GROUND-WATER AVAILABILITY ON THE KITSAP PENINSULA, WASHINGTON

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations

Open-File Report 80-1186

Prepared in Cooperation With
Kitsap County Department of Community Development
and State of Washington Department of Ecology

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GROUND-WATER AVAILABILITY ON THE KITSAP PENINSULA, WASHINGTON

By A. J. Hansen, Jr., and E. L. Bolke

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Tacoma, Washington
1980

UNITED STATES DEPARTMENT OF THE INTERIOR
CECIL D. ANDRUS, SECRETARY

GEOLOGICAL SURVEY
H. William Menard, Director

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CONTENTS

ILLUSTRATIONS

TABLES

METRIC CONVERSION FACTORS

Multiply	By	To obtain
inches (in.)---------------	25.4	millimeters (mm)
	2.54	centimeters (cm)
	0.0254	meters (m)
feet (ft)------------------	.3048	meters (m)
miles (mi)-----------------	1.609	kilometers (km)
square miles (mi^2)----------	2.590	square kilometers (Km^2)
acres----------------------	4047.	square meters (m^2)
gallons per minute (gal/min)	0.06309	liters per second (L/s)
million gallons per day (Mgal/d)	3785.0	cubic meters per day (m^3/d)
feet squared per day--------- (ft^2/d)	.0929	meters squared per day (m^2/d)
degrees Fahrenheit (°F)	0.555, after subtracting 32	degrees Celsius (°C)

The term "mean sea level" used in this report refers to the National Geodetic Vertical Datum of 1929 (NGVD).

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ABSTRACT

Unconsolidated deposits on the Kitsap peninsula are of glacial and interglacial origin. These deposits were divided into three units on the basis of their lithology and hydraulic properties. Two of the three units are composed of layers of sand and gravel alternating with layers of silt and clay. The third unit consists of silt and clay and in most places separates the other two units. The thickness of the upper unit ranges from 200 to 600 feet and the middle unit from 10 to 260 feet. The thickness of the lower unit is believed to range from 2,000 to 3,000 feet.

The water-bearing strata in the upper unit are fairly continuous and average 15 feet in thickness. The lower water-bearing strata probably are not as continuous as those in the upper unit, but they yield larger quantities of water to wells. The silt-and-clay unit averages 70 feet in thickness, occurs generally near sea level, and is not known to contain any major water-bearing deposits.

The average annual ground-water recharge to streams on the Kitsap peninsula was estimated to be 17 times the 1975 annual ground-water pumpage for the peninsula. Some, but an unknown amount, of this water is available for increased withdrawal by wells. Increased withdrawals cause decreased streamflow, declining water levels, and increased seawater contamination.

There appears to be no widespread seawater contamination of wells in the study area. Local areas where chloride concentrations in well water exceed 25 milligrams per liter are the southern part of the Longbranch peninsula, Horsehead Bay, Point Evans, Sinclair Inlet, Eagle Harbor, Fletcher Bay, the north end of Bainbridge Island, and the north tip of the Kitsap peninsula.

INTRODUCTION

Purpose and Scope

The purpose of this report is to summarize the availability of ground water on the Kitsap peninsula as an aid in planning for development and conservation of the resource. The report contains hydrologic information that should be useful in further quantitative evaluation of the resource areally and on a site-specific basis.

This report includes a compilation of well data and a discussion of the distribution and hydraulic characteristics of the water-bearing deposits in certain parts of the peninsula. It also includes a discussion of the potential for seawater intrusion in areas of increasing ground-water withdrawals.

Principally, the study involved interpretation of well logs, well yields, and drawdown data (table 1). Data collected through test-hole augering and drilling were included in the interpretation.

The study was funded cooperatively by U.S. Geological Survey, the Kitsap County Department of Community Development, and the State of Washington Department of Ecology.

Description of the Study Area

The Kitsap peninsula is in the Puget Sound lowland of Washington, bounded by Puget Sound on the east and Hood Canal on the west (fig. 1). The peninsula is joined to the Olympic Peninsula by an isthmus between the heads of Hood Canal and Case Inlet. A bridge connects the Kitsap peninsula with the mainland between the Gig Harbor area and Tacoma. Bainbridge Island is included in the study area. Ferries cross Puget Sound between several points on the peninsula and Seattle. The study area includes all of Kitsap County and parts of Mason and Pierce Counties. The larger population centers are shown in figure 1. Population of the study area in 1975 was about 123,000 and, based on estimates by the Planning Department of Kitsap and Pierce Counties, is expected to increase to 168,000 by 1985 and 187,000 by 1995. Ground water is the principal source of supply for the population centers.

The Kitsap peninsula has an area of about 590 mi^2, and no point is more than 6 mi from seawater. Altitude of the land surface is less than 650 ft above the National Geodetic Vertical Datum of 1929, except in the Gold Mountain upland where the altitude reaches 1,750 ft.

Unconsolidated deposits of sand, gravel, silt, and clay, mostly of glacial or glaciofluvial origin, underlie most of the study area. Bedrock, composed of older volcanic and sedimentary rocks, crops out principally in the Gold Mountain upland.

The area has a temperate marine climate, with cool, dry summers and warm, wet winters. The mean annual temperature is 51°F, and mean annual precipitation is 50 in. Precipitation, which decreases northward, largely reflects the rain-shadow effect of the Olympic Mountains to the west.

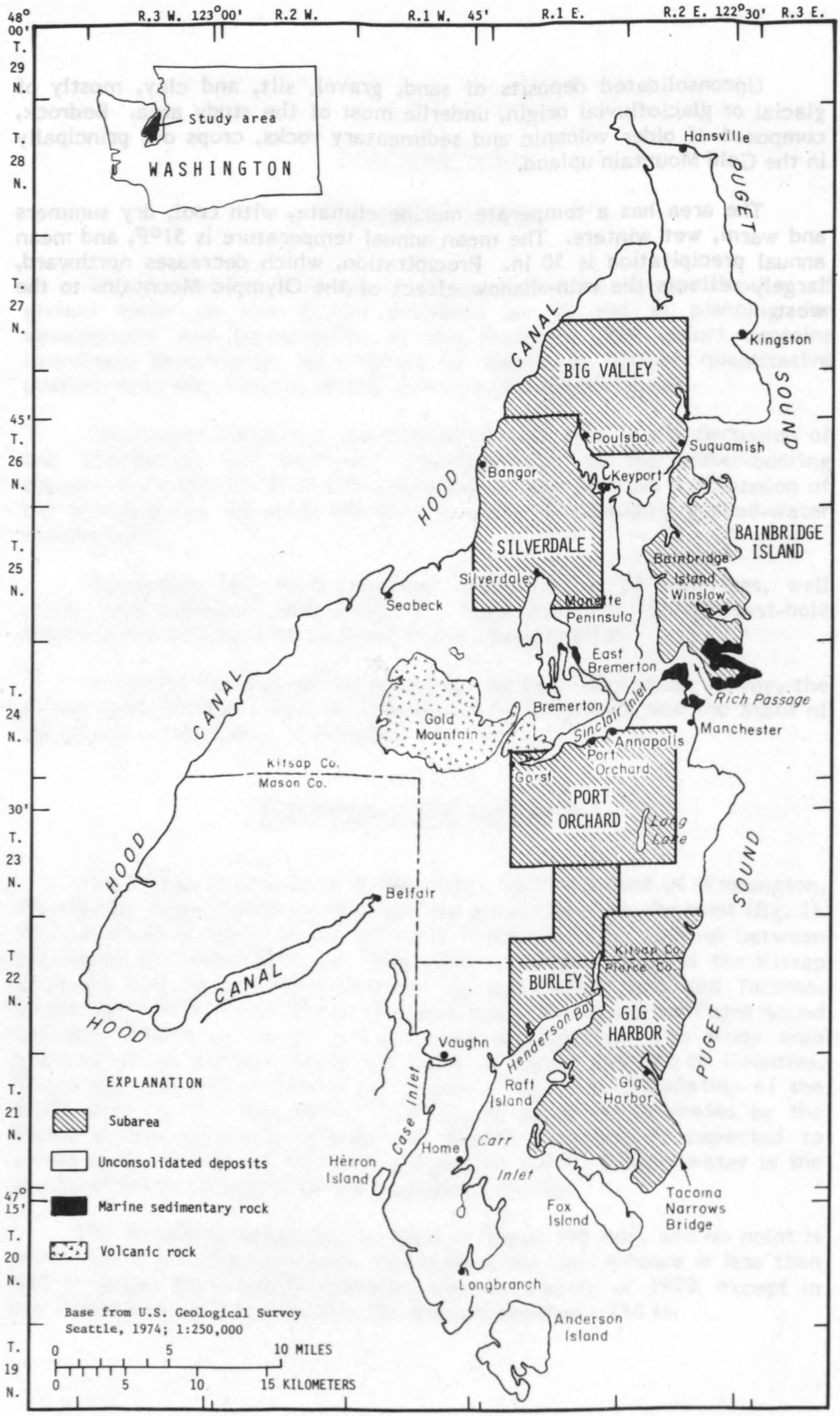
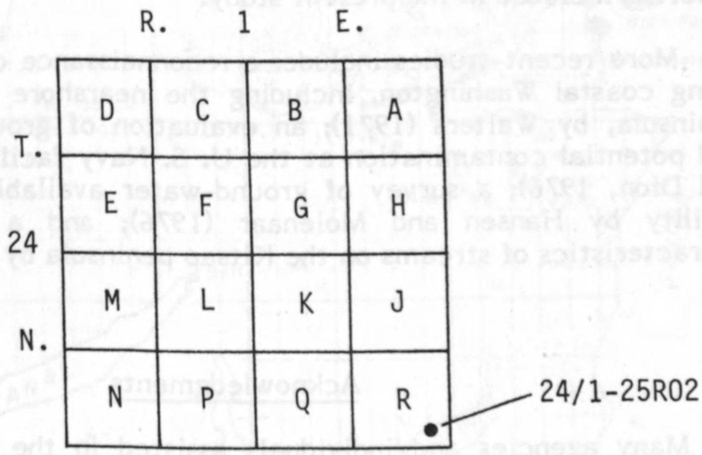


FIGURE 1.--Location of study area and subareas, with generalized geology.

Well-Numbering System

Wells in Washington are assigned numbers that identify their location within a township, range, and section. Well number 24/1E-25RO2 indicates, successively, the township (T.24N) and range (R.1E) north and east of the Willamette base line and meridian; the letter indicating north is omitted because all wells in Washington are north of the Willamette base line. The number following the hyphen indicates the section (25) within the township, and the letter following the section gives the 40-acre subdivision of the section, as shown below. The two-digit number following the letter is the sequence number of the well within the 40-acre subdivision.



SECTION 25

Test Drilling

As an aid in determining the lithologic character of the shallow, unconsolidated deposits commonly tapped by wells on the Kitsap peninsula, test-hole drilling and augering were done by the U.S. Geological Survey at 15 sites in the northern and central parts of the peninsula (fig. 2). An unsuccessful attempt was made to use electrical resistivity data to define shallow water-bearing zones on the peninsula.

The data from the test holes shown in figure 2 were used in conjunction with well logs to determine the thickness and extent of shallow water-bearing and non-water-bearing strata. Data for test wells are given in table 1.

Previous Studies

The geology and ground-water resources of Kitsap County were described by Sceva (1957). The next report, which included the entire peninsula, dealt with both surface- and ground-water resources (Garling, Molenaar, and others, 1965). Much of the information from the latter report is included in the present study.

More recent studies include: a reconnaissance of seawater intrusion along coastal Washington, including the nearshore parts of the Kitsap peninsula, by Walters (1971); an evaluation of ground-water conditions and potential contamination at the U. S. Navy facility at Bangor (Tracy and Dion, 1976); a survey of ground-water availability near that same facility by Hansen and Molenaar (1976); and a study of low-flow characteristics of streams on the Kitsap peninsula by Cummans (1977).

Acknowledgments

Many agencies and individuals assisted in the data collection and field investigation. The Kitsap County Planning Department was helpful in coordinating contacts with other groups. Significant logistical assistance was provided by the Kitsap County Department of Public Works, the Poulsbo Public Works Department, and the Silverdale Water Department. Thanks are due the members of the Kitsap County Public Utility District No. 1 and other water companies, individuals, and corporations for granting access to their wells and lands during the fieldwork.

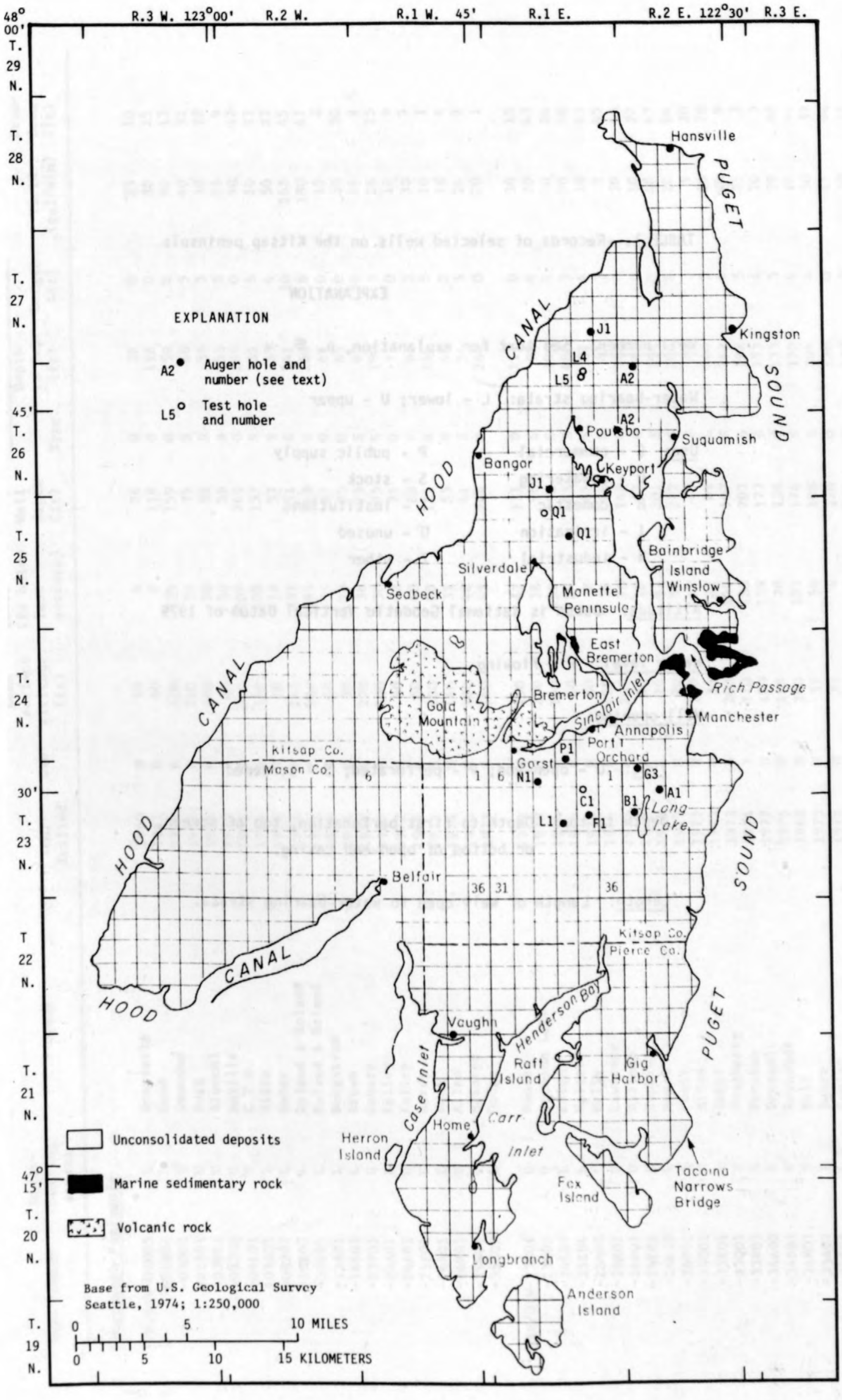


FIGURE 2.--Location of test holes.

TABLE 1.--Records of selected wells on the Kitsap peninsula

EXPLANATION

Well number: See text for explanation, p. 5

Water-bearing strata: L - lower; U - upper

Use:

C - commercial	P - public supply
D - dewatering	S - stock
H - domestic	T - institution
I - irrigation	U - unused
N - industrial	Z - other

Altitude: Datum is National Geodetic Vertical Datum of 1929

Water level: F - flowing

Well opening:

Type: O - open-end; P - perforated; S - screened

Depth to top: Depth to first perforation, top of screen, or bottom of open-end casing.

Length: Length of well open to water-bearing strata.

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Longbranch Peninsula												
20N/01W-01D05	L	Entwistle	1960	H	10	4	26	O	26	0	25	10
-01H01	L	Sund	1961	H	60	F	118	O	118	0	20	25
-01Q01	U	Sammons	1974	H	320	139	159	O	159	0	90	13
-02L01	U	Rugg	1962	H	200	23	71	S	66	5	40	32
-03H01	U	Bloechl	1975	H	180	22	58	S	55	3	10	18
-03J01	U	Antilla	1975	H	80	30	58	S	53	5	15	9
-04L01	U	C.Y.O.	1972	H	300	207	269	O	269	0	50	12
-05A01	L	Bille	1974	H	110	105	137	S	132	5	10	17
-08J01	L	Reher	1973	H	20	12	57	S	53	4	50	27
-10E01	L	Roland & Roland	1973	P	245	237	351	S	341	10	265	45
-10F01	L	Roland & Roland	1971	P	200	195	269	S	260	9	180	41
-15A01	L	Bergstrom	1973	H	60	55	67	O	67	0	15	4
-16B01	L	Brown	1974	H	30	20	85	O	85	0	30	50
-23P01	U	Coburn	1968	I	200	38	75	S	65	10	36	2.5
-24A01	L	Kelley	1967	H	100	50	195	S	190	5	26	25
-24A02	U	Kelley	1972	H	80	52	71	O	71	0	18	9
-25F01	U	Hardy	1965	H	60	40	68	S	63	5	30	7
-26A01	L	Kent	1972	H	100	88	121	S	116	5	10	1
-26R01	U	Allen	1974	H	160	31	53	S	48	5	16	6
-35B01	U	Bainter	1974	H	180	40	61	S	56	5	24	1
-35C02	L	Dodge	1973	H	160	42	264	O	264	0	20	1
21N/01W-23C01	U	Ramsey	1972	H	150	67	111	O	111	0	30	15
-23N02	U	Jackson Lake	1973	H	200	38	96	S	92	4	20	43
-24E01	L	Knight	1974	H	160	152	198	S	194	4	20	24
-25E04	L	Walters	1974	H	40	24	485	S	480	5	30	40
-25M05	L	Kelly	1973	H	80	F	85	S	81	4	10	63
-26A01	U	Lawrence	1974	H	125	36	86	S	81	5	5	45
-26D01	U	Hillman	1973	H	200	76	148	O	148	0	30	45
-26K02	U	Hopkins	1972	H	80	28	67	O	67	0	10	27
-26K03	L	Moval	1974	I	76	47	301	S	294	7	40	47
-26P01	L	Poole	1977	H	70	57	212	S	206	6	20	24
-26Q01	U	Allen	1975	H	120	18	49	S	46	3	5	20
-33E01	L	Imhof	1973	H	35	27	69	S	64	5	20	20
-33Q01	U	Dougherty	1973	H	200	140	167	S	163	4	20	9
-33R01	U	Henshaw	1974	I	210	183	203	S	198	5	15	7
-34A02	U	Dressel	1977	H	180	158	177	S	173	4	20	3
-34B01	U	Reynolds	1975	H	198	70	138	S	133	5	20	48
-34M01	U	Hill	1968	H	280	155	174	S	170	4	10	--
-35A02	L	Buhre	1975	H	55	50	108	S	104	4	30	37
-35C01	L	Kepler	1975	H	35	4	120	O	120	0	15	98
-35F02	L	Hill	1974	H	50	5	125	S	120	5	30	15
-35N02	U	King	1974	H	100	53	79	S	74	5	20	7

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Gig Harbor												
21N/01E-01R01	U	Beckstead	1961	I	290	157	192	O	192	0	20	12
-02B01	L	Gillmen	1973	I	100	F	98	S	94	4	60	17
-02B02	U	Howe	1975	H	140	14	56	S	53	3	35	18
-02D02	L	Walburn	1976	H	60	41	123	S	120	3	40	66
-02F01	L	Rodney	1962	H	105	68	285	O	285	0	40	40
-02K01	U	Washburn	1975	H	200	104	145	S	142	3	20	20
-03402	L	Reed	1975	H	65	54	139	S	135	4	15	65
-03F02	L	Harrison	1976	H	75	72	149	S	144	5	40	41
-10D01	L	Parish	1976	P	155	154	268	S	259	9	122	57
-11G01	U	Hash	1973	H	130	17	50	O	50	0	18	11
-11N01	L	Schuldt	1975	H	160	148	270	S	267	3	10	71
-11R01	U	Rosemount	1974	P	220	128	200	S	181	19	159	40
-12G02	U	Prince	1973	H	260	115	167	S	162	5	22	--
-12H01	U	Uddenberg	1965	P	270	125	192	S	183	9	80	5
-12P01	U	Terry	1975	H	205	67	134	S	129	5	25	25
-12R01	U	Packard	1956	H	160	34	60	P	54	6	20	34
-13B01	U	Scott	1966	H	195	72	157	O	157	0	20	26
-13K01	U	Farmer	1975	H	250	198	221	S	217	4	7	9.5
-13R02	U	Nelson	1961	H	70	16	65	O	65	0	15	24
-14F03	U	Soran	1978	P	240	180	205	S	200	5	25	3.5
-14K01	U	Nebeker	1977	H	110	67	90	O	90	0	13	6
-14L01	U	Whitlock	1973	H	220	175	194	S	193	1	5	10
-14R01	U	Estep	1975	H	130	92	116	S	111	5	12	10
-16B01	L	Olsen	1975	H	60	52	142	S	138	4	30	7
-21K03	L	Davis	1964	H	30	19	82	S	78	4	38	41
-22B01	U	Henderson	1977	H	240	178	215	S	210	5	89	33
-22E02	U	Best	1974	H	150	135	160	O	160	0	15	5
-22R01	U	Eckler	1978	H	130	105	129	O	129	0	15	6
-23L01	U	Farrington	1975	H	245	203	243	S	238	5	60	11
-24H04	U	Schimtz	1977	H	40	14	38	S	35	3	15	4
-24J02	U	Basnaw	1977	H	50	33	59	S	54	5	20	8
-24P01	L	Block	1965	P	205	194	260	S	240	20	500	39
-25B01	U	Freed	1977	H	190	64	114	S	109	5	15	29
-25K01	U	Harbor Water	1972	P	190	164	195	S	185	10	25	4
-25M01	L	Young	1965	H	30	F	74	O	74	0	30	20
-25R01	U	Knuth	1974	H	270	252	273	O	273	0	15	--
-25R02	L	Mullen	1979	H	210	200	235	S	230	5	20	5
-26F02	U	Tyler & McFarland	1976	H	40	0	46	S	33	13	30	21
-27A03	L	Garland	1974	H	20	4	65	O	65	0	16	20
-28C02	U	Lothrop	1976	H	60	46	69	O	69	0	20	5
-28D04	U	Burkhart	1977	H	105	90	111	O	111	0	10	--

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Gig Harbor--Continued												
21N/02E-06A01	U	Hemley	1976	P	175	48	107	S	97	10	40	40
-06B03	U	Feather	1976	H	120	F	61	S	57	4	20	46
-06B04	L	Wilcox	1978	H	100	4	122	S	117	5	20	44
-06C01	U	Johnson Water	1975	P	195	87	111	S	107	4	100	9.1
-07B01	U	St. John's	1959	T	260	147	219	S	214	5	20	21
-07F01	U	Manly	1968	H	275	136	176	O	176	0	20	3
-07L01	U	Harbor Water	1970	P	250	118	159	S	154	5	40	9
-07P01	U	Wright	1974	H	214	99	139	S	134	5	20	12
-08A02	L	Robinette	1959	H	40	33	117	S	112	5	45	10
-17D02	U	Shaw	1967	P	300	250	292	S	282	10	27	--
-17F01	U	Harbor Water	1971	P	310	259	319	S	312	7	20	--
-17F02	L	Gig Harbor	1978	P	341	320	901	S	749	75	708	28
-18D02	U	Bosnick	1973	H	250	125	180	S	175	5	40	20
-18N01	U	Buck	1964	P	90	65	106	S	101	5	107	36
-18Q01	U	Koenig	1974	H	100	69	107	S	104	3	15	14
-19H01	U	Saffeels	1977	H	155	111	142	S	137	5	30	6
-19K01	U	Reierson	1977	H	245	203	233	S	230	3	20	3
-20B01	L	Swinney	1974	C	245	220	356	S	343	13	205	97
-20F01	L	Edwards	1977	P	230	209	388	S	383	5	60	18
-20K01	U	Fairway Land	1978	P	220	199	292	S	282	10	255	59
-20N01	U	Krusel	1979	H	220	178	205	S	202	3	51	2
-21E01	U	Washington State	1975	H	275	248	287	O	287	0	15	32
-21G01	L	Islam	1977	H	195	192	257	S	247	10	50	18
-21N02	U	Fagerness	1978	H	315	155	247	S	240	7	30	5
-28B01	L	Glass	1967	U	250	241	371	S	363	8	20	--
-28B02	L	Cottlesmore	1970	T	255	241	375	S	365	10	60	10
-28B03	L	Peacock	1978	P	290	280	392	S	382	10	310	14
-28C01	U	Litzenberger	1977	H	320	279	324	S	316	8	20	4
-28F06	U	Quinsey	1978	H	230	177	208	S	205	3	30	2
-28K02	L	Aqua Vista	1966	P	240	230	358	S	343	15	83	18
-28P01	U	Weathers	1973	P	195	155	166	P	159	7	20	10
-29C02	U	Hernandez	1979	H	105	36	78	S	73	5	18	18
-29K01	U	Brig O'Dune	1977	C	170	86	118	S	114	4	8	12
-29L02	U	Hopper	1977	H	160	99	120	S	114	6	20	5
-29M02	U	Stratton	1973	H	50	29	102	S	97	5	20	34
-30E02	U	Fields	1977	H	135	37	71	S	67	4	15	16
-30L03	L	Strode	1979	H	120	115	325	S	320	5	5	187
-30P04	U	Unger	1978	H	130	120	143	S	139	4	15	5
-30P05	L	O'Connor	1978	H	180	148	216	S	212	4	15	25
-30R01	U	Gayton	1975	H	60	58	76	S	71	5	8	12
-31A02	U	Hageness	1972	P	82	70	105	S	95	10	50	9.5
-31Q01	U	Wisenburg	1977	H	105	33	80	S	75	5	15	12
-32D01	U	Hansen	1975	H	160	45	75	S	70	5	12	14
-32E04	U	Reynolds	1973	H	130	67	102	S	98	4	20	18
-32F01	U	Mowich	1974	H	190	83	120	S	117	3	15	15
-32F04	U	Alvins	1976	H	190	134	155	P	152	3	10	8
-32M03	U	Rhodes	1978	H	160	70	100	S	95	5	25	14

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening			Yield (gal/min)	Draw-down (ft)
								Type	Depth to top (ft)	Length (ft)		
Gig Harbor--Continued												
22N/01E-13B01	U	McCullough	1978	H	100	5	75	O	75	0	20	45
-13C01	U	Haywood	1965	P	80	40	92	S	87	5	30	15
-13D03	U	Hanson	1979	H	40	20	35	P	25	10	30	13
-13E01	L	Buck & Haywood	1968	P	30	8	109	S	105	4	100	42
-13F02	U	Bennett	1977	P	80	47	60	S	57	3	15	6
-13N03	U	Maleskey	1975	H	25	6	40	O	40	0	20	24
-24A01	U	Kooley	1976	P	300	181	316	S	301	15	220	29
-24D02	L	Peterson	1975	H	10	F	76	O	76	0	--	--
-24K01	U	Clawson	1978	H	140	40	101	S	96	5	10	34
-24L01	L	Paglia	1963	H	20	F	154	O	154	0	60	--
-24P01	U	Hillard	1974	H	60	46	101	S	97	4	10	30
-24P02	L	Wilson	1978	H	20	F	160	S	155	5	15	20
-24Q02	U	Elmore	1977	P	150	30	149	S	140	9	312	64
-24R01	U	McLees	1978	H	220	113	159	S	154	5	15	13
-25F01	U	Quistorff	1959	P	30	F	60	S	53	7	60	28
-26Q01	U	McDaniel	1975	H	45	41	67	O	67	0	12	9
-34Q05	U	Clarke	1973	H	80	40	118	S	113	5	30	29
-34R03	U	McGirk	1971	H	100	--	135	S	132	3	15	36
-35A01	L	Bostian	1957	H	70	40	135	O	135	0	10	20
-35C01	U	Reading	1976	H	70	37	114	S	111	3	40	36
-35G03	U	Wainwright	1979	H	190	133	161	S	157	4	20	10
-35J03	U	S. & I. Development	1976	P	155	74	151	S	141	10	50	13
-35M02	L	Benson	1978	H	120	90	225	S	220	5	15	30
-35N02	U	Ritchie	1976	H	77	62	126	S	121	5	30	31
-35N03	L	Kauppila	1977	H	90	84	257	S	252	5	30	50
-35P01	U	Young	1972	H	130	71	116	S	112	4	6	35
-35Q01	U	Sehmel	1974	I	105	28	136	S	126	10	30	4
-36E01	U	Lewis	1977	H	240	132	163	S	158	5	20	12
-36J01	U	Wirth	1979	H	310	238	297	S	292	5	25	2
-36R01	U	Washington State	1969	T	315	235	351	S	338	13	80	59
-36R02	L	Washington State	1977	T	330	262	501	S	484	17	50	85
22N/02E-03D05	L	U.S. Army	1955	U	384	369	390	S	381	9	15	12
-03N08	L	Bailey	1976	H	80	55	101	S	97	4	30	17
-04Q01	L	U.S. Army	1955	U	246	236	269	S	259	10	30	11
-05D04	L	Dibley	1976	H	180	151	175	S	171	4	20	6
-05H01	L	Stenseng & Berg	1973	H	70	17	92	S	87	5	18	15
-05K03	U	Spadoni	1977	H	300	127	145	O	145	0	20	--
-08C01	U	Spadoni	1977	P	320	67	142	S	131	11	80	24
-08E02	U	Pine Lake	1968	P	380	75	160	S	115	24	93	40
-08F02	U	Pine Lake	1968	P	340	75	145	S	118	27	45	--
-09E05	L	Vantilborg	1969	H	290	223	250	S	245	5	30	--
-09P03	L	Wierman	1976	H	260	244	426	S	421	5	16	156
-16C01	U	Mast	1977	H	265	137	163	S	158	5	10	5
-16F01	U	Van Ryn	1978	H	265	120	155	S	150	5	20	15
-16G02	U	Kopczick	1975	H	280	152	180	S	175	5	10	7
-16L02	L	Warren Construction	1977	P	315	272	316	O	316	0	20	20

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Gig Harbor--Continued												
22N/02E-16M01	L	Hale	1977	H	180	89	199	S	194	5	30	5
-16N02	U	Bisceglia	1978	H	275	95	131	S	126	5	7	30
-17J01	U	Fischer	1967	H	240	F	114	S	110	4	10	90
-17Q01	U	Vlaliovich	1979	H	210	F	79	S	76	3	5	68
-17R01	U	Johnson	1969	H	175	27	72	S	68	4	15	30
-18H01	U	Walsh	1977	H	380	162	249	S	239	10	60	50
-18N01	L	Murray	1978	H	305	195	274	S	269	5	20	25
-19C02	L	Burney	1978	P	330	195	314	S	304	10	60	15
-19F01	U	Purdy Hills	1978	P	310	123	162	S	155	7	40	--
-19H01	U	Bender	1978	H	300	118	146	S	142	4	15	--
-20C01	U	Brown	1978	H	320	64	106	S	101	5	30	9
-20M02	U	Kuhn	1972	H	305	115	150	O	150	0	20	2
-20N01	U	Evergreen Heights	1974	P	300	92	143	S	130	10	40	14
-20Q01	L	Spadoni	1970	N	165	15	128	S	123	5	45	20
-21B02	U	Holmas	1972	P	310	200	250	S	245	5	50	35
-27D01	L	Hogarth	1978	H	190	171	214	S	210	4	15	15
-28A01	U	Meads	1974	H	300	258	285	O	285	0	20	5
-29A02	U	Murphy	1978	H	230	120	160	S	155	5	8	20
-29B01	U	Loesche	1976	H	210	31	85	S	80	5	10	29
-29E01	L	Hemly	1975	P	265	121	303	S	297	6	30	34
-29G01	U	Nelson	1977	H	150	F	61	S	57	4	30	18
-29L01	U	Gadbow	1978	H	100	15	56	S	51	5	60	38
-29N02	U	Kooley	1978	P	310	117	161	S	147	14	83	6.5
-30A04	U	Kerr & Monde	1979	H	345	137	177	S	167	10	40	--
-30G01	L	Peacock Hill	1979	P	295	199	376	S	363	13	60	12
-31H01	U	Gropper	1970	P	275	135	197	S	187	10	150	44
-31J01	L	Harbor Water	1974	P	270	134	324	S	320	4	35	29
-31M01	L	Griffith	1978	H	210	145	266	S	261	5	20	10
-31R01	L	Scandia Gard	1960	C	250	145	275	O	275	0	30	10
-32B02	U	Patterson	1977	H	80	20	70	S	65	5	13	26
-32D01	U	Woodcrest	1976	P	295	125	164	S	156	8	40	4
-32K04	U	Richey	1976	H	100	14	106	O	106	0	20	58
Burley												
22N/01E-02C01	U	Crinean	1974	I	140	7	82	S	77	5	15	59
-02E01	U	Johnson	1975	I	180	F	138	S	133	5	20	75
-02G01	L	Turner	1972	H	120	20	199	O	199	0	45	36
-02H01	U	Hemley	1974	H	80	4	55	O	55	0	20	18
-02J04	U	McKeney	1974	I	40	F	33	S	28	5	50	7
-02J05	L	Weber	1975	H	40	3	131	S	128	3	60	17
-02L01	U	Smith	1973	I	200	108	194	S	189	5	5	62
-02P01	L	Anderson	1974	H	275	246	299	O	299	0	7.5	5
-02P02	U	Allen	1976	H	200	18	97	S	93	4	15	50

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening			Yield (gal/min)	Draw-down (ft)
								Type	Depth to top (ft)	Length (ft)		
Burley--Continued												
22N/01E-03R03	U	Hall	1952	I	240	30	108	--	--	--	70	50
-04Q03	U	Log Inc.	1970	H	245	F	94	S	71	23	237	53
-06D01	U	Nack	1974	H	320	123	163	S	159	4	15	16
-08G01	U	Kidd	1976	I	260	49	110	S	105	5	10	47
-08J02	U	Kaufman	1974	H	300	108	144	S	139	5	10	1
-08Q01	U	Foote & Jackson	1975	H	180	40	110	S	106	4	45	8
-08R01	U	Wright	1975	H	180	50	148	S	143	5	20	53
-09E03	U	Emmert	1975	H	300	90	140	S	135	5	21	10
-09F01	U	Nystrom	1974	H	260	78	121	S	117	4	15	25
-09G02	U	Leonard	1976	I	240	22	92	S	87	5	30	34
-10B02	U	Fredenburg	1967	H	280	45	129	S	124	5	22	35
-10C01	U	Pantzke	1968	H	300	75	166	S	161	5	30	40
-10K03	U	Ballard	1966	H	270	70	123	--	--	--	15	27
-10K04	U	Strittmatter	1973	P	280	60	162	S	157	5	16	30
-10P02	L	Horseshoe Lake	1965	P	300	112	328	S	323	5	40	17
-10Q02	U	Miracle Ranch	1973	P	270	59	188	S	184	4	60	57
-11D01	U	Squire	1975	H	260	53	123	O	123	0	20	13
-11G02	L	Hicks	1973	I	130	104	235	S	230	5	11	4
-11G03	L	Gilmore	1974	H	130	120	244	S	239	5	30	10
-12D02	L	Lakes	--	H	25	F	343	O	343	0	--	--
-14B01	L	Kilmer	1974	H	60	23	132	S	127	5	30	30
-14B03	L	Dillon	1976	H	90	28	127	O	127	0	30	6
-14C02	U	Olsen	1976	H	220	88	134	S	129	5	30	15
-14C03	U	Hartung	1973	H	220	60	130	S	126	4	15	54
-14E01	L	Harbor Water	1971	U	260	250	397	S	388	9	16	75
-14G01	U	Iles	1976	I	80	F	35	S	30	5	30	31
-14M01	U	Wauna Vista	1970	P	240	139	177	S	168	9	40	--
-15L01	L	Davis	1976	H	223	176	264	S	259	5	30	47
-15N01	U	Salantino	1975	H	260	149	198	S	193	5	25	12
-15Q01	L	Baty, Anderson, Roland	1969	P	220	165	260	S	251	9	115	67
-16E03	U	Walker	1969	P	120	F	63	O	63	0	25	2
-16M01	U	Cox	1978	H	115	2	68	S	63	5	40	12
-16N01	U	Brockman	1974	H	95	F	55	S	50	5	30	10
-17B01	U	McKenzie	1979	H	180	50	90	O	90	0	15	1
-17B02	U	Oslin	1979	P	180	44	109	S	104	5	45	--
-17C02	U	White	1973	H	200	64	118	O	118	0	18	4
-17D01	U	Willoughby	1978	H	250	94	137	S	132	5	40	2
-17F01	U	Dancel	1976	H	230	84	124	S	121	3	40	12
-20B02	U	Starkey	1977	H	170	50	80	O	80	0	20	--
-21B01	U	Hoover	1976	H	200	107	157	O	157	0	20	9
-21B02	U	Carnegie	1975	H	175	79	110	O	110	0	20	--
-21D02	U	Ranisman	1968	--	160	53	116	S	111	5	30	2

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Burley--Continued												
22N/01E-21F01	U	Noble	1975	H	140	30	60	S	55	5	45	6
-21G01	U	Cragun	1974	H	280	153	183	S	179	4	10	14
-21H01	U	Tietz	1977	H	290	177	205	S	202	3	15	--
-21K02	U	Harbor Water	1975	P	280	168	231	S	221	10	222	27
-21M02	U	Ramsey	1974	H	95	36	72	S	68	4	30	6
-21R01	L	Siebold	1975	H	240	235	258	O	258	0	25	--
-22L01	L	Wauna Shores	1974	P	285	202	296	S	288	8	50	17
-23C01	U	Wauna Vista	1973	P	225	110	140	S	130	10	35	--
-23M02	L	Robbin & Guthrie	1964	H	140	136	163	S	158	5	30	--
-28D02	L	Sehmel	1977	U	255	207	292	S	289	3	--	--
-28N02	L	Severeid	1978	H	130	127	142	O	142	0	10	1
-29E01	U	Wright	1964	H	230	156	188	O	188	0	14	2
-29E03	U	Pen West	1977	P	230	162	196	S	193	0	52	5.5
-29M01	U	Ruby	1976	H	210	135	178	S	173	5	35	10
-29M02	U	Peterson	1978	H	235	158	188	S	183	5	30	--
-29M03	U	Canales	1973	H	225	149	211	S	207	4	20	39
-29P01	L	Cumbie	1975	H	130	72	152	O	152	0	40	12
-29Q02	L	Wiksten	1977	I	120	63	138	S	133	5	60	27
-32A03	L	Finch	1975	H	50	47	80	O	80	0	15	13
-32H02	U	Clark & Owens	1979	P	110	97	194	S	189	5	36	5
-32P05	L	Zumhoff	1979	H	50	39	179	S	175	4	20	65
23N/01E-25J01	U	Harbor Water	1974	P	400	266	321	S	313	8	150	13
-26J01	U	Hughes	1974	H	170	46	100	S	95	5	10	41
-26P01	U	Burley Terrace	1977	H	280	120	156	S	145	11	310	10
-27E01	U	Keysar	1977	H	320	148	190	S	185	5	10	30
-34H01	U	Harbor Water	1970	P	380	154	192	S	178	14	195	--
-35G01	L	Woodland Ranch	1974	H	200	67	540	S	527	13	18	11
-35J01	L	Boyd	1975	H	140	32	182	O	182	0	24	6
-35Q01	L	Albert	1974	H	160	20	188	S	183	5	20	132
-35R01	L	Blackler	1973	H	120	30	236	S	231	5	30	26
Port Orchard												
23N/01E-02N03	U	Bousch	1959	--	200	64	100	O	100	0	20	22
-03J02	U	Cooper	1961	I	220	50	68	P	64	4	12	2
-03J03	U	Woodward	1966	P	200	77	124	S	119	5	25	7
-03L02	U	Johnson	1977	I	220	72	120	S	115	5	20	23
-03Q02	U	Brant	1976	H	200	65	90	S	85	5	10	13
-04H02	U	Spaeth	1973	H	380	105	207	S	202	5	20	34
-04H03	U	Nieman	1977	H	340	98	138	S	133	5	11	34
-04J03	U	Lombard	1975	H	340	98	203	S	198	5	20	77
-04N01	U	USGS	1976	U	390	--	117	--	--	--	--	--
-09H01	U	Farmer	1976	H	270	6	44	O	44	0	30	14

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening			Yield (gal/min)	Draw-down (ft)
								Type	Depth to top (ft)	Length (ft)		
Port Orchard--Continued												
23N/01E-10G01	U	Silvernale	1974	H	195	20	58	S	53	5	11	5
-10K02	L	C & O Enterprises	1974	H	200	101	208	O	208	0	20	5
-10R01	L	Hird	1974	H	200	87	175	O	175	0	20	30
-10R02	U	Maxwell	1975	H	200	32	90	O	90	0	8	15
-11B02	U	Kemp	1968	I	300	97	130	S	125	5	15	14
-11C01	U	USGS	1976	U	150	F	87	--	--	--	--	--
-11M03	U	Orser	1973	H	180	12	168	S	164	4	32	6
-11P01	U	Thomas	1974	H	200	37	77	S	72	5	15	26
-11Q02	U	Miller	1975	H	220	66	139	S	134	5	10	27
-11R04	U	Morgan	1971	H	295	94	149	S	139	10	44	--
-11R05	U	Matheson	1976	I	270	110	142	S	132	10	48	6
-13F05	U	Pherson	1977	H	330	84	125	O	125	0	8	30
-13L01	U	Jehovah's Wtns.	1976	H	330	47	196	S	193	3	5	129
-14A05	U	Sowa	1950	H	265	93	145	--	--	--	22	7
-14B03	U	Madden	1977	H	200	50	121	S	116	5	20	13
-14D02	U	Burnett	1974	H	200	31	92	S	87	5	20	44
-14F03	U	USGS	1976	U	180	--	90	--	--	--	--	--
-15J02	U	Crone	1968	I	300	121	137	S	133	4	11	5
-15J03	U	Lorenz	1977	P	340	82	175	S	170	5	24	6
-15L01	U	USGS	1976	U	320	--	115	--	--	--	--	--
-22R01	U	Cookson	1977	I	300	61	100	S	90	10	20	17
-23C01	U	Kegel	1975	H	200	95	130	S	125	5	20	12
-23C02	U	Hill	1975	H	200	F	58	S	53	5	1	34
-23D01	L	Adams	1976	H	195	F	430	O	430	0	40	--
-23J03	U	Geibel	1974	H	220	50	111	S	106	5	30	38
-23M01	U	Grilbert	1977	I	260	37	74	S	69	5	20	12
-23N01	U	Martin	1975	H	320	100	120	S	115	5	7	10
-24A02	L	Szymanski	1977	I	240	66	279	S	274	5	40	106
-24B01	U	Szymanski	1974	H	220	40	109	O	109	0	10	50
-24B02	U	Szymanski	1977	I	330	84	211	S	206	5	30	32
-24D02	U	Washington State	1974	H	200	64	167	S	163	4	28	50
23N/02E-04C02	U	Sellers	1974	H	190	121	150	S	145	5	6	20
-04E01	U	Kornman	1974	H	130	50	91	S	86	5	8	35
-04F01	L	Kelley	1974	H	100	30	193	S	188	5	10	74
-04Q01	U	Buen	1959	I	290	170	214	O	214	0	50	16
-05C01	U	Shaw	1973	H	220	26	123	S	119	4	10	77
-05J02	U	Thrall	1974	H	200	42	89	S	84	5	7	41
-05Q01	U	Holmes	1970	I	200	79	147	O	147	0	10	30
-06G01	U	Kriedler	1974	H	210	17	62	S	57	5	7	31
-06G02	U	Mana	1973	H	200	96	200	S	195	5	20	12
-06G03	U	USGS	1976	U	185	--	67	--	--	--	--	--
-06R01	U	Cook	1977	I	280	79	114	S	109	5	20	9
-07B02	U	Madsen	1974	H	200	95	133	O	133	0	10	1

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening			Yield (gal/min)	Draw-down (ft)
								Type	Depth to top (ft)	Length (ft)		
Port Orchard--Continued												
23N/02E-07G02	U	Dillon	1969	--	200	91	132	--	--	--	--	--
-07N02	U	Anderson	1974	I	300	53	131	S	126	5	32	7
-07N03	U	Lake Emelia	1976	P	280	66	156	S	134	22	60	30
-08A01	U	USGS	1976	U	120	--	52	--	--	--	--	--
-08B01	U	Mortenson	1974	H	150	15	101	S	96	5	10	78
-08B02	L	Redwood	1970	H	130	13	105	P	100	5	20	60
-08B03	U	Telvik	1973	H	130	16	42	S	37	5	5	18
-08K01	U	Cherry	1975	H	140	1	38	O	38	0	10	10
-09B01	U	Richardson	1968	P	300	106	168	S	158	10	100	40
-17E01	U	Riedel	1973	I	140	16	107	S	102	5	30	16
-17E02	U	Foreman	1970	I	140	21	128	S	123	5	30	6
-17M01	U	Bothell	1974	I	140	5	49	S	44	5	20	17
-17P01	U	Carnes	1968	H	280	28	105	O	105	0	15	28
-18A01	U	Hewitt	1977	H	140	15	52	S	47	5	9	37
-18A02	U	Feddock	1976	H	140	37	121	S	101	15	30	60
-18B02	U	Williams	1975	H	150	38	68	S	63	5	10	17
-18B03	U	USGS	1976	U	160	--	95	--	--	--	--	--
-18C02	U	Copperthite	1974	H	260	58	95	S	90	5	20	22
-18C03	U	Copperthite	1974	I	260	91	132	S	127	5	20	20
-18C04	U	Whitehead	1974	H	220	74	112	S	107	5	20	22
-18E01	U	Lesher	1975	H	340	86	133	S	123	10	65	30
-18E02	U	Lesher	1968	H	320	86	135	S	115	15	16	9
-18Q01	U	Kegan	1975	H	220	64	108	S	103	5	20	30
-20D02	U	Christianson	1974	H	140	14	57	O	57	0	7	21
-20G01	U	Robinson	1975	I	230	140	177	S	172	5	10	4
-20H01	U	Kasparek	1974	H	220	9	49	S	44	5	6	34
-20J02	U	Vaughan	1973	H	220	8	43	S	38	5	20	12
-20L01	U	North Western	1970	H	160	62	135	S	124	11	16	4
-20R02	U	Vaughan	1958	--	210	7	137	S	131	6	30	33
-21K02	U	Lund	1972	H	360	154	178	S	174	4	8	9
-21L02	U	Phillips	1973	H	370	130	154	S	149	5	10	14
24N/01E-20F02	U	Polish Assoc.	1976	H	180	14	98	S	88	10	77	59
-23B01	L	U.S. Navy	1895	U	20	F	748	--	--	--	--	--
-25A01	L	Kitsap County	1973	N	10	0	54	S	44	10	8	40
-25R02	L	Annapolish Water	1966	P	116	36	1,257	S	1,150	84	800	265
-29Q01	U	Fike	1975	H	130	4	124	P	27	6	8	100
-32E02	L	Domsea Farms	1974	N	40	16	135	S	95	40	197	42
-32E03	L	Domsea Farms	1975	N	45	23	148	S	108	40	304	45
-32E04	L	Domsea Farms	1976	N	45	12	128	S	88	40	300	56
-32E05	L	Domsea Farms	1976	N	55	15	136	S	96	40	310	84
-32E06	L	Domsea Farms	1976	N	55	11	128	S	88	40	305	55
-33J01	U	Bergner	1965	I	160	70	91	S	86	5	16	2

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening			Yield (gal/min)	Draw-down (ft)
								Type	Depth to top (ft)	Length (ft)		
Port Orchard--Continued												
24N/01E-33K04	L	Bremerton	1947	P	35	F	401	--	--	--	--	--
-33L01	L	Bremerton	1945	P	35	F	622	--	--	--	--	--
-34P01	U	USGS	1976	U	140	--	154	--	--	--	--	--
24N/02E-22M01	L	Manchester Water	1946	P	60	16	116	--	--	--	150	15
-28M01	U	Guthrie	1976	H	295	143	253	S	248	5	10	25
-28M02	U	Samuelson	1977	H	300	54	105	S	100	5	15	25
-28N01	U	Stevens	1970	P	290	33	100	S	90	10	40	22
-29A01	U	Best	1966	H	285	139	193	S	188	5	12	20
-29C01	U	Eady	1976	I	340	45	133	S	128	5	20	16
-29C02	U	Fewel	1976	H	340	71	143	S	138	5	15	33
-29P01	U	Gastfield	1968	H	280	100	263	P	257	6	10	52
-29Q01	L	Manchester Water	1974	P	220	57	250	S	191	31	270	106
-29R02	U	Ferguson	1977	I	280	52	87	S	82	5	20	18
-30N02	U	Wiley	--	I	220	55	145	S	140	5	100	15
-30N03	U	Wolf	1970	I	300	45	107	S	102	5	40	20
-31A01	L	Ryan Built Homes	1943	U	340	234	650	P	457	138	325	91
-31E01	U	Simpson	1970	H	330	162	196	S	191	5	15	14
-31G01	L	Village Greens	1976	I	375	285	686	S	666	20	300	164
-32D02	U	Kerkes	1957	P	270	116	146	O	146	0	15	3
-33B01	U	Grohn	1976	H	180	4	45	S	35	10	10	26
-33E01	U	Fuller	1975	H	220	10	57	S	52	5	10	29
-33P02	U	Brockerman	1974	H	240	89	112	S	107	5	5	11
Manette Peninsula												
24N/02E-07D02	L	North Perry	--	P	300	181	436	S	--	51	412	112
-07M01	L	North Perry	1955	P	105	64	277	S	227	50	307	88
25N/02E-19N02	L	North Perry	--	P	140	142	776	--	--	--	--	--
Bainbridge Island												
24N/02E-03C02	L	Bainbridge Island School	1965	T	270	185	282	S	271	11	37	49
-04A02	L	Lynwood Water	1968	C	50	19	125	O	125	0	5	66
25N/02E-02E01	U	Severt	1960	H	120	35	45	P	40	5	1	12
-03K01	U	Krutch	1978	H	250	142	167	S	162	5	15	4
-03L01	U	Okerman	1972	H	160	106	114	O	114	0	21	--
-04C01	L	Komedall	1978	H	125	115	183	S	178	5	7	28
-04D01	U	Conrad	1973	H	120	25	93	S	89	4	8	40
-04D02	U	Needham	1955	I	120	7	45	O	45	0	22	4.5
-04D03	U	Silver	1978	H	110	--	66	S	61	5	8	2
-04D04	L	Yocum	1978	H	100	25	123	S	118	5	7	51

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Bainbridge Island--Continued												
25N/02E-04D05	U	Webb	1978	H	100	23	70	S	65	5	15	32
-04E01	L	Seabold Heights	1975	H	120	22	123	S	113	10	6	84
-04F01	L	Orr	1979	H	85	78	292	S	281	11	30	30
-04J01	U	Filler	1979	H	140	53	73	S	68	5	30	15
-04M01	L	Stanek	1977	H	80	40	163	S	153	10	17	70
-04M02	L	Paulson	1979	H	70	22	102	S	98	4	2	73
-04P01	U	Dimit	1972	H	60	14	51	S	46	5	5	16
-04P02	U	Griffin	1978	H	50	30	50	S	44	6	5	15
-05H01	L	Berg	1950	H	57	50	87	O	87	0	10	--
-05J01	L	Myers	1979	H	60	54	113	S	108	5	9	46
-08F01	L	Seeberger	1978	H	50	42	200	S	190	10	15	12
-08Q01	U	Babcock	1964	H	140	83	121	P	86	35	9	4
-08Q02	L	Taylor	1978	H	140	73	348	S	340	8	9	252
-08Q03	L	Bennett	1978	H	50	--	400	O	400	0	--	--
-09B01	U	Gunther	1977	H	50	39	52	S	46	6	3	10
-09B02	U	Burke	1979	H	40	16	58	S	54	4	6	37
-09E02	U	Olympic Terrace	1968	H	120	99	116	S	110	6	7	2
-09G01	U	Puget Waters	1964	P	60	31	43	O	43	0	30	9
-09H01	U	Rolling Bay	1969	P	60	3	38	S	28	10	43	20
-09K01	U	Rodal	1979	P	105	22	118	S	103	15	100	25
-09P01	U	Tabafundo	1979	H	140	11	38	S	33	5	18	4
-09P02	U	Garcia	1979	H	100	18	30	S	25	5	13	3
-10C01	U	Angell	1975	H	200	109	123	S	118	5	16	--
-10K01	L	Whitney	1976	H	110	100	302	S	297	5	7	147
-11E01	U	Aquino	1974	H	280	47	60	S	55	5	12	5
-14D01	U	Ninemire	1974	H	200	18	77	S	72	5	12	35
-16A01	U	Meadowmeer	1969	P	240	112	143	S	133	10	60	1.5
-16D01	U	Herrick	1978	H	160	89	98	O	98	0	6	2
-16Q01	U	Hedderly-Smith	1979	H	300	207	236	S	232	4	12	18
-17C01	L	U.S. Navy	--	H	140	100	910	--	--	--	30	45
-17E01	U	Cragerud	1978	H	70	62	85	S	--	--	20	1.5
-17E02	L	Brown	1979	U	100	90	148	S	143	5	20	30
-17E03	L	King	1979	H	125	118	158	S	148	10	9	28
-17K01	U	Orr	1977	H	100	26	47	S	37	10	30	9
-17P01	U	Salo	1979	H	90	49	73	S	68	5	20	10
-17Q02	U	Philips	1976	H	100	19	60	O	60	0	30	16
-17Q03	U	Gagner	1978	H	90	39	55	S	53	2	8	5
-20B02	L	Phillips	1979	H	40	23	42	S	39	3	5	11
-20F03	U	Barnett	1978	--	80	63	85	S	70	15	85	--
-20K02	U	Smitty	1979	H	90	66	80	S	76	4	12	8
-20L05	U	Quinn	1979	H	80	60	74	S	70	4	15	5
-20P01	L	Greenle	1978	H	130	126	151	O	151	0	5.5	6
-20P02	L	Evelan	1979	H	130	126	138	S	134	4	12	--

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Port Orchard--Continued												
25N/02E-21C01	L	Kitsap County PUD	1974	P	210	198	398	S	383	15	100	77
-21D01	U	Backland	1979	H	70	38	82	S	79	3	4	33
-21D02	U	Stehle	1979	H	70	30	70	S	68	2	8	30
-21E01	U	Knox	1976	H	40	32	53	S	47	6	12	8
-21F02	U	Van Nortwick	1979	H	140	30	49	S	45	4	20	5
-21G01	U	Moldstad	1972	I	240	151	168	O	168	0	14	--
-21G02	U	Owens	1972	H	240	52	92	S	87	5	12	25
-21K01	L	Allen	1974	H	200	--	193	S	188	5	10	27
-21P01	L	Madayag	1977	H	70	3.4	56	S	52	4	4	38
-21Q02	U	Equashier	1976	H	200	97	138	S	133	5	7	25
-22C01	U	Hoffman	1978	P	120	43	124	S	116	8	8	50
-22N01	U	Swanson	1978	H	160	30	82	S	72	10	8	38
-22N02	U	Kuntz	1978	H	160	48	74	S	64	10	9	12
-22P01	U	Putnam	1975	H	180	91	118	S	113	5	10	13
-22P02	U	Hewitt	1978	H	180	65	91	S	86	5	14	12
-22P03	U	West Sound	1979	H	180	67	127	S	123	4	15	40
-25F02	L	Madrona Water	1974	P	130	95	158	S	134	10	12	30
-27E01	L	Winslow	1966	P	20	3	53	S	48	5	15	22
-27E02	L	Winslow	1966	P	20	5	40	P	30	10	44	22
-27E03	L	Winslow	1967	P	53	F	138	S	123	15	400	20
-27E04	L	Winslow	1971	P	40	F	130	S	120	10	215	72
-27E05	L	Winslow	1974	P	60	F	158	S	142	16	100	40
-28A01	U	Venneman	1973	I	150	36	80	S	61	10	11	4
-28F02	U	Nettleson	1977	H	200	125	154	S	149	5	8	11
-29C01	U	Junas	1967	H	180	134	143	P	138	5	15	--
-34E02	L	Clementz	1972	H	130	127	182	S	177	5	6	28
-34R01	U	U.S. Army	1954	U	291	151	185	S	180	5	5	2
26N/02E-28A01	U	Bomar	1978	H	60	40	70	S	66	4	7	20
-28G01	L	Schadel	1978	H	100	85	188	S	144	28	8	12
-28K01	U	Hogg	1977	H	130	12	36	S	30	6	4	10
-28L02	L	Grant	1978	P	140	126	174	S	168	6	4	30
-28Q01	L	Stice	1979	H	225	215	294	S	289	5	15	69
-33B01	L	Kidder	1979	H	210	201	303	S	299	4	16	14
-33C01	L	Meyer	1978	H	240	230	336	S	332	4	3.5	70
-33D01	U	James	1978	H	120	27	72	S	67	5	7	42
-33D02	U	Hall	1979	H	120	48	108	S	103	5	15	30
-33E01	L	Jellette	1977	--	130	80	142	S	137	5	4	38
-33F01	U	Smith	1979	H	180	38	90	S	86	4	23	33
-33L02	L	Callahan	1979	H	170	140	173	S	168	5	15	9
-33P02	L	Ness	1979	H	160	139	162	S	159	3	5	18
-34C01	L	Tollifson	1977	H	60	50	167	O	167	0	4	10
-35M01	U	Draughen	1975	H	80	61	74	S	70	4	25	10
-35N01	U	Rosenbaum	1978	H	130	30	70	S	63	7	24	20

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Silverdale												
25N/01W-01A02	U	Ilich	1973	H	240	6	70	S	65	5	10	55
-01A03	U	Blatt	1979	H	210	30	71	S	66	5	8	20
-01R01	L	Frazier	1979	H	200	--	317	O	317	0	20	120
-12A01	U	Carlson	1974	H	200	--	98	S	93	5	12	6
-12P01	L	Costleigh	1976	I	100	14	169	S	164	5	40	12
-13C01	U	Matheson	1974	P	200	142	181	S	175	6	30	19
-13C02	U	Thornberg	1974	H	200	--	186	S	181	5	7	3
-13D02	L	Reames	1977	I	60	36	164	S	159	5	30	10
-13G01	U	Lathrop	1972	H	330	261	310	O	310	0	20	26
-13J01	U	Lane	1979	H	420	122	134	S	128	6	10	2
-13J02	U	Ronkar	1979	H	420	86	100	S	98	2	4	8
-24B01	U	Trulock	1979	H	370	272	294	O	294	--	10	13
-24J01	U	Smith	1979	H	350	104	131	S	118	10	5	115
-24Q01	U	Johnson	1977	I	370	104	144	S	134	10	20	18
-25B02	U	Asbury	1976	H	350	65	100	S	95	5	7	29
-25C03	U	Wilson	1974	H	380	26	76	S	71	5	15	36
25N/01E-01C02	U	Coons	1974	H	160	14	38	S	33	5	20	6
-02F03	U	Michaels	1978	H	320	55	123	S	120	3	10	65
-02F04	L	Armstrong & Kamp	1979	U	320	--	470	--	--	--	--	--
-02G01	U	Mangiola	1979	H	330	49	79	S	74	5	15	5
-02J01	U	Evans	1974	H	160	67	89	S	84	5	6	12
-02Q01	U	Richards	1975	H	320	33	55	S	50	5	7	10
-02R01	U	Oliva	1974	H	200	30	94	S	89	5	14	4
-03C02	U	MacFarlane	1975	H	360	150	298	S	293	5	15	14
-03C03	U	Watson	1979	H	340	163	268	S	263	5	15	7
-03D01	U	Stafford Hansell	1974	P	380	146	192	S	176	15	143	22
-03D03	U	Stafford Hansell	1973	P	380	148	185	S	170	15	170	18
-03D05	U	Stafford Hansell	1977	P	380	151	324	S	285	34	887	51
-03F01	U	Ritter	1974	H	350	135	190	S	185	5	8	20
-03G01	U	Ford	1978	H	240	25	85	S	75	10	4	52
-03H05	U	Drengson	1977	H	320	47	85	S	75	10	5	32
-03R01	U	Island Lake W.	1970	P	340	130	238	S	228	10	70	90
-04C01	L	Barrick	1978	H	180	155	289	S	284	5	15	--
-04D01	U	Brown	1978	H	250	77	135	S	130	5	15	17
-04D02	U	Graham	1978	H	240	16	58	S	53	5	30	24
-04Q01	L	USGS	1976	U	190	143	325	S	320	5	--	--
-04R01	U	Barker	1968	H	300	23	98	S	88	10	35	30
-05A02	U	Bennett	1970	H	270	28	60	S	55	5	18	5
-05J01	L	Dawn Park Water	1968	P	240	158	214	S	197	17	300	37
-05K01	U	Vio	1976	H	200	52	78	S	73	5	10	4
-05K02	U	Hamblet	1978	H	190	89	118	S	113	5	13	1
-05P01	L	U.S. Navy	--	U	252	--	415	P	225	40	--	--

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Silverdale--Continued												
25N/01E-05Q01	U	Jarolim	1973	I	160	17	65	S	60	5	20	21
-06E01	L	Minch	1978	I	250	238	331	S	326	5	20	26
-06L01	L	Doerr	1972	H	300	248	338	P	332	6	12	77
-06M01	U	Webb	1978	H	210	90	113	S	108	5	7	14
-06P02	L	Crater	1979	H	280	249	295	S	292	3	5	40
-07B03	U	Meyer	1976	H	280	120	146	S	141	5	15	27
-07C01	L	Dlugosh	1979	H	340	281	371	S	361	10	12	8
-07E02	L	Martin	1976	I	350	242	300	S	295	5	20	22
-07G04	U	Heath	1973	H	280	78	106	S	101	5	10	18
-07G05	L	Pfingstag	1978	H	360	341	423	S	419	4	10	52
-07J01	L	Jenney	1979	H	270	205	260	S	255	5	10	30
-07K01	L	Harrison	1974	P	300	287	312	S	297	15	--	--
-07P01	U	Okerman	1978	P	330	192	240	S	235	5	7	16
-08D01	U	LeQuire	1976	H	280	112	130	S	125	5	8	6
-08F01	U	Collett	1979	H	260	88	135	S	130	5	15	8
-08G02	U	Davis	1975	H	210	32	55	S	50	5	15	6
-08H01	U	Davis	1978	H	160	92	142	S	135	7	12	2
-08J01	U	Bikfasy	1968	S	180	87	107	O	107	0	7	11
-08P01	U	Yob	1973	H	220	55	95	S	90	5	10	25
-09H01	L	Parker	1978	H	200	60	166	S	161	5	14	80
-09J01	L	Peterschmidt	1976	H	180	30	169	S	164	5	15	48
-09K02	L	Gibbs	1973	H	100	23	132	S	127	5	20	80
-10C02	U	Island Lake Bible	1973	I	270	70	170	S	155	15	30	8
-10H01	L	Cantwell	1974	H	280	208	342	S	340	2	12	106
-10L01	U	Pennington	1974	H	240	113	145	S	140	5	7	5
-10N01	L	Kitsap County PUD	1976	U	315	214	480	S	469	11	49	77
-10Q01	U	USGS	1976	U	175	--	127	--	--	--	--	--
-10R02	U	Brennan	1969	H	200	30	70	S	65	5	3.5	34
-11A01	U	Jones	1979	H	180	28	76	S	71	5	2	40
-11B01	U	Olson	1971	--	270	48	80	S	75	5	7	36
-11F01	U	Crouch	1978	H	220	32	111	S	102	9	15	50
-11G01	U	Parker	1979	H	240	57	77	S	72	5	5	13
-11L01	L	Lott	1973	H	180	105	139	S	134	5	12	--
-11L02	L	Harrington	1966	H	250	--	225	S	220	5	8	50
-11N02	U	Mottinger	1974	H	200	23	115	S	110	5	9	83
-11N03	L	Boblet	1979	H	220	33	250	S	240	10	20	112
-12C02	U	Spohn	1976	H	200	44	84	S	79	5	6	28
-13C02	L	Rea	1974	H	240	135	231	S	229	2	12	35
-13F01	L	Wonders	1975	H	180	88	200	S	195	5	10	18
-13H01	L	Stevenson	1979	H	200	--	432	S	427	5	8	8
-14C01	U	Stutz	1978	H	120	22	53	S	48	5	2	18
-14C03	L	Novak	1979	H	120	23	80	S	75	5	3	52
-14M02	L	Allpress	1974	H	140	8	99	S	94	5	8	76
-14N02	L	Allpress	1965	H	100	F	172	O	172	0	--	--

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
<u>Silverdale</u>--Continued												
25N/01E-15L01	U	Hagan	1972	H	180	18	85	S	81	4	--	--
-15N02	U	V.F.W. Post	1975	H	210	14	87	S	84	3	10	55
-15P01	L	Lane	1978	H	115	105	128	S	123	5	15	8
-16R02	L	Silverdale Water	1959	P	200	94	206	O	206	0	93	27
-17G01	L	Youngs	1978	I	170	115	193	S	188	5	16	6
-18B01	U	Snider	1979	I	300	158	182	S	177	5	20	2
-18C01	U	Mae	1974	H	300	125	144	O	144	0	7	10
-18J01	U	Dillon	1979	H	270	96	106	S	101	5	7	1
-18M01	U	Haury	1978	H	470	121	144	S	139	5	10	10
-19A01	L	Davis	1977	I	300	180	218	S	208	10	20	10
-19A02	U	Spychala	1976	H	300	41	60	S	57	3	10	9
-19H02	U	Sinclair	1975	H	350	176	209	S	204	5	15	18
-19M01	L	Warren	1975	H	460	393	428	S	418	10	10	--
-19R01	U	Cruz	1972	H	350	157	193	S	188	5	15	5
-20C01	L	Silverdale Water	1963	P	180	133	264	S	247	17	200	41
-20L02	U	Nordby	1973	--	120	36	52	S	47	5	30	12
-20M03	U	Ruble	1974	H	300	154	194	S	191	3	10	6
-20N01	U	Waldbillig	1961	I	200	85	119	S	114	5	26	17
-21B01	L	McKaeg	1948	--	100	40	91	O	91	0	--	15
-21J02	L	Larson	1973	H	100	83	115	S	110	5	6	13
-22C02	U	Pursell	1973	H	180	95	130	S	125	5	12	11
-22E01	L	Beck	1966	H	140	70	140	S	135	5	24	60
-22F01	L	Silverdale Water	1974	U	80	F	1,193	--	--	--	--	--
-22F02	L	Silverdale Water	1975	U	80	35	194	S	143	31	412	103
-22H01	L	Butler	1979	H	200	83	108	O	108	0	13	4
-22M01	L	Peterson	1956	--	90	72	155	O	155	0	10	35
-22M02	L	Peterson	1965	U	80	64	160	O	160	0	30	34
-22N01	L	Pensch	1962	H	40	14	63	O	63	0	30	18
-23C01	L	Dahlke	1975	H	120	87	110	S	105	5	8	6
-23M01	U	Oesterhaus	1978	H	240	16.4	37	S	32	5	16	4.4
-23Q02	L	Page	1975	H	200	166	192	S	189	3	20	4
-24M01	L	Smith	1976	H	230	208	275	S	265	10	12	20
-26D01	U	Cooper	1978	H	210	70.4	95	S	91	4	10	2.5
-27G01	L	McNeill	1974	H	210	--	257	O	257	0	5	--
26N/01E-13B01	L	Poulsbo	1967	P	360	107	313	S	298	15	400	36
-13D01	U	Bryan	1975	H	360	120	195	S	190	5	7	45
-13K01	U	Abel	1970	H	300	61	112	P	102	10	15	21
-15B03	U	Hahto	1974	H	80	0	35	S	33	2	7	17
-15G03	L	Ermence	1975	H	100	11	100	S	95	5	15	51
-15L02	U	Hanson	1978	H	100	7	42	S	37	5	15	19
-17A01	L	U.S. Navy	--	U	410	--	555	P	493	35	--	--
-17N01	L	U.S. Navy	--	U	350	--	665	P	383	106	--	--
-18L01	L	U.S. Navy	--	D	25	F	124	S	86	38	1,865	74
-18L02	L	U.S. Navy	--	--	211	158	341	S	296	45	920	--
-18L03	L	U.S. Navy	1977	D	19	13	185	S	110	75	1,000	34

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Silverdale--Continued												
26N/01E-18L04	L	U.S. Navy	1977	D	34	11	200	S	125	75	1,000	29
-18N01	L	U.S. Navy	1977	D	19	13	185	S	110	75	1,000	20
-18N02	L	U.S. Navy	1977	D	42	19	208	S	133	75	1,000	24
-18P01	L	U.S. Navy	1976	D	97	40	266	S	170	50	1,000	27
-18P02	L	U.S. Navy	1976	D	137	80	329	S	245	50	950	42
-18P03	L	U.S. Navy	1976	D	180	125	382	S	267	42	900	41
-19C01	L	U.S. Navy	--	U	90	--	550	--	--	--	--	--
-19Q01	L	U.S. Navy	--	U	290	--	650	--	--	--	--	--
-19Q02	L	U.S. Navy	--	Z	290	238	425	S	356	55	--	--
-19Q03	L	U.S. Navy	--	Z	290	--	430	S	350	45	--	--
-20R02	U	McFarland	1975	H	425	184	242	S	237	5	15	10
-21F01	U	Tiedeman	1977	H	420	161	220	S	215	5	16	30
-21G02	U	Strandskov	1955	I	420	125	187	O	187	0	10	12
-21Q01	U	Gorman	1979	I	380	133	182	S	177	5	20	17
-25F03	L	Norman	1973	--	85	78	120	S	115	5	15	7
-25G02	L	Stenborn	1977	H	110	93	173	S	168	5	16	30
-27D01	L	Erickson	1977	H	260	234	333	S	329	4	7	57
-27D02	U	Medcalf	1978	H	260	76	136	S	131	5	15	40
-27G02	L	Johnson	1974	H	80	69	99	S	94	5	7	17
-28C01	U	Evans	1979	H	380	163	192	S	187	5	10	6
-28E01	U	Oymesich	1975	H	430	170	190	S	185	5	10	4
-28E02	U	Bramel	1978	H	400	172	217	S	212	5	13	--
-28P01	U	Waali	1968	P	360	152	193	S	188	5	25	13
-29A02	L	U.S. Navy	--	--	460	--	516	P	217	84	--	--
-29N01	L	U.S. Navy	--	--	375	304	660	P	360	75	--	--
-29R01	L	U.S. Navy	--	U	410	--	820	--	--	--	--	--
-30L01	L	U.S. Navy	1963	P	325	236	331	S	316	15	300	50
-31A01	L	U.S. Navy	--	--	340	--	810	--	--	--	--	--
-31A02	L	U.S. Navy	--	Z	340	294	581	S	426	90	--	--
-31A03	L	U.S. Navy	--	Z	340	--	574	S	467	84	--	--
-31D01	L	U.S. Navy	--	--	340	--	832	--	--	--	--	--
-32K01	L	U.S. Navy	1966	N	280	232	675	P	611	64	173	63
-33A01	U	Hauf	1975	H	260	27	122	S	117	5	15	5.5
-33D01	U	Cook	1974	H	385	112	152	O	152	0	15	--
-33E01	U	Hemisphere R.	1979	H	340	93	158	S	156	2	5	65
-33F02	U	Smith	1976	H	230	91	120	S	115	5	16	2
-33J01	U	USGS	1976	U	210	--	117	--	--	--	--	--
-33M04	L	Hinckley	1964	H	300	247	346	O	346	0	13	60
-33N02	U	Marshall	1973	H	260	45	125	S	121	4	6	44
-33P01	U	Clauson	1978	H	180	7	63	S	44	10	8	35
-33R02	U	Parker	1965	I	340	145	170	S	165	5	10	15
-34F02	U	Waali	1965	H	185	32	74	P	69	5	7	27
-34G02	L	Settle	1973	H	200	156	196	S	191	5	20	6
-34L03	U	Hamilton	1973	H	240	46	151	S	147	4	17	31
-34P01	U	Parkinson	1974	H	340	142	237	S	232	5	20	41

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening			Yield (gal/min)	Draw-down (ft)
								Type	Depth to top (ft)	Length (ft)		
Silverdale--Continued												
26N/01E-35A01	L	Munroe	1975	H	30	14	245	S	240	5	15	70
-35D01	L	Chase	1975	H	60	49	169	S	165	4	10	42
-35E02	L	Wasell	1974	I	60	50	391	S	386	5	60	67
-35G01	L	Larm	1969	I	40	30	174	S	172	5	44	10
-36B01	L	Rasmussen	1972	I	360	253	604	S	579	25	268	143
-36M01	L	Kitsap County PUD	1975	P	20	F	741	S	702	39	345	154
-36N02	L	U.S. Navy	1968	P	15	F	802	S	725	61	455	30
Big Valley												
26N/01E-01A01	U	Tucker	1975	H	300	158	188	S	182	6	7	10
-01A02	L	Broderick	1978	H	280	176	241	S	235	6	15	20
-01C02	L	Pavey	1976	H	400	255	333	S	328	5	30	20
-02G01	L	Ekelmann	1976	H	220	131	269	S	264	5	20	54
-02H01	U	Fleury	1974	I	400	236	296	S	286	10	25	--
-02J01	U	Bjorgen	1978	H	250	60	121	S	116	5	27	54
-02L04	L	USGS	1976	U	80	--	345	--	--	--	--	--
-02L05	L	USGS	1976	U	80	0	312	S	302	10	446	151
-03A01	U	Benge	1978	H	290	173	236	S	231	5	10	21
-03B01	U	Walker	1978	H	310	150	230	S	225	5	5	65
-03F01	U	Waite	1979	H	390	227	244	S	240	4	8	13
-03L01	U	Chapple	1975	H	395	250	325	S	315	10	12	30
-04F01	L	Hogan	1978	H	200	149	423	S	418	5	20	--
-05J01	U	Kilburn	1978	H	160	1	95	S	80	15	11	63
-08M01	L	U.S. Navy	1976	U	200	182	517	P	497	20	--	--
-09F01	L	Swanson	1977	I	310	133	307	S	297	10	30	31
-09L02	U	Johnson	1975	H	395	129	274	S	269	5	12	106
-09L03	U	Dunn	1973	H	400	110	246	S	241	5	5	110
-09M01	L	Streun	1976	H	380	211	334	S	329	5	12	77
-10B01	U	Sanderson	1978	P	370	115	181	S	171	10	25	15
-10L01	U	U.S. Army	1955	H	291	94	128	S	118	10	13	2
-10N02	U	Kaster	1963	H	230	F	119	P	99	20	30	20
-10P01	U	Rasmussen	1974	I	230	89	137	S	132	5	20	2
-11E01	U	Haines	1977	H	180	16	93	S	88	5	12	5
-24A01	U	Van Slyke	1975	H	200	27	68	S	63	5	6	25
-12C01	U	Foss	1978	H	200	39	73	S	70	3	7	22
-12D01	L	Warren	1978	H	250	170	407	O	407	0	20	17
-12D02	U	Galloway	1978	H	285	75	103	S	98	5	10	10
-12D03	U	Bauer	1979	H	260	13	70	S	65	5	15	6
-12D04	U	Wells	1979	H	260	45	113	S	108	5	7	40
-12E01	U	Chamberlin	1979	H	200	38	63	S	50	13	6	5
-12G01	L	Thomson	1978	H	180	125	181	S	177	4	10	30
-12N01	U	Bjorlie	1978	H	215	75	99	S	89	10	10	10
-12Q02	L	Gallanger	1968	P	365	119	290	S	280	10	150	70

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Big Valley--Continued												
26N/02E-05C01	L	Coultas	1978	H	240	222	381	S	375	6	13	--
-05E01	L	Okerman	1978	H	290	223	337	S	331	5	30	22
-05F01	L	Invey	1977	H	260	194	214	S	209	5	10	8
-05L01	L	Pentz	1977	H	240	151	173	S	164	9	9	7
-05M01	U	Webster	1974	H	300	48	93	S	88	5	5	38
-05M02	L	Salo	1979	H	270	250	392	S	382	10	15	28
-06A02	U	USGS	1976	U	145	--	117	--	--	--	--	--
-06D01	U	Carlson	1979	H	240	60	85	S	80	5	7	10
-06F01	U	Walton	--	--	190	18	68	P	62	6	--	--
-06F02	U	Hahto	1973	H	200	67	127	S	123	4	5	46
-06K01	L	Buford	1979	H	260	140	341	S	338	3	6	168
-06M02	U	Giles	1978	H	200	13	71	S	65	6	20	37
-06P01	U	Strunk	1974	H	225	23	105	S	100	5	20	60
-07E01	U	Stocker	1977	H	230	32	146	S	141	5	7	80
-07E02	U	Schneider	1978	I	260	91	126	S	121	5	20	2.5
-07N01	L	Liming	1978	H	320	140	286	S	282	4	13	40
-07R03	L	Anderson	1975	H	380	178	421	S	416	5	6	210
-08J01	L	Nistrand	1978	H	200	143	221	S	216	5	35	29
-09H01	L	Miller Bay	1969	P	260	255	452	S	432	20	150	85
-09H02	L	Miller Bay	1979	P	260	217	413	S	393	20	251	56
-10N01	L	Indianola Water	1969	P	110	78	215	S	205	10	49	40
-11N01	L	Thompson	1979	H	240	160	226	S	221	5	12	24
-17H01	L	Johnson	1979	H	125	30	122	S	117	5	6	67
-17K01	L	Indian Health	1978	H	175	92	279	S	274	5	--	--
-18B01	L	Hawkins	1979	H	340	117	366	S	361	5	15	158
-18C01	L	Tinner	1977	H	300	124	343	S	339	4	9	176
-19H01	U	Buczek	1975	H	300	70	102	S	92	10	10	20
-20E01	L	Kitsap County PUD	1971	U	282	220	401	O	401	0	--	--
-20H01	L	Suquamish Imp.	1970	U	300	230	460	S	445	15	196	138
-20L01	L	Kitsap County PUD	1961	U	200	133	220	P	185	35	489	44
-20M01	L	Kitsap County PUD	1971	U	267	199	345	P	325	20	356	38
-20P01	L	Indian Health	1978	U	196	113	247	S	237	10	150	26
-20Q01	L	Indian Health	1978	H	120	97	216	S	211	5	40	63
-21N01	L	Chief Seattle	1968	P	130	54	270	S	260	10	75	37
27N/01E-12P01	L	Schneidler	1978	H	180	145	175	S	170	5	12	18
-12P02	L	Terhune	1978	H	150	130	343	S	338	5	30	70
-13M01	L	Getz	1979	H	140	60	130	S	125	5	9	48
-14K01	L	Newcity	1978	H	80	52	92	S	87	5	15	10
-14K02	L	Richard	1978	H	80	68	198	S	193	5	15	10
-22H01	U	Thompson	1974	P	40	30	39	O	39	0	12	1
-22Q02	L	Myhre	1965	H	80	70	188	O	188	0	32	40
-22Q03	U	Briderbing	1974	H	100	8	68	S	63	5	4	52
-23C01	U	Jones	1975	H	80	45	57	S	52	5	--	--

TABLE 1.--Records of selected wells on the Kitsap peninsula--Continued

Well number	Water-bearing strata	Owner	Year drilled	Use	Land surface altitude (ft)	Water level (ft below land surface)	Well depth (ft)	Well opening: Type	Well opening: Depth to top (ft)	Well opening: Length (ft)	Yield (gal/min)	Draw-down (ft)
Big Valley--Continued												
27N/01E-23C02	L	Triplet	1979	H	80	56	130	S	126	4	16	6
-23M01	L	Francklyn	1978	H	120	46	302	S	297	5	50	39
-23N01	L	Washington State	1962	U	185	119	383	S	380	3	15	95
-26E01	L	Dupee	1978	I	340	256	565	S	555	10	120	72
-26J01	U	USGS	1976	U	165	--	97	--	--	--	--	--
-27E02	L	Edgewater Est.	1963	H	190	120	267	O	267	0	20	55
-27F01	L	--	1969	--	225	140	259	--	--	--	90	99
-27R01	U	Myriah	1973	H	320	123	138	P	135	3	4	10
-28R01	U	Nylin	1970	I	250	110	167	S	162	5	15	8
-33B01	L	Gregersen	1960	H	160	150	300	O	300	0	14	26
-33C02	L	Coulter	1974	H	120	104	168	S	163	5	15	32
-33J01	L	Zaske	1978	H	380	254	424	S	418	6	8	146
-33N02	L	Luckey	1973	H	130	120	215	S	210	5	15	10
-34M01	L	Jansen, et al	1970	H	400	286	505	S	500	5	11	188
-34R01	L	Gurce	1971	H	300	185	304	S	299	5	15	43
-35C01	L	Swanson	1979	H	370	252	358	S	342	16	20	60
-35J01	U	Nash	1975	H	160	12	119	S	114	5	10	72
-36E01	U	Muller	1978	H	180	34	95	S	90	5	15	25
-36J01	U	Jurgens	1969	H	375	198	293	S	288	5	15	7
27N/02E-20G01	L	Grasso	1974	H	40	3	80	S	75	5	6	63
-20G04	L	Hansen	1979	H	30	11	84	S	79	5	12	29
-20H02	L	Arnston	1973	H	80	54	151	S	148	3	11	65
-20H03	L	Date	1978	H	70	46	129	S	125	4	15	35
-20L03	L	Kentner	1979	H	30	13	65	S	62	3	15	35
-20P01	U	Hansen	1975	H	100	F	83	S	78	5	17	18
-21A03	U	Jones	1975	H	200	46	72	S	68	4	6	15
-21C01	L	Olson	1979	H	100	40	198	S	193	5	20	--
-21P01	U	Lindblad	1978	H	120	55	110	S	106	4	15	42
-21P02	U	Lindblad	1978	H	120	37	77	S	72	5	30	23
-22E01	U	Laun	1973	H	180	84	109	S	104	5	8	12
-27M01	L	Counsellor	1979	H	70	28	161	S	156	5	20	26
-28E01	L	Gilbreath	1978	H	200	154	200	S	195	5	13	10
-28Q01	L	Hulti	1975	H	170	120	178	S	172	6	15	14
-28R01	L	Steele	1974	H	100	50	149	S	146	3	15	26
-31P01	L	Benson	1974	H	300	134	371	S	366	5	15	153
-32M01	L	Opsata	1970	H	170	100	550	S	540	10	50	60
-33C03	U	Tweten	1974	H	220	63	113	S	108	5	5	10
-33E01	L	Vanbranchi	1979	H	140	85	265	S	260	5	15	38
-34C02	L	Kitsap County PUD	1974	U	55	--	465	S	445	15	--	--

THE HYDROLOGIC SYSTEM

The extent of hydraulic connection between the Kitsap peninsula and the surrounding area is unknown, but the authors believe that the source of practically all fresh water on the Kitsap peninsula is local precipitation. Part of the precipitation is returned to the atmosphere by evapotranspiration, part runs off the land surface to streams, and the remainder infiltrates the soil, eventually to become ground water. Ground water, in turn, leaves the area through subsurface discharge to Puget Sound, Hood Canal, streams, springs, and wells. On a long-term basis the total discharge from the ground-water system equals the recharge to it.

Average annual precipitation on the Kitsap peninsula ranges from 25 in. in the north to 70 in. in the southwest (U.S. Weather Bureau, 1965). Actual average annual evapotranspiration, as computed by a method developed by Thornthwaite and Mather (1957), ranges from 17 in. in the north to 23 in. in the southwest. Streamflow on the peninsula consists of direct runoff and ground-water discharge to the streams. The average annual streamflow and the low-flow characteristics of streams on the peninsula were presented by Cummans (1977).

Ground water on the Kitsap peninsula is obtained principally from the unconsolidated deposits and to a lesser extent from the consolidated rocks. Most moderate to large supplies of ground water are obtained from the numerous water-bearing sand-and-gravel strata. The consolidated rocks are of volcanic and marine sedimentary origin. Most exposures of volcanic rock are in the Gold Mountain upland (see fig. 1). Sedimentary rocks are exposed on the south end of Bainbridge Island and along the south shore of Rich Passage. Elsewhere in the study area, the consolidated rocks are buried beneath younger unconsolidated deposits. Little water occurs in the fractures and interstices of the consolidated rocks.

The unconsolidated deposits that overlie the consolidated rocks over most of the peninsula are of glacial and interglacial origin and are as much as 3,000 ft thick (Hall and Othberg, 1974). For the purpose of this report, the unconsolidated deposits have been divided into three units. The upper and lower units consist principally of glacial drift deposited by the ice or by glacial meltwater. They are composed of layers or beds of sand and gravel alternating with layers of silt and clay. The lower unit also includes non-glacial deposits of generally fine-grained material. The middle, or silt-and-clay, unit consists of a nonglacial deposit of silt and clay that, in most places, separates the other two units. The three units correlate to those described by Garling and Molenaar (1965) as shown in table 2. The thickness of the upper unit is commonly between 200 and 400 ft but in some areas may be as much as 600 ft. The middle unit is commonly between 10 and 80 ft thick but may be as thick as 260 ft. Thickness of the lower unit is believed to be between 2,000 and 3,000 ft.

The areal extent and thickness of water-bearing strata in both the upper and lower hydrologic units are poorly known. Correlation of well data, even over distances of less than a mile, is commonly difficult. No single water-bearing stratum could be traced over large distances. Hydrologic data suggest, however, that the many beds or layers of sand and gravel, although of limited extent, are imperfectly connected, perhaps through stringers, and thus form a network of deposits where permeability varies considerably in both lateral and vertical directions. These strata collectively form a hydraulic system that is analogous to an areally extensive body more commonly referred to as an aquifer. Because of the imperfect or unknown hydraulic connection between beds or layers, the term aquifer is not used in this report.

The upper unit contains fairly continuous sand-and-gravel water-bearing beds or layers, herein designated collectively as the "upper water-bearing strata". Sand-and-gravel water-bearing beds or layers in the lower unit are generally less continuous than in the upper unit and are designated "lower water-bearing strata" in this report. The middle unit is not known to contain any major water-bearing deposits.

TABLE 2.--Correlation of lithologic units

Garling and Molenaar (1965)		This report	Hydrologic properties
Vashon Drift	Recessional outwash	Upper Unit	Thin, discontinuous, mostly dry; locally yields water for domestic use.
	Till		Generally low hydraulic conductivity; some wells locally tap permeable melt-water deposits. Ground-water availability of units above is not discussed
	Advance outwash	Upper sand-and-gravel water-bearing strata	Contains fairly continuous water-bearing sand-and-gravel beds or layers whose thicknesses range from 10 to 80 ft; most well yields are between 10 and 50 gal/min.
	Colvos Sand Member		
Kitsap Formation		Middle Unit (silt and clay)	Generally low hydraulic conductivity, underlies most of the peninsula.
Salmon Springs Drift		Lower Unit Lower sand-and-gravel water-bearing strata	Contains numerous sand-and-gravel beds or layers of unknown areal extent and thickness of as much as 300 feet; well yields usually range between 20 and 100 gal/min.
Pre-Salmon Springs Drift		Lower sand-and-gravel water-bearing strata	

Upper Water-Bearing Strata

The upper water-bearing strata, which occur principally in the lower part of the upper unit (table 2), consist primarily of a fairly continuous sand zone. The average thickness obtained from interpretation of drillers' logs is 15 ft; maximum known thickness is about 60 ft. The altitude of the base of the upper strata ranges from 350 ft above sea level to about sea level.

Most reported yields of wells tapping the upper water-bearing strata are between 10 and 50 gal/min, although some wells yield as much as 200 gal/min. Most wells in the area are domestic wells that supply one or a small number of households. Because of this, the amount of water needed is small, and therefore the reported yields are small. In addition, these wells are generally open to only a few feet of the water-bearing strata. Because most wells in the upper unit only partially penetrate the water-bearing strata, the potential yield of wells that fully penetrate the water-bearing strata exceeds reported values.

Well yields depend largely on the transmissivity of the water-bearing material. Transmissivity for the upper strata was estimated from the specific capacity reported in drillers' records using the method of Theis (in Bentall, 1963, p. 331-336). This method presupposes that the well is fully efficient and fully penetrating. Most wells do not meet these criteria, and the degree to which they fail to meet them produces a transmissivity value proportionately below the true one. The hydraulic conductivity for a particular area was obtained by dividing the transmissivity by the thickness of the water-bearing beds and averaging the data from individual wells in the area. Average transmissivity for a subarea was then estimated by multiplying the average hydraulic conductivity of the subarea by the thickness of the water-bearing strata in the subarea. Higher transmissivities indicate areas where larger well yields might be expected. The estimated transmissivities range from 500 to 3,000 ft^2/d.

Water in the upper water-bearing strata is under artesian pressure in most locations. In general, the direction of ground-water movement is toward Puget Sound, Hood Canal, and the major streams. In areas where the upper water-bearing strata extend into Puget Sound or Hood Canal, discharge occurs directly to the sea. Otherwise, discharge occurs to streams, wells, springs, and as diffuse seepage at altitudes above sea level. Finally, some of the water in the upper unit moves vertically downward through the silt-and-clay unit.

Silt-and-Clay Unit

The silt-and-clay unit separates the upper and lower units over most of the study area. The unit consists principally of horizontally-bedded silt and clay, with occasional layers of sand and gravel. Because of its relatively low hydraulic conductivity, this unit retards the vertical movement of water between the upper and lower units.

The thickness of the silt-and-clay unit is variable and reaches a maximum of about 260 ft. The altitude of the top of the unit (fig. 3) ranges from about 230 ft above sea level to about 80 ft below sea level.

Theoretically, and as defined in table 2, the base of the upper unit should be at the same altitude as the top of the middle unit. However, most wells in the upper unit only partially penetrate the unit, and thus the data are not available to define the lithology and hydraulic properties through the full thickness. For this reason, the base of the upper water-bearing strata is depicted herein by the known altitudes of well bottoms; consequently, the depicted base probably is above the actual base of the unit in some parts of the area.

Lower Water-Bearing Strata

Although hundreds of wells have been drilled into the lower water-bearing strata, their areal distribution and depths are insufficiently known to permit mapping of individual sand-and-gravel strata. The thickness of the lower unit locally exceeds 3,000 ft, and productive zones are reported to occur at numerous depths. However, so few wells have been drilled to these depths that little is known of the areal extent or water-bearing properties of the very deep zones.

Most wells are in the upper 300 ft of the lower unit (table 2). Wells that exceed 1,000 ft in depth have been drilled at several sites, including sites south of Sinclair Inlet near Port Orchard, near Keyport, and near Fletcher Bay. The lower water-bearing strata are generally coarser grained than the upper water-bearing strata. The former are usually described as gravel in the drillers' logs and the latter as sand and gravel. Generally, the reported yields of the lower water-bearing strata are several hundred gallons per minute, and in the Port Orchard area are as much as 1,700 gal/min.

In general, water levels in the lower water-bearing strata are lower than in the upper water-bearing strata, indicating vertical movement of water downward. In most areas, the water level in wells tapping the upper 300 ft of the lower strata is above sea level. The effects of development of water supplies from these strata cannot be determined because of the limited data.

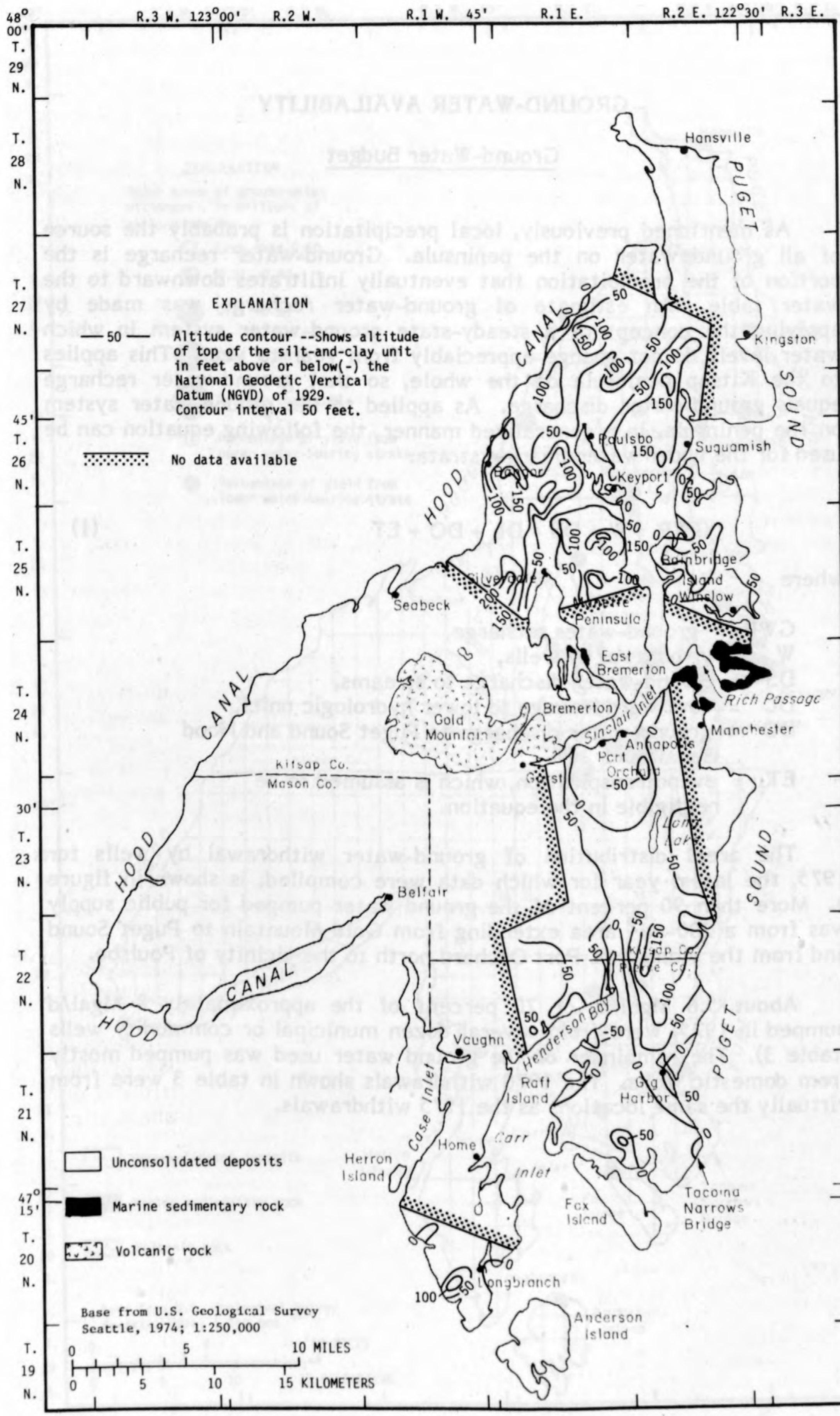


FIGURE 3.--Altitude of the top of the silt-and-clay unit.

GROUND-WATER AVAILABILITY

Ground-Water Budget

As mentioned previously, local precipitation is probably the source of all ground water on the peninsula. Ground-water recharge is the portion of the precipitation that eventually infiltrates downward to the water table. An estimate of ground-water recharge was made by applying the concept of a steady-state ground-water system in which water levels do not change appreciably from year to year. This applies to the Kitsap peninsula on the whole, so that ground-water recharge equals ground-water discharge. As applied to the ground-water system on the peninsula, in a generalized manner, the following equation can be used for the upper water-bearing strata:

$$GWR = W + DS + DL + DO + ET \qquad (1)$$

where

GWR = ground-water recharge,
W = withdrawal by wells,
DS = ground-water discharge to streams,
DL = downward leakage to lower hydrologic units,
DO = ground-water discharge to Puget Sound and Hood Canal, and
ET = evapotranspiration, which is assumed to be negligible in the equation.

The areal distribution of ground-water withdrawal by wells for 1975, the latest year for which data were compiled, is shown in figure 4. More than 90 percent of the ground water pumped for public supply was from a 200-mi^2 area extending from Gold Mountain to Puget Sound and from the vicinity of Port Orchard north to the vicinity of Poulsbo.

About 5.6 Mgal/d, or 70 percent of the approximately 8 Mgal/d pumped in 1975, were from several dozen municipal or community wells (table 3). The remainder of the ground water used was pumped mostly from domestic wells. The 1970 withdrawals shown in table 3 were from virtually the same locations as the 1975 withdrawals.

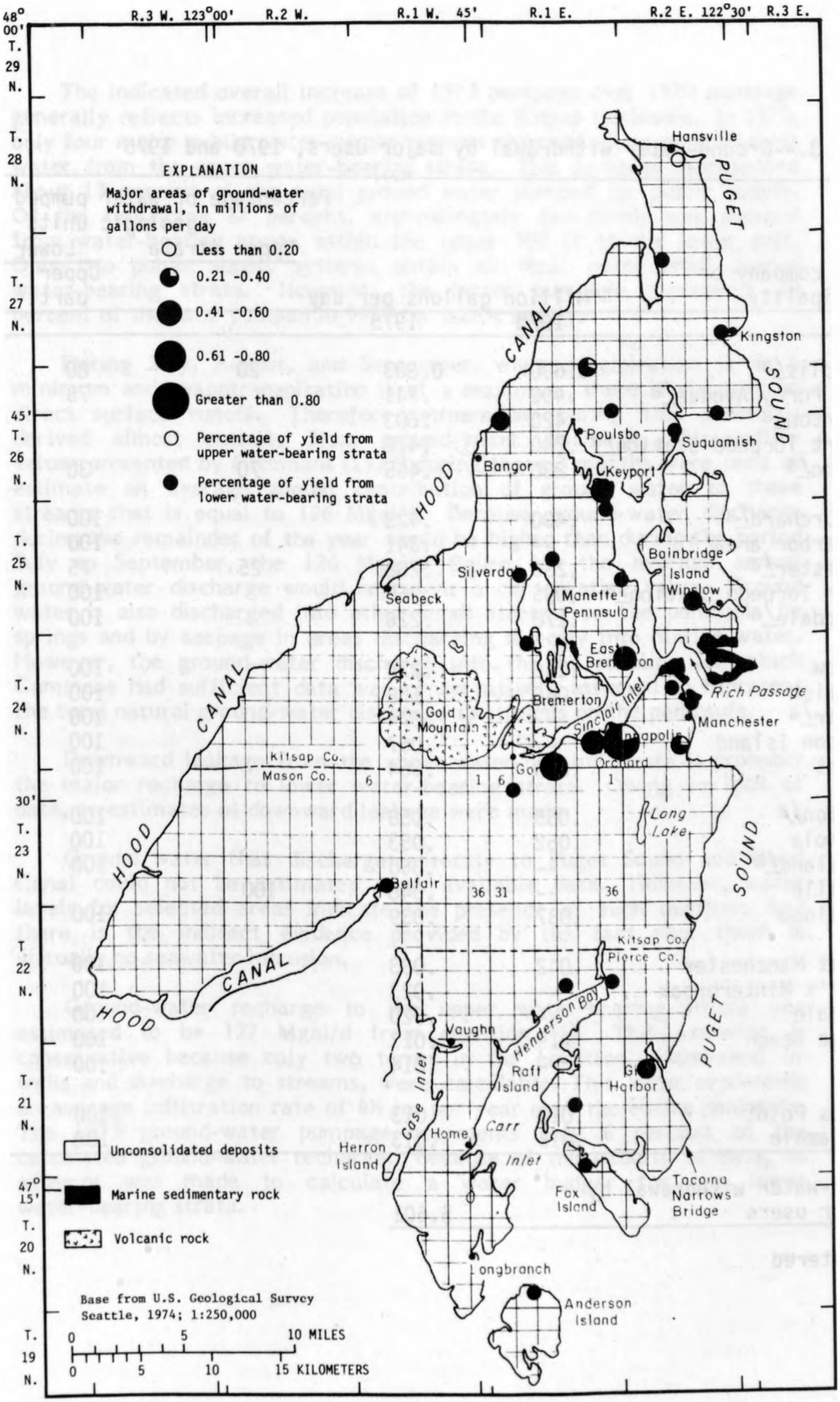


FIGURE 4.--Distribution of major ground-water pumpage, 1975.

TABLE 3.--Ground-water withdrawal by major users, 1970 and 1975

Water company or municipality	Million gallons per day		Percentage of water pumped from geologic units		
			Upper strata	Lower strata	
	1970	1975		Upper part	Lower part
Annapolis/a	0.600	0.803	20	80	
North Perry Avenue/a	.490	.741		75	25
Bremerton/a	.420	.603			100
Keyport Torpedo Station/a	.240	.478			100
Poulsbo/a	.230	.465	70	30	
Port Orchard/a	.400	.423		100	
Gig Harbor area/a	--	.341		100	
Manchester/a	.230	.288	25	75	
Bangor Torpedo Station/a	.095	.265		100	
Silverdale/a	.170	.226		100	
Winslow	.160	.224		100	
Suquamish	.048	.158		100	
Belfair/a	--	.074		100	
Anderson Island	--	.067		100	
Keyport	.070	.064		100	
Kingston/a	.085	.058		100	
Indianola	.052	.053		100	
Fox Island/a	--	.050		100	
Hansville	--	.048	100		
Sunnyslope	.037	.039		100	
Navy at Manchester	.042	.033		100	
Miller's Minterbrook	--	.023		100	
Artondale	--	.020		100	
Watauga Beach	.019	.017		100	
Purdy	--	.014		100	
Erlands Point	.011	.013		100	
Port Gamble	.016	.013		100	
Ground-water withdrawal by major users		5.601			

/a metered

The indicated overall increase of 1975 pumpage over 1970 pumpage generally reflects increased population in the Kitsap peninsula. In 1975, only four major public water-supply systems obtained all or part of their water from the upper water-bearing strata. This pumpage represented about 13 percent of the total ground water pumped for public supply. Of the remaining 87 percent, approximately two-thirds was pumped from water-bearing strata within the upper 300 ft of the lower unit. Only two public supply systems obtain all their water from deeper water-bearing strata. However, the latter pumpage represents 23 percent of the total pumped in 1975 for public supply.

During July, August, and September, when precipitation is at a minimum and evapotranspiration is at a maximum, there is virtually no direct surface runoff. Therefore, streamflow during this period is derived almost entirely from ground-water discharge. Streamflow values presented by Cummans (1977) during these 3 months were used to estimate an average annual contribution of ground water to these streams that is equal to 126 Mgal/d. Because ground-water discharge during the remainder of the year would be higher than during the period July to September, the 126 Mgal/d figure for the average annual ground-water discharge would represent a conservative value. Ground water is also discharged into other small streams on the peninsula by springs and by seepage in areas discharging directly into marine water. However, the ground-water discharge into the 43 streams for which Cummans had sufficient data was conservatively assumed to represent the total natural ground-water discharge to streams on the peninsula.

Downward leakage from the upper water-bearing strata is probably the major recharge to lower water-bearing strata. Owing to lack of data, no estimates of downward leakage were made.

Ground water that discharges directly to Puget Sound and Hood Canal could not be estimated from available data. However, water levels for selected areas indicate the presence of such outflow. And there is the indirect evidence provided by the fact that there is virtually no seawater intrusion.

Ground-water recharge to the upper water-bearing strata was estimated to be 127 Mgal/d from equation (1). This estimate is conservative because only two terms in the equation, withdrawal by wells and discharge to streams, were calculable. This value represents an average infiltration rate of 4½ in. per year over the entire peninsula. The 1975 ground-water pumpage represents only 6 percent of the calculated ground-water recharge. Because of the paucity of data, no attempt was made to calculate a water budget for the lower water-bearing strata.

Effects of Increased Withdrawal by Wells on the Ground-Water Budget

Because ground-water pumpage represents only a small part of the calculated minimum ground-water recharge, it is reasonable to assume that additional ground-water supplies are available. If pumpage is increased from the upper and lower water-bearing strata, the following effects will occur:

1) Ground-water levels will decline in both the upper and lower strata.
2) Streamflow and spring flow will be decreased.
3) Lateral outflow in both bodies will be decreased.
4) Seawater intrusion will be initiated or accelerated (to be discussed in a later section of this report).

If pumpage is increased in the upper water-bearing strata alone, downward leakage to the lower water-bearing strata will be decreased. If pumpage is from the lower water-bearing strata alone, the downward leakage will be increased. Generally, these effects will be localized, depending on the magnitude and distribution of pumpage.

Ground-Water Conditions by Subareas

Maps were prepared in subareas (fig. 1) for which data were available to show the variation in:

1) transmissivity of the upper water-bearing strata
2) altitude of the top of the silt-and-clay unit
3) thickness of the silt-and-clay unit.

The boundaries of each subarea were arbitrarily selected for ease of data compilation; however, the boundaries were selected partly on the basis of geohydrologic inference, such as for Bainbridge Island. The mapped areas include Big Valley, Silverdale, Bainbridge Island, Port Orchard, Burley, and Gig Harbor subareas. The transmissivity maps are useful in determining areas where additional water may be developed for short-term well yields. Sufficient data were available in these areas also to discuss the maximum and minimum reported well yields for the upper water-bearing strata and aspects of seawater intrusion as related to the top of the silt-and-clay unit. Because of lack of data for the lower water-bearing strata, except for pumpage, the following discussion of the subareas emphasizes conditions for the upper water-bearing strata. Well yields discussed in this report refer to short-term yields.

The indicated overall increase of 1975 pumpage over 1970 pumpage generally reflects increased population in the Kitsap peninsula. In 1975, only four major public water-supply systems obtained all or part of their water from the upper water-bearing strata. This pumpage represented about 13 percent of the total ground water pumped for public supply. Of the remaining 87 percent, approximately two-thirds was pumped from water-bearing strata within the upper 300 ft of the lower unit. Only two public supply systems obtain all their water from deeper water-bearing strata. However, the latter pumpage represents 23 percent of the total pumped in 1975 for public supply.

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The altitude of the top of the silt-and-clay unit is coincident with the base of the upper water-bearing strata in most places in the peninsula. Thus, the silt-and-clay unit is a "marker" bed or layer and, where it exists, provides a reference to either the upper or the middle hydrologic unit. Maps showing the altitude of the top and the thickness of the silt-and-clay unit are also useful in assessing seawater intrusion potential in the upper water-bearing strata. In coastal areas, where the top of the silt-and-clay unit is below sea level the upper water-bearing strata can be in good hydraulic connection with the sea and, as such, are more susceptible to seawater intrusion. On the other hand, if the top of the silt-and-clay unit is above sea level near the coast, the upper water-bearing body is not susceptible to seawater intrusion.

Potential contamination of wells in the study area from seawater intrusion is based on: (1) proximity of wells to Puget Sound; (2) the distribution and amount of pumpage; and (3) altitude and thickness of the silt-and-clay unit.

Big Valley Subarea

The maximum known thickness of the upper water-bearing strata in the Big Valley subarea is about 60 ft in an area northeast of Poulsbo, and the average thickness in the Big Valley subarea is 15 ft. The maximum known transmissivity for the upper water-bearing strata is about 2,000 ft^2/d in an area about 3 mi northeast of Poulsbo (fig. 5). Large yields are probable from wells tapping the upper water-bearing strata northeast of Lincoln. There, the average yield of several wells is 350 gal/min, and the thickness of water-bearing materials averages 30 ft. Other areas where high transmissivity values are known are southwest of Lofall near the coast and northwest of Poulsbo.

Two areas with large yields to wells tapping the lower water-bearing strata are west of Suquamish, where yields up to 500 gal/min have been reported, and Big Valley, township 26N/1E, section 2, where one well yielded about 400 gal/min.

The only part of the Big Valley subarea where the top of the silt-and-clay unit is below sea level is near Lofall (fig. 6), and this is used as a criterion for its susceptibility to seawater intrusion. The top of the silt-and-clay unit extends from 15 ft below sea level south of Lofall to 180 ft above sea level northwest of Suquamish. The thickness of this unit averages 90 ft and varies from less than 50 ft in Big Valley southeast of Lofall to 240 ft northwest of Suquamish (fig. 7).

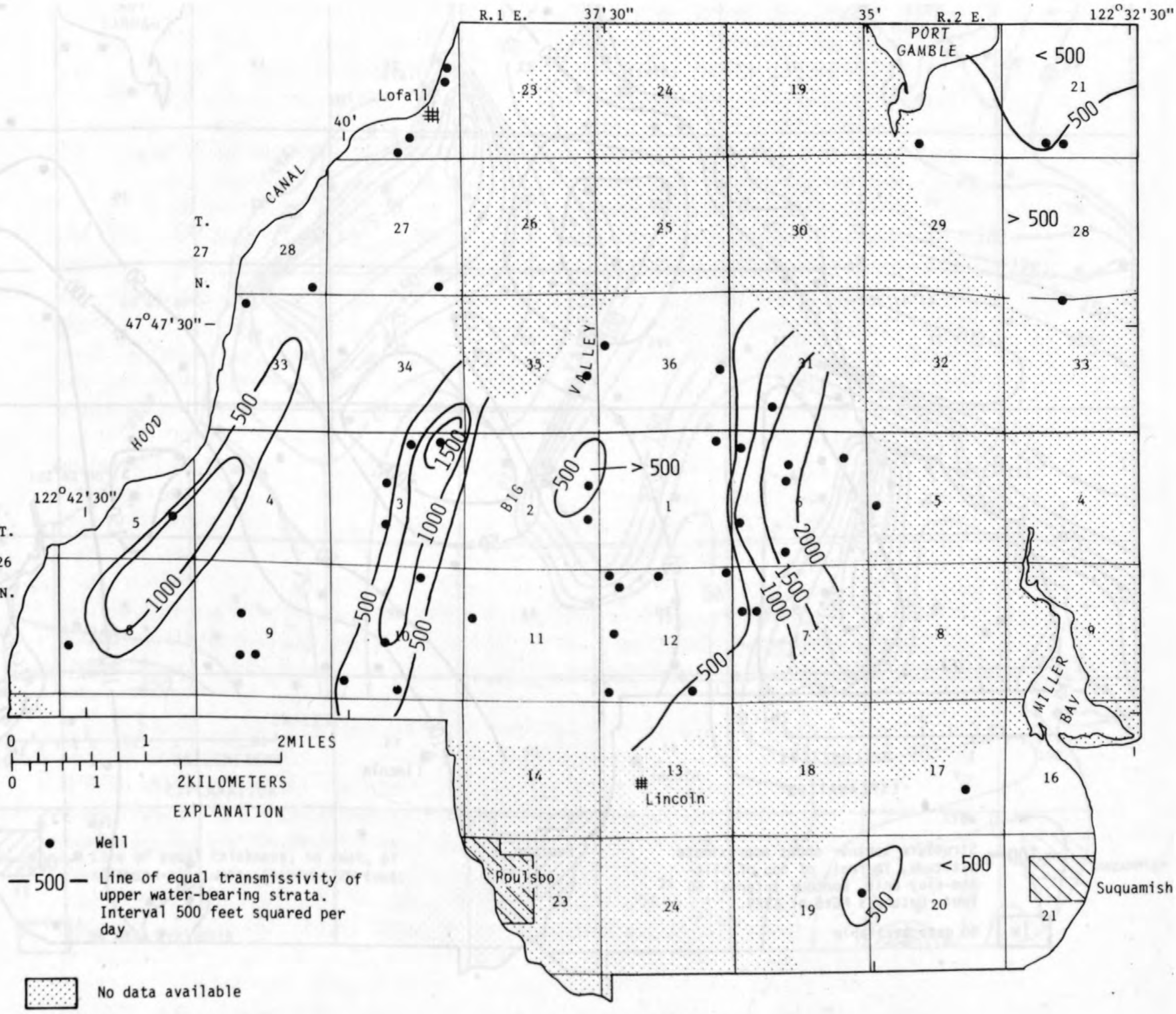


FIGURE 5.--Transmissivity of the upper water-bearing strata, Big Valley subarea.

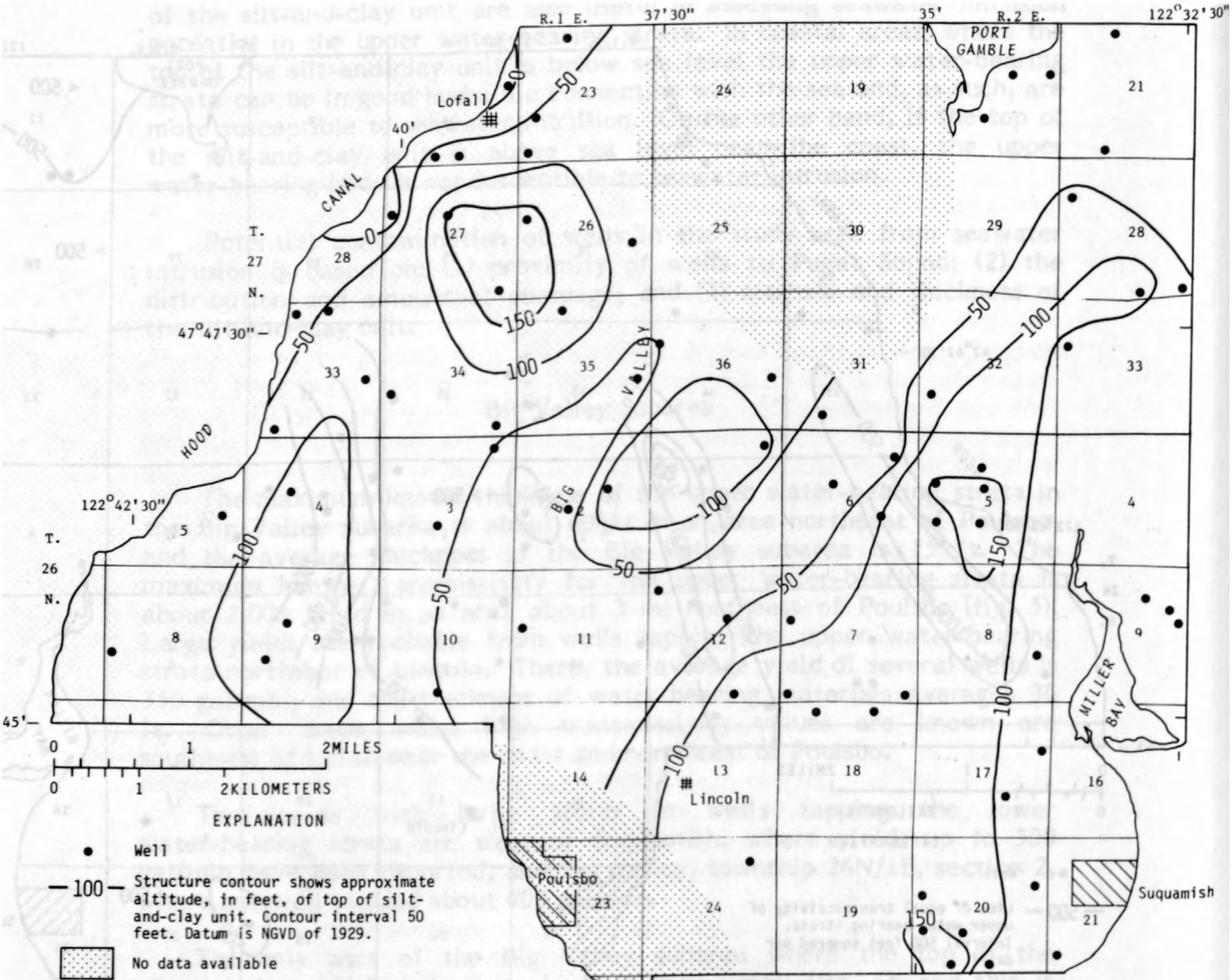


FIGURE 6.--Altitude of the top of the silt-and-clay unit, Big Valley subarea.

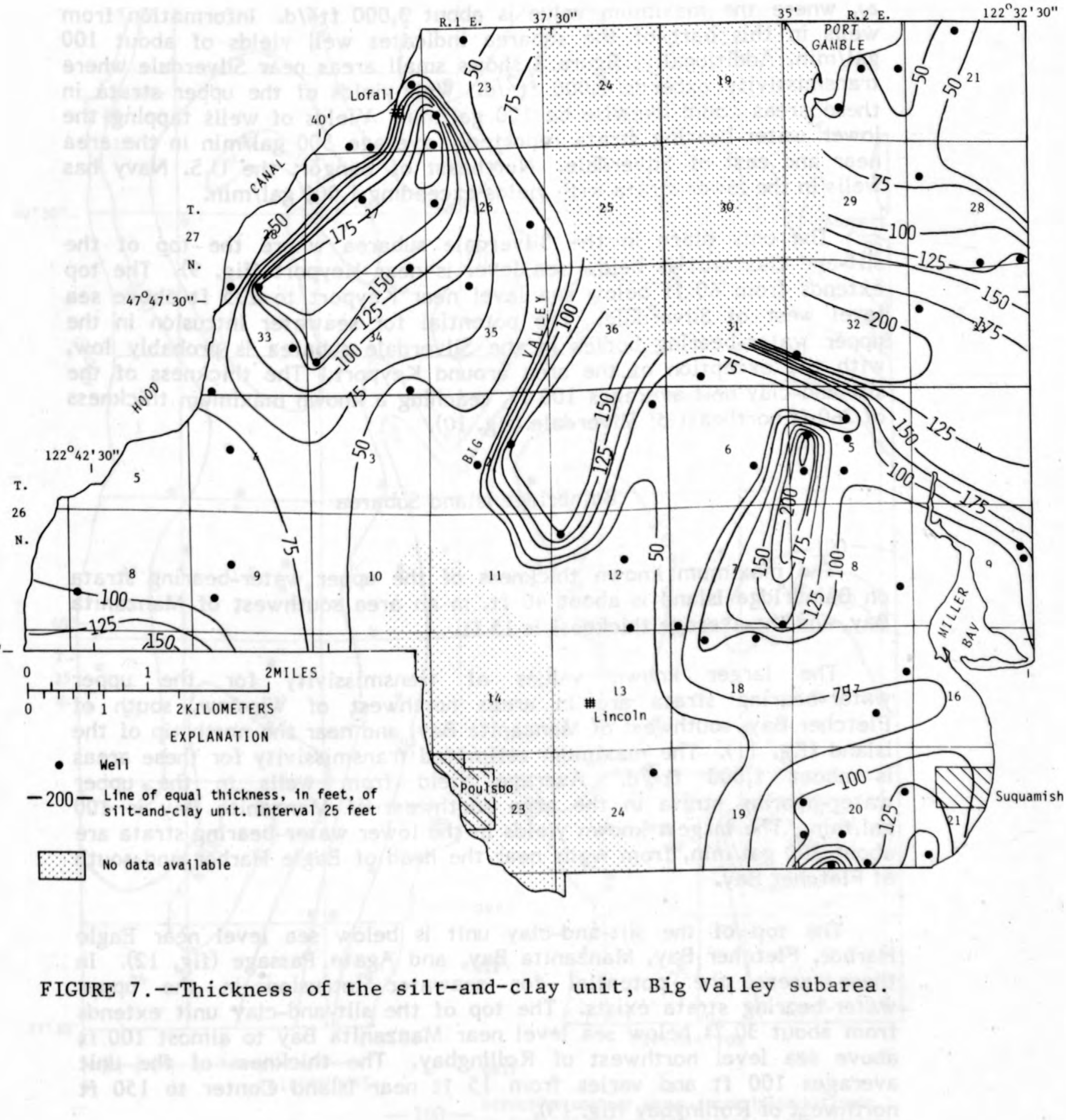


FIGURE 7.--Thickness of the silt-and-clay unit, Big Valley subarea.

Silverdale Subarea

The maximum thickness of the upper water-bearing strata in the Silverdale subarea is about 60 ft, and the average thickness is 20 ft. The largest known transmissivity for the strata is west of Keyport (fig. 8), where the maximum value is about 3,000 ft^2/d. Information from wells in this part of the subarea indicates well yields of about 100 gal/min. Additionally, figure 8 shows small areas near Silverdale where transmissivity exceeds 2,000 ft^2/d. Well yields of the upper strata in these areas could likewise be 100 gal/min. Yields of wells tapping the lower water-bearing strata reportedly average 300 gal/min in the area near and east of Silverdale. Northeast of Bangor, the U.S. Navy has wells in the lower strata with yields exceeding 1,000 gal/min.

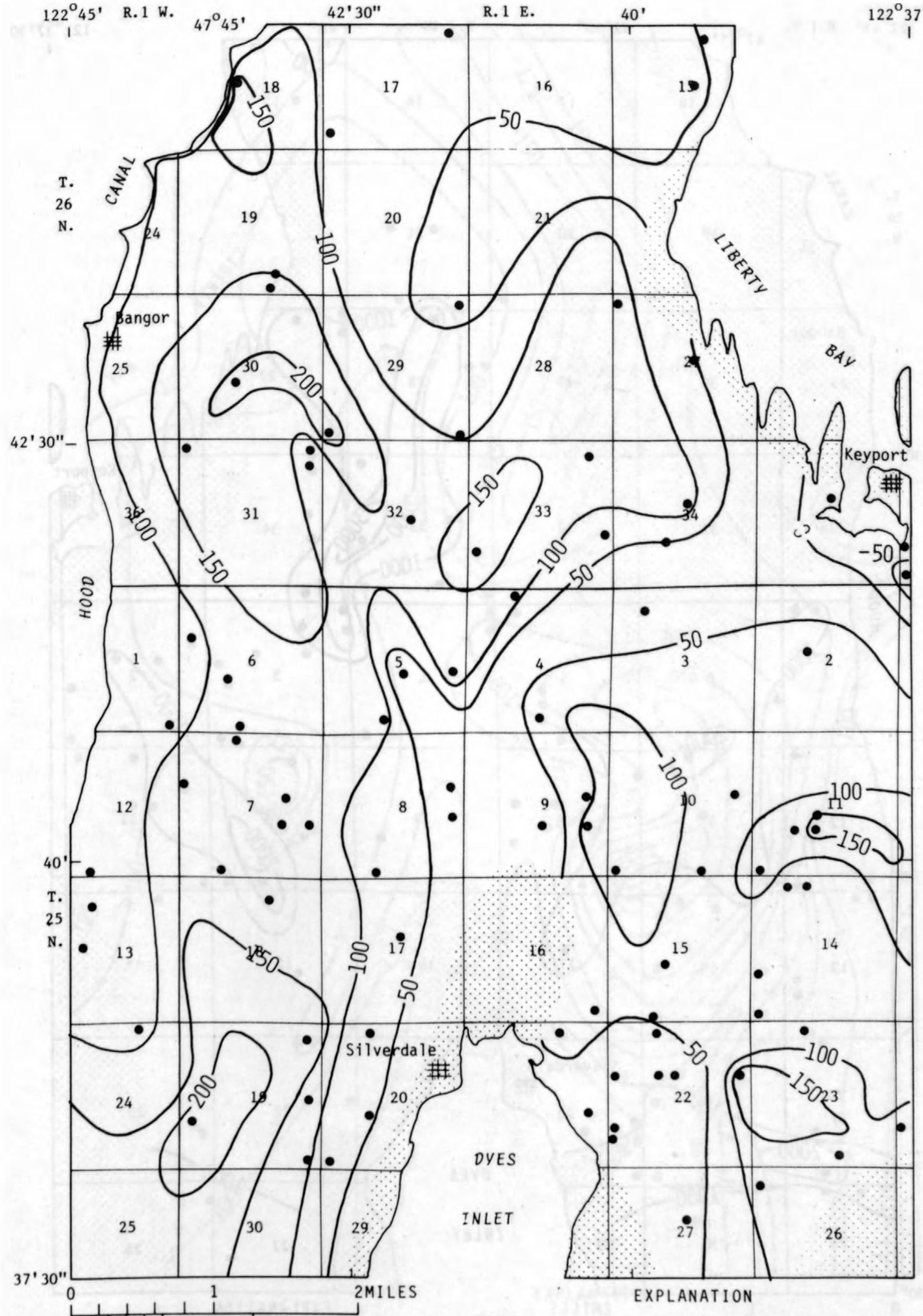
The only place in the Silverdale subarea where the top of the silt-and-clay unit is below sea level is near Keyport (fig. 9). The top extends from 60 ft below sea level near Keyport to 235 ft above sea level west of Silverdale. The potential for seawater intrusion in the upper water-bearing bodies in the Silverdale subarea is probably low, with the exception of the area around Keyport. The thickness of the silt-and-clay unit averages 100 ft, reaching a known maximum thickness of 260 ft northeast of Silverdale (fig. 10).

Bainbridge Island Subarea

The maximum known thickness of the upper water-bearing strata on Bainbridge Island is about 40 ft, in an area southwest of Manzanita Bay, and the average thickness is 15 ft.

The larger known values of transmissivity for the upper water-bearing strata are in areas northwest of Winslow, south of Fletcher Bay, southwest of Manzanita Bay, and near the north tip of the island (fig. 11). The maximum estimated transmissivity for these areas is about 1,000 ft^2/d. Average yield from wells in the upper water-bearing strata in the area southwest of Manzanita Bay is 100 gal/min. The largest known yields in the lower water-bearing strata are about 200 gal/min, from wells near the head of Eagle Harbor and south of Fletcher Bay.

The top of the silt-and-clay unit is below sea level near Eagle Harbor, Fletcher Bay, Manzanita Bay, and Agate Passage (fig. 12). In these areas the potential for seawater intrusion in the upper water-bearing strata exists. The top of the silt-and-clay unit extends from about 30 ft below sea level near Manzanita Bay to almost 100 ft above sea level northwest of Rollingbay. The thickness of the unit averages 100 ft and varies from 15 ft near Island Center to 150 ft northwest of Rollingbay (fig. 13).



EXPLANATION

● Well

—100— Structure contour shows approximate altitude, in feet, of top of silt-and-clay unit. Contour interval 50 feet. Datum is NGVD of 1929.

[dotted box] No data available

FIGURE 8.--Transmissivity of the upper water-bearing strata, Silverdale subarea.

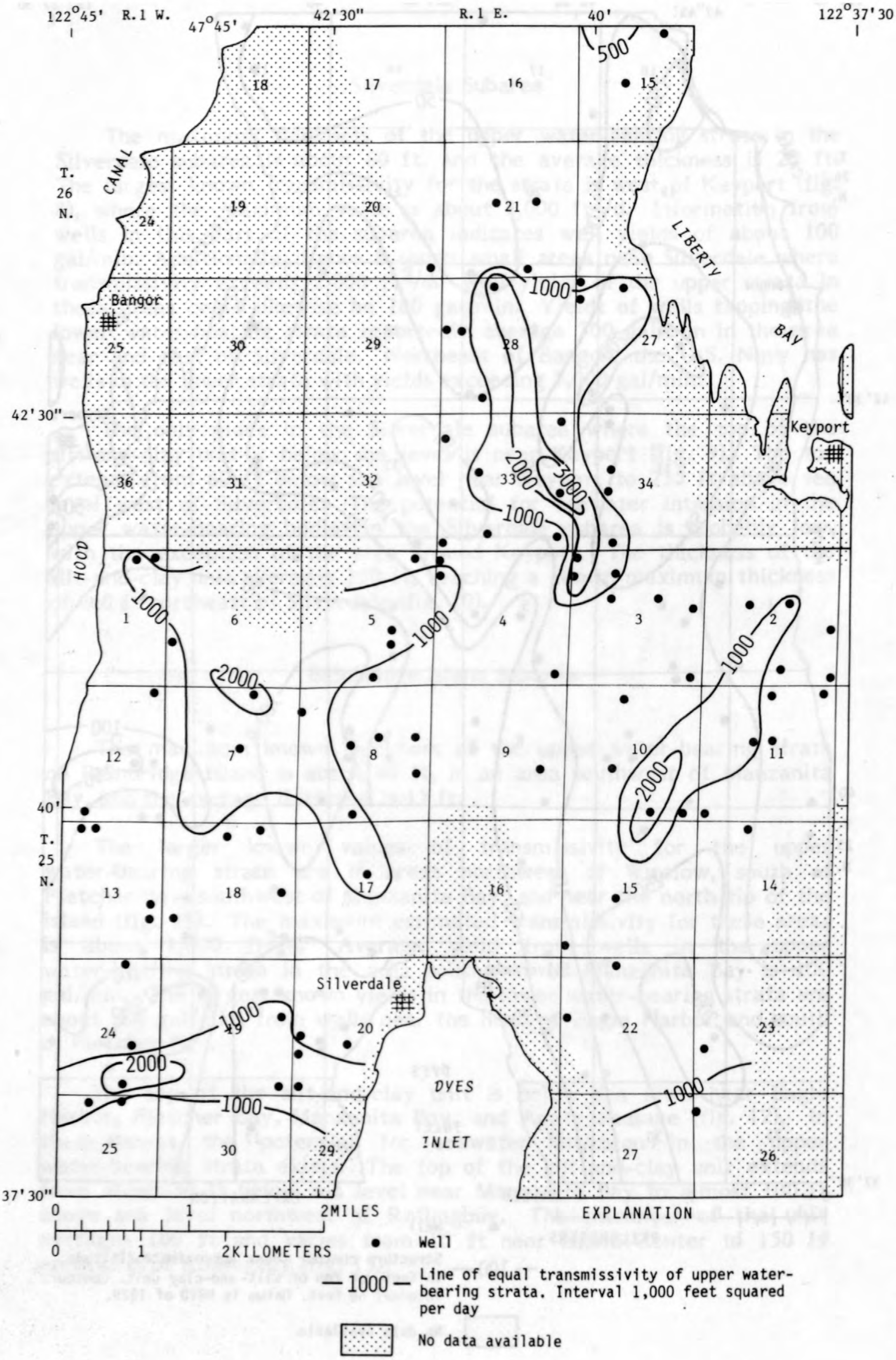


FIGURE 9.--Altitude of the top of the silt-and-clay unit, Silverdale subarea.

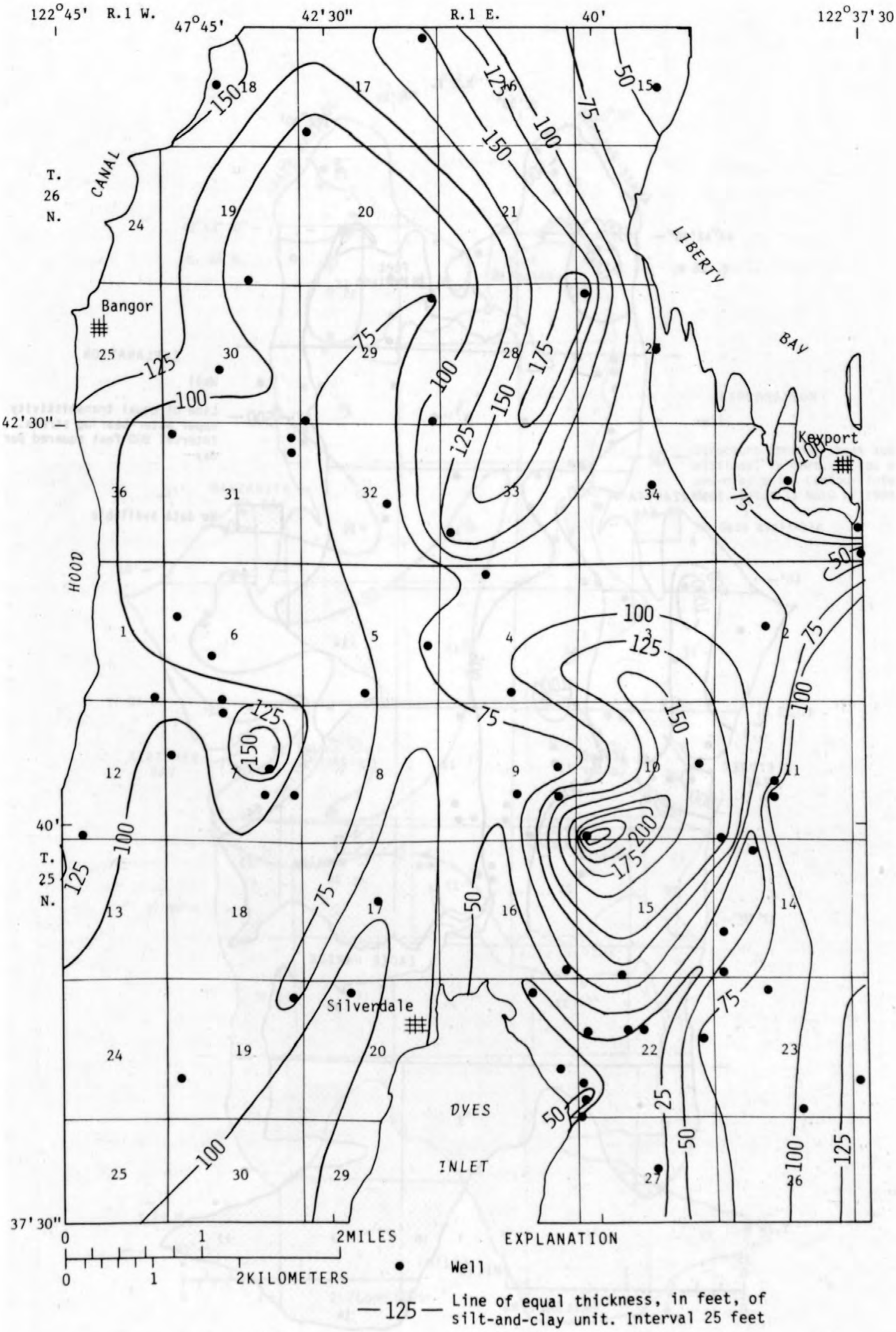


FIGURE 10.--Thickness of the silt-and-clay unit, Silverdale subarea.

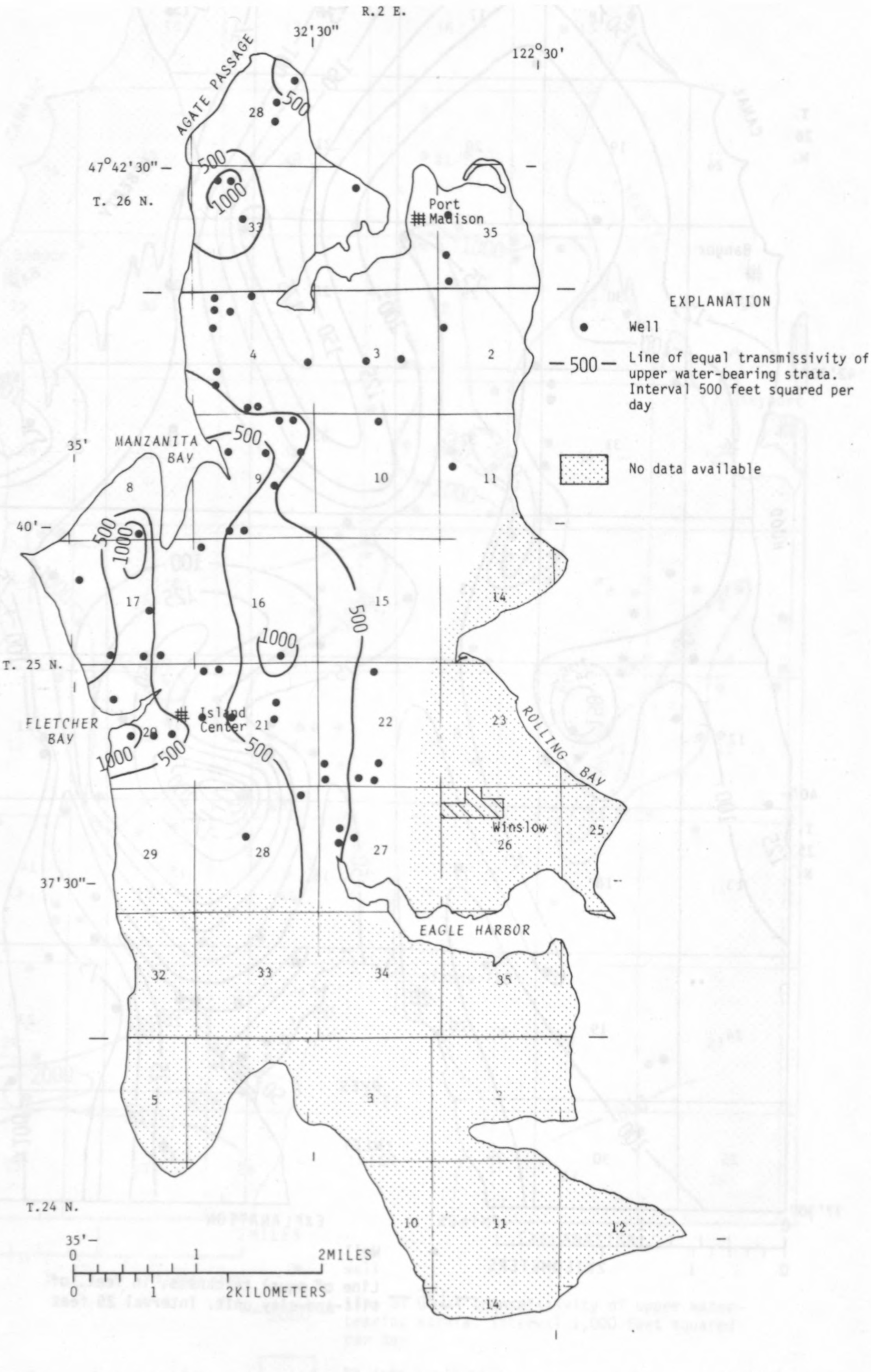


FIGURE 11.--Transmissivity of the upper water-bearing strata, Bainbridge Island subarea.

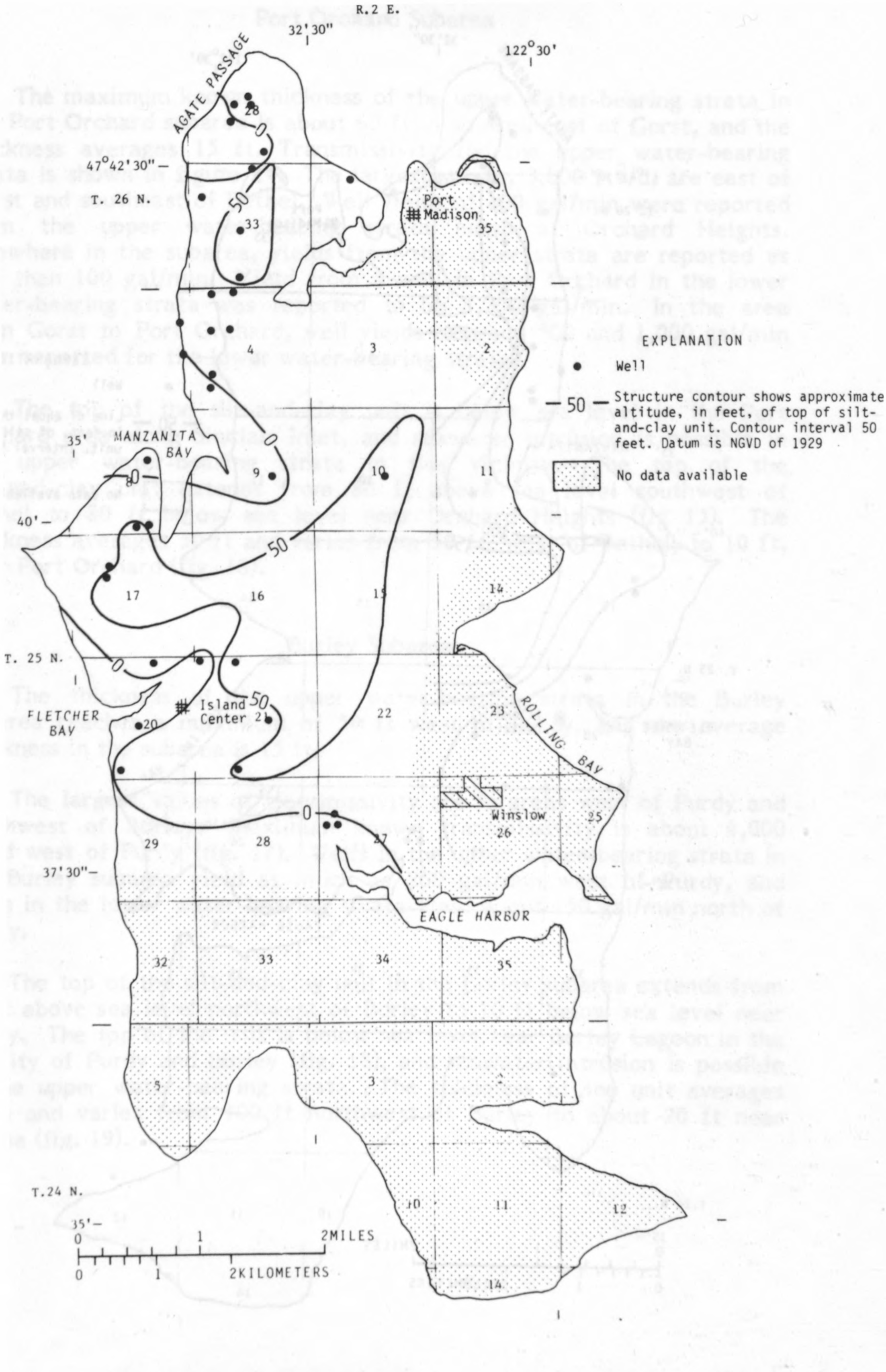


FIGURE 12.--Altitude of the top of the silt-and-clay unit, Bainbridge Island subarea.

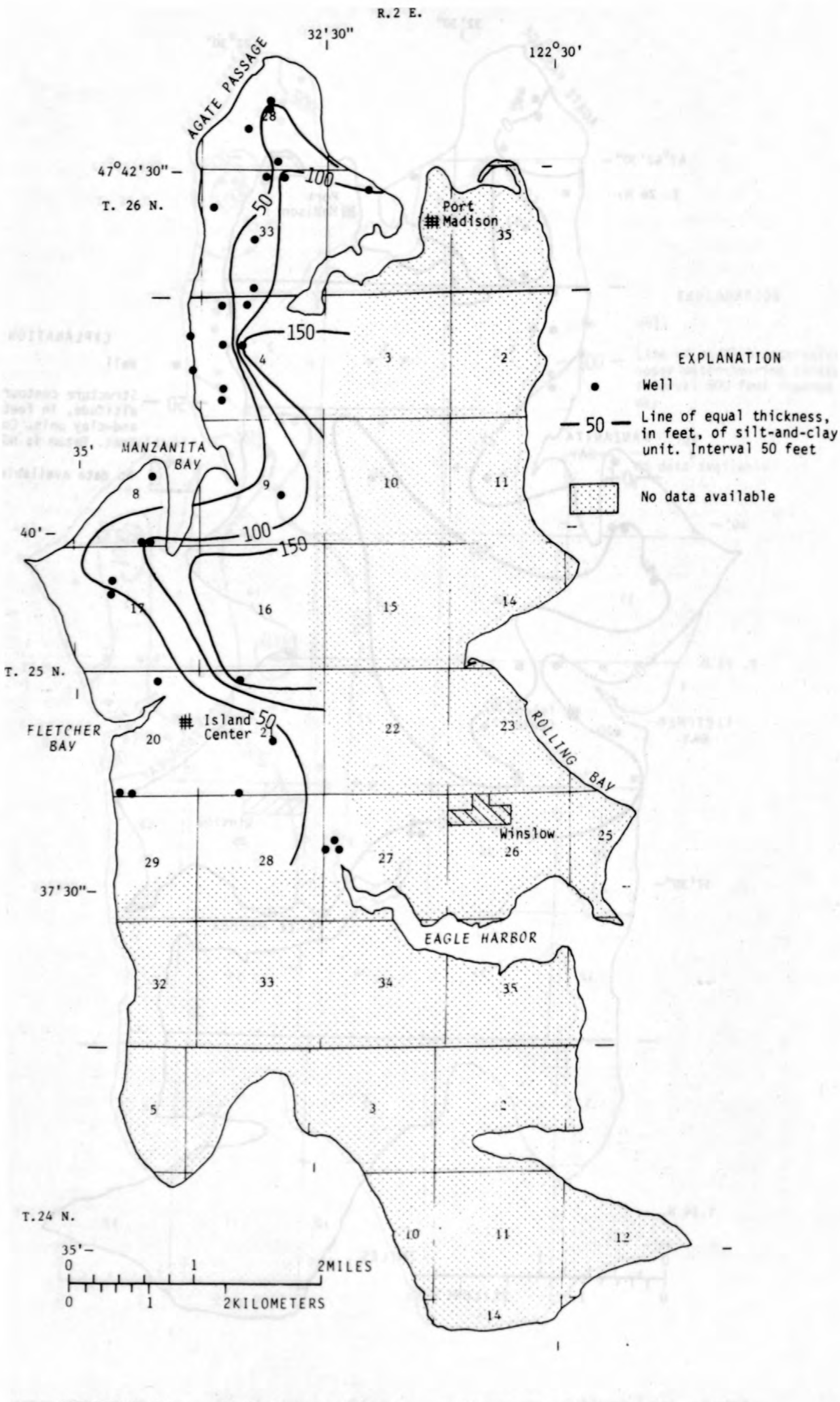


FIGURE 13.--Thickness of the silt-and-clay unit, Bainbridge Island subarea.

Port Orchard Subarea

The maximum known thickness of the upper water-bearing strata in the Port Orchard subarea is about 60 ft in an area east of Gorst, and the thickness averages 15 ft. Transmissivity for the upper water-bearing strata is shown in figure 14. The largest values, 3,000 ft^2/d, are east of Gorst and southeast of Bethel. Well yields of 100 gal/min were reported from the upper water-bearing strata north of Orchard Heights. Elsewhere in the subarea, yields from the upper strata are reported as less than 100 gal/min. Yield from a well in Port Orchard in the lower water-bearing strata was reported to be 1,700 gal/min. In the area from Gorst to Port Orchard, well yields between 500 and 1,000 gal/min were reported for the lower water-bearing strata.

The top of the silt-and-clay unit is below sea level in the Port Orchard area along Sinclair Inlet, and seawater intrusion is possible in the upper water-bearing strata in this vicinity. The top of the silt-and-clay unit extends from 80 ft above sea level southwest of Bethel to 80 ft below sea level near Orchard Heights (fig 15). The thickness averages 30 ft and varies from 50 ft, west of Bethel, to 10 ft, near Port Orchard (fig. 16).

Burley Subarea

The thickness of the upper water-bearing strata in the Burley subarea reaches a maximum of 50 ft west of Purdy, and the average thickness in the subarea is 15 ft.

The largest values of transmissivity are in areas west of Purdy and northwest of Burley. Maximum known transmissivity is about 4,000 ft^2/d west of Purdy (fig. 17). Wells in the upper water-bearing strata in the Burley subarea yield as much as 200 gal/min west of Purdy, and wells in the lower water-bearing strata yield about 150 gal/min north of Purdy.

The top of the silt-and-clay unit in the Burley subarea extends from 80 ft above sea level northwest of Burley to 10 ft below sea level near Purdy. The top of the unit is below sea level near Burley Lagoon in the vicinity of Purdy and Burley (fig. 18), and seawater intrusion is possible in the upper water-bearing strata. The thickness of the unit averages 50 ft and varies from 100 ft northwest of Burley to about 20 ft near Wauna (fig. 19).

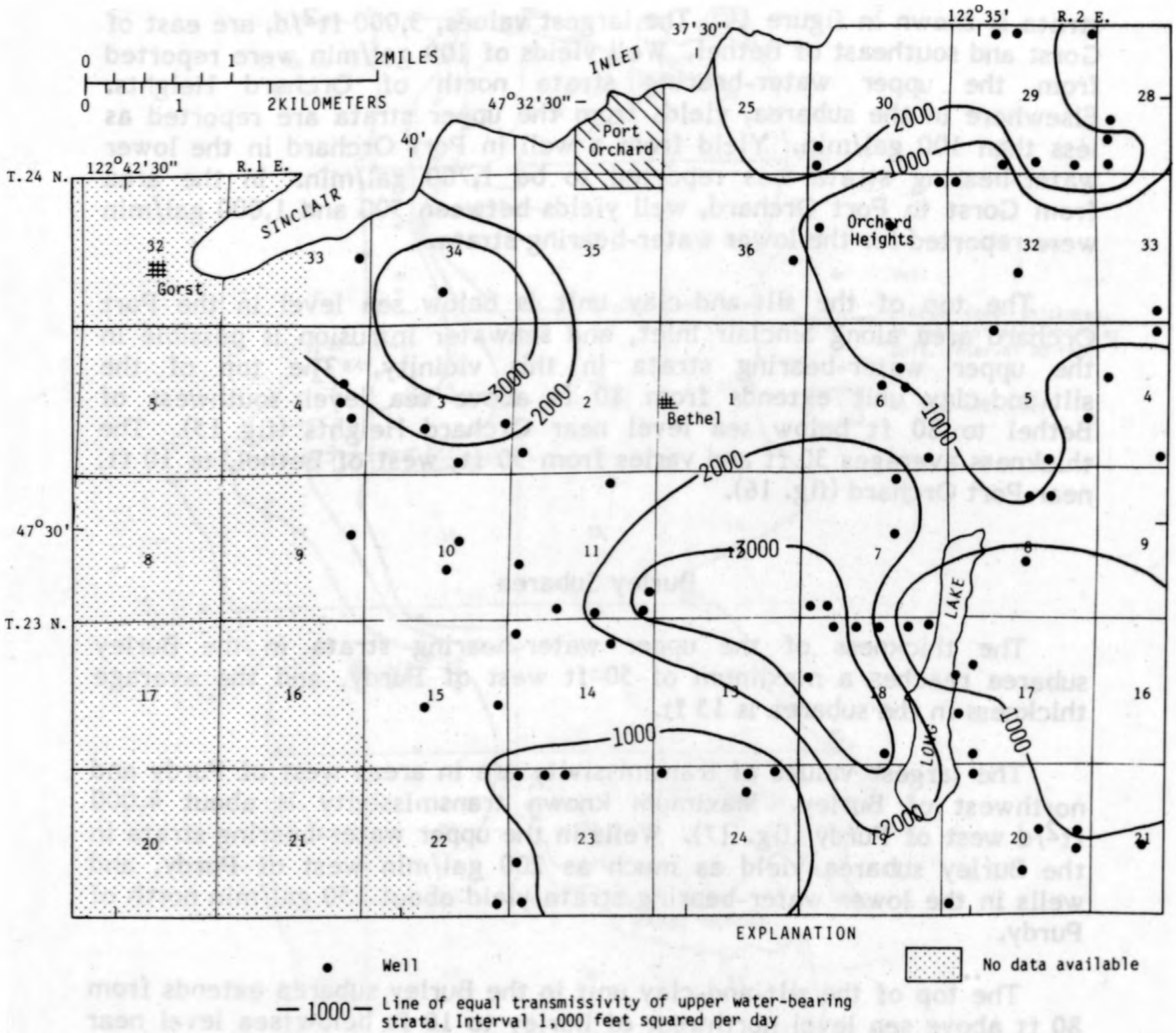


FIGURE 14.--Transmissivity of the upper water-bearing strata, Port Orchard subarea.

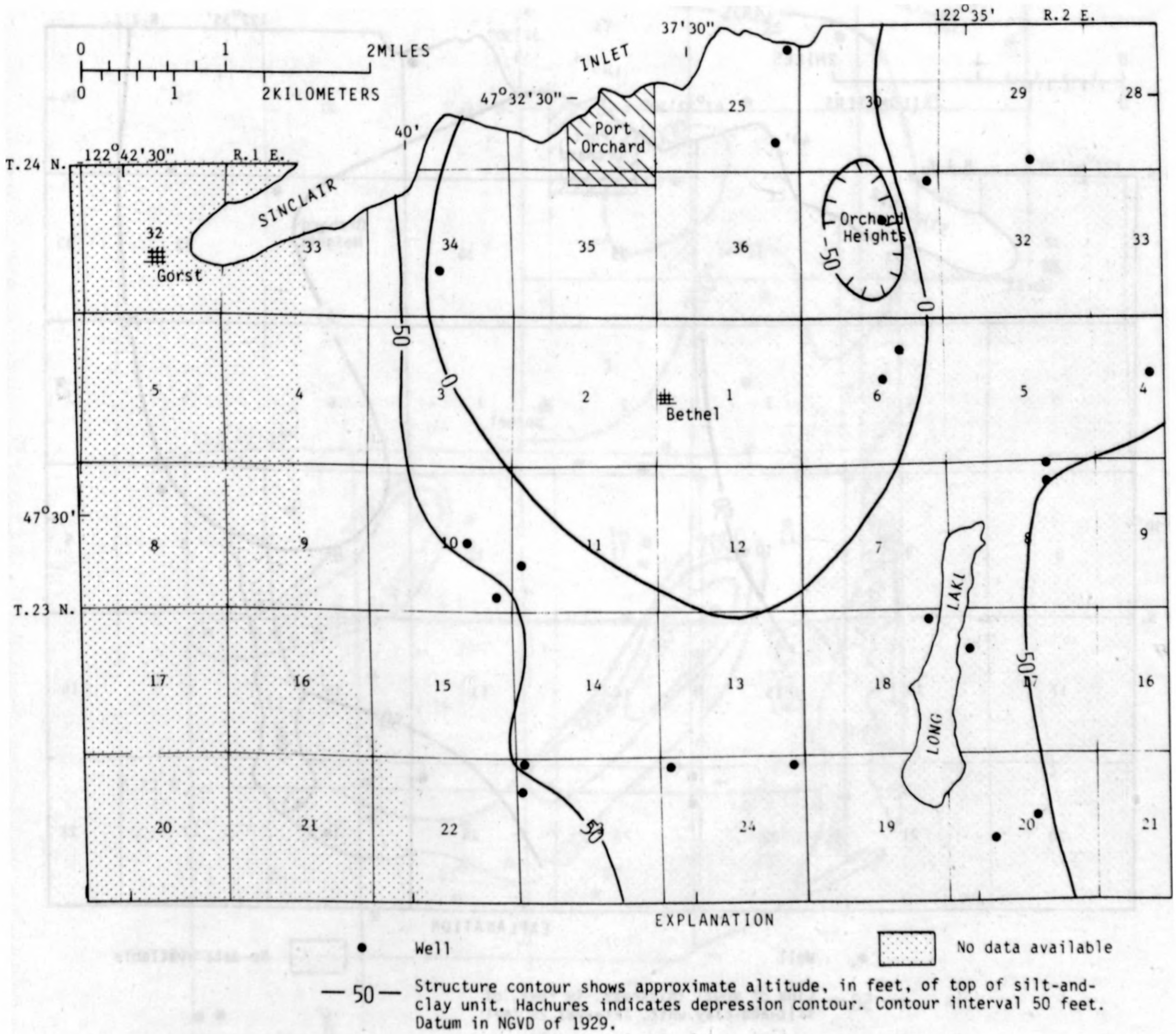


FIGURE 15.--Altitude of the top of the silt-and-clay unit, Port Orchard subarea.

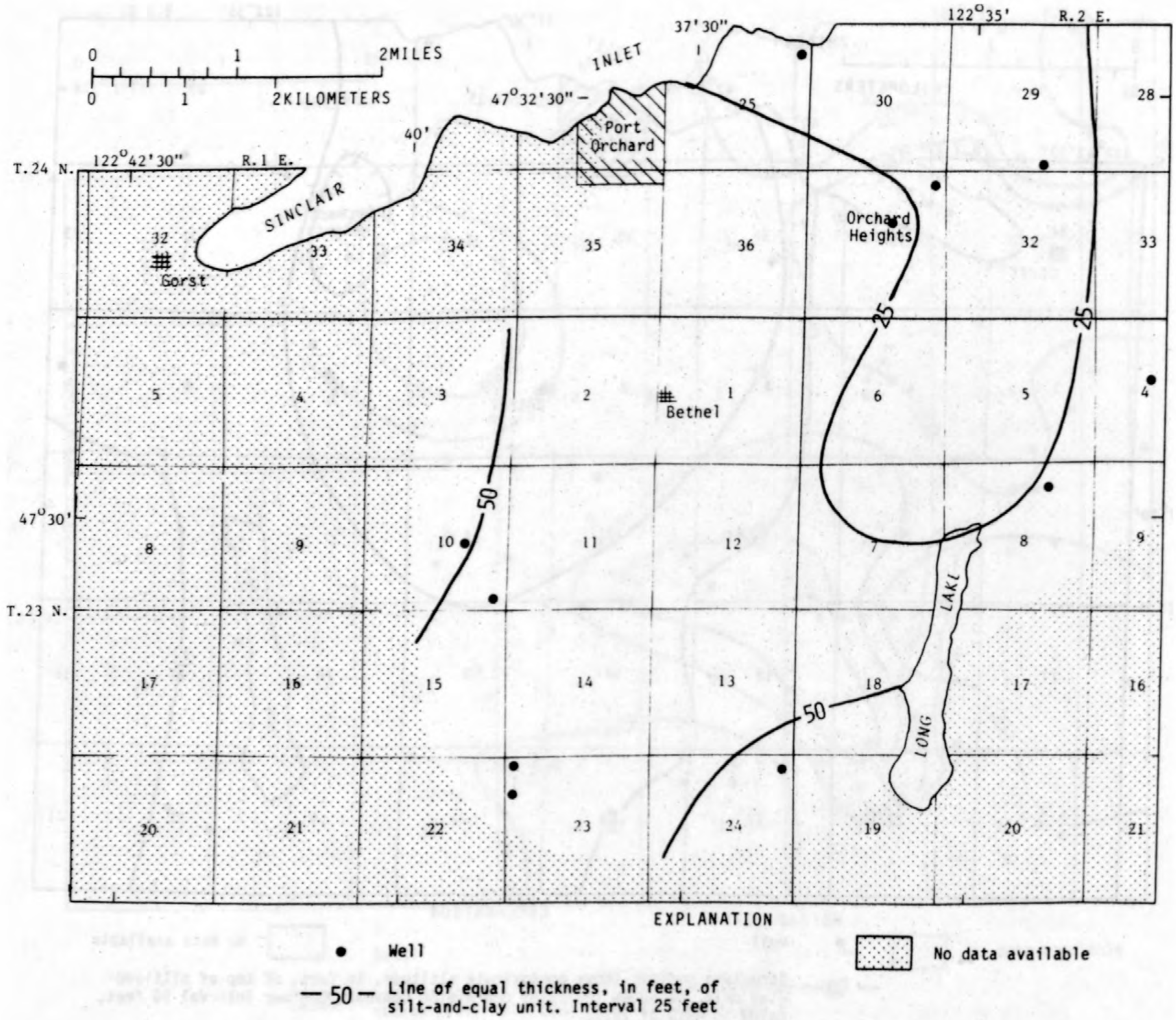


FIGURE 16.--Thickness of the silt-and-clay unit, Port Orchard subarea.

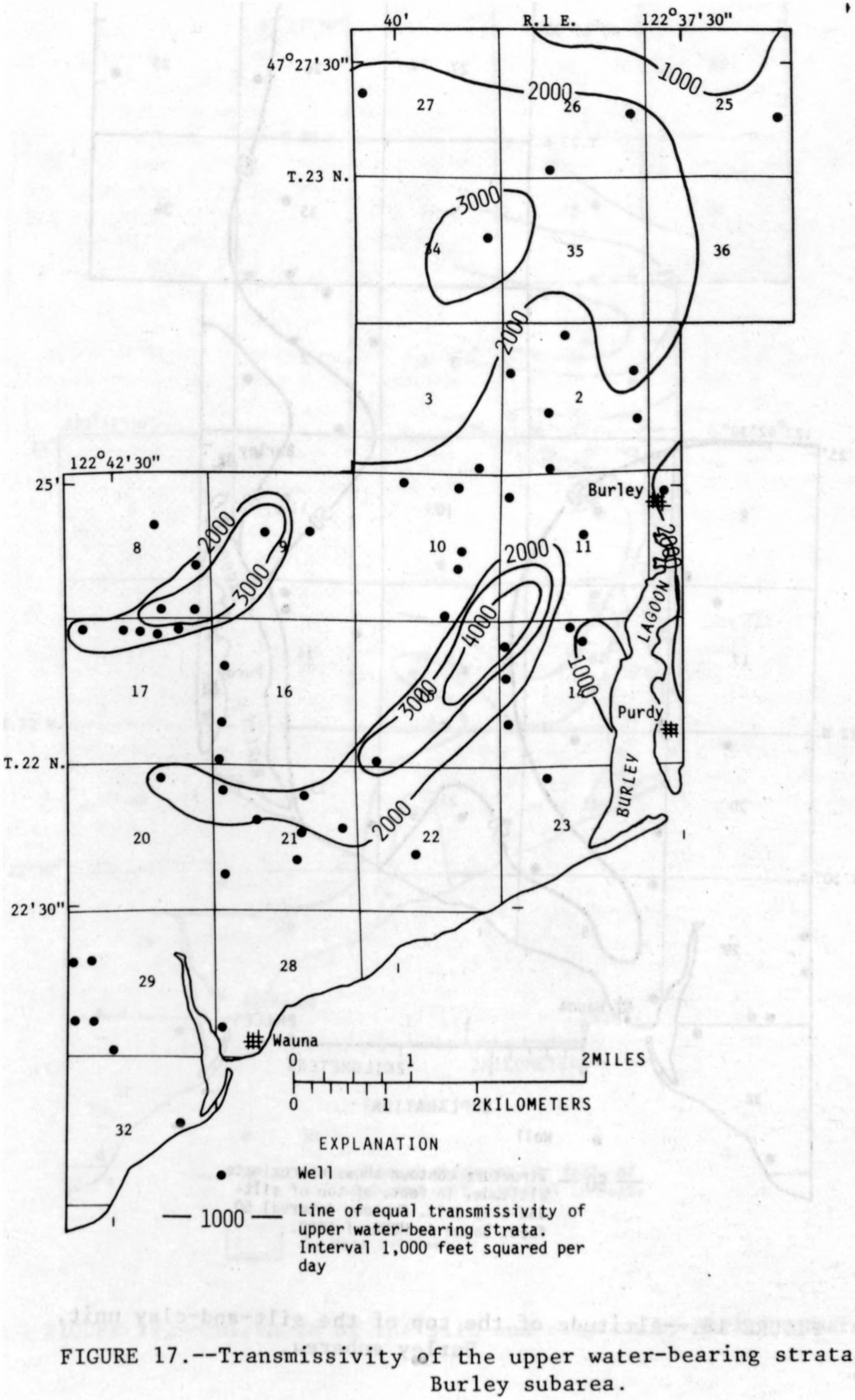


FIGURE 17.--Transmissivity of the upper water-bearing strata, Burley subarea.

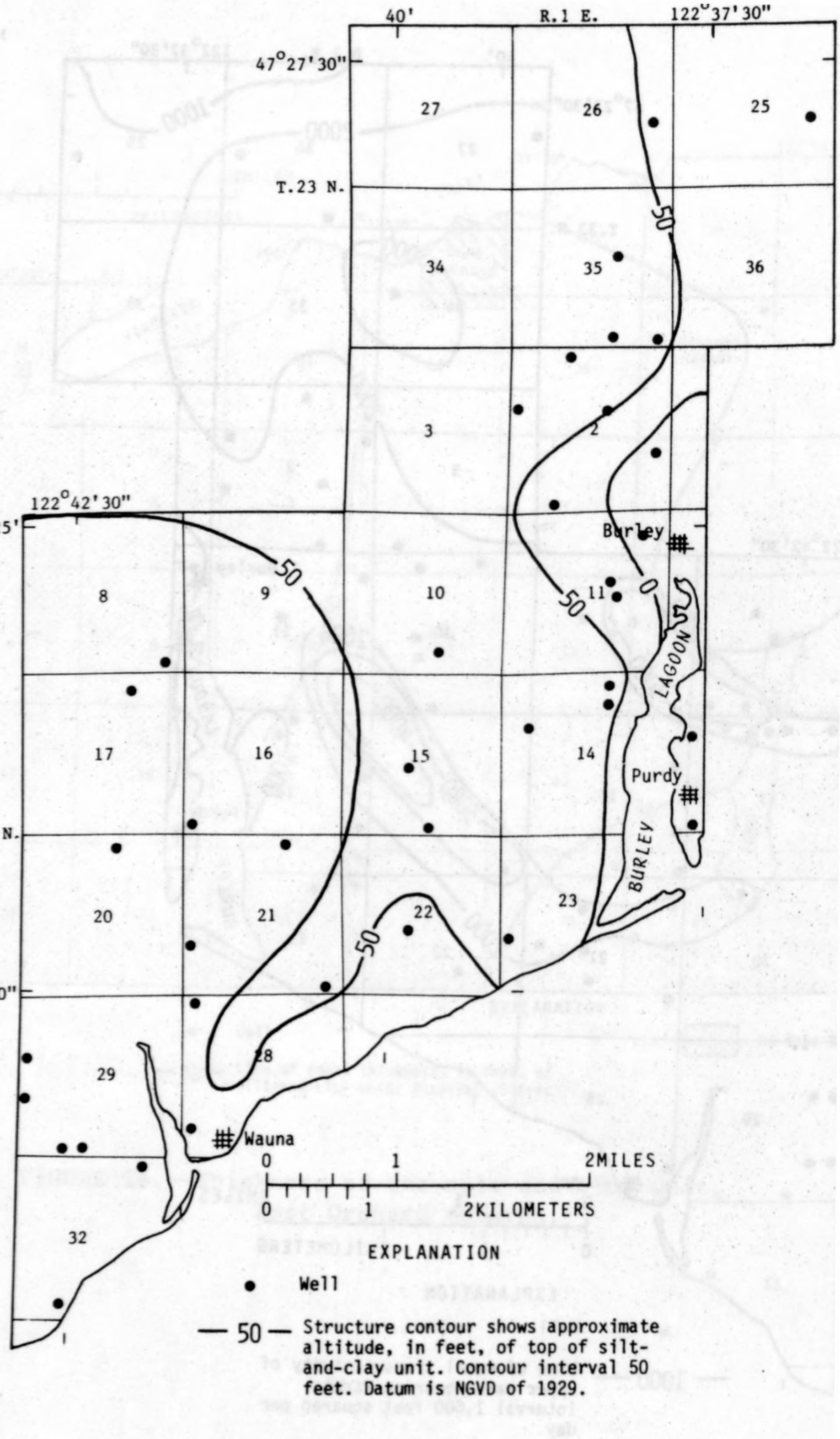


FIGURE 18.--Altitude of the top of the silt-and-clay unit Burley subarea.

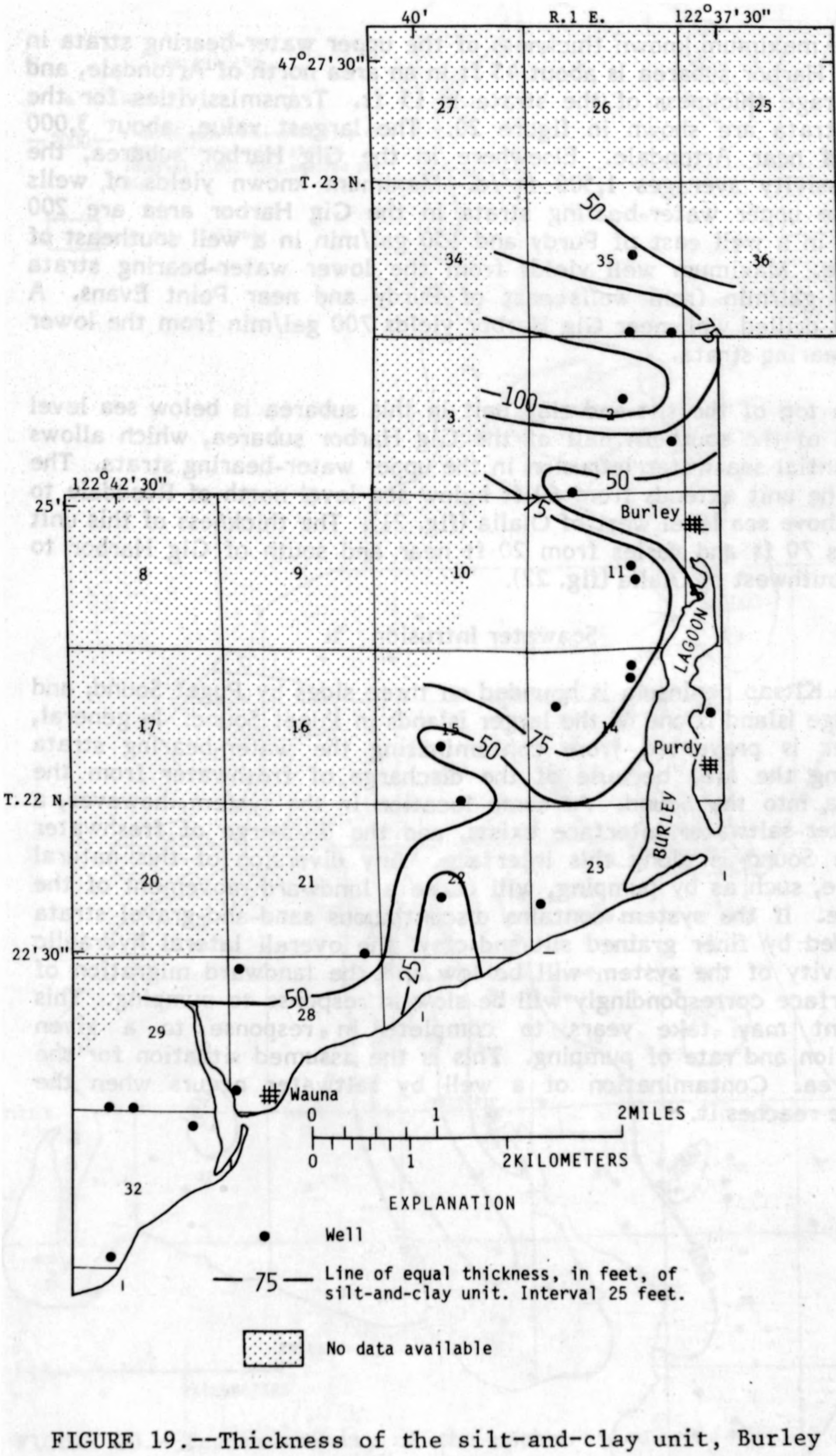


FIGURE 19.--Thickness of the silt-and-clay unit, Burley subarea.

Gig Harbor Subarea

The maximum known thickness of the upper water-bearing strata in the Gig Harbor subarea is about 45 ft in an area north of Artondale, and the average thickness of the strata is 15 ft. Transmissivities for the upper strata are shown in figure 20. The largest value, about 3,000 ft^2/d, is near Artondale. Elsewhere in the Gig Harbor subarea, the transmissivity averages 1,500 ft^2/d. Maximum known yields of wells from the upper water-bearing strata in the Gig Harbor area are 200 gal/min in a well east of Purdy and 150 gal/min in a well southeast of Rosedale. Maximum well yields from the lower water-bearing strata are 200 gal/min from wells east of Purdy and near Point Evans. A recently drilled well near Gig Harbor yields 700 gal/min from the lower water-bearing strata.

The top of the silt-and-clay unit in this subarea is below sea level in much of the southern half of the Gig Harbor subarea, which allows for potential sea-water intrusion in the upper water-bearing strata. The top of the unit extends from 60 ft below sea level north of Rosedale to 180 ft above sea level west of Olalla (fig. 21). The thickness of this unit averages 70 ft and varies from 20 ft near and south of Gig Harbor to 180 ft southwest of Olalla (fig. 22).

Seawater Intrusion

The Kitsap peninsula is bounded on three sides by Puget Sound, and Bainbridge Island is one of the larger islands in Puget Sound. In general, saltwater is prevented from contaminating the water-bearing strata underlying the area because of the discharge of freshwater from the peninsula into the Sound. At some location in the system, however, a freshwater-saltwater interface exists, and the discharge of freshwater into the Sound is along this interface. Any diversion of this natural discharge, such as by pumping, will cause a landward movement of the interface. If the system contains discontinuous sand-and-gravel strata surrounded by finer grained silt-and-clay, the overall lateral hydraulic conductivity of the system will be low and the landward migration of the interface correspondingly will be slow in response to pumping. This movement may take years to complete in response to a given distribution and rate of pumping. This is the assumed situation for the study area. Contamination of a well by saltwater occurs when the interface reaches it.

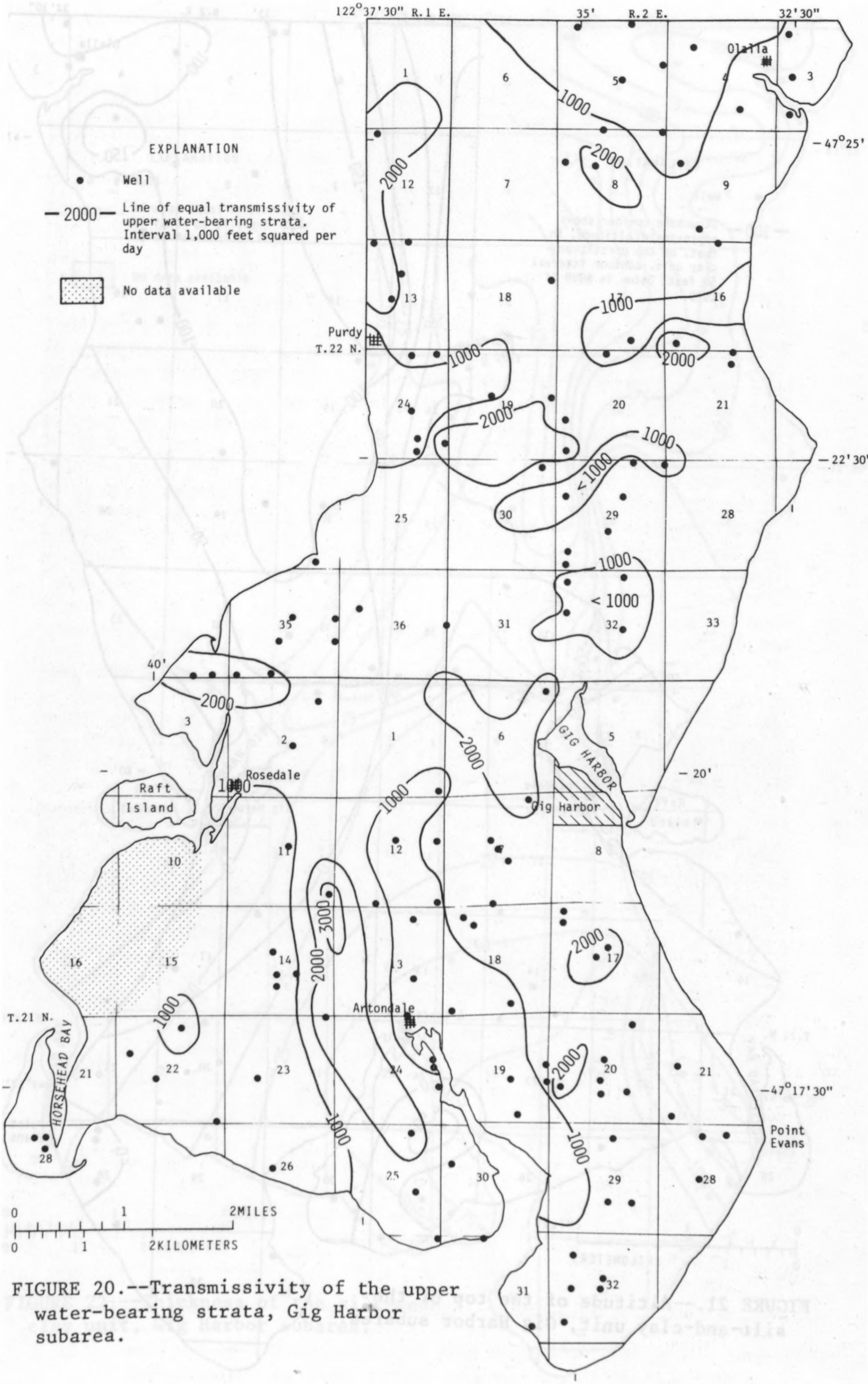


FIGURE 20.--Transmissivity of the upper water-bearing strata, Gig Harbor subarea.

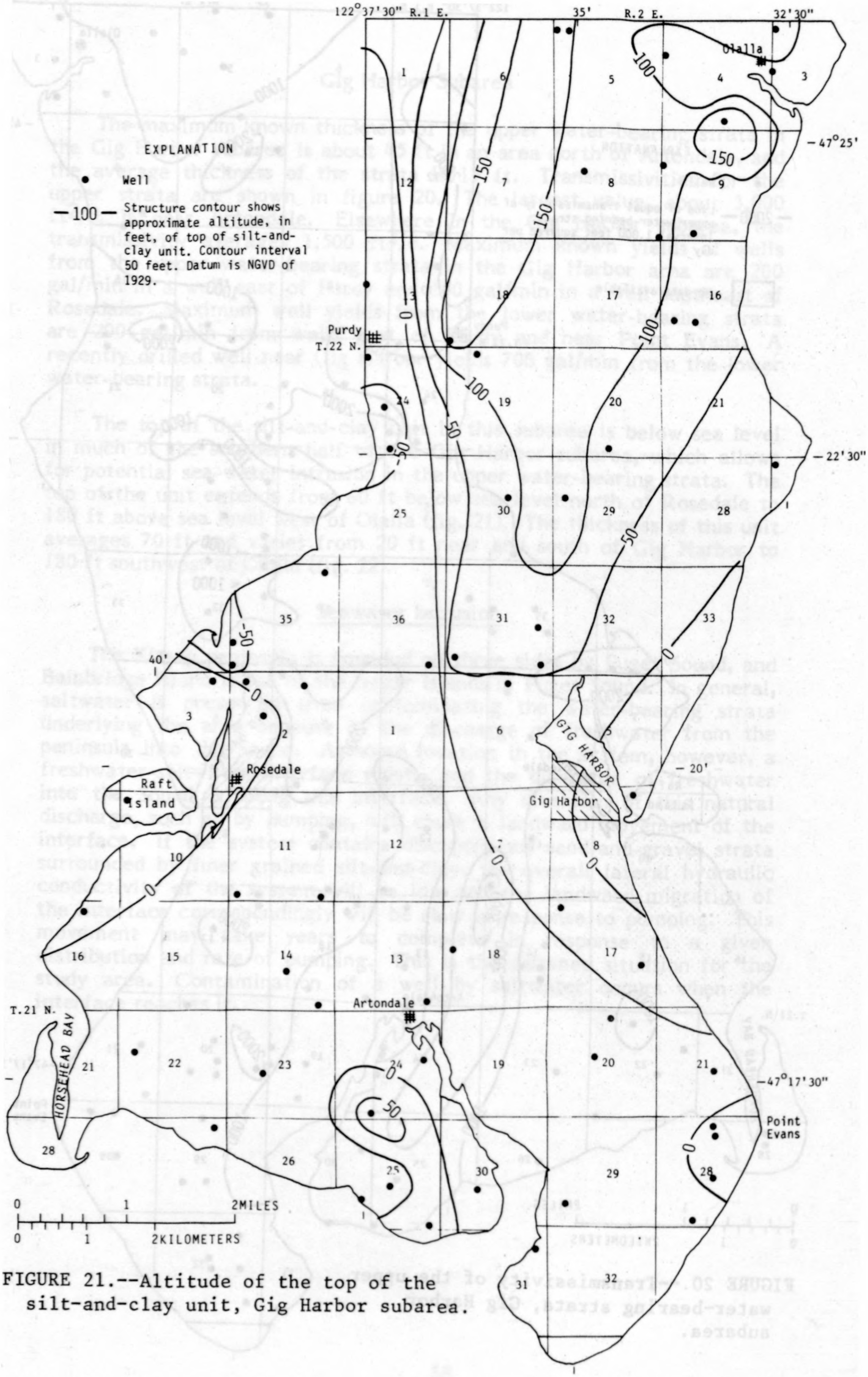


FIGURE 21.--Altitude of the top of the silt-and-clay unit, Gig Harbor subarea.

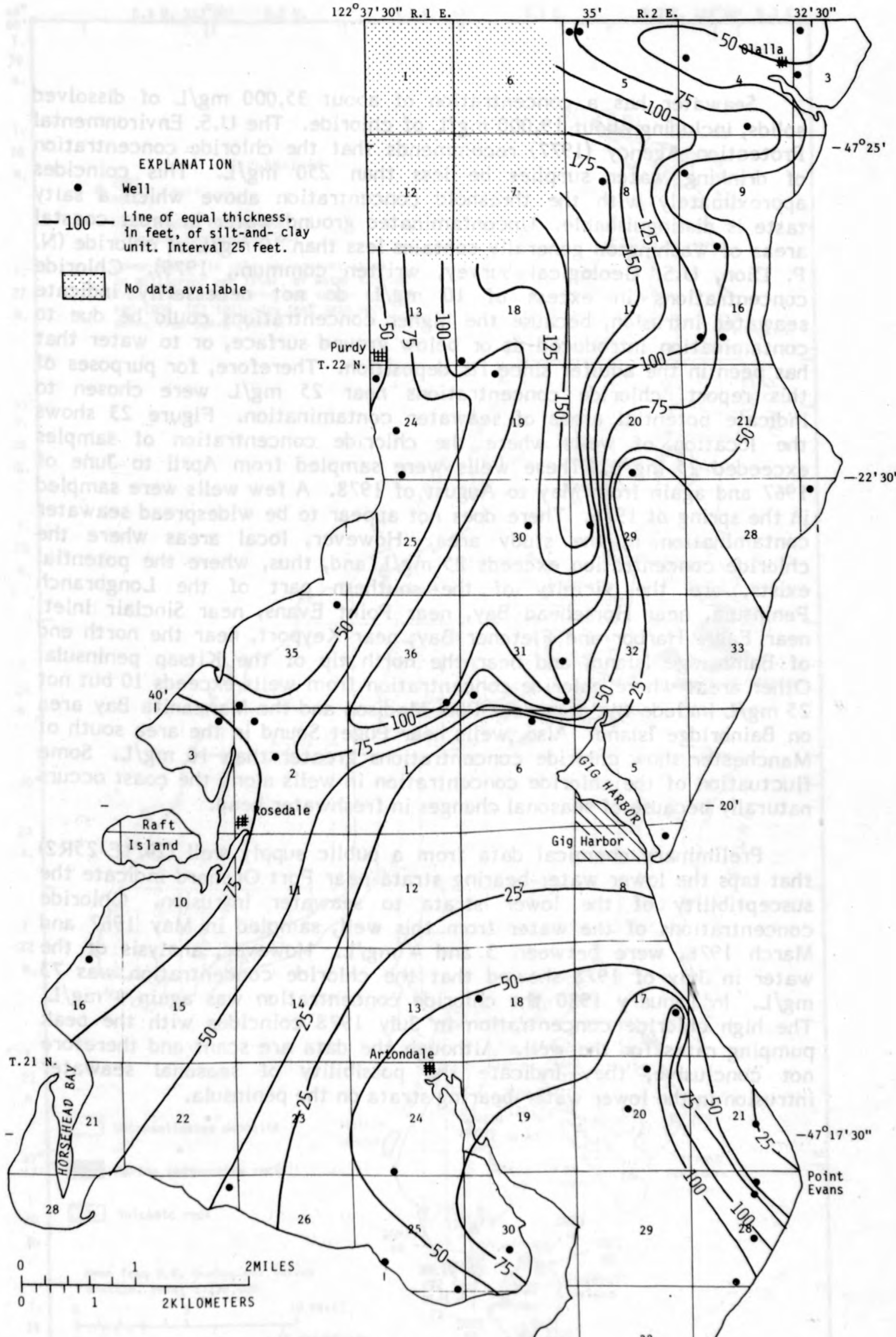


FIGURE 22.--Thickness of the silt-and-clay unit, Gig Harbor subarea.

Seawater has a concentration of about 35,000 mg/L of dissolved solids, including about 19,000 mg/L of chloride. The U.S. Environmental Protection Agency (1977) recommends that the chloride concentration of drinking water supplies be less than 250 mg/L. This coincides approximately with the threshold concentration above which a salty taste is distinguishable. Uncontaminated ground water in most coastal areas of Washington generally contains less than 10 mg/L of chloride (N. P. Dion, U.S. Geological Survey, written commun., 1979). Chloride concentrations in excess of 10 mg/L do not necessarily indicate seawater intrusion, because the higher concentrations could be due to contamination introduced at or below ground surface, or to water that has been in the aquifer since its deposition. Therefore, for purposes of this report, chloride concentrations near 25 mg/L were chosen to indicate potential areas of seawater contamination. Figure 23 shows the location of wells where the chloride concentration of samples exceeded 25 mg/L. These wells were sampled from April to June of 1967 and again from May to August of 1978. A few wells were sampled in the spring of 1976. There does not appear to be widespread seawater contamination in the study area. However, local areas where the chloride concentration exceeds 25 mg/L and, thus, where the potential exists, are the vicinity of the southern part of the Longbranch Peninsula, near Horsehead Bay, near Point Evans, near Sinclair Inlet, near Eagle Harbor and Fletcher Bay, near Keyport, near the north end of Bainbridge Island, and near the north tip of the Kitsap peninsula. Other areas where chloride concentration from wells exceeds 10 but not 25 mg/L include the area near Port Madison and the Manzanita Bay area on Bainbridge Island. Also, wells near Puget Sound in the area south of Manchester show chloride concentrations greater than 10 mg/L. Some fluctuation of the chloride concentration in wells along the coast occurs naturally because of seasonal changes in freshwater head.

Preliminary chemical data from a public supply well (24/1E-25R2) that taps the lower water-bearing strata near Port Orchard indicate the susceptibility of the lower strata to seawater intrusion. Chloride concentrations of the water from this well, sampled in May 1967 and March 1976, were between 3 and 4 mg/L. However, analysis of the water in July of 1978 showed that the chloride concentration was 73 mg/L. In January 1980 the chloride concentration was again 4 mg/L. The high chloride concentration in July 1978 coincides with the peak pumping rates for the well. Although the data are scant and therefore not conclusive, they indicate the possibility of seasonal seawater intrusion in the lower water-bearing strata on the peninsula.

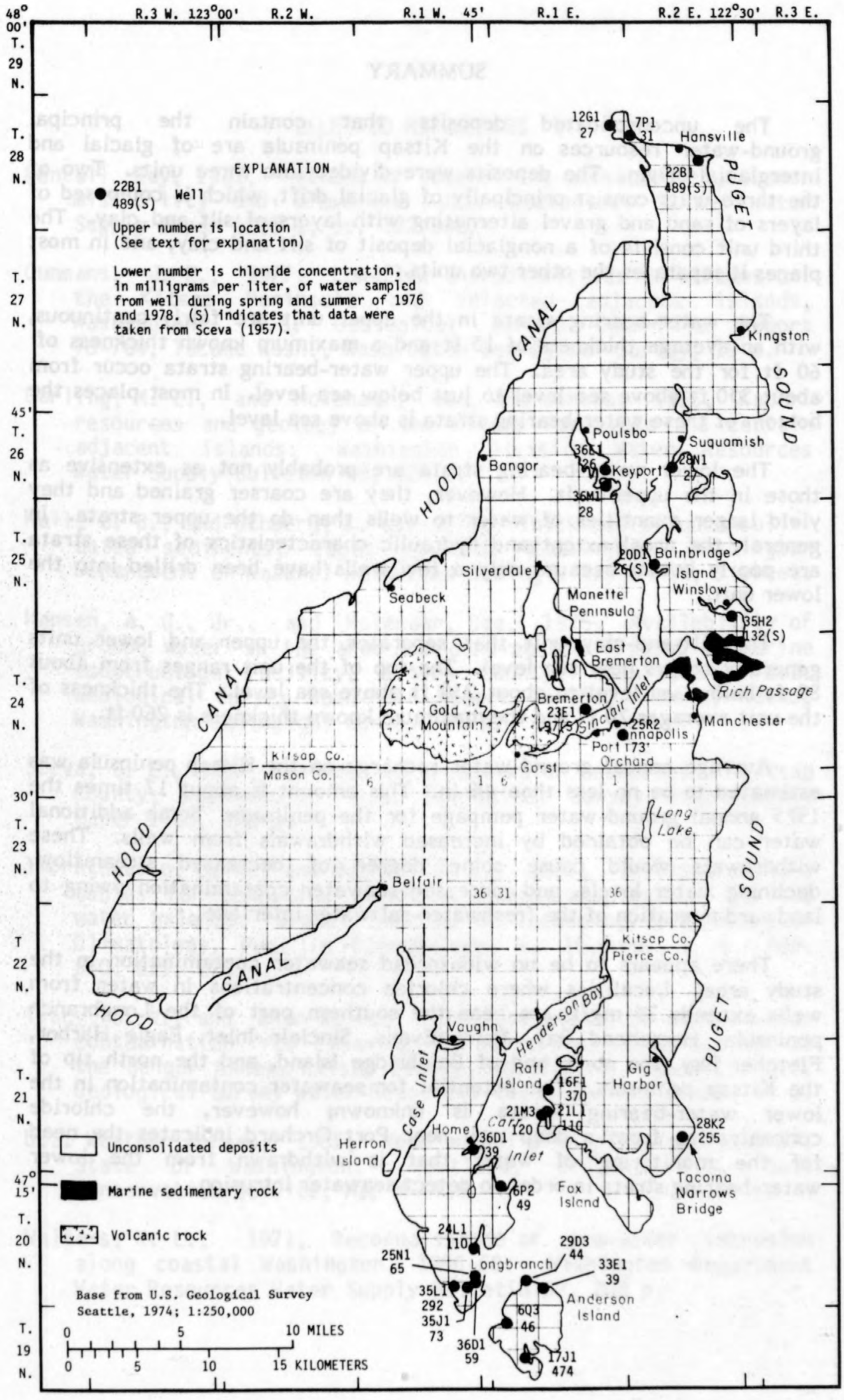


FIGURE 23.--Location of wells in Kitsap Peninsula where chloride concentration exceeded 25 mg/L in spring and summer of 1976 and 1978.

SUMMARY

The unconsolidated deposits that contain the principal ground-water resources on the Kitsap peninsula are of glacial and interglacial origin. The deposits were divided into three units. Two of the three units consist principally of glacial drift, which is composed of layers of sand and gravel alternating with layers of silt and clay. The third unit consists of a nonglacial deposit of silt and clay, and in most places it separates the other two units.

The water-bearing strata in the upper unit are fairly continuous, with an average thickness of 15 ft and a maximum known thickness of 60 ft for the study area. The upper water-bearing strata occur from about 350 ft above sea level to just below sea level. In most places the bottom of these water-bearing strata is above sea level.

The lower water-bearing strata are probably not as extensive as those in the upper unit. However, they are coarser grained and they yield larger quantities of water to wells than do the upper strata. In general, the areal extent and hydraulic characteristics of these strata are poorly known because only a few wells have been drilled into the lower unit.

The silt-and-clay unit that separates the upper and lower units generally occurs near sea level. The top of the unit ranges from about 80 ft below sea level to about 230 ft above sea level. The thickness of the unit averages 70 ft and the maximum known thickness is 260 ft.

Average annual ground-water recharge on the Kitsap peninsula was estimated to be no less than 4½ in. This amount is about 17 times the 1975 annual ground-water pumpage for the peninsula. Some additional water can be obtained by increased withdrawals from wells. These withdrawals would cause some degree of decreased streamflow, declining water levels, and increased seawater contamination owing to landward migration of the freshwater-saltwater interface.

There appears to be no widespread seawater contamination in the study area. Localities where chloride concentrations in water from wells exceeds 25 mg/L are near the southern part of the Longbranch peninsula, Horsehead Bay, Point Evans, Sinclair Inlet, Eagle Harbor, Fletcher Bay, the north end of Bainbridge Island, and the north tip of the Kitsap peninsula. The potential for seawater contamination in the lower water-bearing strata is unknown; however, the chloride concentration from a deep well near Port Orchard indicates the need for the monitoring of water that is withdrawn from the lower water-bearing strata in order to detect seawater intrusion.

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