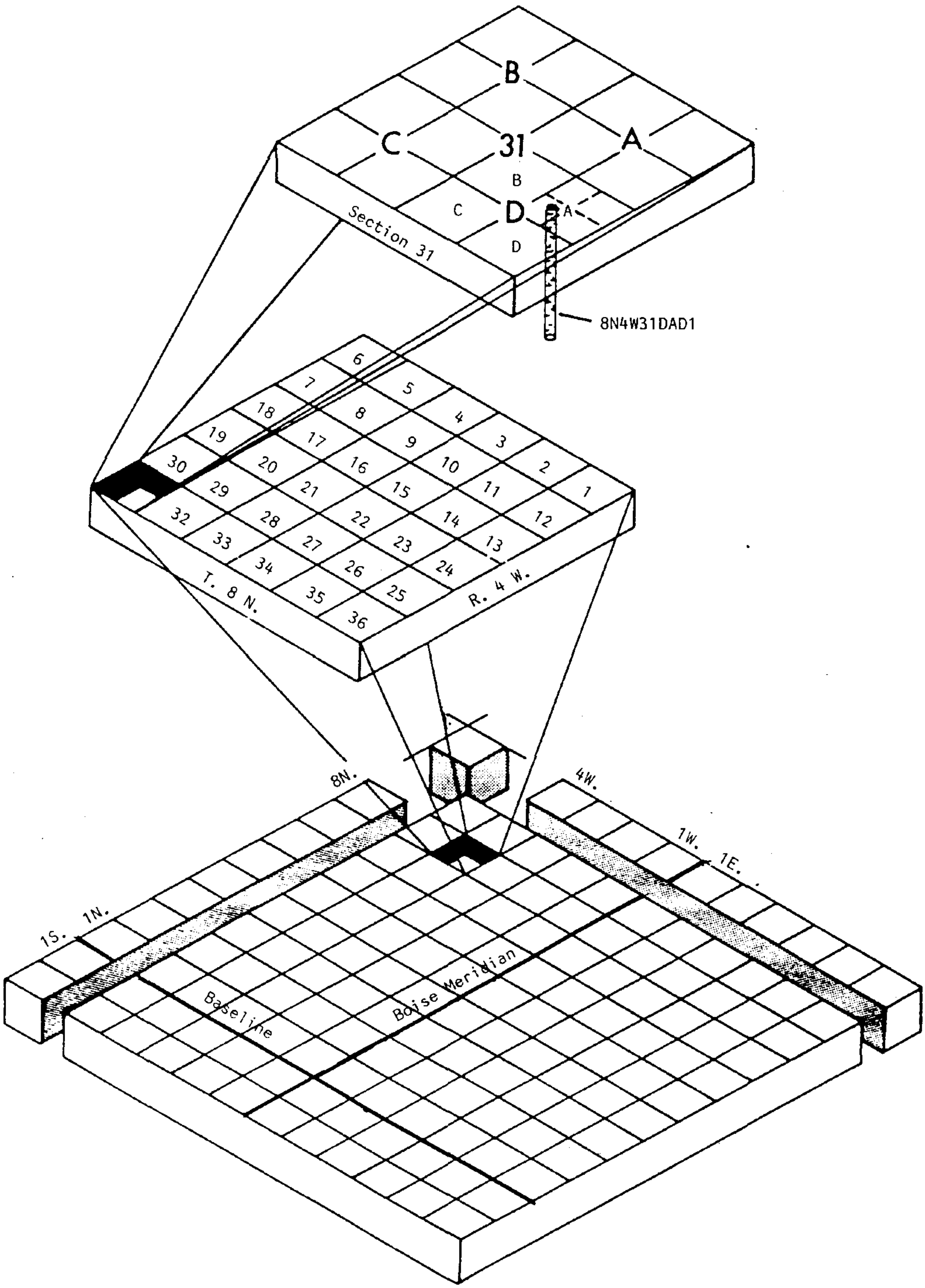


Figure 3 -- Well-numbering system.

CHAPTER 2

DATA COLLECTION AND PRESENTATION

This chapter includes a description of data collection procedures and a presentation of water level and water quality data for the Payette County study area. Interpretation of water level and water quality data are presented in following chapters.

Water Level Data and Well Locations

Information on wells in the Payette County study area was collected in a several stage inventory process. This process included a review of drillers' logs, supplied by the Idaho Department of Water Resources. Wells were selected from these data for a field inventory. These selected wells were located in the field, and water levels were measured when the well was not pumping. Some of these wells visited during the summer of 1984 were selected for additional water level measurements in the fall of 1984 and spring of 1985.

The criteria used to choose a well for field visitation included: 1) location, 2) construction, and 3) pumping schedule or use. The location is important to obtain a reasonable spatial distribution of wells in order to cover the entire study area. Well construction is important in order to relate water level and quality data to geology. The pumping schedule and well use helps determine the schedule for water level measurement and the water quality sampling. An inactive well is best for determination of static ground water levels, while an active well is best for obtaining water quality samples.

Table 1 contains well and water level data from wells visited in the summer and fall of 1984 and the spring of 1985. The 1984 summer measurements were taken during the well inventory. Water level measurements were taken in the fall to document conditions after the irrigation season when the canals are drained and the irrigation wells are off. Spring 1985 measurements were taken to indicate ground water levels prior to the summer irrigation season. Most wells were inactive for a period of weeks to months prior to the fall and spring water level measurements. However, a few of the irrigation wells had been operating shortly before the spring measurements, but the well owners reported pumpage as light and infrequent. Table 1 includes water level measurements from 174 wells visited in the summer of 1984, 70 from the fall of 1984 , and 97 from the spring of 1985. Figure 4 shows the location of the wells listed in table 1. Figure 5 shows the location of wells used for the fall and spring measurements. The water level data are used to construct maps of water level elevation, depth to water and fall to spring net water level change, presented later in the report.

Chemical Water Quality Information

Chemical water quality information was obtained from three main sources for the Payette County study area: 1) fourteen wells were sampled by the University of Idaho in June, 1985, as part of this study (table 2), 2) sixteen wells were sampled by the USGS as part of a Lower Payette River Basin study (table 3) (Parliman, 1986), and 3) fourteen water quality analyses from municipal wells were selected from those made

TABLE 1. INVENTORY OF SELECTED WELLSIN THE PAYETTE COUNTY STUDY AREA, IDAHO
INCLUDES: SUMMER, FALL, AND SPRING WATER-LEVEL DATA (1984-85)
(WELL LOCATIONS ARE SHOWN IN FIGURE 4)

ELEVATION = ELEVATION OF MEASERING POINT AS INTERPOLATED FROM TOPOGRAPHIC MAPS

WELL DEPTH = DEPTH OF WELL TAKEN FROM WELL LOGS (FEET)

DEPTH TO WATER = DEPTH TO WATER ACTUALLY MEASURED , OR REPORTED BY THE OWNER, TENANT OR DRILLER; "FLOWING" INDICATES THAT THE WATER LEVEL IS ABOVE LAND SURFACE BUT THE HEIGHT ABOVE LAND SURFACE IS NOT KNOWN

PERFORATION INTERVAL(S) = TWO NUMBERS (45-50) INDICATE PERFORATIONS BETWEEN THE 45 AND 50 FOOT INTERVAL (45-50;70-80;110) INDICATES TWO PERFORATION INTERVALS AND A CASING LENGTH OF 110 FEET

DIAMETER = DIAMETER OF WELL CASING

USE = THE PRINCIPLE WATER USE; D, DOMESTIC; I, IRRIGATION; IND, INDUSTRIAL; M, MUNICIPAL; S, STOCK; N, NONE R, REST ROOMS; DS, DUST CONTROL F, FIRE CONTROL; T, TEST WELL C, COMMUNITY WELL

OTHER SYMBOLS; P - PUMPING
RP - RECENTLY PUMPED
* -DATA REPORTED BY OWNER
? - NO DATA AVAILABLE
- IDAHO POWER POLE NO.
DTW - DEPTH TO WATER
R/U - RARELY USED
S/S - SULFUR SMELL
I/S - IRON STAIN
P/G - PRESSURE GAUGE
F/W - FLOWS IN WINTER
N/A - NO ACCESS
D/C - DUST CONTROL

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
T.6N. R.3W.											
20BBC1	HARMON HUGHES	2545	468	258-278 330-450,460	16		149.7		11-03-84	I	
								149.7	04-13-85		
29DDD1	GILLETTE RIDDLE	2530	275	170	6			100.0	04-13-85	D,U	
30ADD1	GAYLON KRONCE	2510	238	210-230,238	8		99.0		11-03-84	D,S	RP
31CDD1	SAND HOLLOW HALL	2425	118	118	6		19.2		11-03-84	D	R/U
								19.9	04-13-85		
T.6N. R.4W.											
7BDC1	BOB HENNGLER	2600	705	430-680,690	16	P			06-14-84	I	#1001
							271.0		11-01-84		

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	DEPTH TO WATER FALL	DEPTH TO WATER SPR.	DATE	USE	REMARKS
								279.2	04-13-85		RP
7BCB1	SAME	2610	735	345?-660,670	16	P			06-14-84	I	#1002
10ABA1	TIM SHAW	2500	?	?	4	137.1			06-21-84	I	N/L
								137.0	04-13-85		
13DDD1	MR. KELLEHER	2480	265	190-255,255	10			79.0	04-15-85	D	RP
28CCC1	JOE ROBERTS	2665	660	330-645	16	286.8			06-20-84	I	#666
							284.6		11-03-84		
								283.3	04-13-85		
28CCD1	SAME	2640	570	292-542	16	N/A			06-20-84	I	#667
35DAC1	SAME	2560	440	200-440	16	P			06-20-84	I	
								231.7	04-13-85		
34ACB1	ART WILSON	2500	311	130-150, 290-311,311	16	130.0			06-19-84	I,U	
							127.5		11-03-84		
								127.6	04-13-85		
<u>T.6N. R.5W.</u>											
1BCD1	MARK MALSON	2420	354	222-350;350	16	127.2			06-26-84	I	#1005
2ADC1	SAME	2460	606	272-?-484,?	16	P			06-26-84	I	#1008
							155.3		11-01-84		
								144.4	04-14-85		RP
1AAC1	SAME	2450	660	235-255 314-416 435-455;660	16	P			06-26-84	I	#1010
							129.5		11-01-84		
								130.0	04-14-85		
1CCC1	EDWIN NICHOLS	2530	450	274-334 349-399 416-436;450	12	204.5			06-15-84	I	#1000
							201.8		11-01-84		
								200.6	04-14-85		
3CDD1	JOHN TITCOMB	2480	?	?	?	200.0			06-18-84	S	
3DCC1	SAME	2490	?	?	?	187.8			06-18-84	S	

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
4CBB	W.H. GRASSMICK	2290	194	186-194,194	6			76.9	04-14-85	D	
	CLARK STRONG	2260	145	98	6			83.9	4-14-85	D	
8DDD1	CHARLES JOHNSON	2290	110	84-104,104	16			31.5	04-14-85	I	
9ABC1	MR. SEWARD	2300	166	?	?	32.5			06-06-84	I	
							29.2		11-01-84		
								33.1	04-14-85		
11DAD	STANLEY NELSON	2380	205	204	8	71.5			06-26-84	S	
							68.2		11-01-84		
								71.2	04-14-85		
12BAB1	EDWIN NICHOLS	2560	460	400-460;460	12	239.6			06-15-84	D,I	
13CDC1	LUKE	2585	510	352-507,507	14				6-26-84	U,I	N/A,#654
14DBA1	LUKE	2580	404	287-387,392	16				6-26-84	U,I	N/A,#656
16BAA1	JOE DOMENICO	2320	106	106	6			51.8	04-14-85	D	
21CDD1	HUGO VAN VLIET	2400	150*	?	?		103.7		11-05-84	D	R/U
								106.5	04-14-85		
22CBA1	JOHN TAYLOR	2425	325	160-268,278	16-5	?			06-26-84	U	
							110.8		11-01-84		
								112.4	04-14-85		
23CDC1	RAY OBENDORF	2590	499+	299-499;499	16	269.5			06-04-84	I	#636
23DCB1	SAME	2585	503	299-499;499	16	P			06-27-84	I	#638
							282.7		11-01-84		
								267.3	04-14-85		
23DDA1	SAME	2620	540	309-539;539	16-12	P			06-19-84	I	#644
24BBA1	SAME	2582	503	298-495;498	16-12	P			06-19-84	I	#652
							268.4		11-01-84		
								266.8	04-14-85		
26CBD1	LONNIE SKOGSBERG	2480	400	100-390;400	16	159.4			06-19-84	I	#63
26BCD1	SAME	2480	425	318-398;408	16	P			06-19-84	I	#634

T.7N. R.3W.

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
17BDA1	MRS. RASMUSSEN	2235	102	100	10		FLOWS		11-04-84	D	200GPM*
18DBB1	GUS ZEIGLER	2235	27	10-20,20	12		5.2		11-04-84	I	
								5.3	04-14-85		
18ACC1	SAME	2235	150	150	4		FLOWS		11-04-84	D	1GPM
								<1GPM	04-14-85		
29CAB1	TOM PULLEY	2320	129	129	6		66.0		11-04-84	U,D	
								66.6	04-14-85		
31CBB1	JAMES DEBOGART	2420	108	108	6		69.2		11-04-84	D	
19CDD1	GEORGE RAU	2320	?	?	?		50.0		11-03-84	D	
								55.2	04-14-85		
T.7N. R.4W.											
2CDD1	ROBERT KORTE	2245	40	21-28;38.5	6	9.5			08-13-84	D	
							13.1		11-03-84		
								16.3	04-14-85		
3DAD1	DOUG KOCHER	2252	35	35	6	11.0			08-13-84	I	
							13.4		11-03-84		
								14.8	04-14-85		
4DBA1	IVA HILL	2252	40	34-39;40	6	6.0			08-13-84	D, I	
4DAC1	MR. PIPER	2452	33	33	6	8.8			08-03-84	D	
4DCA1	HIGH SCHOOL	2260	66	17-47,66	10	P			08-13-84	I	
6ACC1	KENNETH GASTON	2262	25	21-24;25	8	2.9			08-07-84	I	
6BDD1	C. B. EMPEY	2262	31	26-30;31	6	4.2			08-07-84	D	
7ABB1	JOE SCHMID	2285	54	38-53,54	6		15.4		11-03-84	S	RP
								18.3	04-14-85		RP
8AAC1	BURL HAINES	2275	66	44	6	4.9			08-08-84	S	S/W
9ABC1	WILLIAM SHIPLEY	2265	65	50-60;60	6	12.8			08-03-84	I	
9ABC1	KERRY SHIPLEY	2265	46	40	6	12.9			08-03-84	I	

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
9ACB1	ELEM. SCHOOL	2270	63	45-63	10	P			08-13-84	I	
9BDD1	NEW PLYMOUTH	2280	100	52-72,100	12	20.0			06-05-84	M	
						17.0			06-25-84		
						16.0			08-01-84		
15CBB	GARTH JENSEN	2340	74	70	6	36.6			08-14-84	D	
15BDD1	ROBERT MCCAULOW	2320	167	157	6	41.9			08-15-84	D	S/W
16DDD	EDWIN GROGAN	2345	145	113	6	41.5			08-14-84	D	
							39.3		11-03-84		
								46.1	04-14-85		RP?
17AAC1	JOHNNY GOFF	2320	80	60-73,73	6			24.3	04-13-85	D	
19DCB1	TIM SHAW	2552	?	?	4	214.3			06-21-84	I	R/U
								214.8	04-13-85		
23ADA	RAY FRATES	2282	45*	41-45,45*	6	10.1			08-14-84	D	
23DDA	W.R. SMITH	2340	84	84	6	28.3			08-14-84	D	
							30.6		11-03-84		
								35.4	04-14-85		
23ADA1	CLARENCE BYRD	2290	74	?	6	P			08-14-84	D	
24DDA1	DARREL HOLBROCK	2300	162	154	6	29.5			08-3-84	D	
24DDC	DENNIS HOLBROCK	2340	343	343	6	61.5			08-06-84	D	I/S
25CCC1	LAWRENCE GOFF	2400	100	98.7	6	53.5			08-06-84	D	
							53.2		11-03-84		
								59.6	04-14-85		
25DDC1	T.J. WELCH	2400	195	190	6	79.5			08-06-84	D	
28BCC1	TIM SHAW	2480	?	?	4	140.5			06-21-84	I	N/L
								140.8	04-13-85		
28DAA1	L.& K. CATTLE CO.	2440	208	140-202;208	16	94.0			08-06-84	S	
							92.4		11-03-84		
								94.7	04-14-85		
28AAA1	LLOYD GREY	2405	80	78	6	50.0			08-06-84	D	
33CCB1	TIM SHAW	2540	343*	?	4	185.0*			1980	S	N/L

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEV-VATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
								187.3	04-13-85		
35BBB1	MRS. LOFTIN	2420	137	137	6	68.8			08-06-84	D	
36ABD1	DUANE GRANDEN	2400	110	90-100,100	6	44.4			08-06-84	D	
T.7N. R.5W.											
1BBA1	BEN SCHUSTER	2261	71	63-68;68	6	22.1			07-27-84	D	
2BAB1	LEE WRIGHT	2267	51.6	51.6	6	28.3			07-31-84	D	
5ACB1	GERALD STELLING	2280	160	128	6	72.6			08-01-84	D	
2BDB1	STEVE BATT	2270	83	69	6	12.1			08-15-84	D	
8AAD1	PETER MCCABE	2156	65	33-43;45.5	6	7.8			07-27-84	D	
							8.7		11-01-84		
								8.0	04-12-85		
9DBA1	BARRY BLOOM	2180	66	57-63;63.5	6	26.3			08-01-84	D	
9CDC1	CHARLES WINEGAR	2180	?	?	12		17.4		11-01-84	I	#388
								15.6	04-12-85		
10BDD1	DALTON SURMEIR	2320	199	178	6	55.8			07-31-84	D	
11AAB1	GEORGE BUCKWAY	2270	85	58-66;68	6	12.9			07-31-84	D	
11ABA1	HAROLD PARKER	2290	84	58	6	13.3			07-30-84	D	
							18.5		11-03-84		
								20.2	04-12-85		
11CCD1	MARION TAYLOR	2390	195	142-152;152	6	86.35			07-30-84	D, I	
							83.5		11-01-84		
								84.3	04-12-85		
12DCD1	MONTY HINSON	2340	81	73.5-79.5;81	8	38.4			07-27-84	S	
13BAC1	LARRY CHURCH	2380	275	267	6	58.6			06-21-84	D,S	
13DCC1	RHIENHOLD STOHLER	2460	400	220-240 328-388;393	12	150?			06-15-84	I	
							150?		11-01-84		
								130?	04-12-85		

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
14CDC1	TOM LIMBAUGH	2375	400	170-210 260-320 332?-372?;377?	16-14	P			06-15-84	I	#438
							82.4		11-03-84		
								83.2	04-12-85		
15DDC	DAVID BALL	2400	165	147	6	105.8			07-27-84	D	
17DAC1	SAM RALSTON	2175	134	41.5	6	P			06-15-84	D,I	
22BAC1	WMV PARKER	2360	205	163-173;178	8	54.0			06-26-84	I	
								51.6	04-12-85		
24DDC1	HOWARD SEVY	2500	606	416-434 464-474 524-604;604	12	P			06-15-84	I	P/G
							206.0		12-? -84		*
							206.0		01-24-85		*
						235.0			05-? -85		*
						260.0			06-? -85		*
						270.0			07-? -85		*
						260.0			09-? -85		*
25DBB1	JIM LIBBY	2460	352	273-333;350	?	P			06-15-84	I	
							150.9		11-01-84		
								155.0	04-12-85		
27BAB1	WARREN CARNEFIX	2430	375	255-275 310-350 340-348-;358	16-5	P			06-14-84	I	
							144.7		11-01-84		
27DDA1	TOM LIMBAUGH	2295	205	109-119 156-196;?	16	1.5			06-14-84	I	F/W#101
							2.0 ?		11-01-84		
32DDB1	GRANT WIER	2280	108	108	6			78.4	04-14-85		
34CCA1	F.H.A.	2420	240	169-179 200-230;235	12	147.5			06-07-84	I	
							144.0		11-01-84		
								143.7	04-12-85		
34DBC1	CASCADE ORCHARD	2440	448	191-231, 265-302, 310-390,398	16	130.7			06-06-84	I	

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
								125.5	04-12-85		
T.8N. R.3W											
17ABA1	TOM PENCE JR.	2340	40	OPEN	3 FT.			37.0	04-15-85	U	
18DCD1	TOM PENCE JR.	2260	?	?	4			1.5	04-15-85	D	
T.8N. R.4W.											
7CCC1	PAUL BEUS	2190	340	40	6			31.7	04-14-85	D	
7CCC2	SAME	2200	115	59	6			49.7	04-14-85	U	
17DDA1	PAT HIGBY	2300	125	110	6	95-100*			08-14-84	S	
								90.0	04-14-85		P
17DDA2	SAME	2280	?	?	?			84.9	04-14-85	U	
17AAA1	R.C. ROLAND	2210	200	36	6			16.5	04-15-85	S	
17AAA2	SAME	2210	100*	?				20.0	04-15-85	D	
20CDB1	GARY SEAWARD	2186	38	19-29;29	6	11.2			08-07-84	D	
							12.6		11-03-84		
								12.6	04-13-85		
26ADB1	TOM PENCE	2240	?	?	?			43.9	04-15-85		
30BBB1	NERRIS IRVIN	2210	45	25-30;30	6	13.7			08-08-84	D	
31CAA1	LARRY SCHMELZEL	2230	76	59-75;76	6	P			08-14-84	I	
							14.5		11-03-84		
								14.5	04-13-85		
31CBB1	JOE SCHMID	2237	36	31-36;36	6	9.2			08-07-84	D	
32ADD1	WILLIAM WANDER	2230	60	28-40;40	6	19.6			08-08-84	D	
32DDC1	DICK HAYES	2230	40	31-39;40	6	13.1			08-15-84	I	S/W
							16.2		11-03-84		
								17.1	04-13-85		
33DCD1	GRANT ZEIMER	2235	79	77	6	15.5			08-13-84	D	S/W

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
33ACC1	SHIGETA FARM	2217	100	50	6	6.6			08-13-84	D	
34ADB1	WILBURN WEST	2200	45	19-29;33	6	13.8			08-14-84	D	RP
							8.5		11-03-84		
								6.6	04-13-85		
T.8N. R.5W.											
1CCD1	MOTORCYLE PARK	2250	411	59	6			43.5	04-12-85	I,R	
1BCB1	SAME	2400	450	60	12			165.4	04-16-85	DC	
2CAB1	JACK WHITE	2290	255	OPEN	?	DRY			08-15-84	U	
2CBD1	DALE WHITTLE	2235	265	77	6	37.0			08-15-84	D	
2CBA1	ROBERT REID	2240	310	105	6	80.0			07-31-84	D	<5GPM*
							85.3		11-02-84		RP
								84.5	04-12-85		RP
5CAD1	MERLE ASHWORTH	2135	36	19-33;34	12	P			07-24-84	I	
							6.3		11-01-84		
								6.6	04-12-85		
9BDC1	ALBERT CHORN	2175	350	34	6			27.4	04-12-85	D	SHOP
9BDC2	SAME	2175	?	?	6		24.2		11-01-84	D	
								28.9	04-12-85		
9CDC1	BILL ROYSTON	2165	150	47	8	P			07-24-84	S	
10AAA1	MRS. FAIRCHILD	2150	112	19	6	6.4			08-15-84	D	
							8.2		11-02-84		
								9.2	04-12-85		
10CDD1	SHADY RIVER COMM.	2150	85	18-25;42	6	7.6			07-23-84	C	S/W
11ABB1	VERNON SHEFFIELD	2169	142	44	6	10.3			07-24-84	D	S/W
							10.4		11-02-84		
								11.9	04-12-85		
13ACB1	ED MAHLER	2165	47	21-22;26	6	6.7			07-25-84	S	RP
14BAA1	MARK MOGENSON	2158	200	91	6	9.0			07-24-84	D,I	S/W
							9.2		11-02-84		
								10.2	04-12-85		

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
15CCC1	MRS. WENZEL	2188	90	51	6	45.5			07-24-84	I	
							28.5		11-01-84		
								41.2	04-12-85		
21DCB1	JIM BAXTER	2210	127	99	6	50.1			07-25-84	D	
22AAD1	FRUITLAND	2210	68	?	16-24			26.0	05-30-84	M	NO.4
							20.4		12-07-84		
22AAD2	SAME	2210	72	35-51	16	25.2			06-05-84	M	NO.5
							33.5		12-07-84		
22ACA1	SAME	2210	?	?	?	39.0			07-16-84	M	NO.9
							25.0		12-07-84		
22ACA2	SAME	2210	175	30-40,76-81, 89-113, 127-132,175	10-20	40.0			07-16-84	M	NO.10
							22.0		12-07-84		
23BBB1	SAME	2210	95	64-78,?	?	27.4			07-16-84	M	NO.11
							24.0		12-07-84		
24DDC1	CLAYTON TSCHIRGI	2200	90	32-37;37	6	9.6			07-24-84	D	
							15.3		11-03-84		
								17.4	04-12-85		
25ACC1	TOM MURATA	2217	36	30-35;36	6	8.7			07-24-84	D	
26BCC1	MRS. TALBOT	2225	47.5	47.5	6	9.6			07-25-84	I,U	
26DDC1	F.B. PAYLOR	2232	55	39-43;45	6	8.3			07-25-84	D	
							14.8		11-03-84		
								16.2	04-12-85		
27ADD1	FRUITLAND	2220	65	47-60,66	12	17.0			06-12-84	M	NO.14
						15.2			07-16-84		
							19.9		12-07-84		
27ACB1	SAME	2220	115	46-90	12		32.2		12-07-84	M	NO.3
27ACB1	STAN SHERICH	2220	60	40-50;60	6	15*			08-02-84	D	
27CBC1	TONY HENGGELER	2220	241	193-197;199	6	103.0			08-24-84	D	
							96.6		11-01-84		

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
								98.6	04-12-85		
33AAD1	HIWAY REST STOP	2220	217	200-217;217	8-4	?			07-30-84	P	
34CBB1	J.R. SIMPLOT	2180	212	192	6	53.2			07-30-84	D	S/W
							96.6		11-02-84		RP
34BC?1	LOMA LINDA CORP.	2260	307	156	10						
34BC?2	LOMA LINDA CORP.	2260	320	70-95,102	10						
34BBA1	PAUL STUDEBAKER	2255	100	65	6	64.8			08-01-84	D	
36DCC1	JAN VANBEEK	2260	50	43-49;49	8	28.0			07-27-84	D,S	
T.9N. R.4W.											
33AAB1	LEONARD PATTON	2410	200*	?	?			182.0	04-15-85	S	
36BAA1	JOE CROUCH	2320	100	70	6			37.2	04-16-85	D	
T.9N. R.5W.											
1ABA1	RON SHURTLEFF	2180	100	92-100;100	6	64.6			07-11-84	D	
1DDB1	BENITO RAMIREZ	2240	185	185	6	113.9			07-05-84	D	
1DDD1	FIRST SECURITY	2240	230	145-155;158	6	P			07-05-84	D	
							110.3		11-02-84		
								114.1	04-12-85		
2ADD1	KEITH ALLEN	2120	50	24-30 36-43;43	12	5.6			07-03-84	I	
							8.0		11-02-84		
								7.5	04-12-85		
2CDc1	ROGER LINCOLN	2120	100	25-37;100	10-12	10.9			07-05-84	U	
							11.8		11-02-84		
								10.7	04-12-85		
11CDC1	PAY. VALLEY FRUIT	2130	199	30	6	9.8			07-05-84	IND.	
11CDC2	SAME	2130	34	20-30	6	9.7			07-05-84	IND.	
11DCB1	TOM GOSS	2130	55	34	16	6.4			07-05-84	D	

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
11ACC1	ROGER LINCOLN	2130	36	22-28;29	6	7.3			07-05-84	D	
12BBC1	ED CAIN	2128	53	?	12	10.6			07-10-84	I	N/L
							10.6		11-02-84		
13BDA1	KENDO YASUDO	2310	265	251	6	169.5			06-29-84	D	
14BAD1	ROBERT BLACKETOR	2140	40	27-31;33	8	4*			07-03-84	D	
14DAA1	VERLE EICHLER	2188	103	70-90;90	6	47.5			07-03-84	D,I	
							41.5		11-02-84		
								48.0	04-12-85		
14ADD1	BRENT FRATES	2185	100	68-78;78	6	43.6			07-05-84	U	
22DDD1	VERNE COLVIN	2158	65	35-41;44	6	13.6			07-02-84	I,S	
							16.1		11-02-84		
								19.9	04-12-85		
22ADD1	BILL SNOOK	2152	35	35	6	P			07-01-84	I	
							10.8		11-02-84		
								13.9	04-12-85		
23AAD1	LEE RABY	2210	85*	85*	6	68.7			07-10-84	D,I	
23BDD1	MRS. MORDHORST	2175	113	86	6	31.2			07-10-84	D	
24CBA1	RAY MEYERS	2220	?	?	12	104.5			06-29-84	I,U	
24CBA2	SAME	2230	?	?	12	P			06-29-84	I,U	#474
25BBD1	KARL BRONSON	2300	300	130-185;194	12	126.5			06-28-84	I	#174
							124.6		11-02-84		
								124.6	04-01-85		
25BCD1	SAME	2340	359	200-240 299-359;359	12-10	182.5			06-29-84	I	
25CCD1	WALT KIRTLEY	2270	?	?	?	172.1			06-28-84	I	#213
								170.5	04-12-85		
26ADD1	ROBERT KING	2285	285	200-220;220	8	P			06-29-84	I	
26DDD1	WALT KIRTLEY	2250	305	240	12	P			06-28-84	I	
26CAC1	SAME	2212	?	?	?	79.0			06-28-84	I	N/L#202

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

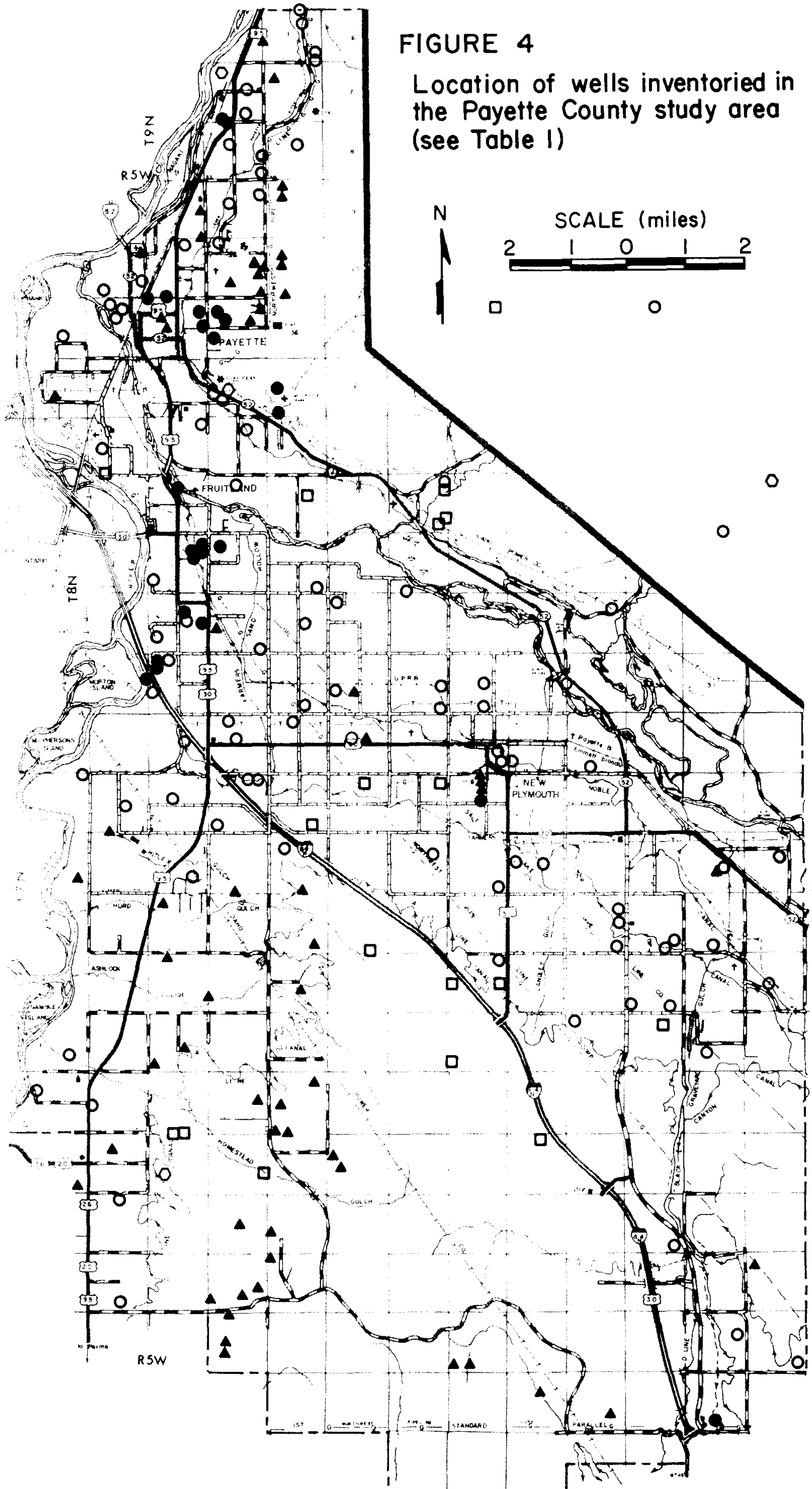
WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	DEPTH TO WATER FALL	DEPTH TO WATER SPR.	DATE	USE	REMARKS
								83.5	04-12-85		
26BBA1	ROBERT BOWKER	2180	182	54-58;62	6	35.5			07-03-84	I	
26ADB1	GENE GREY	2250	280	111.5	12	102.9			06-29-84	I	
							103.0		11-02-84		
								100.7	04-12-85		
26DAA1	MR. THOMASON	2280	240	160	12	P			06-28-84	I	
27ABB1	MRS. CARL TIPTON	2150	30	29.5	8	19.6			07-11-84	D	P
27CDD1	CITY OF PAYETTE	2155	150	70-145,150	10-16	14.0			05-04-84	M	NO.8
						12.0			07-10-84	M	
							11.0		09-06-84		
28DDD1	SAME	2150	188	157-177,186	20-10	20.0			01-04-84	M	NO.11
						15.0			08-08-84		
28CDA1	ROGER SEXTON	2145	114	60	6	16.3			07-18-84	D	
28DDA1	LLOYD PIERCE	2150	40	22-28;31.6	6	P			07-12-84	I	
28AAD1	CEMETERY	2140	50	30-45,45	12	P			07-03-84	I	BY BLDG.
								13.1	04-12-85		RP
28AAD2	SAME	2140	?	?	?	4.5			11-02-84	I	IN PIT
								7.8	04-12-85		
32DBD1	N. SOLTERBECK	2140	20	20	6		3.9		07-12-84	D	
								4.3	04-12-85		
33CAA1	DAVID POSEY	2150	40	22-31;36.5	6	14.4			07-12-84	I,D	
							17.8		11-02-84		
33DDA1	SMITH'S FOOD KING	2142	200	19	8	20.65			08-02-84	I	
33ABD1	DON RICH	2150	35	19-24;26	6	9.8			07-18-84	I	
33ACB1	FIELDON WILLIAMS	2145	30	20-27;28.5	6	12.2			07-18-84	I	
33ABA1	IVA DANIELS	2150	37	19-24;26.5	6	13.0			07-18-84	I	
33DDA1	R. FAIRCHILD	2142	80	20	6	5.6			07-18-84	I	

TABLE 1. INVENTORY OF SELECTED WELLS IN THE PAYETTE COUNTY STUDY AREA, IDAHO cont.

WELL NO.	OWNER OR TENANT	ELEVATION (FEET)	WELL DEPTH (FEET)	PERFORATION INTERVAL (FEET)	DIAM. (INCHES)	DEPTH TO WATER SUM.	FALL	SPR.	DATE	USE	REMARKS
34ADD1	CITY OF PAYETTE	2200	198	83-188,198	10-16	52.0			05-21-84	M	N.9
34AAD1	SAME	2190	228	155-205,228	16-18	35.0			01-03-84	M	NO.15
						43.0			05-21-84		
						43.0			07-26-84		
34ABC1	KIWANIS PARK	2140	?	?	?		12.4		11-02-84	F	
								10.7	04-12-85		
34BDC1	JR. HIGH SCHOOL	2150	50	17-27;27	10	P			07-19-84	I	
34CDB1	JAMES FRANKLIN	2140	28	14-18;19	6	4.7			07-12-84	I	
34BCA1	COUNTY COURTHOUSE	2150	178	20-28;28	10	7.7			07-19-84	I	
							8.8		11-02-84		
								10.0	04-12-85		
35BDC1	CITY OF PAYETTE	2240	260	160-251,251	10-18			94.0	11-28-83	M	NO.17
						96.0			06-05-84		
35BCD1	SAME	2200	300	128-182,280	6	65.0			07-10-84	T	
35AAA1	DALLAS GOFF	2247	191	160	8	123.4			07-3-84	I	
35ACD1	ROD STARK	2260	?	?	12	117.0			07-02-84	I	N/L
35CBB1	BLAINE MAY	2230	290	260	6	P			07-02-84	I	
36BBB1	RON SWISHER	2260	250	94-204;204	6	145.2			07-02-84	D	
							145.8		11-02-84		
								142.7	04-12-85		
T.10N. R.5W.											
36DCD1	RON SHURTLEFF	2172	85	69-74;79	6	54.9			07-11-84	D	

FIGURE 4

Location of wells inventoried in the Payette County study area (see Table 1)



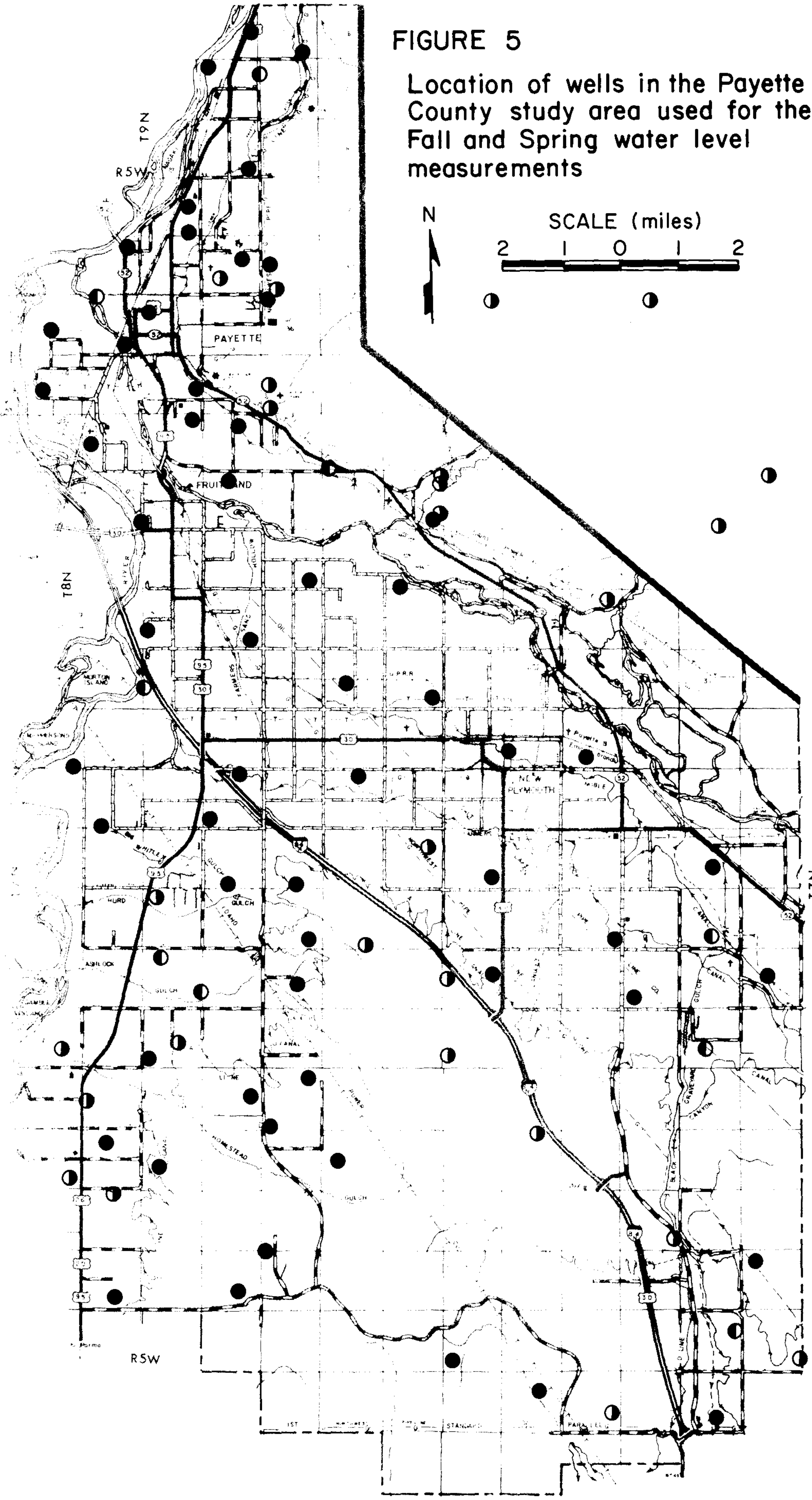
EXPLANATION

- ● MUNICIPAL/INDUSTRIAL
- ○ DOMESTIC
- ○ UNUSED
- □ STOCK
- ▲ IRRIGATION

} WELL USE

FIGURE 5

Location of wells in the Payette County study area used for the Fall and Spring water level measurements



EXPLANATION

- ● LOCATION OF WELLS MEASURED BOTH SPRING AND FALL
- ◑ LOCATION OF WELLS MEASURED IN FALL 1984
- ◐ LOCATION OF WELLS MEASURED IN SPRING 1985

TABLE 2. CHEMICAL WATER QUALITY DATA COLLECTED BY THE UNIVERSITY OF IDAHO, 1985; PAYETTE COUNTY, IDAHO.

Reference No.	Well No.	Date Sampled	Well Depth (ft)	Conductance (umhos at 25°C)	pH	Temperature (°C)	Hardness as CaCO	Dissolved mg/l Ca	Dissolved mg/l Mg	Dissolved mg/l Na	Dissolved mg/l K	Sodium Absorbtion Ratio.	Dissolved mg/l Zn	Dissolved mg/l Mn	Dissolved mg/l Fe	Dissolved mg/l B	Tot. Alk. (mg/l as CaCO)	Dissolved mg/l HCO	Dissolved mg/l CO	Dissolved mg/l SO	Dissolved mg/l Cl	Dissolved mg/l SiO	Dissolved mg/l NO -N	Total Phosphorus (mg/l)	Total Residue (mg/l, 105°C)	Cation Anion Percent Diff.
1	9N5W22CCD1	6/17/85	50	1900	7.6	12.0	696	197.8	49.1	184.8	6.8	4.3	0.01	1.82	0.52	0.62	378	461	0	480	91	32	0.04	0.16	1414	+4.6
2	9N5W36BBB1	6/18/85	250	559	7.9	18.0	163	42.2	14.1	53.3	1.7	2.6	0.09	<0.005	<0.01	0.08	179	218	0	54	30	28	0.94	0.03	345	+5.1
3	8N5W01CCD1	6/18/85	411	901	7.8	18.0	241	45.5	30.9	81.6	13.0	3.2	0.14	0.09	0.02	0.13	426	519	0	48	13	70	0.45	0.20	520	-6.4
4	8N5W02CBD1	6/18/85	265	1801	7.5	18.0	549	97.9	74.0	143.6	23.4	3.8	0.04	0.14	0.24	0.21	400	488	0	336	109	62	0.66	0.13	1188	-0.7
5	8N5W34BC?1	6/19/85	307	626	7.4	15.5	171	49.0	11.9	69.4	7.2	3.3	0.05	0.33	0.07	0.16	268	327	0	48	12	57	0.21	0.09	415	-0.1
6	7N5W08AAD1	6/18/85	65	1357	7.6	14.0	317	91.7	21.3	179.5	7.5	6.2	<0.005	1.82	0.25	0.23	432	527	0	189	80	51	0.46	0.12	914	-1.6
7	7N5W27DDA1	6/17/85	205	213	7.8	19.0	75	21.8	4.9	13.4	3.3	1.0	0.01	0.06	0.02	0.09	93	113	0	11	11	57	0.11	0.03	168	-5.7
8	7N5W32DDB1	6/18/85	108	486	7.6	15.0	193	55.8	13.1	28.4	4.8	1.3	0.02	<0.005	<0.01	0.13	183	223	0	39	20	53	3.20	0.06	332	+1.3
9	7N4W07ABB1	6/18/85	54	924	8.0	14.0	264	70.0	21.8	108.0	2.7	4.1	0.03	<0.005	<0.01	0.28	346	422	0	90	34	60	4.25	0.07	617	+1.5
10	6N5W04CBB1	6/17/85	194	645	7.5	16.0	265	77.0	17.7	24.3	7.8	0.9	0.01	0.16	0.04	0.13	158	193	0	69	60	62	0.09	0.04	466	+1.8
11	6N5W16BAA1	6/17/85	106	313	7.7	18.0	199	55.4	14.8	19.8	5.5	0.9	0.02	<0.005	<0.01	0.14	152	185	0	42	32	60	1.54	0.05	342	+2.2
12	6N5W24BBA1	6/17/85	503	162	8.2	24.5	42	14.0	1.6	16.6	2.0	1.6	0.01	0.06	<0.01	0.17	75	91	0	11	4	43	<0.01	0.03	124	-4.3
13	6N4W13DDD1	6/19/85	265	348	7.5	16.0	116	35.6	6.6	27.1	2.3	1.5	0.05	<0.005	<0.01	0.09	128	156	0	30	14	32	1.91	0.10	219	-1.2
14	6N3W31CDD1	6/19/85	118	661	7.5	16.0	265	78.7	16.8	29.1	4.0	1.1	0.14	<0.005	0.02	0.07	157	141	0	84	67	36	2.18	0.09	457	-0.7

Hardness as equivalent CaCO = 2.5(mg/l of Ca) + 4.1(mg/l of Mg), (Drever, 1982)

U.S. Salinity Laboratory Staff (1954), SAR = (Na)/ Ca + Mg /2 , in mg/l

Bicarbonate calculated from the equation, Total Alkalinity - 0.8202 = HCO , in mg/l (Hem, 1983)

TABLE 3. CHEMICAL WATER QUALITY DATA COLLECTED BY THE USGS 1975-1982; PAYETTE COUNTY, IDAHO.

Reference No.	Well No.	Date Sampled	Well Depth (ft)	Conductance (umhos at 25°C)	pH	Temperature (°C)	Total Hardness as $CaCO_3$	Dissolved mg/l Ca	Mg	Na	K	Sodium Absorbtion Ratio.	Dissolved ug/l Zn	Mn	Fe	B	Tot. Alk. (mg/l as $CaCO_3$)	Dissolved mg/l HCO_3	CO_3	SO_4	Cl	SiO_2	NO_3-N	Fl	Total Phosphorus (mg/l)	Total Residue (mg/l, 180°C)	Cation Anion Percent Diff.
15	9N5W13CCB1	06/07/79	88	5320	7.3	9.0	-	365.0	394.0	536.0	-	-	-	-	-	-	390	488	0	3600	62	5.0	-	-	<0.04	-	-7
		10/14/82		609	7.5	15.0	220	63.0	16.0	53.0	2.5	1.6	34	15.0	5	90	290	350	0	31	4	39.0	1.8	.30	0.07	394	+3
		06/21/83		3850	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
16	9N5W27DAA1	08/28/75	46	736	7.7	14.5	250	69.0	20.0	67.0	3.5	1.8	-	-	<10	-	363	442	0	35	6	35.0	2.4	.30	<0.01	-	<-1
17	8N5W03BAD1	08/28/75	26	650	7.8	16.0	250	65.0	21.0	41.0	11.0	1.1	-	-	<10	-	262	320	0	50	17	48.0	3.7	.50	0.35	-	+2
		08/09/79		390	7.4	10.0	-	48.0	39.0	15.0	-	-	-	-	-	-	290	353	0	< 5	<10	7.2	-	-	<0.04	-	
		10/01/82		761	8.0	17.5	310	82.0	25.0	39.0	14.0	1.0	16	8.0	< 3	100	0	?	0	59	14	50.0	7.6	.50	0.38	490	
18	8N5W08BAA1	10/12/82	220	963	7.7	14.5	89	16.0	12.0	180.0	15.0	9.4	340	39.0	270	140	510	620	0	10	27	56.0	<.1	.40	0.20	597	-5
19	8N5W08BAA2	10/12/82	40	383	7.2	12.5	120	34.0	9.4	33.0	2.1	1.4	16	3200.0	610	40	180	220	0	18	7	31.0	<.1	.80	0.60	232	-3
20	8N5W26BCC1	08/28/75	48	262	8.0	16.0	90	18.0	11.0	18.0	3.6	.8	-	-	40	-	128	156	0	8	2	50.0	.4	.50	0.08	-	-2
21	8N5W27ADD1	10/19/82	30	980	7.4	15.0	410	120.0	26.0	51.0	9.5	1.2	24	700.0	460	50	340	410	0	150	45	58.0	<.1	.40	0.03	650	-2
22	8N4W17BDA1	10/10/75	18	3000	7.6	14.0	560	120.0	63.0	570.0	11.0	11.0	-	-	<10	-	894	1090	0	870	81	52.0	4.8	.40	0.32	-	-3
23	8N4W17BDA2	10/13/82	80	2310	7.3	15.5	740	170.0	76.0	240.0	9.6	3.8	30	140.0	50	210	380	460	0	540	210	48.0	16.0	.20	0.07	1520	+1
24	8N4W30DCA2	10/15/82	60	655	7.6	15.3	240	71.0	16.0	36.0	5.7	1.1	53	960.0	38	40	170	210	0	62	67	53.0	.2	.40	0.08	408	<-1
25	7N5W15CDC1	10/19/82	200	418	7.8	16.5	150	42.0	11.0	25.0	3.9	.9	96	-	4	50	110	130	2	52	32	54.0	.2	.40	0.02	282	<+1
26	7N4W09ACB1	10/13/82	62	0	7.3	16.5	230	63.0	18.0	66.0	4.0	-	96	17.0	15	100	290	360	0	41	21	50.0	3.9	.50	0.18	438	+2
		10/18/82	195	605	7.4	15.0	200	62.0	12.0	61.0	2.2	-	29	430.0	1800	70	300	370	0	33	8	30.0	<.1	.40	<0.01	322	-1
27	7N4W13CBB1	10/15/82	137	169	9.1	17.0	22	8.5	0.1	31.0	0.8	2.9	23	6.0	31	20	50	61	0	7	1	16.0	<.1	.30	0.05	102	21
		10/29/82	128	368	7.4	15.5	64	17.0	5.2	54.0	8.4	3.2	71	3.0	4	40	0	200	14	17	7	55.0	1.7	.60	0.10	253	-6
28	7N4W15BDC1	10/10/75	167	281	8.6	16.0	82	31.0	1.0	26.0	0.9	1.3	-	-	80	-	102	100	12	22	13	20.0	<.1	.30	0.04	-	-1
29	7N4W25CCC1	05/07/82	100	1440	-	-	-	163.0	79.3	58.0	11.2	-	-	20.0	210	3760	-	255	0	625	8	-	<.1	.29	-	1110	<+1
		10/19/82		710	7.2	13.5	150	40.0	12.0	110.0	2.7	4.2	-	6.0	16	130	270	330	0	78	18	60.0	4.1	1.20	<0.01	476	+2
30	7N3W07ACD1	10/10/75	65	234	8.0	14.0	56	16.0	4.0	33.0	2.2	1.9	-	-	<30	-	132	161	0	1	1	30.0	<.1	.50	0.10	-	-1

TABLE 4. CHEMICAL WATER QUALITY DATA OF SOME PUBLIC WATER SUPPLIES COLLECTED BY THE IDHW; PAYETTE COUNTY, IDAHO

City Well No.	Date Sampled	Well Depth (ft)	Hardness as CaCO	Dissolved mg/l Ca	Mg	Na	K	Dissolved solids (mg/l)	Dissoved mg/l Zn	Mn	Fe	SiO	Tot. Alk. (mg/l as CaCO)	Dissolved mg/l SO	Cl	NO -N	Fl	Cation Anion Percent Diff.
Payette																		
No. 14	09/28/77		278	64	27	51.3	5.2	448	0.01	0.15	0.30	42	276	80	28	<0.04	0.20	-1.0
No. 15	08/14/79	228	226	54	21.6	47.9	4.3	403	<0.001	0.19	0.02	34	264	65	15	-	-	-2.5
	12/10/80		222	74	20.7	59.5	-	411	0.002	0.21	0.37	-	245	65	16	-	0.27	+8.9
Fruitland																		
No. 1	08/08/75	68	132	27	14.5	48.3	3.3	299	0.1	<0.01	0.04	12	200	20	< 2	2.6	0.59	+2.6
No. 2	08/08/75	68	132	26	14.5	48.5	3.6	299	0.01	0.01	0.1	10	200	23	< 2	2.8	0.62	+1.9
No. 3	08/08/75	115	192	46	17.6	76.5	4.9	397	0.02	0.03	0.04	12	300	39	2	3.9	0.76	+2.4
No. 4	08/08/75	68	200	43	20.7	67.5	6.1	431	0.01	0.01	0.03	13	292	43	2	6.8	0.76	+0.9
	10/10/68		220	51	23.0	92.0	-	510	-	0.05	0.42	-	348	66	2	6.0	0.78	+0.1
No. 5	10/09/68	72	272	61	29.0	88.0	-	586	-	0.05	0.45	-	380	70	2	6.4	0.85	+1.0
No. 6	04/24/73	204	180	46	15.0	68.0	-	528	-	0.05	0.04	-	272	36	18	1.7	0.79	-1.4
No. 9	06/12/78	145	114	26	10.1	47.9	6.3	305	0.002	0.09	0.22	56	191	21	17	1.4	0.82	-3.6
No. 10	06/21/78	175	86	21	6.6	40.0	5.7	278	0.005	0.11	0.71	55	160	13	9	0.5	0.76	-3.1
Loma Linda Subdivision																		
No. 2	05/10/77	320	398	126	25.2	53.5	8.9	751	0.1	0.96	0.96	57	228	280	10	0.04	0.63	+1.1
Interstate Rest stop																		
	01/11/77	217	70	21	4.5	24.4	6.4	206	0.1	0.16	0.23	67	138	< 10	6	1.15	0.58	-9.3

available through the IDHW (table 4). The USGS ground water data were obtained from the STORET data base system operated by the EPA.

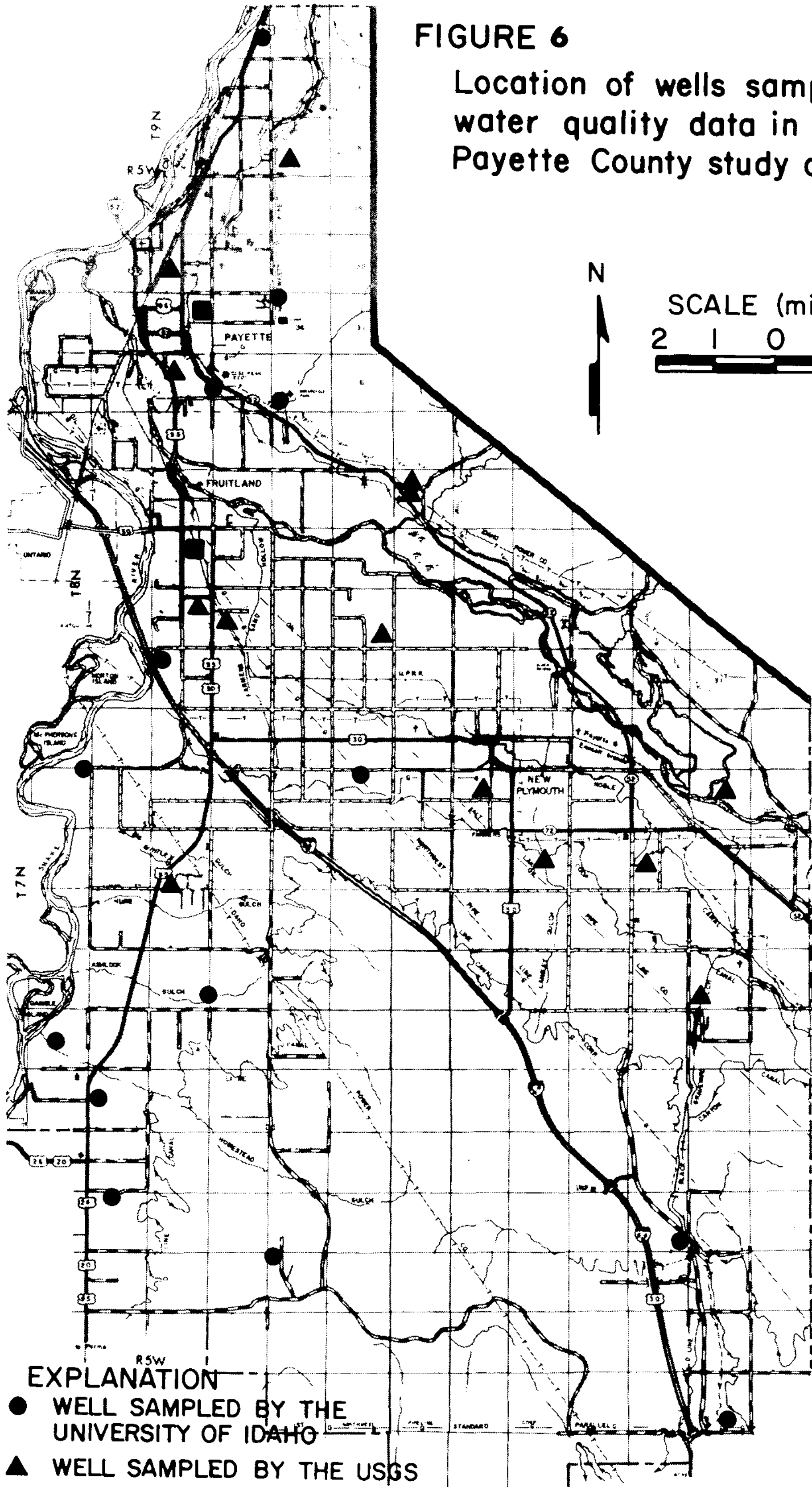
<u>University of Idaho Samples</u>

Table 2 contains the chemical water quality information for the 14 water well samples collected as part of this study. The samples were collected in June, 1985. The criteria used for choosing the wells to be sampled included: 1) known well construction, 2) frequent well use during the sampling period, and 3) well location. The locations for these wells and other wells sampled by USGS and IDHW are shown on figure 6.

Field determinations during the University of Idaho sampling program included: temperature, electrical conductivity (E.C.), pH, and alkalinity. All other constituents, including the E.C. value reported in table 2, were determined by the Analytical Services Laboratory at the University of Idaho. The major cations were determined by a Technican Auto Analyzer (ICP). The major anions were determined by EPA approved methods described below (Worthington, 1985). Chlorine was determined by the Molir Method; the amount of nitrogen in the form of nitrate and was determined by a reduction volume procedure and is reported as NO_3-N. Total phosphorus was determined by the Kiejdahl Digestion method. Amount of sulfur as sulfate was determined by the turbidimetric method. These sulfur values were compared to a total sulfur analysis using a ICP. The sulfur values from the ICP are only slightly higher than those determined by the turbidimetric method. This suggests that most of the sulfur is in the form of sulfate. A sulfate value calculated by the lab is reported in table 2. Silicon was determined by analysis using the ICP. The

FIGURE 6

Location of wells sampled for water quality data in the Payette County study area



EXPLANATION

- ● WELL SAMPLED BY THE UNIVERSITY OF IDAHO
- ▲ WELL SAMPLED BY THE USGS
- ■ MUNICIPAL WELL SAMPLED BY THE IDHW (NOT ALL WELLS SHOWN)

resultant silicon values were converted to silica in mg/L by multiplying the inverse of the gravimetric factor times the concentration of silicon. This method assumes all of the silicon is in the form of silica which may have a slight tendency to inflate the actual silica value. The silica values determined by this method and reported in table 2 are simillar to the values reported by the USGS in table 3. Hardness was calculated from the equation below,

$$(Ca^{++})\ (2.5) + (Mg^{++})\ (4.1) = \text{Hardness as mg/L } CaCO_3$$

where all values are in mg/L (Freeze and Cherry, 1979, p. 387).

Water samples were collected after the well was pumped for a period of time so that the volume pumped exceeded twice the amount of water stored in the borehole. In most cases the well had been pumping for several hours before sampling took place. Water samples were collected in new plastic bottles at the nearest outlet to the well. Unpreserved samples, kept on ice in the field and during shipment to the lab, were analysed within two days of collection. Electrical conductivity, chlorine, sulfate, total residue and total phosphorus were determined from unpreserved water. Water samples to be analysed for nitrates were preserved by the addition of H_2SO_4 until the pH was below 2. Nitrate-nitrogen was determined from both unpreserved and preserved samples with what appears to be an insignificant difference in values. The nitrate values reported in table 2 are from the preserved water samples.

Cation and anion balances were calculated for the data presented in table 2. The balances have a percent difference range of .7 to 6.4 percent (table 2). The four major cations (Ca^+, Mg^+, Na^+, K^+) were compared to the three major anions (Cl^-, SO_4, HCO_3) with 6 of the 14 sample comparisons having greater milliequivalents of cations than anions.

USGS Data

The USGS ground water quality data are presented in table 3. All the wells sampled were analysed following the USGS schedule 42, which includes the major cations and anions. Some wells were also analysed for the trace metals, iron, manganese, zinc and boron. Total dissolved solids were determined by residue upon evaporation at 180°C. Field parameters included: conductivity, pH, alkalinity and water temperature.

Cation and anion balances were calculated for the data in table 3. The balances have a percent difference range of 1 to 7 percent with the exception of one sample that has a percent difference of -21 percent. The magnesium was anomalously low for this sample. The four major cations (Ca^+, Mg^+, Na^+, K^+) were compared to the three major anions (Cl^-, SO^-_4, HCO^-_3). Seven of the 21 samples had greater cations than anions.

IDHW Data

The data in table 4 were made available through the IDHW and result from the ongoing program of municipal well sampling. These data are a selection of the most complete analyses that are available. Most of the chemical water quality data available for municipal well systems after 1978 were not suitable for this study because too few constituents were included in the analysis. A cation and anion balance analysis shows a percent difference range from 1 to 9.3 percent. Eight of the 14 samples have greater cations than anions.

CHAPTER 3

HYDROGEOLOGY

A brief discussion of regional geology is presented at the start of this chapter. The following section on local geology describes the rock formations that are exposed in the study area and that are important to ground water resources. A brief geologic history section is also presented.

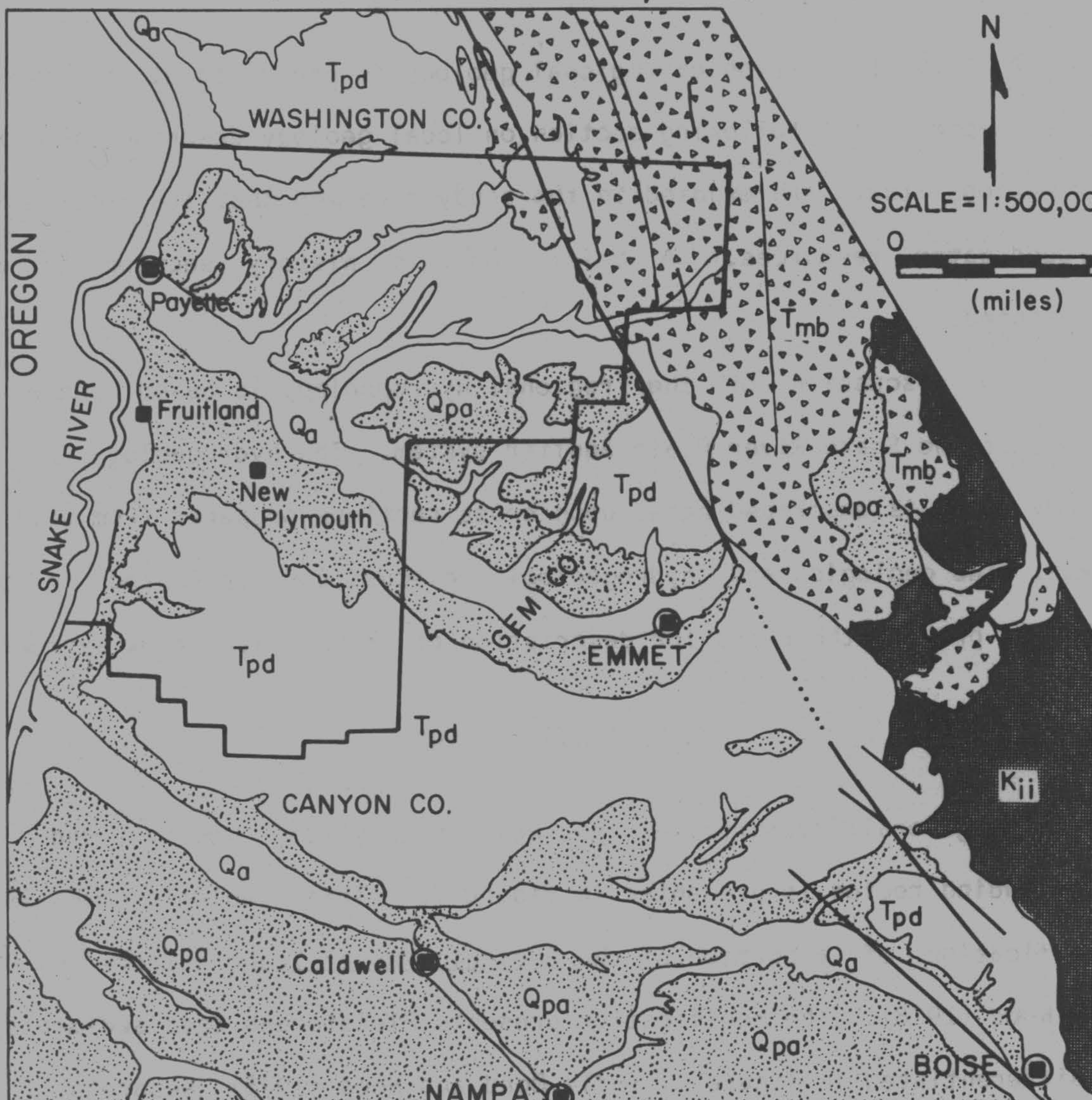
The discussion of the regional hydrogeology is based upon a USGS study of the Snake River Plain Aquifer system. The hydrogeology of the study area is described based upon cross sections prepared from well log data. The geologic and hydrogeologic discussions presented in this chapter provide the basis for description of ground water flow systems.

Regional Geology

The generalized surficial geology of Payette County and the surrounding region is presented in figure 7. This geologic map is a modification of a portion of the Geologic Map of Idaho authored by Bond and Wood (1978). The modification presents Pleistocene aged sediments as undifferentiated in figure 7, while Bond and Wood (1978) separate these sediments into two separate units. The major rock units exposed in Payette County and the surrounding area are described in table 5.

The rocks exposed in the study area are predominantly late Tertiary and Quaternary aged sediments while the mountain ranges to the north, northeast, and east are predominantly older Tertiary Volcanics and Basalt or even older crystalline rocks of the Idaho batholith. According to Hill (1963) the western Snake River Plain may be thought of as a large

FIGURE 7 GEOLOGIC MAP OF PAYETTE COUNTY AND THE SURROUNDING REGION
(modified from Bond, 1978)



EXPLANATION	Q_a	Recent Alluvium
Fault	Q_{pa}	Pleistocene sediments (undifferentiated Caldwell and Nampa sediments and Ten Mile Gravel)
	Tpd	Idaho Group (Idaho Fm.) (undifferentiated)
	T_{mb}	Columbia River Extrusive Basalts
	K_{ii}	Idaho Batholith

Table 5. Major rock units exposed in Payette County and the surrounding region (modified from Savage, 1961 and Smith, 1981).

Geologic Age				Formation or Unit (with estimated thickness in feet)	Brief Description
Quaternary	Recent			Late and Early fluviatile and eolian deposits 0-50± Qa	Clay, silt, sand and gravel; generally nonconsolidated. Some caliche in early deposits. Occupies modern flood plains and low strata deposits.
Quaternary	Pleistocene	Late	Snake River Group	Caldwell and Nampa sediments (undifferentiated) 0-50 Qpa	"Terrace gravels", clay, silt, sand and gravel; generally nonconsolidated. Some caliche. Generally below 2,500 feet elevation; "Provo and Bonneville floods."
				---- unconformity ------	
Quaternary	Pleistocene	Early	Snake River Group	Tenmile Gravel 500± Qpa	"Terrace gravels", clay, silt, sand, gravel and cobbles; nonconsolidated to poorly consolidated, some caliche. Fluviatile with some crossbedding, channeling and stratification. Generally good imbrication--current flowing southwest or west. Piedmont alluvial fill, chiefly crystalline rock with some disintegrated pebbles. Aggrading Pleistocene stream deposit.
Tertiary to Quaternary	Pliocene to Pleistocene		Idaho Group	Glenns Ferry Formation Chalk Hills Formation Banbary Basalt (Grassy Mt. Basalt) Poison Ck. Formation Tpd	Clay, ash, silt, sand and fine gravel; unconsolidated. Diatomite (impure) limestone, shale and sandstone. A fluviatile deposit with local lacusterine beds. Generally below 3,000 feet elevation.
Tertiary	Miocene to Pliocene			Columbia River volcanic extrusives Tmb	Fine-grained basalt to coarse-grained diabase; angite, plagioclase and olivine phenocrysts. Erosional remnants and larger masses. Ash, pumice and ignimbrite layers, scoria and obsidian.
Cretaceous to Tertiary	Midcretaceous to Miocene			Idaho Batholith intrusives Kii	Granitic type rocks. Grayish to light and dark mottled; equigranular quartz diorite. Local variations with porphyritic and gneissic facies.

sediment filled trough formed by a graben. The formations surrounding this trough have been identified as the source rocks for these sediments. Savage (1961) states that the sedimentary rocks tend to become finer as one travels west, away from the volcanic and crystalline rocks. The thickness of the sediments near Payette County exceeds 5,000 feet based upon data from the Ore-Ida Foods No. 1 well in Ontario, Oregon (Wood and Anderson, 1981). Only the uppermost portion of the sediments is important with respect to ground water development within the Payette County study area.

Local Geology

Drillers' logs throughout the county report interlayered sequences of clays, shales, silts, sands and gravels. Thin zones of sandstone have been encountered by some drillers. Basalts are found at great depths and are not important sources of water. An exploratory gas well called Virgil Johnson No. 1, located in the SE 1/4 of sec 27, 8N4W, noted the first basalt at about 4,000 feet below land surface (Newton and Corcoran, 1963).

The near-surface sedimentary rocks are divided into the following rock units: 1) Pliocene-Pleistocene Idaho Group (Formation), 2) Early Pleistocene Tenmile Gravel, 3) Late Pleistocene Caldwell and Nampa Sediments, and 4) Recent Fluviatile and Eolian deposits (Savage, 1961).

Idaho Group (Formation)

The Idaho Formation has been raised to group status by some authors, Malde and Powers (1962), Corcoran and others (1962), and Wood and

Anderson (1981), and has been subdivided into the Upper and Lower Idaho Groups. The Lower Idaho Group is exposed south of the Snake River and towards the northern edge of the Owyhee Mountains (Wood and Anderson, 1981). The Upper Idaho Group extends to northern boundary of the Snake River Plain (Wood and Anderson, 1981), which includes the Payette County region. The name Idaho Group is used for the purposes of this report.

The geologic map (figure 7) shows the extensive nature of the Idaho Group in the study area. This unit is well exposed southeast of Clay Peak near the City of Payette. The geologic contact with the overlying Caldwell and Nampa Sediments is not distinct (Savage, 1961). Savage reports that the Idaho Group is composed of up to 1800 feet of interlayered clay, shale, ash, silt, sandstone, oolitic limestone, impure diatomite and fine gravel. The lower boundary of the Idaho Group is difficult to recognize from well logs because of the similar nature of the underlying formations (Savage 1961).

The depositional environment for the Idaho Group appears to have been a series of stable lakes alternating with fluctuating shallower lakes. These alternating depositional environments created irregular thicknesses and types of lithologies depending on location (Savage, 1961). For example, sand and gravel deposits were formed on deltas and beaches, while fine sands and clays were deposited in progressively lower energy environments.

The sand and gravel layers in the Idaho Group are the principle ground water sources (aquifers) for the deep irrigation wells in the county.

Tenmile Gravel

Tenmile Gravel is composed of unconsolidated silt, sand and gravel with some localized caliche layers. The size of the gravel, the crossbedding, and the imbrication suggest deposition occurred when melt water runoff flowed in a west and southwesterly direction during Pliestocene glaciation (Savage, 1961). The rock type of the gravel suggests the primary source was the uplands of the Boise Ridge; some of the gravel also contains pebbles from the Columbia River Basalts. Tenmile Gravel is well exposed in a gravel pit about 2 miles south of the intersection of Highway 95 and Interstate 84.

Caldwell and Nampa Sediments

Caldwell and Nampa sediments are difficult to differentiate in the field. As a result, these deposits are normally mapped as one unit. They are composed of clay, silt, sand, and are an important source of gravel in some localities. Flow direction indicators suggest that water flow during deposiion was to the north and northwest rather than the west and southwest pattern of the Tenmile Gravel. Caliche layers suggest hot and cold climate cycles during deposition (Savage, 1961). Caldwell and Nampa sediments are exposed along the high terraces north of the Payette River directly east of Payette.

Recent Deposits

Recent deposits are fluviatile and eolian in origin. Much of these deposits are reworked older deposits that form the modern floodplains and lower terraces along the present river systems. Clays, silts, sands and gravel compose these deposits.

The recent deposits are important ground water sources for the shallower wells in the study area. Shallow driven and hand dug wells are still in use in parts of the study area.

Geologic History

A description of the geologic history of southwestern Idaho is presented by Savage (1958). Savage ties the regional geologic history with the local rock units of Gem and Payette Counties in his "County Report No. 4", published in 1961. The information presented below is taken from Savage (1958 and 1961) and is intended to provide a general overview of the major geologic events.

Pre-Cenozoic History

There are no Pre-Cenozoic age rock units exposed in the study area. Tectonic events occurring at least 136 million years ago during the Pre-Cenozoic time formed northwest trending features that controlled later erosional patterns and topographic features. Because the study area is contained in what once was a deep northwest trending valley, the Pre-Cenozoic rock types have been covered by thick layers of sediments eroded from sources to the east.

Cenozoic History

The lifting of the Idaho batholith during the Miocene Era and its later erosion supplied the source material for the sediments deposited in the earlier formed basins and valleys. Lava flows and fault block dams temporarily blocked major surface drainages allowing thick accumulation of these sediments, the most extensive of which is the Idaho Group.

Geologic features such as cross-bedding and layering and grain size in the Idaho Group suggest alternating lacustrine and fluviatile environments.

Large volumes of melt water from central Idaho created extensive gravel deposits over the older Idaho Group sediments during Pleistocene and Pliocene glaciation. The Tenmile Gravels are thought to be deposited over a large area by these torrential flood waters which later waned. Eventually, the Caldwell and Nampa sediments were deposited. Subsequent erosional downcutting by rivers formed the highest prominent terraces found in Payette County.

Recent

The lower terraces were formed by post-glacial erosion and deposition. Reworked fluviatile and eolian deposits form the floodplains along the present river systems.

Regional Hydrogeology

The USGS has studied the hydrogeology of the western Snake River Plain as part of a nation-wide study of the major aquifer systems in the United States. Recent USGS publications provide most of the information for this section. A good description of the hydrogeologic framework of the Snake River Plain is contained in Whitehead (1984).

Payette County lies in the extreme western region of the Snake River Plain. The extent of the plain is shown in figure 8. The boundaries were determined by either topographic divides or geologic contacts between Tertiary age sediments and older crystalline rocks. Geologic and

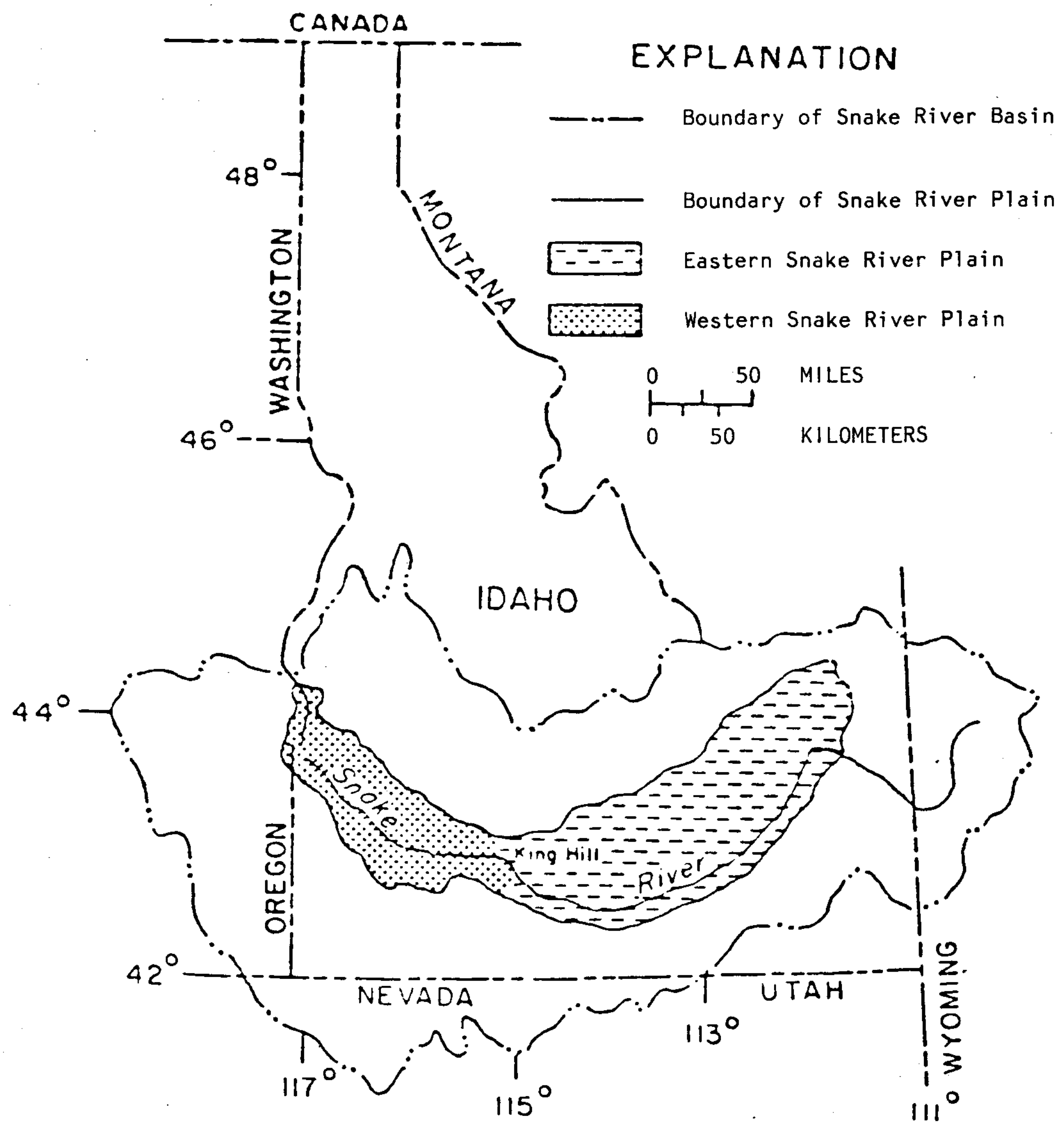


Figure 8. Location of the Snake River Plain.
(Bigelow, Goodell and Newton, 1984)

hydrologic characteristics divide the Snake River Plain into eastern and western regions with King Hill roughly the dividing point.

The basalts and interbedded sands that underlie the eastern plain yield large quantities of ground water. The western portion of the plain consists mostly of Tertiary aged sediments with minor amounts of basalt in some areas. Payette County includes some basalt in the northeast corner of the county outside of the study area; basalt is not a source of ground water in the study area. Most aquifers in the Western Snake River Plain are sands and gravels interlayered with clays and shales. Well yields are generally lower in the western plain than the eastern plain.

Wood and Anderson (1981) have proposed that three major hydrologic units exist in the Nampa-Caldwell and surrounding area. These units may be representative of most of the western Snake River Plain, including the Payette County study area. These three units include: 1) a shallow cold water aquifer system, 2) an intermediate warmer water unit contained within a substantial layer of blue clay, and 3) deep hydrologic units identified by oil and gas well logs.

The shallow cold water system was subdivided by Wood and Anderson (1981) into: 1) an upper sand and gravel unit consisting of the surficial deposits and terrace gravels, 2) the basalts of the Snake River Group, and 3) the clay, silt, sand and gravel lenses of the upper portions of the Glenns Ferry Formation (table 5).

The intermediate hydrologic unit is considered to be middle Glenns Ferry Formation and consists of interlayered sands within a zone of blue clay. The thickness of the blue clay zone varies from several feet to over 400 ft. in the Nampa-Caldwell area. This clay zone is identified in drillers' logs as far east as Boise and as far west as the Payette County study area. This unit is identified in the deeper irrigation wells in the southwestern portion of Payette County. Wood and Anderson (1981, p. 37) state that: "The color of the clay is due to sulfide enrichment and may indicate deposition under a reducing environment. However, secondary iron sulfide enrichment could be caused by post depositional water migration."

Temperature gradient studies conducted by Wood and Anderson (1981) show that the water within the blue clay zone is 5^{o} to $15^{o}C$ warmer than the overlying aquifers. They suggest that the blue clay is acting as an impermeable to semipermeable capping layer which retards the upward migration of water except where faulting, slumping or fracturing has taken place.

Some deep hydrologic units have been identified by Wood and Anderson (1981) as potential water producing zones. The water occurs under confined conditions and is probably located in the lower Glenns Ferry Formation and below. These deep water producing zones in the Nampa-Caldwell area are located from 1,500 to 5,500 feet below land surface. The only wells penetrating to these depths in the Payette County study area are some oil and gas exploration wells discussed in a report by Newton and Corcoran (1963). Two of these exploration wells flow water at the surface, which is used by their present owners. Virgil Johnson No. 1 or possibly No. 2 exploration well, located in the SE1/4 of sec. 27, T8N, R4W, supplies water for a Mr. Johnson. The Ted Daws No. 1 well is near the Virgil Johnson well in the NE1/4 of sec. 34, T8N, R4W. The present owner of the Ted Daws No. 1 well, Wilber West, occasionally uses the flowing well for irrigation and stock purposes. The former well is over 3,500 feet deep and the latter is about 1,700 feet deep.

Kjelstrom (1984) reports that 5.8 million acre feet per year of precipitation falls directly on the eastern plain, while 3.4 million acre feet per year falls on the western plain. Estimates by Kjelstrom show 10 percent of the precipitation on the eastern plain is recharged to groundwater while less than 2 percent or 0.05 million acre feet of the total precipitation on the western plain is recharged to ground water. The lower percent of recharge to the western plain is thought to be due to higher annual consumptive use rates caused by higher annual temperatures. The balance of the recharge to ground water is from runoff from the surrounding mountains, underground flow from the eastern plain and surface water recharge from irrigation practices.

A water table contour map of the Snake River Plain, compiled by Bassick (1985) based on 1980 data, is presented in figure 9. The general direction of ground water flow is to the northwest in Payette County. Irrigation water from the Boise and Payette Rivers is probably the major source of recharge to much of the plain. Recharge also occurs from runoff from the mountains along the northern border of the western plain. The contours shown on figure 9 have been influenced greatly by surface water irrigation practices (Bassick, 1985).

Local Hydrogeology

Cross-sections have been constructed using the lithologies reported in drillers' logs in order to present information on the subsurface

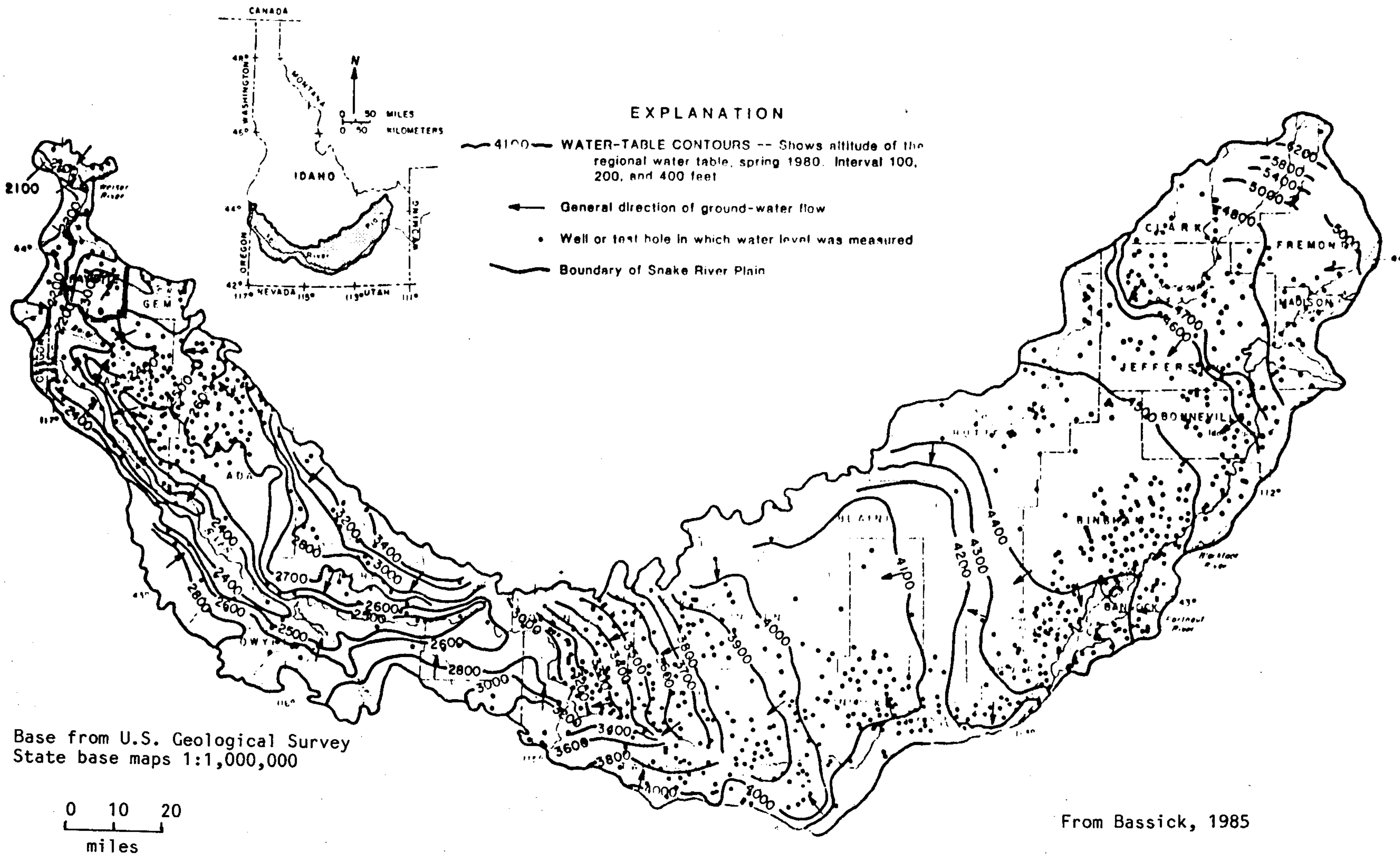


Figure 9. Water-table contour map of the Snake River Plain, Spring, 1980.

hydrogeology in the study area. These cross-sections also present information on the water level elevation and the perforated or open intervals of the wells. Figure 10 shows the locations of the cross-sections constructed in the study area, while figures 11, 12, 13, and 14 present the individual cross-sections.

Cross-section A to A' starts in the Snake River floodplain and trends in a southeasterly direction for about 5 miles, terminating in the highest terrace (figure 11). There is a seepage face near the bottom of the prominate scarp which is well marked in the field by vegetation (phreatophytes) over most of its length.

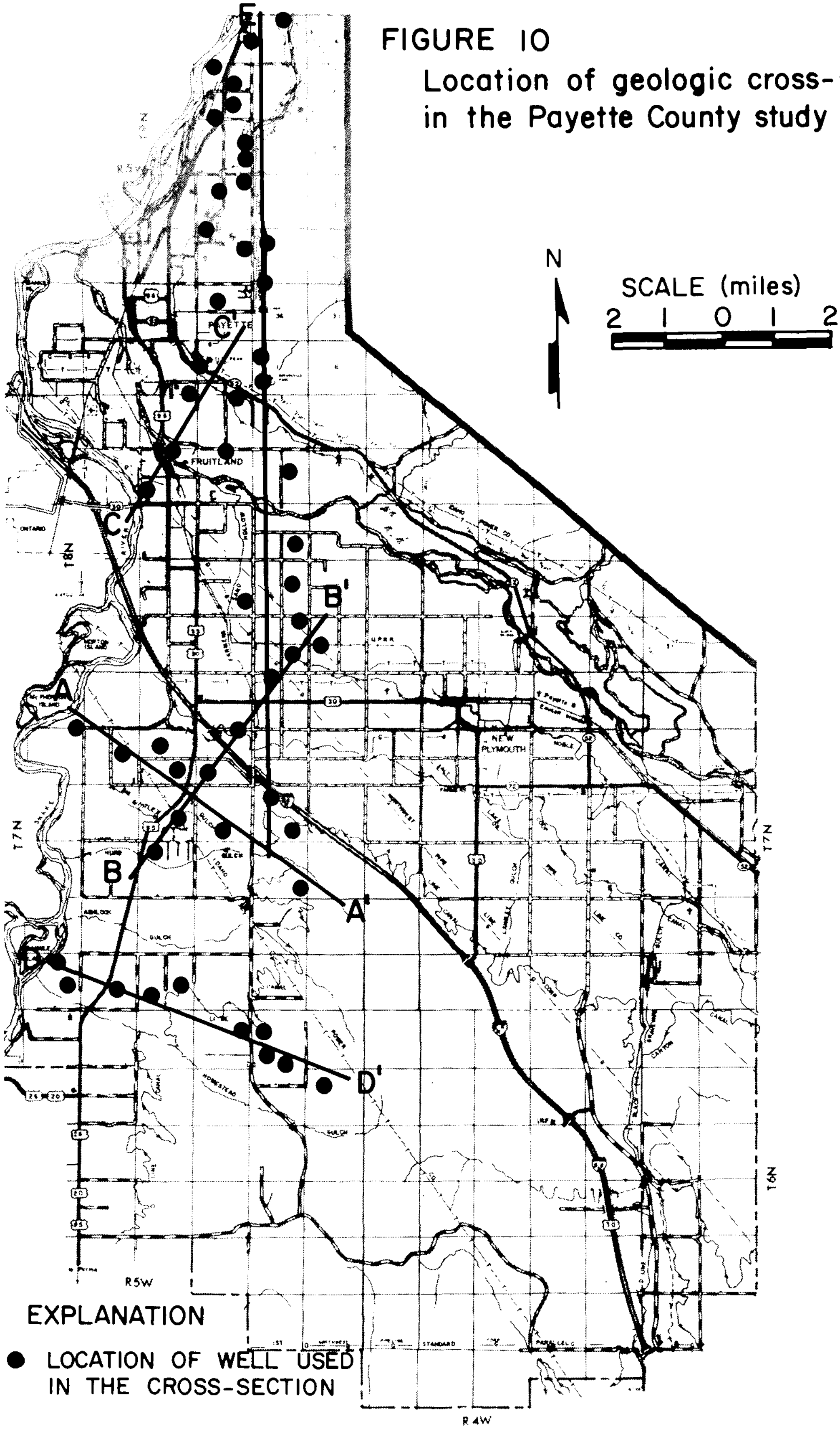
Cross-section D to D' is located about 4 miles south of A to A' and follows the same general trend (figure 12). This cross-section begins at the Snake River at a point where there is not an extensive floodplain and extends southeast about 6 miles. Springs are common along the east banks of the Snake River.

Cross-section B to B' starts in the Snake River Valley, crosses the high terrace area in a northeast direction and ends in the Payette River Valley (figure 13). A persistent clay and sand and/or gravel sequence is noticeable in the wells northeast of interstate 84. This sand and/or gravel layer is the water source for most of the shallow domestic wells in the valley.

Cross-section C to C' starts near the Highway 30 Snake River Bridge (figure 13). It trends in a northeast direction for about 3 miles ending near Clay Peak. The blue clay zone is shown to be quite extensive. Wells near Clay Peak mostly penetrate blue shale or clay. Well yields in this area are extremely low.

FIGURE 10

Location of geologic cross-sections in the Payette County study area



EXPLANATION

● LOCATION OF WELL USED IN THE CROSS-SECTION

FIGURE 11 HYDROGEOLOGIC CROSS-SECTION A-A'
PAYETTE COUNTY, IDAHO

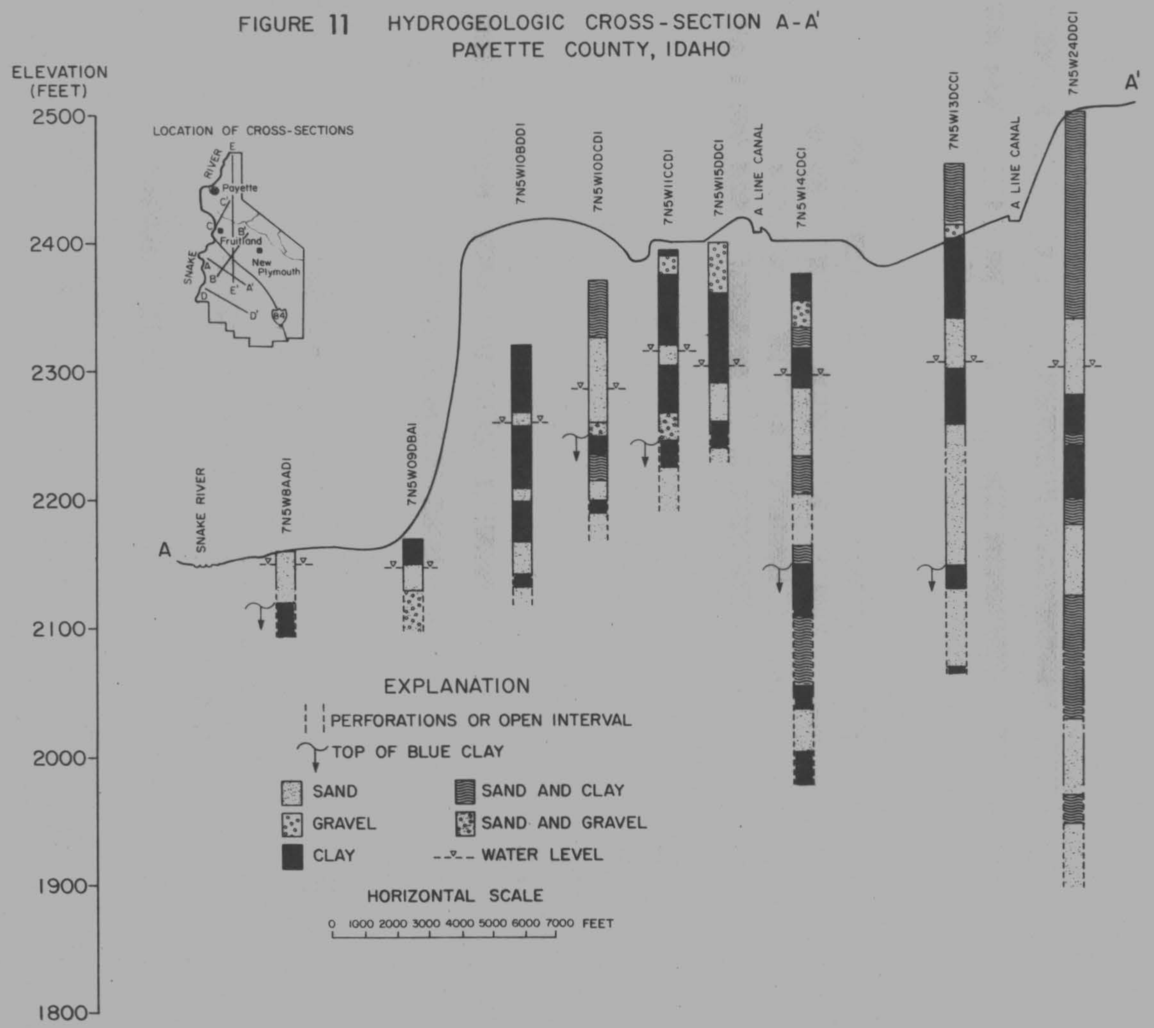


FIGURE 12 HYDROGEOLOGIC CROSS-SECTION D-D'
PAYETTE COUNTY, IDAHO

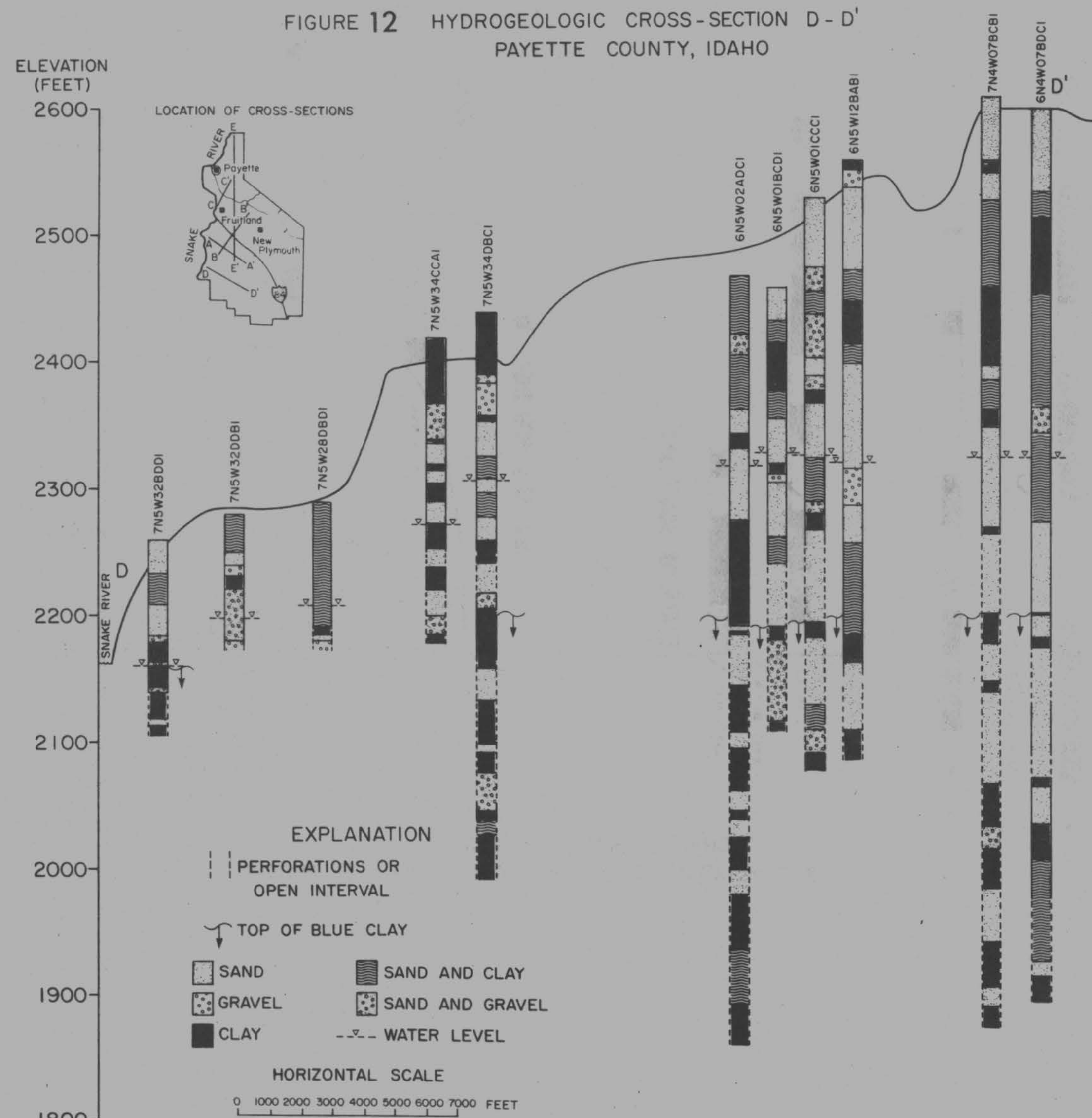


FIGURE 13 HYDROGEOLOGIC CROSS-SECTION C - C'
PAYETTE COUNTY, IDAHO

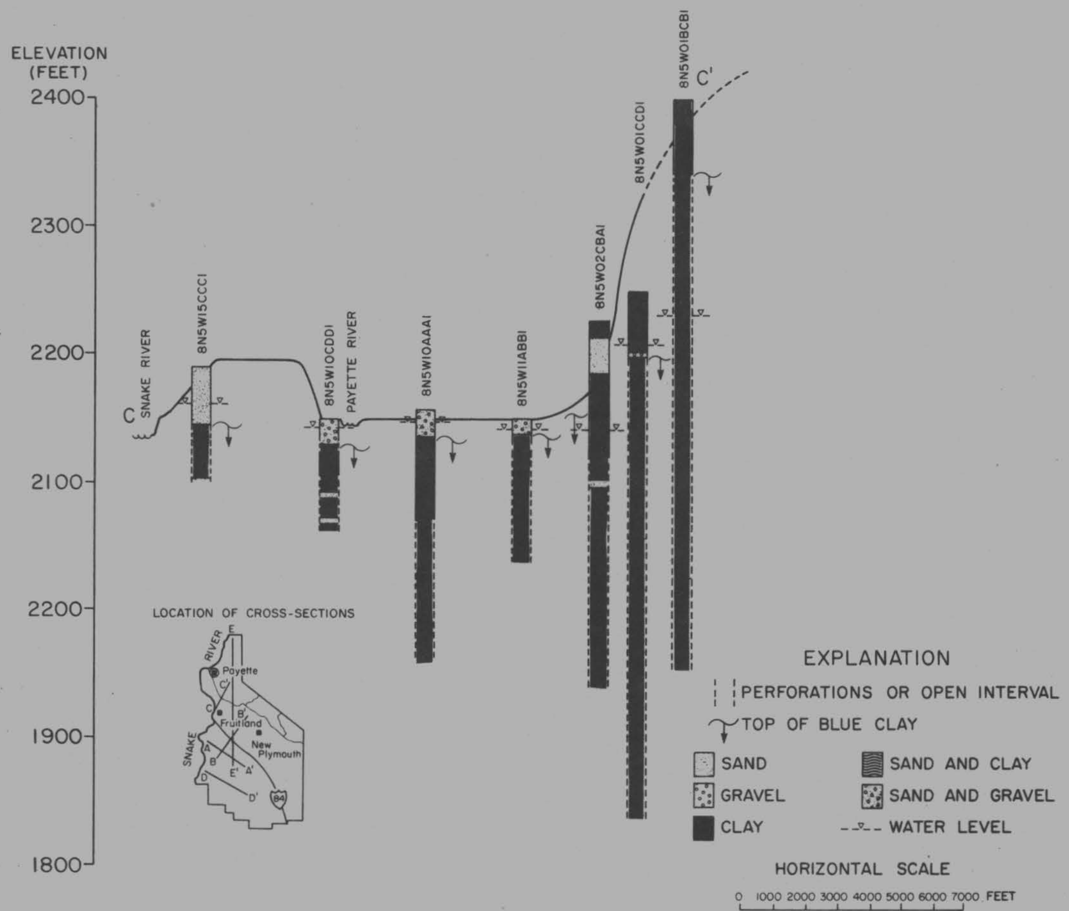


FIGURE HYDROGEOLOGIC CROSS-SECTION B - B'
PAYETTE COUNTY, IDAHO

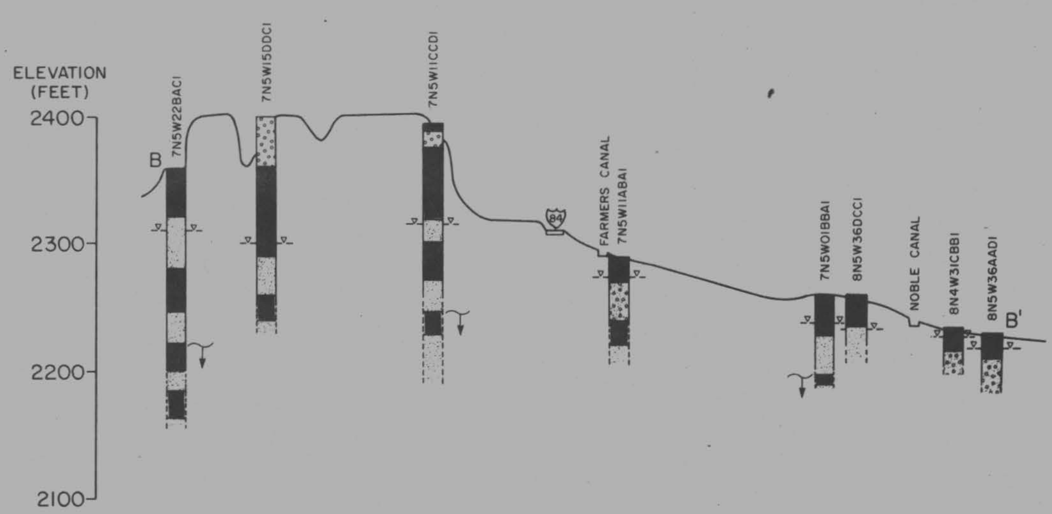
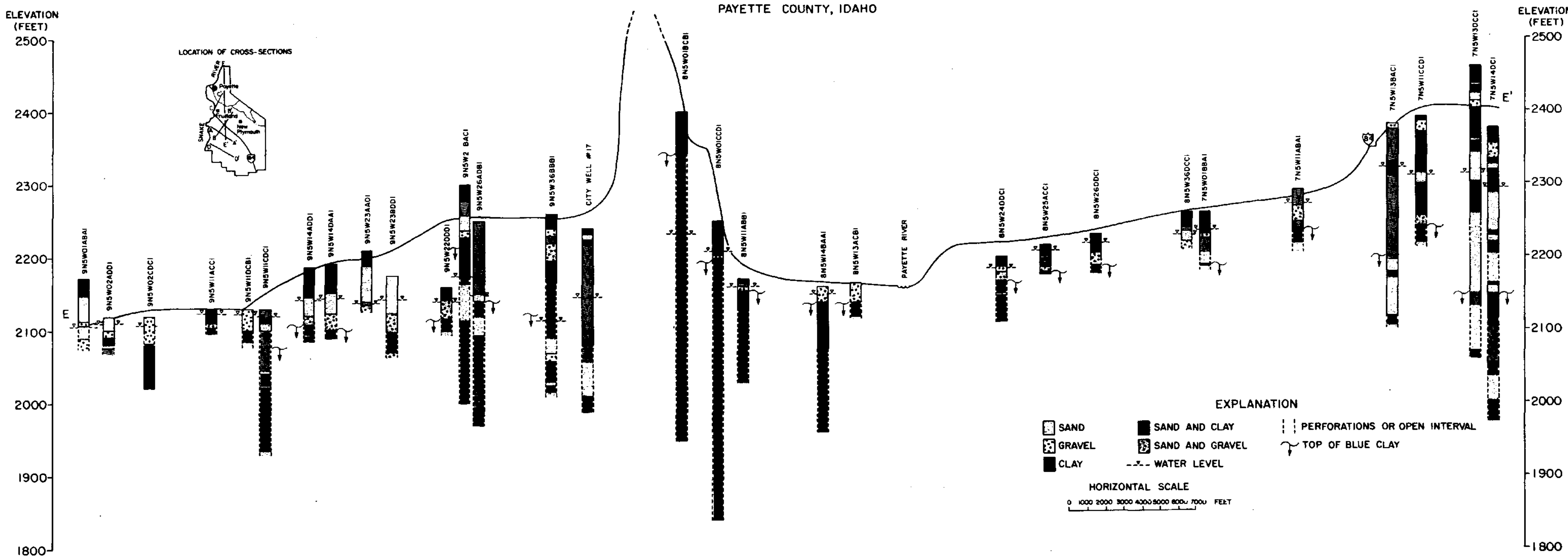


FIGURE 14 HYDROGEOLOGIC CROSS-SECTION E - E'
PAYETTE COUNTY, IDAHO



Cross-section E to E' starts along the northern border of the county and extends due south for about 15 miles (figure 14). The wells shown represent the lithologic variability that occurs from north to south in the study area.

Although the geologic formation names are not specified on the cross sections, most of the wells in the Payette County study area are completed in the sediments of the Glenns Ferry Formation of the Idaho Group with some wells in the younger terrace gravels and surficial deposits.

Clays, shales, sand and gravels or combinations of these sediments are the most common lithologies reported in the drillers' logs. The lithologies shown in the cross-sections have been simplified. Clays and shales are noted as clay. Sandy clay or thin layers of clay and sand are noted as clay/sand on the cross-sections. Other notations on the sections are sand, sand and gravel, and gravel.

The cross sections show a complex sequence of fine- and coarse-grained sediments. The thicknesses and percentages of each of these lithologies vary within the study area. For example, well 8N5W01BCB1 in cross-section E to E' shows a clay zone over 400 feet in thickness, while the wells to the south and north show lithologies less dominated by clay.

Detailed correlation of specific lithologic layers over broad portions of the study area is difficult for two reasons. First, individual clay or gravel units were not uniformly deposited over broad areas because of the alternating energy conditions (stream, small intermittent lake, large lake) in the area both temporally or spatially. Lacusterine deposits were most likely reworked by meandering streams.

Most coarse-grained zones were deposited as discontinuous lenses that vary in thickness and lateral extent. Second, there may be a considerable inconsistancy in the lithologic identification of units by well drillers in the study area. A coarse sand identified by one driller may be called pea gravel by another driller.

Cross-sections A to A' and D to D' show that the elevation of the first perforation intervals tend to be located near the top of a blue clay zone (figures 11 and 12). This blue clay zone may be an important feature for interpretation of water quality data and for understanding ground water flow systems. Wells requiring high yields tend to be constructed deeper than the first production zone above the blue clay, and are perforated opposite a series of water bearing sands within the blue clay zone.

The cross-sections show that the elevation of the water levels tend to mirror topography. In most cases, the water level elevations are similar between deep and shallow wells. These similar water levels suggest that there is limited vertical flow within the sediments; most of the ground water flow is subhorizontal. A significant difference between water levels in wells exists on the western side of cross-sections A to A' and D to D' (figures 11 and 12). The water level difference probably reflects a thinning of sand and gravel zones and the outcropping of shallow aquifers along the edge of the terrace. A more complete interpretation of these water levels is not possible because many of the wells draw water from several individual aquifers. Discharge from the shallow aquifers occurs along the terraces as seeps and springs.

CHAPTER 4

HYDROLOGY

Both hydrologic and hydrogeologic data are required to describe the ground water flow systems in the Payette County study area. Hydrogeologic data are presented in Chapter 3. Data on well depths, depth to water, water level elevations and temporal water level fluctuations are presented in this chapter. Water quality data are presented in Chapter 5.

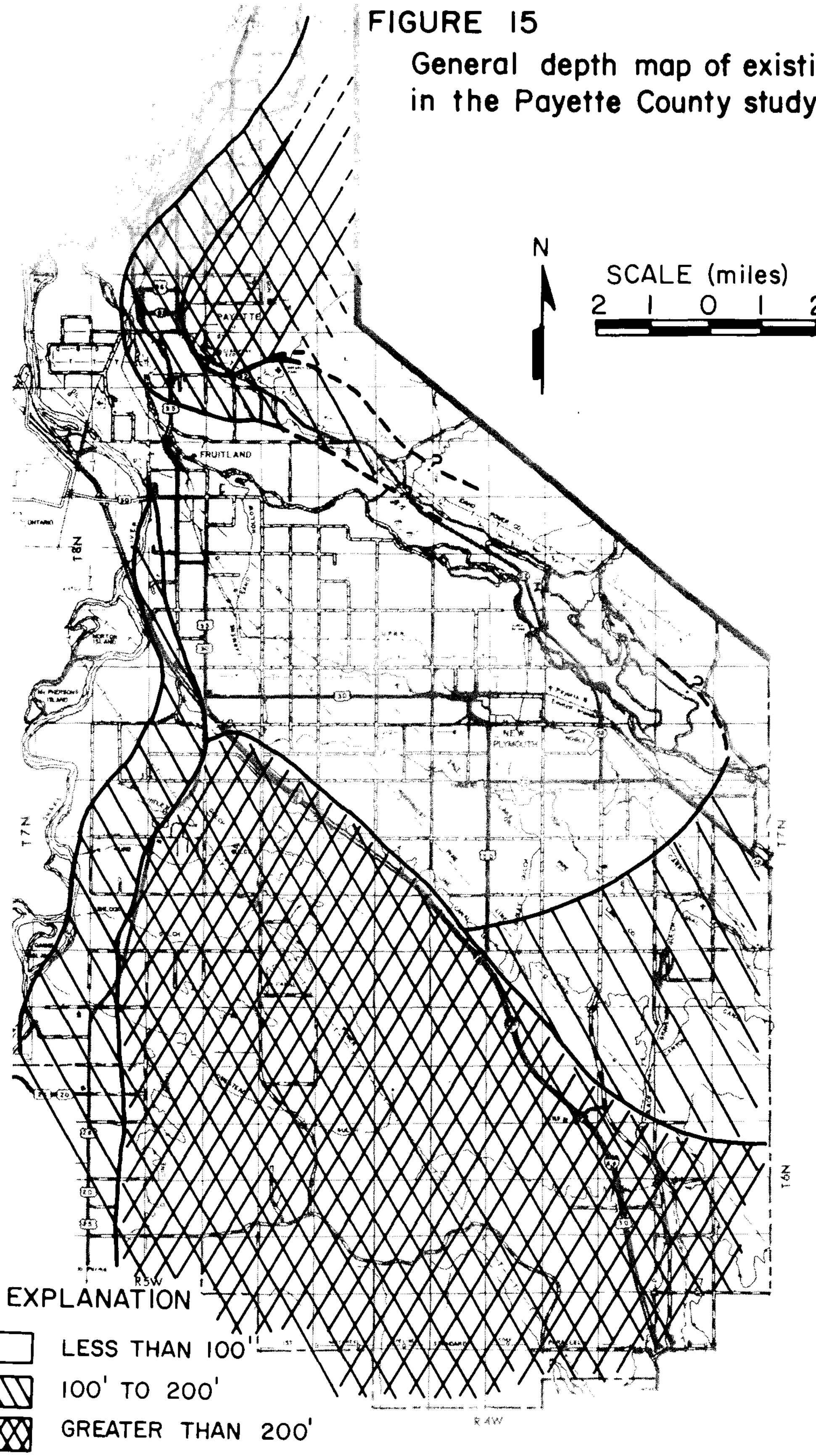
Well Depth

Well depths and types in Payette County range from sand points that are less than 20 feet deep to irrigation wells that are greater than 700 feet deep. The depth of a well is controlled by the hydrogeology, the static water level and the desired yield. The shallowest wells are used mostly for domestic purposes and generally are located on the floodplains. In most cases, well depths increase as the land surface elevation increases. About 65 percent of the wells inventoried are less than 200 feet deep. Most of these wells are for domestic purposes. Of the remaining 35 percent, more than half are greater than 300 feet deep. Most of the deeper wells are for irrigation purposes and are located south of Interstate 84 and east of Highway 95 in the southern portion of the county.

A well depth map is presented in figure 15 which is based upon the well data collected during this study. This map roughly defines the depth range below land surface in which most wells are constructed, and may be used as a guide for new well development. This map obviously is

FIGURE 15

General depth map of existing wells in the Payette County study area



EXPLANATION

- LESS THAN 100'
- 100' TO 200'
- GREATER THAN 200'

influenced by wells chosen for the study. The map may not be used to predict the required depth of an irrigation well in an area where most wells are used for domestic purposes. Conversely, most of the wells inventoried south of Interstate 84 and east of Highway 95 are deep irrigation wells; a domestic well in this area may not need to be as deep as is shown on figure 15.

Ground Water Levels

Ground water levels may be examined from two references: depth to water level below land surface and elevation of water level above sea level. Depth to water is important because it is a factor in determining well depth and it controls the pump setting in a well. Depth to water generally is dependent upon local topography. For example, a well located on a small 50-foot high hill has a depth to water 50 feet greater than a well located nearby on the flat. Contours of equal ground water elevation are used to determine the direction and pattern of ground water flow. A map of ground water elevations may be used to estimate depth to water at any site by subtracting the water level elevation from the land surface elevation.

More than 200 water level measurements were taken during this study. The depth to water measurements may be grouped as follows: 1) 55 percent are less than 50 feet, 2) 20 percent are between 50 and 99 feet, 3) 10 percent are between 100 and 149 feet, and 4) the remaining 15 percent are evenly spread between 150 and 286 feet. Most of the shallow water levels are from domestic wells located in the lower elevations of the Payette and Snake River Valleys. Although water levels tend to mimic the topography as shown in figures 11 to 14, depth to water generally increases with an increase in land surface elevation. The deepest water levels were measured in irrigation wells located south of Interstate 84 and along the northeastern portion of the study area.

Data on the elevations of water levels in wells may be used to determine the direction and pattern of ground water flow and the interrelationships of ground water and surface water systems. The typical procedure is to plot elevations of water levels on a map at the locations of the wells measured. The differences in water level elevations between wells reflect horizontal and/or vertical ground water gradients. Vertical gradients are much smaller than horizontal gradients in most parts of the study area; nearby deep and shallow wells have about the same water level elevation. In such areas, contour maps of water level elevation may be constructed using data from wells of any depth. Care must be taken to segregate water level data by well depth in areas where vertical gradients are significant.

Errors involved in preparing a map of water level elevation for Payette County stem from three major sources: 1) errors in measuring depth to water, 2) errors in determining the elevation of the top of the well and 3) errors in interpreting the comparability of data from nearby wells of different construction. Wells in the Payette County study area were measured with an accuracy of $\pm$0.10 feet. Some measurements may reflect recent pumpage, but most data accurately represent static conditions. The land surface elevations at wells measured in Payette County were estimated from U.S. Geological Survey topographic maps. The error in these estimates is on the order of $\pm$10 feet. Water level data on the geological cross sections suggest that there is not a consistent vertical gradient in any portion of the study area. Variations in water level elevations with well depth are within the error band of the land surface elevation determination noted above.

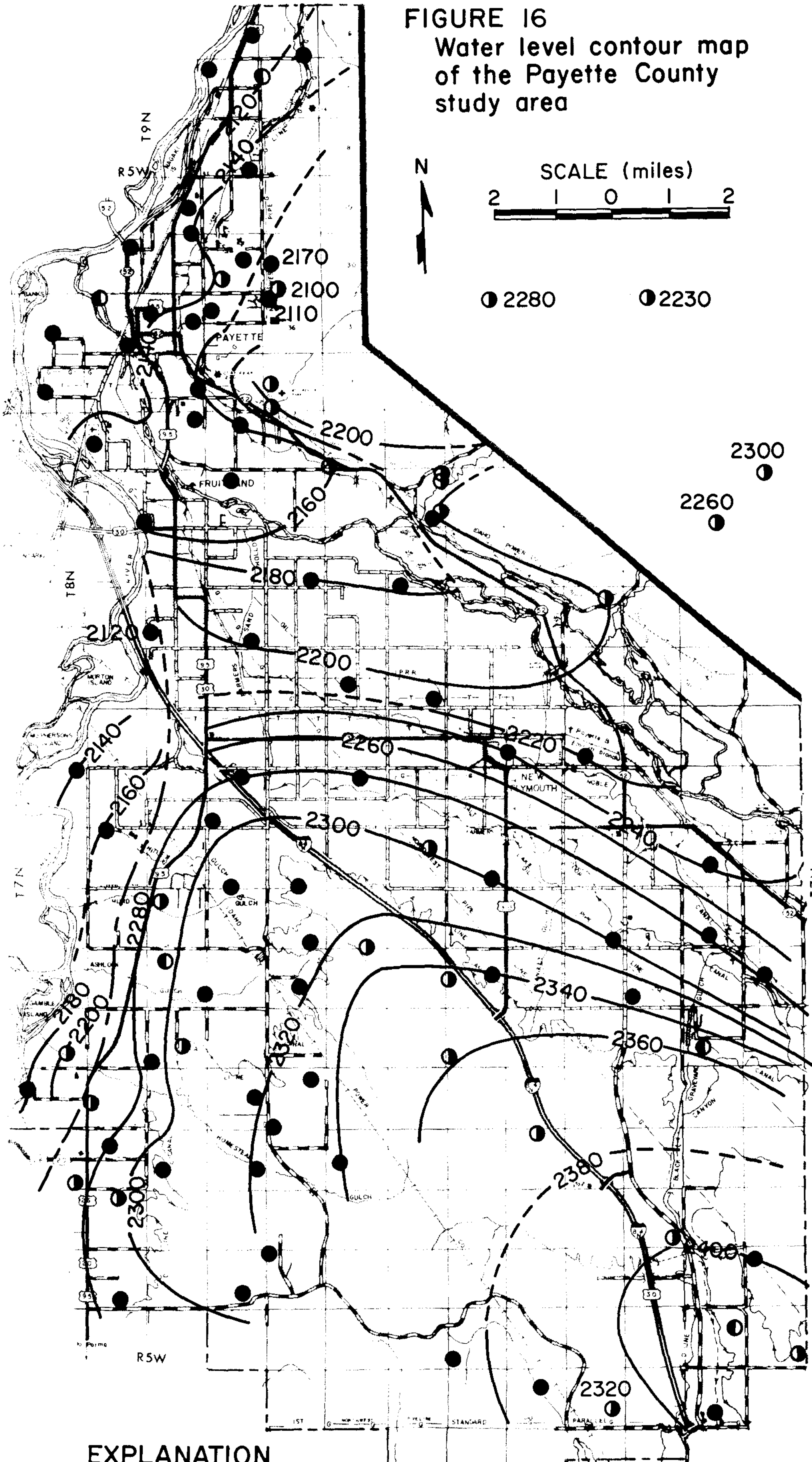
The water level data for the Payette County study area supports preparation of a contour map of ground water elevations with a 20-foot contour interval (figure 16). The water level contour map presented in figure 16 is based upon water level data collected in November, 1984 and May, 1985. Water level differences between the November and May measurements do not significantly affect the general configuration or location of the individual contour lines.

Recharge and discharge areas may be inferred from the pattern of the water level contour lines. Ground water is entering the Payette County study area from two directions. The portion of the study area south of the Payette River receives ground water from the southeast, while the area north and east of the Payette River receives water from the northeast.

In the southeast corner of the county there is a northwest trending ground water divide that roughly parallels Interstate 84. Ground water on the southwest side of this divide flows toward the Snake River. Ground water discharge to the Snake River is represented by the many springs and seeps along the base of the prominent scarp along the east side of the river. Ground water on the northeast side of the divide flows toward the Payette River.

A hydraulic discontinuity (abrupt change in ground water elevation) is suggested along the Snake River on the west side of the study area

FIGURE 16
Water level contour map of the Payette County study area



EXPLANATION

- WATER LEVEL CONTOUR
- WATER LEVEL CONTOUR INFERRED
- CONTOUR DISCONTINUITY BECAUSE OF DEEP WELLS ON EAST SIDE AND SHALLOW WELLS ON WEST. SEE FIGURES
- ● LOCATION OF WELLS MEASURED BOTH SPRING AND FALL
- ◑ LOCATION OF WELLS MEASURED IN FALL 1984
- ◐ LOCATION OF WELLS MEASURED IN SPRING 1985

(figure 16). This water level pattern also is shown on cross sections A to A' and D to D' (figures 11 and 12). Possible causes for the measured water level pattern near the river include: 1) construction characteristics of the wells used to create figures 11, 12 and 16; and 2) lithologic changes. The hydrologic discontinuity is located along the topographic scarp that marks the edge of the floodplain along the Snake River. Wells located east of this feature have considerably higher water level elevations than those on the floodplain. Wells located on the floodplain are much shallower than those to the east. There is insufficient well log information to delineate any lithologic changes in this area. Thus, the reason for the existence of this hydrologic feature is unknown.

Ground water on the northeast side of the divide flows toward the Payette River. The pattern of the water level contours suggests that the Payette River receives discharge from the ground water system in most of the study area. The ground water gradient is lower in the Fruitland area. The Payette River may lose water to the ground water system just upstream from its confluence with the Snake River.

The water level contours suggest that ground water flows toward the Payette River from the highlands to the northeast. The quantity of water entering the river from this direction probably is small because of the fine-grained nature of the sediments in this area and the lack of significant surface water irrigation to provide recharge to the ground water system.

The pattern of water level contours near the City of Payette is complex. Factors that may be affecting ground water levels in this area include: 1) effects of municipal pumpage, 2) localized areas with significant vertical ground water gradients, and 3) a greater percentage of clay in the lithologic section.

Temporal Water-Level Fluctuations

The purpose of this section is to present and discuss the temporal fluctuations of ground water levels that occur in the study area. These include seasonal and annual fluctuations as well as multi-year water-level trends.

Ground water level fluctuations reflect the balance between the recharge to and discharge from a groundwater system. Water levels rise when recharge exceeds discharge and decline when discharge exceeds recharge. Under natural conditions the seasonal high and low water levels are repeated in magnitude and time year after year. Man's activities generally alter this recharge and discharge balance affecting both short-term and long-term water level patterns.

Ground water levels under natural conditions in the Payette County study area were probably highest in the spring and lowest in the fall. Late winter and spring are times of recharge from snow melt, high stream flow and increased rainfall. Water levels probably increased until May or June when increased evapotranspiration rates and recharge rates caused discharge to be higher than recharge; ground water levels thus declined until the cycle was repeated. Man has influenced this natural seasonal fluctuation primarily by increasing recharge from surface water diversion for irrigation, and by increasing discharge from ground water pumpage for irrigation, municipal and domestic uses.

The use of surface water for irrigation has been identified by Young and Norvitch (1984) as a major influence on water levels in much of southern Idaho. Water diverted from surface water systems recharges the ground water via leaky canals and ditches and the land application of water for crop irrigation. Ground water levels in areas of intense surface water irrigation are lowest in the spring prior to the irrigation season and highest in the fall at the end of the irrigation season.

Ground water pumpage for irrigation generally results in the highest water levels occurring in the spring prior to the initiation of pumpage; the lowest levels occur in the fall at the end of the pumpage season. Ground water pumpage for other purposes can also affect ground water levels. Most of the wells in the study area are used for domestic purposes. As such, the wells are operated intermittantly throughout the year. The total pumpage of domestic wells within the study area is significant but the water level effects are small because the wells are distributed throughout the area. The pumpage of industrial and municipal wells affect ground water levels in proportion to their pumping rates and periods of operation. There are few industrial wells in the study area. The municipal wells probably create local water level effects in the aquifers. Maximum pumpage is typically in summer; the water level patterns from municipal use are similar to irrigation wells.

Well hydrographs in figures 17 and 18 are from wells located on the lower terraces between Interstate 84 and the Payette River (Young and Norvitch, 1984). These hydrographs are representative of relatively shallow wells located within areas intensively irrigated with surface water. Water levels in figures 17 and 18 are at their lowest point in

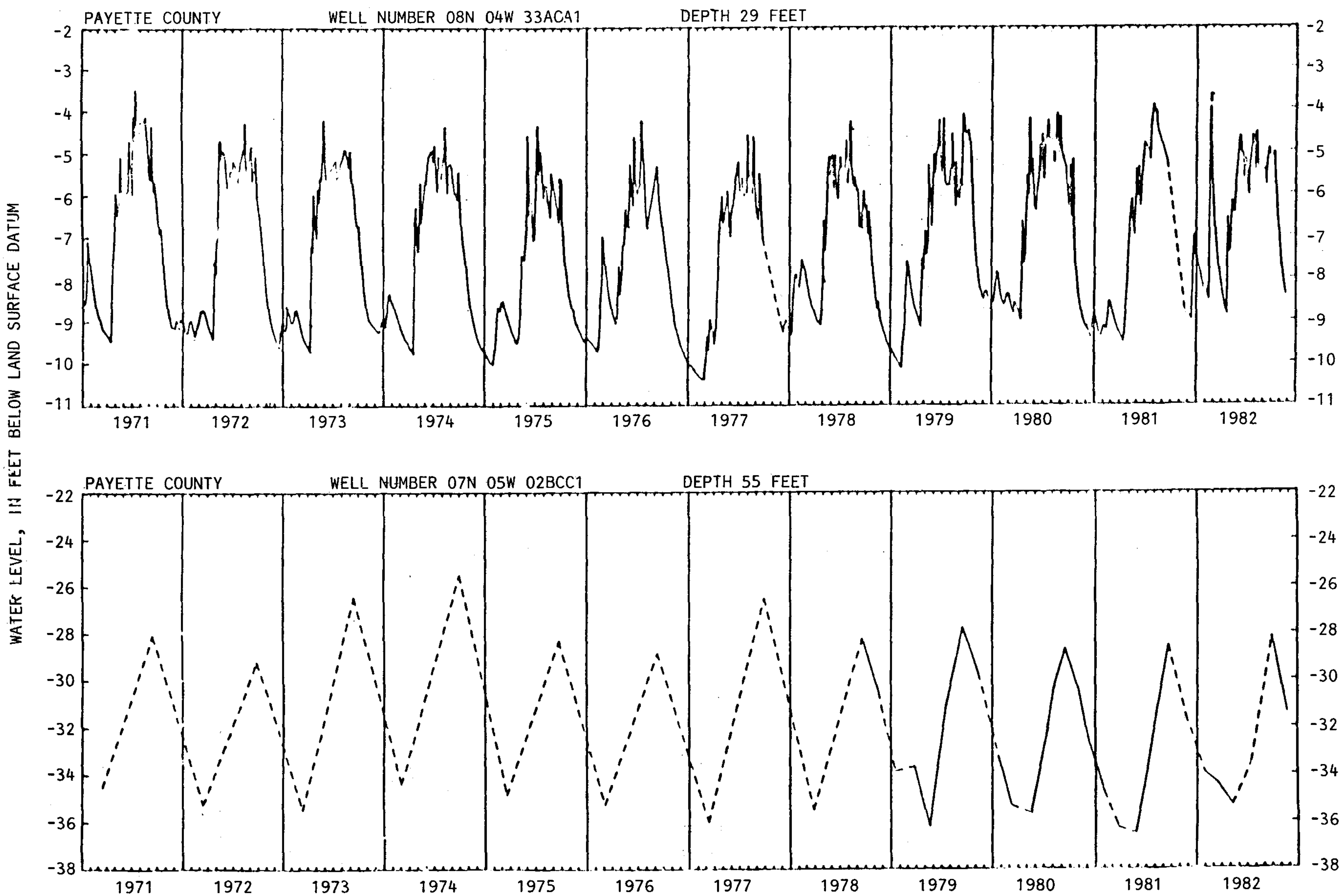


Figure 17. Hydrographs of wells 8N4W33ACA1 and 7N5W02BBC1 in the Payette County study area (Young, 1983).

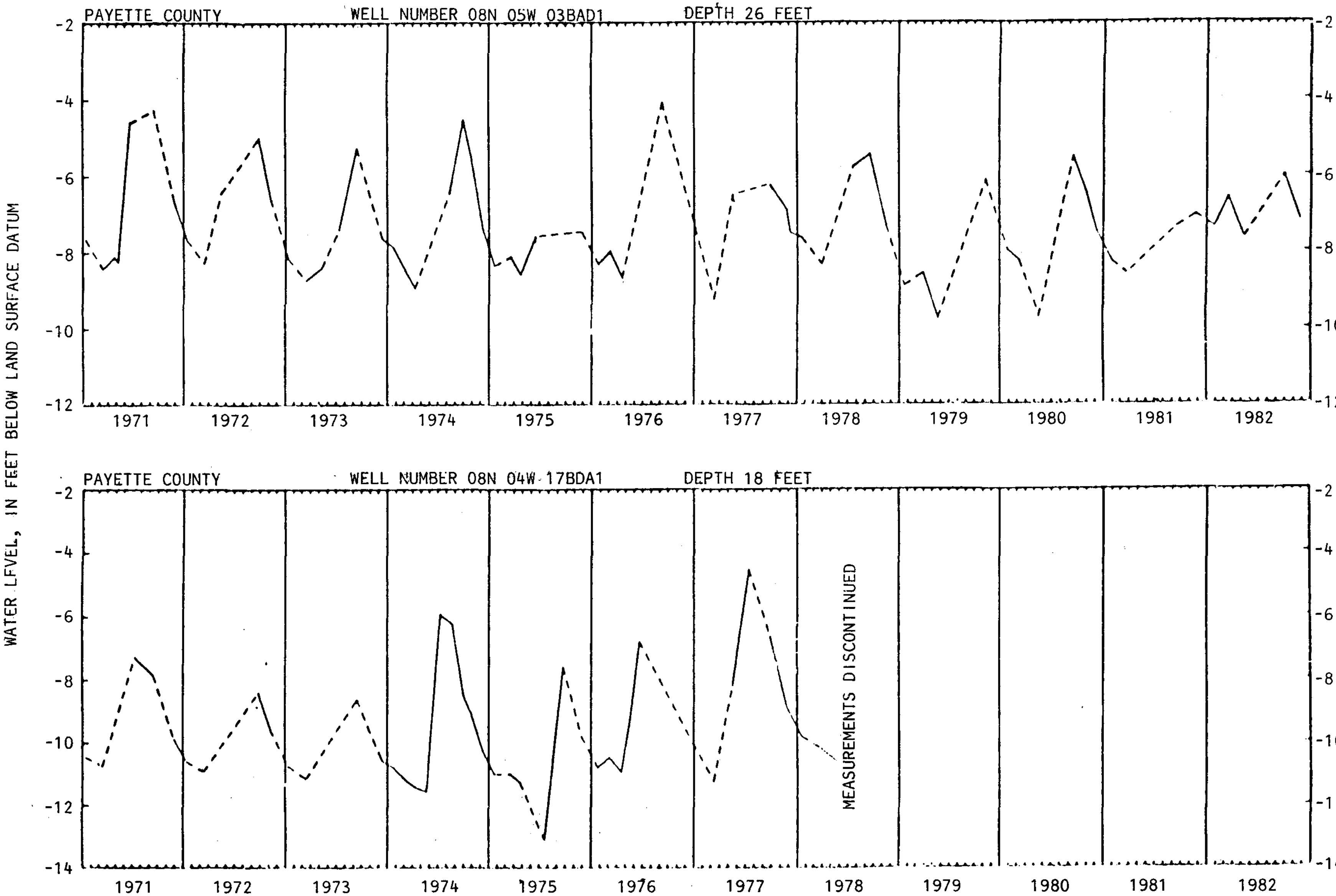


Figure 18. Hydrographs of wells 8N5W03BAD1 and 8N4W17BDA1 in the Payette County study area (Young, 1983).

March to April, then increase to their highest levels in June through July. Water levels start to decrease near the end of the irrigation season and continue their decline until the cycle is repeated. The net annual fluctuation is from 3 to 10 feet. Besides the annual or seasonal changes, water levels may fluctuate in response to short periods of irrigation within a season as is shown by the well hydrograph 8N4W33ACA1 in figure 17.

Long-term water level trends are best interpreted from multi-year hydrographs like those presented in figures 17 and 18. These hydrographs suggest that ground water levels in the surface water irrigated areas are stable since seasonal water levels are roughly repeated at similar levels for each successive year. The long-term trends of ground water levels in the surface water irrigated areas will remain stable as long as recharge from surface water irrigation does not decline.

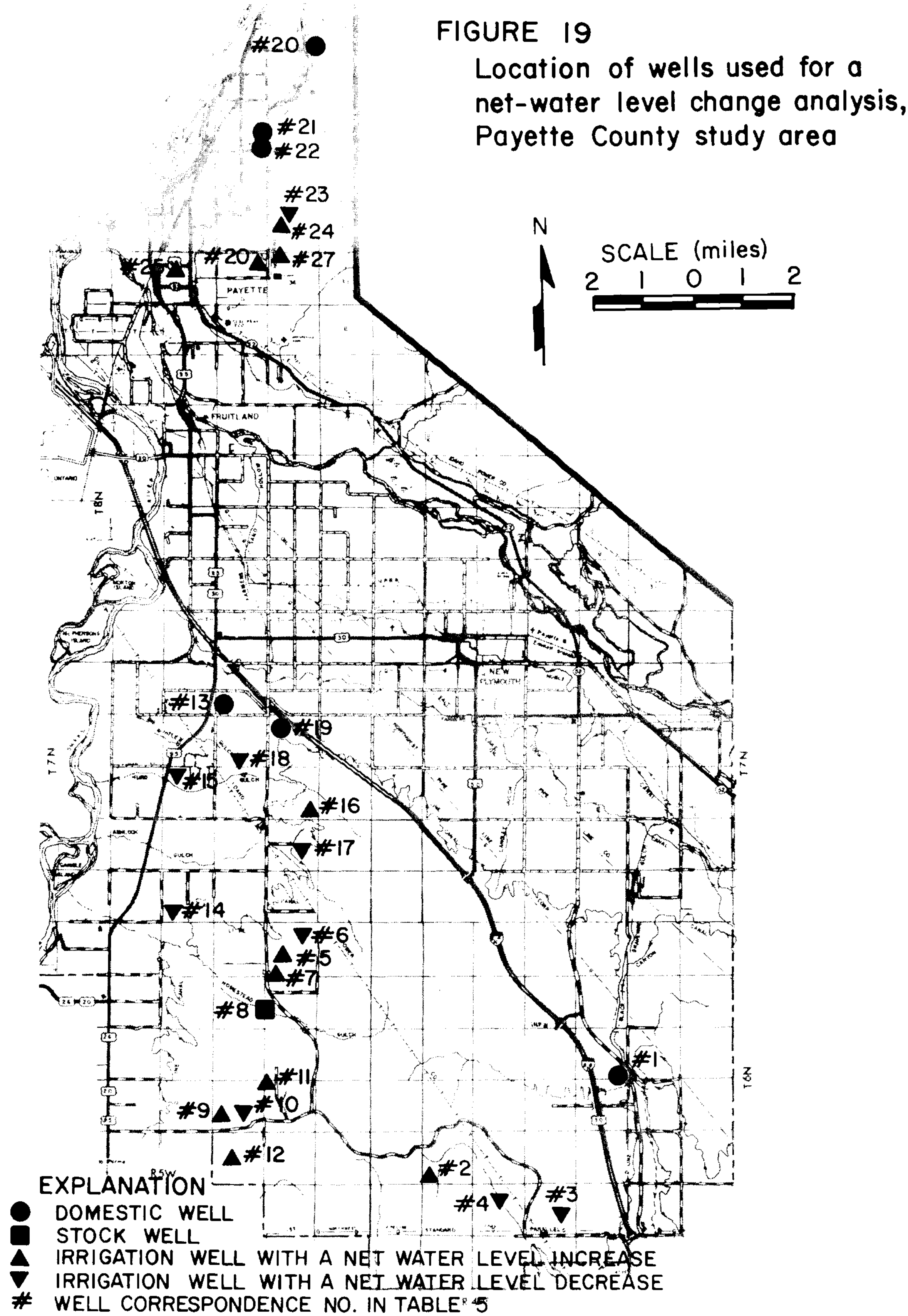
Multi-year hydrographs are not available for the ground water irrigated areas. The best data upon which to evaluate the impacts of ground water pumpage are the water levels measured at the time of drilling compared to the water levels measured during this study. The net water level change and rate of change for 27 wells, located in the two major ground water irrigated areas within the study area, are reported in table 6 (figure 19). Seasonal variations in water levels are recognized as a large source of error for the water level comparison presented in table 6. In order to minimize this problem, the month of completion on the drilling log was matched as close as possible to the measurement dates from table 1 of this report. Eighteen of the 27 dates compared in table 6 are within one month of each other.

Table 6. Net water level change since completion of well; Payette County, Idaho.

Well Location	Well No.	A Depth to Water at Drilling Date	A Depth to Water at Drilling Feet	B Depth to Water During Study Date	B Depth to Water During Study Feet	Net Water Level Change from A to B Feet*	Rate of Change Ft/Year
6N4W13DDD1	1	4/68	100	4/85	79	+ 21	+ 1.2
28CCC1	2	9/73	310	11/84	285	+ 25	+ 2.3
35DAC1	3	4/71	227	4/85	232	- 05	- 0.4
34ACB1	4	1/71	118	11/84	128	- 10	- 0.8
6N5W01BCD1	5	4/70	146	4/85	144	+ 02	+ 0.1
01AAC1	6	10/79	125	11/84	130	- 05	- 1.0
01CCD1	7	11/67	240	6/84	240	00	0.0
11DAD1	8	6/76	32	6/84	72	- 40	- 5.0
23CDC1	9	3/69	270	6/84	270	00	0
23DCB1	10	3/71	270	4/85	279	- 09	- 0.6
24BBA1	11	3/63	280	4/85	267	+ 13	+ 0.6
26CBD1	12	3/67	153	6/84	160	+ 03	+ 0.2
7N5W11CCD1	13	7/83	95	7/84	86	+ 09	+ 9.0
13BAC1	14	7/72	61	6/84	59	+ 02	+ 0.2
22BAC1	15	12/80	45	4/85	52	- 09	- 1.8
24DDC1	16	9/71	216	12/84	206	+ 10	+ 0.8
25DBB1	17	12/79	150	11/84	151	- 01	- 0.2
14CDC1	18	10/78	75	11/84	83	- 08	- 1.6
34CCC1	19	6/74	100	6/84	148	- 48	- 4.8
9N5W01DDD1	20	3/80	130	4/85	114	+ 16	+ 3.2
14AAD1	21	7/83	50	7/84	43	+ 07	+ 7.0
14DAA1	22	8/78	50	7/84	48	+ 02	+ 0.3
25BCD1	23	11/64	152	6/84	183	- 21	- 1.1
25BAC1	24	4/71	130	4/85	125	+ 05	+ 0.4
34BCA1	25	6/73	18	7/84	8	+ 10	+ 0.9
35AAA1	26	12/74	123	7/84	123	00	0
36BBB1	27	6/83	150	7/84	145	+ 05	+ 5.0

* + = Water Level Rise
  - = Water Level Decrease

FIGURE 19
Location of wells used for a net-water level change analysis, Payette County study area



The wells north and east of Payette show a general water level rise with the exception of well 9N5W25BCD1. The water level rise probably reflects the effects of irrigation using surface water. The water level decline noted for well 9N5W25BCD1 may reflect a measurement error.

Water level trends are less clear in the ground water irrigated area south of Interstate 84. Nine of the 15 irrigation wells show a water level decrease while 6 show no change or an increase in water level since drilling. The maximum calculated rate of water level decline in this area is 4.8 feet per year for well 7N5W34CCC1. No long-term trends may be drawn from these data.

CHAPTER 5

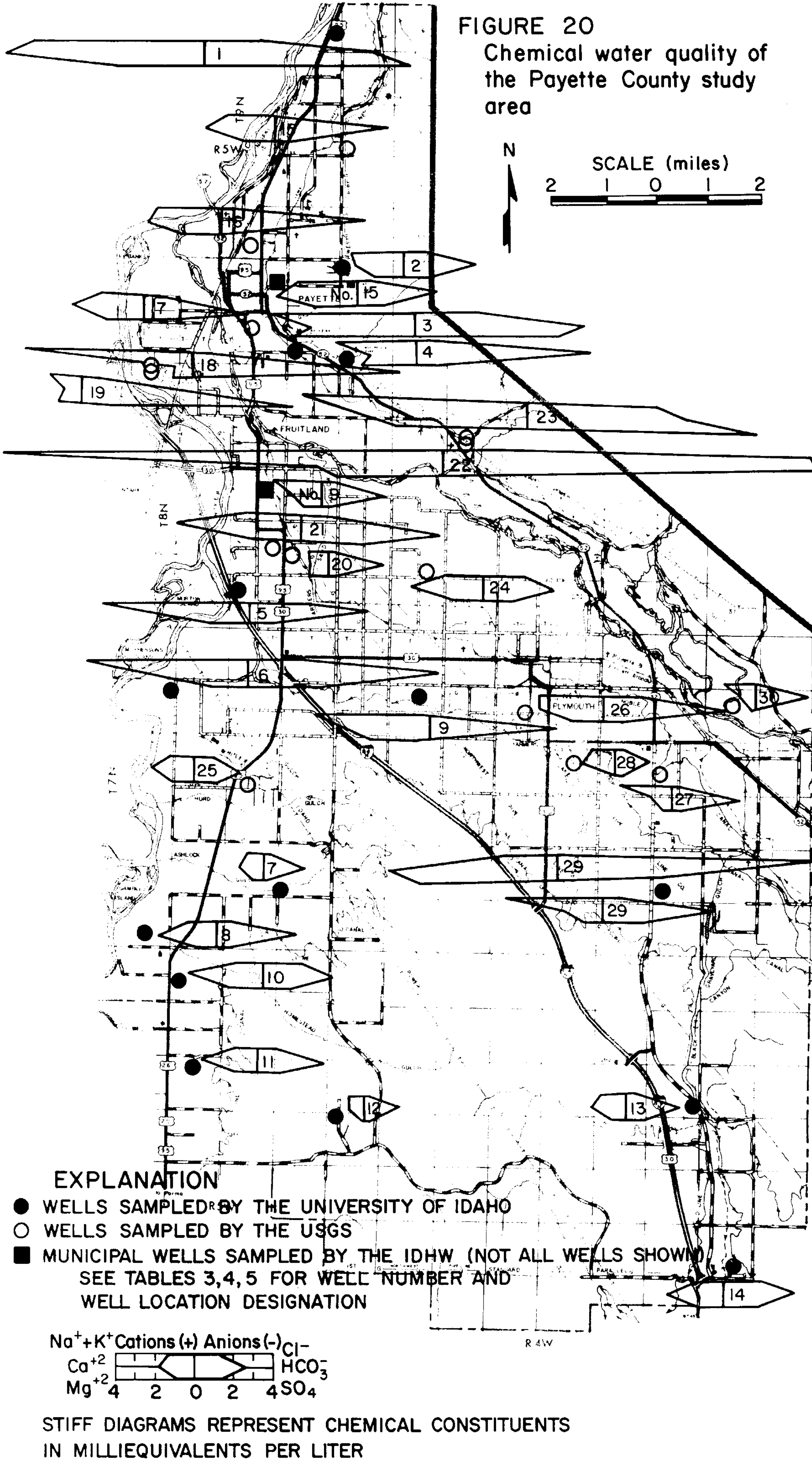
WATER QUALITY DATA

Forty-two water quality analyses from three different sources provide information on ground water conditions within the Payette County study area. Fourteen well samples were collected in June, 1986, as part of this study. Water analyses for 16 wells originally sampled by the USGS were obtained from the EPA's storet data retreival system. Twelve analyses for municipal wells were obtained through city records and the IDHW. These data are presented in tables 2, 3, and 4.

The water quality conditions range widely within the study area Electrical conductivity values (a measure of total dissolved solids) range from 162 to 5,320 umhos/cm. Wide ranges are also noted for calcium (14 to 365 mg/L) and bicarbonate (75 to 1,090 mg/L) concentrations and for temperature (9 to 24.5^{o}C). Twenty out of 41 analysis for manganese exceed the .05 mg/L maximum drinking water standard. Iron exceeds the .3 mg/L standard in 9 analysis, while 16 of the analyses exceed the 0.1 mg/L concentration level at which iron staining is a problem.

Areal variations in water quality may be graphically represented by the use of "stiff" diagrams. These diagrams present the major cations and anions as a geometric shape that allows comparison from area to area. Three identifiable chemical water quality types are suggested by the stiff diagrams in figure 20, plus a fourth water type which varies in water quality more widely than the first three. The reference number on each stiff diagram corresponds to a well listed in table 2, 3 or 4. Type I water is identified in relatively deep wells that draw most if not all their water from below the first major blue clay layers. Wells

FIGURE 20
Chemical water quality of the Payette County study area



6N5W24BBA1, 7N5W27DDA1 and 7N4W13BDC1 (see stiff diagrams 12, 7 and 27) pump Type I water from below the blue clay at well depths greater than 150 feet. Type I water is characterized by low total dissolved solids with high percentages of sodium, calcium and bicarbonate. A mild to strong hydrogen sulfide smell is usually noticeable. The blue clay may act as a low permeability barrier preventing the mixing of water from above.

Type II waters are identified in wells 7N5W32DDB1, 6N5W04CBB1, 6N5W16BAA1, 6N4W13DDD1, 6N3W31CDD1 and probably 7N5W15CDC1 (see stiff diagrams 11, 13, 14 and 25). Water from these wells is characterized by having higher amounts of total dissolved solids than Type I waters and are predominately calcium bicarbonate waters. Wells that produce Type II water are located both in the southern portion of the study area and north of the City of Payette. They range in depth from 106 to 265 feet but do not penetrate the blue clay. Wells with Type II water generally are located away from intensive surface water irrigation and probably represent a mixing of native water quality above the blue clay with water from irrigation activities.

Type III waters are identified in a small area east of the City of Payette near Clay Peak. Type III waters are characterized by high amounts of sodium, potassium and bicarbonate. The water quality of wells 8N5W01CCD1, 8N5W02CBD1 and possibly 8N5W08BAA1 (see stiff diagrams 3, 4 and 6) probably represent water that has not been significantly affected by irrigation practices. All three wells are greater than 200 feet deep and penetrate thick clay layers.

Type IV waters are identified in wells located in the lower elevations along the Snake and Payette Rivers. The chemical composition of the ground water varies greatly as suggested by the stiff diagrams in figure 20. The total dissolved solids concentrations are in the middle and higher ranges. Calcium, sodium and bicarbonate are generally the dominant ions. Wells generally are shallow (<100 ft) and do not penetrate significant layers of blue clay. Wells with Type IV water are in areas where the water quality has been impacted to a great extent by surface irrigation.

Temporal variations in water quality occur in some Type IV wells. In well 9N5W13CCB1, electrical conductivity decreased from 5,320 umhos/cm in June, 1979, to 609 umhos/cm in October, 1982, and then increased to 3,850 umhos/cm in June, 1983 (table 3). Well 7N4W25CCC1 shows a similar pattern although not to the same magnitude. Stevens (1962) suggests that canal water low in dissolved solids may mix with the ground water causing the resultant dissolved solids to decrease as the irrigation season progresses. Conversely, irrigation return flow water that is poor in quality may recharge the ground water lowering the water quality. Surface and ground water interactions make characterization of water quality from shallow wells difficult in intensely farmed portions of the study area.

CHAPTER 6

GROUND WATER FLOW SYSTEMS

Ground water flow systems described in this chapter represent a combination of the hydrogeologic, water level and water quality data presented in the previous chapters. The hydrogeologic and water level data do not support delineation of a number of individual ground water flow systems. The water quality data suggest that the ground water resources may be divided into four general groups. These groups provide the basis for the discussion of ground water flow systems presented in this chapter.

Flow System I (water quality Type I) includes a series of sand aquifers 1 to 20 feet thick interlayered with blue clay which are intercepted by deep irrigation wells in the southern portion of the study area. Water in this system flows to the west-northwest toward the Snake River or northeast toward the Payette River. Recharge for this system probably is from irrigation to the southeast of the study area and from stream flow along the Boise Front. Discharge probably occurs to the two rivers. There is some indication of water level decline due to ground water pumpage from this system. The water quality is good with low total dissolved solids but with a mild to strong smell of hydrogen sulfide.

Flow System II (water quality Type II) occurs in two portions of the study area. This system in stratigraphically located above System I in the southern portion of the county. The unit consists of sand and gravel layers interlayered with brown to yellow clay. Recharge is from surface irrigation in the study area, irrigation practices to the southeast, and stream flow along the Boise front. Discharge is to the Snake and Payette

Rivers. No water level decline has been indicated by the limited data. Water quality is slightly poorer than in System I with higher total dissolved solids.

Another Type II flow system occurs in the northern portion of the county in and northeast of the City of Payette. The lithology is similar to that found in the southern portion of the study area. Water level data suggest that recharge is from surface irrigation and underflow from the highlands to the northeast. Discharge is to the Snake River. Water level records suggest no long term water level declines.

Flow System III includes a small area near Clay Peak southeast of the City of Payette characterized by a lithology composed almost entirely of clay. Well yields are low. Recharge to this system probably is from the highlands to the northeast. Discharge is to the Payette River. Water quality is characterized by high concentrations of sodium, potassium and bicarbonate.

Flow System IV includes the flood plain areas and low terrace areas. Aquifers are shallow and are composed of sands and gravels. This water resource system is dominated by surface water irrigation. Both water levels and water quality reflect the annual irrigation season. Discharge from this system is to the Snake and Payette Rivers.

CHAPTER 7

EXISTING AND POTENTIAL WATER RESOURCE PROBLEMS

This chapter addresses five existing or potential water resource problems within the Payette County study area. These include: 1) ground water availability in some areas of proposed or possible increased housing development, 2) short well life and decreasing yields in the City of Payette municipal wells, 3) declining water levels and well yields in the predominantly ground water irrigated area south of Interstate 84, 4) ground water quality and its suitability for use, and 5) land use changes affecting water levels in shallow wells.

Increased Housing Developments

Adequate quantity and quality of ground water are important factors in the suitability of an area for increased housing development. There are six areas within the Payette County study area that are expecting or presently experiencing increased housing development. The following discussion briefly evaluates the expected well depths, water levels and water quality of each area based upon the information presented in previous chapters.

Area 1 is a narrow section of land about a quarter of a mile wide and one mile long that parallels Highway 52 from Clay Peak to the motorcycle park east of Payette. There are about 12 single family houses in this area. Well owners report low yields and hard water. Wells yield more water south of the highway at lower elevations. Clay and shale with infrequent thin sand beds are the common lithologies shown on drillers' logs. Well depths are generally less than 100 feet in the lower elevations south of the highway; depth to water ranges from 25 to 50 feet. Well depths near the highway and north towards the bluffs are generally greater than 200 feet. Well yields are lower in this area; depth to water ranges from 50 to 108 feet. Water quality is generally good with total dissolved solids in the range of 500 to 1,000 mg/L. The potential for development of a high yield well for a subdivision in this area is low.

Area 2 is located north and east of the City of Payette and is roughly defined by the airport, city dump and the intersection of Iowa Avenue and 7th Street. This area is probably the most rapidly growing subdivision area in the county. The present subdivisions include: Rolling Hills, Vista, Bell Place and Goff. The southwest corner of the area is near several municipal wells; the extreme eastern edge has some deep irrigation wells, but most of the wells are for single family residences. Well yields are usually sufficient for domestic needs. Well depths vary from 100 to 300 feet. The average depth is about 220 feet based upon an inventory of 25 wells. Most ground water is obtained from sands and gravels below one or more clay layers. Depth to water ranges from 40 to 130 feet with the average being about 80 feet. Long-term water levels should remain stable unless irrigation with ground water increases significantly. Water quality is good in the subdivision areas, but some wells to the west and north have experienced high sulfide and iron concentations. The potential for development of a production well for a new subdivision in this area is good.

Area 3 is between the City of Fruitland and the Snake River. Housing developments have increased along the edge of the high bank overlooking the river. Well depths along the high bank range from 90 feet near Highway 30 to over 200 feet at the Interstate 84 rest area. The Loma Linda subdivision wells are 307 and 320 feet deep. Water levels are shallow in the north, about 20 feet below land surface, and tend to deepen to the south to about 60 to 80 feet. No reliable data are available on well yields in this area. Some of the wells in this area produce sand. This is a well construction problem that may be avoided with proper consideration of well screens and possible gravel packs. Water levels in the area should remain stable even with increased pumpage since recharge in this area is mostly from surface water irrigation. The water quality is suitable for domestic use, although some poor quality water may be found in shallow wells associated with surface water irrigation. The potential for water supply development in Area 3 is good.

Area 4 is locally called the Hill Top Subdivision. It is located 2 miles south of the intersection of Highway 95 and Interstate 84. This subdivision is developed on a gravel-capped ridge at about 2,400 feet elevation. Well owners report adequate well yields for domestic purposes. Drillers' logs for the area show that ground water is obtained mostly from sand layers just above the blue clay. Well depths are between 150 and 200 feet, and depth to water is from 80 to 100 feet depending on the land surface elevation. The water quality is the Type II described previously and is considered good for domestic use. There are successful irrigation wells south of this subdivision so deep well potential is good for yields suitable for a small subdivision.

Area 5 is a relatively broad, flat area on top of the first high terrace above the Snake River, north and east of Anderson Corner. Existing housing developments occur mostly along the edge of the scarp and along Highway 95. Well owners reported adequate well yields for general domestic purposes. Drillers' logs in the area show that ground water is drawn from a sand and gravel layer located just above the blue clay. Well depths range from 80 to 200 feet; depth to water ranges from 35 to 100 feet. The deepest water levels occur on the edge of the scarp. The water is the Type II quality and is considered good for domestic use. The well yield potential for this area is good.

Area 6 is located in the vicinity of Sand Hollow in the southeast corner of the county. Existing housing developments occur mostly along the north-south trending Sand Hollow road. Although no well owners were interviewed in the immediate area, the ones contacted in the surrounding area reported well yields suitable for domestic use. Drillers' logs show that most water for domestic use comes from above the major blue clay zone, which is about 350 feet below land surface based upon data from a deep irrigation well in the area. Well depths for domestic wells range from 120 to 275 feet. Depth to water varies from 20 to 125 feet, but it is probably less than 50 feet for most domestic wells. The water quality is Type II and is considered good for domestic uses. Again, the well yield potential in this area is good.

Payette Municipal Wells

The municipal wells of Payette historically have been plagued by rapidly decreasing well yields. Recently a well had to be taken out of service for rehabilitation after only two years and three months of operation. Encrustation initiated by bacteria is blamed as the plugging mechanism for the well screen and pump screen. The city water superintendent describes the problem as a build up of a red greasy slime on any submersed part of the pump or well. It generally can be removed with a putty knife. Occasionally this build up is scaly and more difficult to remove. In rare occasions there is black slime present. Standard chlorine and acid treatments presently are used to rehabilitate city wells. These treatments, although successful in increasing the well yield, are generally short-lived. This portion of the report includes a discussion of the problem and alternative solutions.

The red and occasionally black slime found on the submersed parts of the well is evidence that a bacteria is thriving in the well and probably the surrounding substrata (Smith, 1986). The red slime is suggestive of an iron reducing type of bacteria. Smith, of the Johnson Well Screen Company, suspects sulfate reducing bacteria also are present. The type of bacteria actually causing the problem is of minor importance since well treatment for this type of problem is effective for all the common problem bacteria.

It is unknown whether the bacteria are introduced to the well site by the drilling process or if the bacteria are native to the substrata. McNabb and Dunlap (1975) indicate that iron, manganese and sulfate reducing bacteria thrive in an anaerobic environment rich in, iron, manganese and sulfate. Such an environment exists in the Payette area.

The common iron and manganese bacteria reduce iron or manganese to an insoluble state, which is then deposited in the bacterial slime within the well and in the voids of the surrounding substrata. Sand also collects in the slime. The accumulation of slime is the plugging mechanism within the well.

A successful well rehabilitation program for a well with bacteria caused encrustation must attack two separate problems. The bacteria must be killed to inhibit further slime growth, and the scale and encrustation must be removed. The common treatment to attack both problems includes alternating chlorine and acid treatments along with strong agitation to facilitate chemical dispersion and the mechanical break up of the encrustation. This rehabilitation method presently is being used by the city and probably is the best method available at this time.

The frequency of treatment probably is the most important part of a rehabilitation program. For reocurring problems the Johnson Well Screen Company suggests that treatments be scheduled at routine times (Smith, 1986). The time between each treatment is location specific, but treatments once a year may be warranted. A chlorine only treatment may be alternated with the chlorine and acid treatments to reduce the corrosion problems associated with the acid. Treatment should occur before a significant loss of yield is noticed. Detailed records on well yield and pumping water levels are important in determining the optimum frequency of treatment. The Johnson Well Screen Company suggests treatment is necessary before one-third of the yield is lost, but more frequent treatments are not unrealistic (Smith, 1986).

Southern Irrigation Wells

Irrigation well owners in the area south of Interstate 84 and east of Highway 95 have complained of declining water levels and decreased well yields. Two alternative problems may be occurring in the area. First, yields from individual wells may be decreasing because of well or pump problems. Second, regional water levels may be declining annually in response to ground water pumpage. The following discussion describes these problems and possible mitigative measures.

A decrease in well yields can result from deterioration of the well or pump. Potential well problems include plugging of the well screen, sand backfilling of the well or partial well collapse. The following steps may be taken to identify well problems. First, static water level and pumping water level measurements must be obtained. These data should be compared with previous measurements of this type. Comparison of static water level data allows identification of any problems of long term water level decline in the aquifer. A well problem is identified if the static water level measurements are similar but pumping water levels have significantly lowered with time. Well rehabilitation procedures vary from chlorine/acid treatments described for the Payette wells to well reconstruction. Downhole television and/or borehole geophysical data aid in the identification of the characteristics of the well problem. A pump problem is identified if the well yield is down but the pumping water levels have not significantly declined. Pump deterioration commonly occurs from bacterial slime accumulations, sand pumping or galvanic corrosion. Pump repair should be accompanied by correction of the problem such as limiting the entry of sand into the well.

The problem of regional decline of ground water levels is best identified by comparison of water level measurements taken in the spring prior to the initiation of pumpage for irrigation. The only mitigation measures that may be applied in areas of regionally declining water levels are reductions in pumpage or possibly well deepening to intercept different aquifer zones.

The well yield and water level problems reported in the southern portion of the study area probably represent a combination of regional water level decline and well/pump problems. The limited data previously presented suggest that annual water level declines are small in the area of concern, probably less than 2 feet per year. Small water level declines generally do not cause significant decreases in well yield. Most of the reported problems are probably related to well/pump deterioration. A number of the irrigation wells produce some sand. Continued sand pumpage leads to failure of both the well and the installed pump.

Ground Water Quality and Suitability for Use

The ground water quality determines the suitability of that water for use. The Environmental Protection Agency (EPA) has established drinking water standards that are based on either the health risks of a constituent, or undesireable esthetics such as smell or taste. Standards established for esthetic reasons can often be violated without a health risk. Legally these standards only apply to public water systems; however, if a water source violates a quality standard, it is advisable to contact a local state health agency to clarify any health risks involved.

The water quality found in the Payette County study area is compared with recommended standards in Table 7. The table shows that recommended drinking water standards for sulfate, nitrate, total dissolved solids, iron and manganese are exceeded for some samples. These constituents are discussed in the following pages.

Sulfate

Eight of 50 samples exceed the 250 mg/L recommended limit for sulfate. This limit was established for esthetic reasons; higher concentration can cause a bitter taste to the water. Sources for sulfates are extensive and it is a predominant anion in many places (Hem 1983).

In reduced environments sulfate is reduced to sulfide, with hydrogen sulfide being the common sulfide form. Although considered harmless, the rotten-egg odor of hydrogen sulfide is noticeable to various degrees in many of the wells in the county. In general, the process of sulfate reduction requires the presence of sulfate reducing bacteria and organic matter, both of which are believed to be present in the subsurface in the Payette area.

Nitrate

Natural sources of nitrogen rarely cause concentrations in ground water to exceed drinking water standards. Increased concentrations often can be attributed to man's activities. The human related nitrate sources are the organic wastes from plant debris, animal wastes and

Table 7. Selected water-quality characteristics and their relation to use (modified from Parliman, 1982).

Constituent or Property	Source or Significance	Range of Concentrations in Sampled Wells	Effects Upon Usability
Specific conductance	An indicator of dissolved mineral content of water	162-5320 umhos/cm	Indicator of mineral content. A measure of the capacity of the water to conduct a current of electricity, and varies with the concentration and degree of ionization of the different minerals in solution; the more minerals, the larger the specific conductance.
pH	Hydrogen-ion concentration	pH 7.2-8.6	A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increased alkalinity; values lower than 7.0 indicate increased acidity. Corrosiveness of water generally increases with decreasing pH, but excessively alkaline water also may be corrosive. Recommended level for public water supplies ranges from 6.5 to 8.5.[1]
Hardness as Calcium carbonate ($CaCO_3$)	In most waters, nearly all hardness is due to calcium and magnesium	22-696 mg/L	Soap consuming capacity of a water. Forms white scale on teakettles and plumbing and rings in bathtubs. Although hardness is less of a factor with synthetic detergents than with soap, it is still desirable to soften hard water for esthetic as well as economic reasons.
Calcium (Ca), Magnesium (Mg)	Dissolved from practically all soils and rocks, but especially from limestone, dolomite, and gypsum	8.5-365 mg/L Ca 1-394 mg/L Mg	Causes most of the hardness in water. Calcium and magnesium combine with bicarbonate, carbonate, sufate, and silica to form heat-retarding, pipe-clogging scale in boilers and in other heat-exchange equipment. A high concentration of magnesium has a laxative effect, especially on new users of the supply.
Sodium (Na) Potassium (K)	Dissolved from practically all rocks and soils, especially feldspars, clay minerals, and evaporites. Present in sewage and commercial fertilizers	15-536 mg/L Na 0.8-23.4 mg/L K	More than 50 mg/L sodium and potassium in the presence of suspended matter causes foam in boilers, which accelerates scale formation and corrosion. Dissolved sodium concentrations may be important to sodium-restricted diets.

Table 7. Continued.

Constituent or Property	Source or Significance	Range of Concentrations in Sampled Wells	Effects Upon Usability
Sodium-absorption-ratio[2] (SAR)	Dissolved calcium, magnesium, and sodium from rocks and soils	0.8-11	Estimates the degree to which sodium in irrigation water tends to enter into cation-exchange reactions in soil. High values indicate that sodium replaces absorbed calcium and magnesium. This replacement damages soil structure and decreases permeability.
Bicarbonate (HCO^3), Carbonate (CO_3)	Action of carbon dioxide in water on carbonate cementing material and rocks, such as limestone, dolomite, and travertine	61-1090 mg/L HCO_3 0-14 mg/L CO_3	Produce alkalinity. When heated in the presence of calcium and magnesium, can form scales in pipes and release corrosive carbon-dioxide gas. Aid in coagulation for the removal of suspended matter from water.
Alkalinity as calcium carbonate ($CaCO_3$)	Nearly all produced by dissolved bicarbonate and carbonate	50-890 mg/L	Measure of water's capacity to neutralize acids. May produce objectionable taste.
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, sulfides, and other sulfur compounds. May be derived from industrial wastes, both liquid and atmospheric	1-2600 mg/L SO_4	Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate, in combination with other ions, imparts bitter taste to water. Some calcium sulfate is considered beneficial in brewing processes. Recommended maximum limit for public water supplies is 250 mg/L.[1]
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and industrial wastes.	1-210 mg/L Cl	A salty taste can be detected when concontrations exceed 100 mg/L. In large quantities, increases the corrosiveness of water. Present available removal methods not generally economical for most uses. Recommended maximum limit for public water supplies is 250 mg/L.[1]
Fluoride (F)	Dissolved in small quantities from most rocks and soils. Added to many public supplies	0.2-1.2 mg/L	Fluoride concentrations in limited amounts have beneficial effect on the structure and resistance to decay of children's teeth. Excessive concentrations

(Continued)

Table 7. Continued.

Constituent or Property	Source or Significance	Range of Concentrations in Sampled Wells	Effects Upon Usability
			produce objectional dental fluoriosis (tooth mottling). Optimum recommended limits for public water supplies range from 0.7 to 1.2 mg/L and are based on annual average maximum daily air temperatures.[3]
Dissolved solids (total residue)	Mineral constituents dissolved from rocks and soils	102-1520 mg/L	Recommended maximum limit for public water supplies is 500 mg/L.[1] Water containing more than 1,000 mg/L of dissolved solids is unsuitable for many purposes.
Silica (SiO_2)	Dissolved from practically all rocks and soils	5-69 mg/L SiO_2	Together with calcium and magnesium silica forms a low heat-conducting, hard, glassy scale in boilers and turbines. Silica inhibits deterioration of zeolite-type water softners and corrosion of iron pipes by soft (0-75 mg/L $CaCO_3$) water.
Nitrate (NO_3) as nitrogen (N)	Atmosphere, legumes, plant debris, animal excrement, nitrogenous fertilizer in soil, and sewage	< .1-16 mg/L N	Small amounts help reduce cracking of high-pressure boiler steel. Encourages growth of algae and other organisms that produce undesirable taste and odors. Concentrations in excess of 10 mg/L are suspected as cause of methemoglobinemia (blue-baby disease) in infants. Mandatory maximum limit for public water supplies is 10 mg/L.[3]
Iron (Fe)	Dissolved from practically all rocks and soils, especially igneous and sandstone rocks. Also caused by corrosion of pipes, pumps and other cast iron or steel equipment or the presence of iron bacteria.	< .01-1.8 mg/L Fe	When concentrations are more than 0.1 mg/L (more than 100 ug/L), iron commonly precipitates on exposure to air, causing turbidity, staining of plumbing fixtures and laundry, and tastes and colors that are objectionable in food, beverages, textile processes, and ice manufacture. Recommended maximum limit for public water supplies is 0.3 mg/L, or 300 ug/L.[1]

Table 7. Continued.

Constituent or Property	Source or Significance	Range of Concentrations in Sampled Wells	Effects Upon Usability
Zinc (Zn)	Dissolved from rocks and soils, most commonly from sphalerite, commonly in carboante rocks.	< 0.005-0.34 mg/L	5 mg/L is the recommended maximum drinking water level to prevent undesirable taste affects, although concentrations higher than 40 mg/L can be tolerated. Zinc concentrations as low as 0.02 mg/L are toxic to fish.[4]
Manganese (Mn)	Mostly a minor constituent. Dissolved from rocks and soils, usually in the form of oxides.	< 0.005-3.2 mg/L	Essential element in plant metabolism. Forms coatings on other mineral surfaces. Recommended maximum drinking water level is 0.05 mg/L.[4]
Boron (B)	Mostly a minor constituent. Dissolved from rocks and minerals. May be present in sewage and industrial waste.		Small amounts essential to plant growth. Recommended limit for crops is 0.75 mg/L.[4]

[1] U.S. Environmental Protection Agency (1977b)

[2] U.S. Salinity Laboratory Staff (1954) $SAR = \frac{(Na+)}{\sqrt{\frac{(Ca^{+2})+(Mg^{+2})}{2}}}$, in meq/L

[3] U.S. Environmental Protection Agency (1977a)

[4] Hem (1983)

sewage. Nitrate fertilizers also are a significant source in agricultural areas. Shallow sand and gravel aquifers not overlain by clay are most vulnerable to nitrate contamination from surface sources such as animal feed lots and agricultural practices. Such aquifers are used for domestic water supply sources along the low lands in the study area.

The maximum recommended drinking water standards (10 mg/L) is violated only by one well sample from those contained in tables 2, 3 and 4 in Chapter 2. However, 12 of 41 samples analysed for nitrate are above 3 mg/L. These data suggest that some nitrate contamination is present in the study area. Elevated nitrate levels also have been reported by the local IDHW office. A more detailed evaluation of this problem may be warranted in the county.

Total Dissolved Solids

Total dissolved solids concentrations represent the quantity of dissolved constituents in the water. Water with total dissolved solids (TDS) of less than 1000 mg/L is considered fresh, but the maximum recommended drinking water level is 500 mg/L. Values greater than 500 mg/L are not necessarily harmful, but a salt taste often occurs at higher values, and many uses are restricted because of mineral deposition.

The 500 mg/L standard is violated in 9 of 42 samples in tables 2, 3, and 4. Four of these samples exceed 1000 mg/L. The high values are mostly from shallow wells in heavily irrigated areas. The extreme values do not represent a health hazard directly but illustrate the close relationship of ground water quality with irrigation. This suggests other constituents could be a problem in these areas.

Iron and Manganese

Iron and manganese are both common constituents in ground water, although usually in minor concentrations. Both constituents become insoluble oxides when exposed to oxygen, which results in the most commonly reported problem. Dissolved iron concentrations exceeding 0.3 mg/L and dissolved manganese concentrations exceeding 0.05 mg/L cause the familiar red and black oxide stains noted on bathroom fixtures. Twenty out of 41 analysis for manganese exceed the .05 mg/L maximum drinking water standard. Iron exceeds the .3 mg/L standard in 9 analysis, while 16 of the analyses exceed the 0.1 mg/L concentration level at which iron staining is a problem.

Land Use Changes Affecting Shallow Wells

A high number of shallow wells exist in the lower elevations of the study area. Shallow wells are used because water levels are near the surface, and because in some areas the water at greater depth is esthetically of poor quality. Some of the shallow water resource systems have been created by irrigation. The water supply for these wells is highly dependent upon surface irrigation. Cessation of irrigation because of a change of land use will reduce recharge and adversely affect the shallow wells. The magnitude of the impact will be dependent upon the scale of land use change. Similar changes might occur from changes in irrigation practices such as going from gravity to sprinkler irrigation or lining canals.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

General Conclusion

The Payette County study area is underlain by an extensive ground water resource in a thick sedimentary sequence. The dominant source of recharge is surface water irrigation. Ground water discharge is to the Payette and Snake Rivers. Ground water levels are generally stable with little evidence of water level decline. Water quality is good although some areas have high total dissolved solids, sulfate, nitrate, iron and manganese concentrations.

Specific Conclusions

1) The hydrogeology of the area is complex; correlation of specific lithologic units between wells is difficult. The top of a blue clay sequence provides the best hydrogeologic basis for correlation with water level and water quality data.
2) The contour map of water level elevations shows that ground water enters the study area from two general directions, the southeast, and the northeast. Water entering Payette County from the southeast flows in a northwest direction along a ground water divide that parallels Interstate 84. Water south and west of the divide flows toward the Snake River. Water north and east of the divide flows toward the Payette River. In the northern portion of the study area water enters from the northeast and flows south and west into the Payette and Snake Rivers.

3) Water levels respond to the effects of surface water irrigation in the low-land areas with low levels in the spring and high levels from summer to fall. No long term water level declines are apparent in these areas. Water level data from the area of ground water pumpage are very limited, but large scale water level decline is not suggested.

4) Three ground water quality types (Type I, II and III) may be identified in the study area, each with a unique water quality. A fourth water type (Type IV) occurs in areas intensively used for irrigation and includes a wide range in ion concentrations. Type I water has low TDS with high percentages of sodium, calcium and bicarbonate and occurs in deeper zones in the southern portion of the county. Type II water is slightly higher in TDS, is a calcium bicarbonate water, and is found near the City of Payette and overlying Type I water in the south. Type III water is higher yet in TDS, sodium, potasium and bicarbonate with a high concentration of magnesium. Type III water is found only near Clay Peak. Type IV water quality is variable and is found at shallow depths in areas of heavy irrigation.

5) Only one of the suggested areas for housing development has potential water supply problems. The area along Highway 52 near Clay Peak is underlain by thick sequences of clay, and well yields are small. Water quality in this area (Type III) is also poorer than in most of the other suggested housing development areas.

6) Well life problems in the City of Payette appear to be caused by a bacteria that may be indigeneous to the subsurface. The present

treatments of chlorine and acid are the recommended mitigation procedures. A more frequent maintenance program may be required to maintain well yields.

7) Limited data suggest that there is some quality degradation of shallow ground water systems in irrigated areas. Nitrates are high in some wells but few violate drinking water standards.

<u>Recommendations</u>

1) Contact should be made with the U.S.G.S. requesting that a deep irrigation well be added to the water level monitoring program. Possible candidate wells are: 6N5W13CDC1, 6N5W14DBA1, 6N5W01BCD1, and 7N5W34CCA1 (table 1).

2) The City of Payette should institute a well rehabilitation program on a regular basis as part of system maintenance. A cost analysis should be done comparing the existing ground water system to surface water or combined ground water/surface water systems.

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