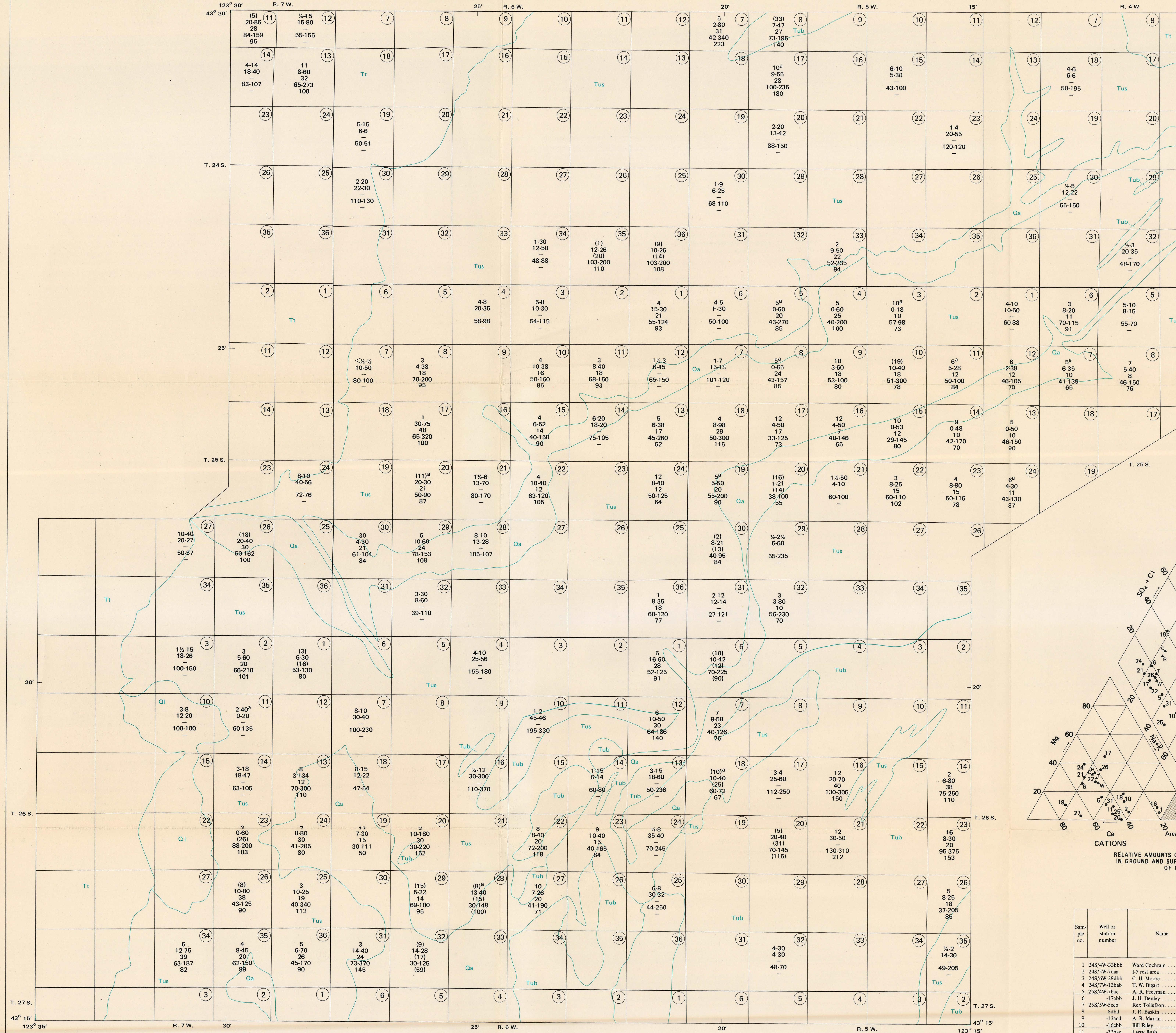
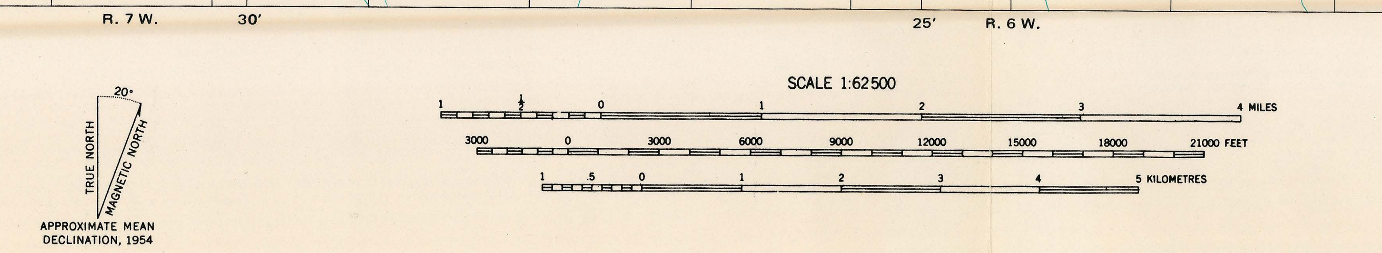
PREPARED IN COOPERATION WITH
DOUGLAS COUNTY

WATER-RESOURCES INVESTIGATIONS 32-74
OPEN-FILE REPORT (SHEET 2 of 2)

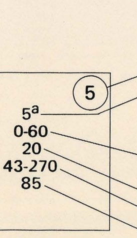


Geology modified from Baldwin (1964), Hampton (1957), Lawrence (1961), Patterson (1961), Payton (1961), and Westhusing (1959).



WELL-CHARACTERISTICS MAP

EXPLANATION



Section number
Median of discharge rates reported for bailer tests, in gallons per minute. Where fewer than four values reported, the range in rates is shown
Depth to water; range in feet (F indicates level above land surface)
Median of depths to water, in feet
Total depths of wells; range in feet
Median of total depth of wells, in feet

Medians not shown where fewer than four values are reported from sections; ranges in depths shown where two or three values are reported.

Medians in parentheses ( ) are of limited usefulness because of extreme variability of individual values.

[a]Significant number of unsuccessful wells due to insufficient water as reported by drillers. Values for failures not included in compilation.

See Geohydrologic Map for explanation of geologic symbols.

WELL CHARACTERISTICS AND PERFORMANCE

Well-Characteristics Map

The well-characteristics map is the same scale as the geohydrologic map and covers the same area. It is intended to help the prospective owner or driller of a well to estimate probable depths and performance to be expected within the sections shown. If the proposed location is near the edge of a particular square-mile section and if the geohydrologic map indicates similar rock types in the adjacent section, the well data from the adjacent section can be used to refine estimates.

The map is based on about 700 water-well drillers' reports submitted to the Oregon State Engineer from 1955 through 1973. Reports of wells abandoned after drilling and reports containing ambiguous data were not used. Locations of wells commonly have been reported by drillers on the basis of township, range, and section. For some wells, locations within a section are known; for others, locations are known only as precisely as the section.

The median is the value for which half the reported values are larger and half are smaller. The usefulness of the median can be shown by an example, as in sec. 19, T. 25 S., R. 5 W. Median depth to water was 20 feet (6 m), and none of the water levels was less than 5 (1½ m) or more than 50 feet (15 m) below land surface. Similarly, the median well depth was 90 feet (27 m), and none was less than 55 feet (17 m) or more than 200 feet (60 m). The median discharge rate reported from tests (not permanent production) was 5 gpm (0.3 l/s). This value does not take into account the amount of drawdown below static water level that was necessary to produce a given rate of discharge.

In some areas underlain by rocks of low permeability, some of the wells may have been been "overtested"; that is, the reported rate of withdrawal may have been attained only with substantial or complete drawdown of the water level, which would mean that the well could not produce this rate of discharge on a sustained basis.

The following alternative approaches can be used to estimate prospects for obtaining a water well: (1) Interpolate data from nearby sections that can be expected to have similar conditions; (2) obtain advice from a well driller with local experience; (3) check on the availability of new or more recent information from the office of the U.S. Geological Survey in Portland, Oreg., or the office of the Oregon State Engineer in Salem; (4) check with well owners in the vicinity of the proposed drilling location.

Sections from which a significant number of unsuccessful wells have been reported are indicated on the map.

General Statistics

Most of the wells are 6-inch (15-cm) diameter domestic wells (see diagram of typical well installation) and were airlift or bailer tested to determine yield.

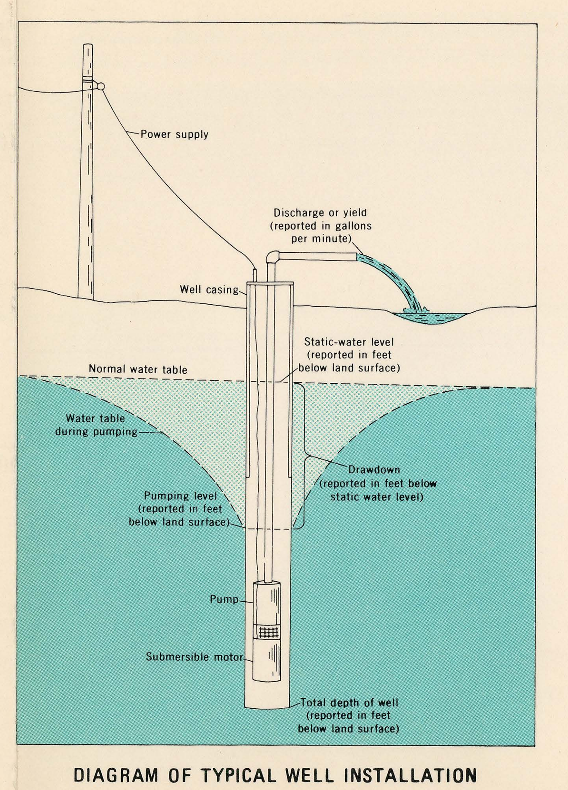


DIAGRAM OF TYPICAL WELL INSTALLATION

Records of wells drilled in 1960 or later were analyzed for depth, completion method, and construction. Information about wells drilled since 1960 is relatively complete, and these wells are likely to have been constructed according to practices that minimize the potential for pollution and that conform to present requirements of the Oregon State Engineer. Since 1960, 80 percent of the wells were drilled by the cable-tool method and 20 percent by rotary or air-rotary method. Ninety percent of the wells were completed by open-hole construction, using a surface or conductor casing but no screen or perforated pipe opposite water-yielding intervals.

The table below shows the approximate statistical distribution of well depth in the study area. It shows, for example, that 50 percent of the wells are less than 95 feet (29 m) deep and 90 percent are less than 155 feet (47 m) deep. Rotary methods are usually faster than cable-tool methods, especially for deep wells drilled in hard materials; therefore, rotary drilling tends to be used more often where water levels are deep or where it is expected that deeper wells will be needed to supply adequate quantities of water.

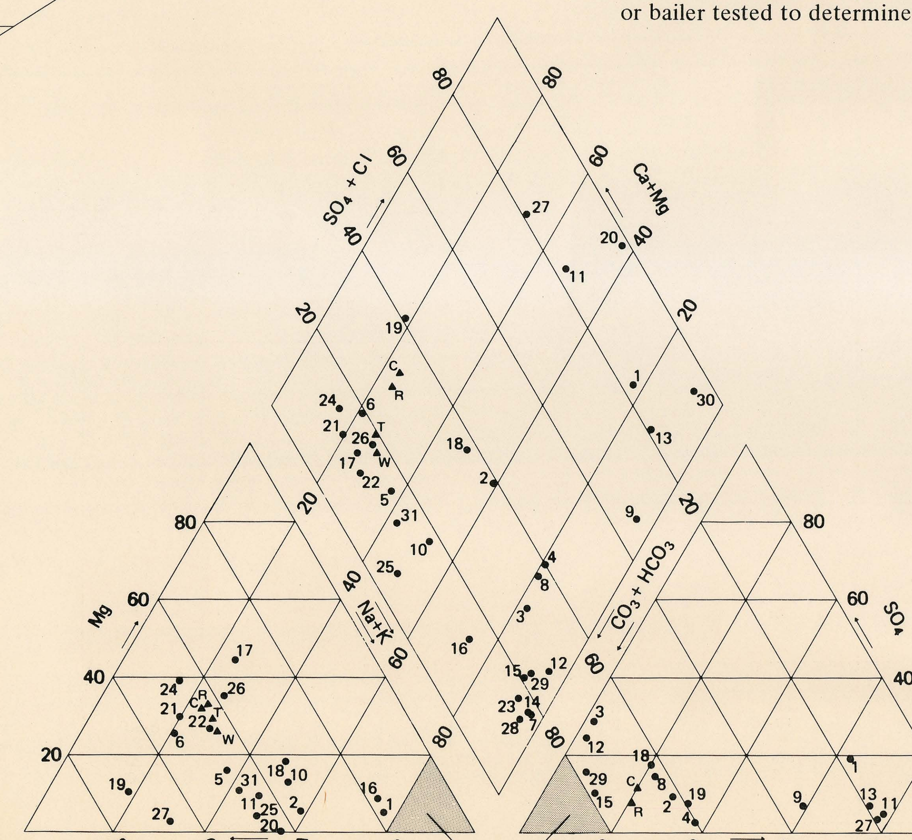
Percentage of wells less than indicated depth	Well depths, in feet		
	All methods	Cable-tool drilling	Rotary drilling
50	95	80	150
75	120	100	200
90	155	130	250

Specific Capacity of Wells

The specific capacity of a well is a measure of the production potential yield of the well and is reported as the discharge rate divided by the amount of lowering of the water level during bailing or pumping. Specific capacity depends on the ability of the geologic formation to transmit water and on the efficiency of the particular well. The median values of specific capacity of about 70 sections in the study area range from less than 0.02 gpm/ft (gallon per minute per foot of drawdown) (0.004 l/s/m) to as much as about 1.2 gpm/ft (0.25 l/s/m). The average value is about 0.2 gpm/ft (0.04 l/s/m). Many wells may be adequate for domestic supplies; however, the low values of specific capacity indicate that yields would be too low and power consumption too high for practical use of well water for commercial irrigation.

CHEMICAL CHARACTER OF THE GROUND WATER

Ground water in the Sutherlin area is diverse in chemical character, as indicated by the different shapes and sizes of the chemical diagrams on the geohydrologic map. Distribution of quality types follows no recognizable areal pattern, but waters with a high concentration of dissolved mineral matter are mostly of the sodium chloride type. The triangular diagram shows chemical types of water also, and waters that are similar in character (though not necessarily in concentration) plot close together. Some surface waters are shown for reference; they are of the calcium magnesium bicarbonate type.



RELATIVE AMOUNTS OF SELECTED CHEMICAL CONSTITUENTS IN GROUND AND SURFACE WATER BASED ON PERCENTAGE OF EQUIVALENT WEIGHTS

CHEMICAL ANALYSES OF WATER

(Analyses by U.S. Geological Survey)

Sample no.	Well or station number	Name	Principal geologic source	Depth interval of water-bearing zone (feet)	Date of collection	Milligrams per litre: Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Arsenic (As)	Boron (B)	Dissolved solids[1]	Hardness, as $CaCO_3$	Specific conductance (micromhos/cm)	pH	Temperature °C	Temperature °F	Sodium-adsorption ratio (SAR)
1	24S/4W-33bbb	Ward Cochram	Tus	19-80	9/29/73	7.4	0.89	-----	130	20	640	3.1	475	0	390	990	0.6	0.01	0.06	0.007	1.8	2,420	410	3,920	7.9	----	----	14
2	24S/5W-7daa	I-5 rest area	Tub	19-140	2/ 6/73	20	.16	0.08	38	3.4	72	.4	201	0	23	56	.2	.04	.06	.000	.38	312	110	537	8.0	----	----	3.0
3	24S/6W-28dbb	C. H. Moore	Tus	30-110	12/19/73	14	.38	.000	13	1.8	86	.4	184	0	59	3.2	.2	.49	.09	.024	.39	271	40	428	8.3	----	----	5.9
4	24S/7W-13bab	T. W. Bigart	Tt	60-273	12/18/73	7.9	.30	.000	13	.0	62	.4	121	0	60	2.6	.8	.78	.03	.005	.48	211	32	341	8.3	----	----	4.7
5	25S/4W-7bac	A. R. Freeman	Tus	20-80	12/19/73	21	.16	.000	9.4	1.9	8.6	.3	48	0	1.8	3.7	.1	1.9	.09	.000	.11	79	31	102	7.3	----	----	.7
6	-17abb	J. H. Denley	Tus	40-64	12/18/73	21	12	.49	62	18	26	1.4	288	0	30	17	.1	.32	.09	.11	.31	[2]332	230	550	7.0	11.0	52	.7
7	25S/5W-5ccb	Rex Tollefson	Tus	20-75	9/19/72	10	.03	.000	3.9	.1	170	.4	320	32	32	25	1.0	.97	.06	.01	1.4	438	10	718	8.5	----	----	23
8	-8dbd	J. R. Baskin	Tus	90-110	9/19/72	12	.009	.000	23	3.2	130	.7	285	0	50	62	.4	.21	.03	.003	.89	423	71	735	7.3	----	----	6.7
9	-13acd	A. R. Martin	Tus	30-170	2/ 8/73	9.7	.30	.000	5.4	1.8	230	.8	215	7	38	230	.5	.05	.03	.001	2.3	629	21	1,160	8.4	----	----	22
10	-16cbb	Bill Riley	Tus	20-67	5/ 4/71	26	.70	.21	39	8.5	67	.9	284	0	14	24	.2	.0	.03	–	–	320	130	512	7.4	12.7	55	2.5
11	-32bac	Larry Bush	Tus	20-70	6/28/73	15	.09	.13	110	15	140	.9	127	0	24	330	.3	.06	.03	.018	.53	699	340	1,290	7.7	15.0	59	3.3
12	25S/6W-1bdc	Joe Clark	Tus	27-77	9/20/72	9.5	.03	.000	5.2	1.5	190	.4	384	0	11	74	.9	.03	.15	.000	2.1	484	19	807	8.0	----	----	19
13	-11adb	K. T. Reed	Tus	70-435	9/22/72	9.5	.02	.000	49	17	610	3.0	367	0	100	820	.4	1.0	.03	.000	.50	1,790	190	3,210	7.5	----	----	19
14	-11cad	Victor McLind	Tus	20-100	9/21/72	8.1	.02	.04	4.0	1.1	240	1.0	575	0	9.8	63	.9	.13	.03	.000	1.4	613	15	1,023	8.1	----	----	27
15	-20bab	R. T. Fuller	Tus	33-84	9/21/72	11	.009	.000	8.9	3.4	160	1.4	384	0	39	32	.4	.30	.03	.000	.46	447	36	731	7.6	----	----	12
16	-23bcd	D. R. Wright	Tus	18-72	2/ 7/73	10	.29	.02	17	5.0	83	.8	257	0	26	4.6	.6	.01	.03	.01	.44	274	63	456	8.2	----	----	4.6
17	-29dcc	R. E. Weise	Tub	75-160	9/21/73	17	.03	.12	22	19	20	.9	195	0	15	4.8	.3	.02	.00	.002	.06	195	130	322	7.1	----	----	.8
18	25S/7W-35acc	LaVerne Murphy	Tus	20-65	9/29/73	13	.24	.06	27	9.0	43	5.5	134	0	34	21	.2	3.9	.03	.001	.22	237	100	387	7.3	16.0	61	1.8
19	26S/5W-6aba	S.F. Mohr	Tus	40-225	2/ 9/73	17	.33	.000	14	1.3	3.8	.7	36	0	16	2.6	.1	.00	.03	.000	.31	73	40	103	8.1	----	----	.3
20	-14dbd	J. C. Price	Tub	40-250	2/ 7/73	28	.18	.000	190	.2	290	.8	12	7	2.9	740	.3	.04	.03	.02	.73	1,270	480	2,390	8.8	----	----	5.8
21	-20add	D. I. Gilkeson	Tub	21-145	2/ 9/73	23	1.4	.03	17	6.1	7.5	.1	96	0	5.2	3.5	.0	.30	.09	.000	.23	111	68	161	8.0	----	----	.4
22	-23cdb	G. L. Banta	Tub	21-130	2/ 7/73	35	.20	.01	27	9.6	19	.3	164	0	9.6	4.9	.2	.10	.09	.004	.29	187	110	279	7.2	----	----	.8
23	26S/6W-15bca	D. L. Cooper	Tub	50-250	6/28/73	40	.06	.01	2.3	.0	32	.2	21	27	5.2	5.0	.2	.01	.06	–	–	122	6	151	9.3	18.0	64	5.8
24	-19bdb	Robert Buri	Tub	25-32	6/28/73	57	.04	.03	25	13	8.6	1.1	121	0	11	3.7	.1	4.9	.09	.005	.04	201	120	263	6.9	21.0	70	.3
25	-22daa	A. B. Hebard	Tus	30-76	6/28/73	29	.28	.02	30	1.7	37	.2	186	0	3.7	4.4	.1	.00	.06	-----	-----	198	82	303	8.0	14.0	57	1.8
26	-33bba	C. E. Good	Qa	37-39	5/ 4/71	62	.06	.037	13	7.3	9.4	2.0	80	0	7.8	3.7	.1	.4	.12	-----	-----	147	62	158	6.5	13.3	56	.5
27	-36adb	G. J. Osterman	Tub	20-205	9/19/72	14	.02	.09	200	4.6	110	.7	169	0	24	400	.2	.01	.00	.000	.50	837	520	1,650	7.4	----	----	2.1
28	26S/7W-2cac	R. F. Frederick	Tus	35-175	2/ 7/73	11	.11	.01	3.5	1.0	120	.6	269	20	22	14	.3	.01	.03	.000	.68	325	13	553	9.0	----	----	15
29	-24ddb	Norman Lewellyn	Tub (?)	30-200	2/ 7/73	16	.16	.01	5.8	.6	83	.3	189	0	14	21	.3	.02	.15	.000	.76	234	17	385	8.1	----	----	8.8
30	-35dad	C. L. Johnson	Tus	40-150	2/ 9/73	7.1	7.0	.06	46	5.2	700	2.3	113	0	4.0	1,100	.3	.00	.03	.009	1.9	1,920	140	3,710	7.1	----	----	26
31	27S/5W-5bcb	O. D. Caldwell	Tub	22-121	2/ 6/73	42	.18	.000	37	5.1	39	.1	220	0	9.4	11	.2	.12	.09	.002	.34	253	110	374	7.6	----	----	1.6
R	14-3122.5	S. Umpqua R. at Roseburg[3]			10/67-4/69	-----	-----	-----	11	5.1	6.0	1.9	55	0	8	12	.1	.4	-----	-----	-----	81	48	124	7.4	----	----	.7
W	14-3195	N. Umpqua R. at Winchester			10/67-4/69	17	-----	-----	5.7	2.0	3.9	.9	32	0	2.2	2.3	.1	.2	.09	-----	.02	50	22	63	7.4	----	----	.4
C	14-3208	Calapooya Cr. near Umpqua			4/18/68	15	-----	-----	9.5	4.5	5.7	.4	45	0	5.8	8.0	.0	.1	.08	-----	.00	68	42	108	7.7	----	----	.4
T	14-3209.5	Umpqua River near Tyee			8/67-4/69	-----	-----	-----	6.9	2.9	4.5	1.0	39	0	3	3.4	.1	.2	-----	-----	-----	63	29	80	7.4	----	----	.8

[1] Calculated values with bicarbonate recomputed as carbonate.
[2] Analysis included 0.0006 milligram per litre of mercury (Hg).
[3] Not shown on geohydrologic map.

FACTORS AFFECTING THE USABILITY OF GROUND WATER

Standards

The Federal Water Pollution Control Administration (1968) recommended drinking-water standards for public supplies, based on those established by the U.S. Public Health Service (1962). Some of the standards that apply to samples listed in the table of chemical analyses include:

Constituent	Recommended permissible limit of concentration in mg/l (milligrams per litre)
Iron (Fe)	0.3
Manganese (Mn)	.05
Sulfate (SO_4)	250
Chloride (Cl)	250
Fluoride (F)	[1]1.2
Boron(B)	1
Arsenic (As)	.05
Nitrate (NO_3) + nitrite (NO_2), expressed as nitrate	44
Dissolved solids	500

[1]Value based on average maximum daily air temperature in vicinity of Roseburg.

The above are recommended limits for public supplies; however, concentrations exceeding these values may be acceptable to many users.

Of the constituents listed, excessive iron or manganese causes staining of plumbing fixtures and laundry and can give a peculiar taste to the water. Chloride in excess of about 500 mg/l (milligrams per litre) and dissolved solids in excess of 1,000 mg/l give a salty or mineral taste to the water. Sulfate causes permanent hardness of water and in excessive concentrations can have a laxative effect on persons not accustomed to the water. Fluoride is beneficial up to the recommended limit because it retards dental decay, but in concentrations of more than several milligrams per litre can eventually cause darkening or mottling of children's teeth. Large amounts of nitrate can cause methemoglobinemia (blue-baby effect) in infants.

Excessive hardness is undesirable but seldom is cause for rejection of a water supply. Commercial softeners can be used for most supplies. The U.S. Geological Survey uses the following rating for hardness:

Hardness range (as $CaCO_3$) (mg/l)	Rating
0 - 60	Soft
61 - 120	Moderately hard
121 - 180	Hard
More than 180	Very hard

Excessive arsenic ingested over a period of time can result in chronic poisoning. Diagnosis is difficult because many of the symptoms are often attributable to other causes.

A boron concentration of only a few milligrams per litre has a toxic effect on some plants; yellowing of leaves is one symptom. Some plants are more sensitive than others; many nut and fruit trees are among the more sensitive. Water that contains more than 4 mg/l of boron may be unsuitable even for tolerant crops (Federal Water Pollution Control Administration, 1968, p. 153).

The sodium-adsorption ratio (SAR) of a water is a measure of the suitability of the water for irrigation. Where SAR values are high, sodium in the water tends to replace calcium and magnesium adsorbed on the soil, and it results in clogging of the soil. Diagrams used by the U.S. Salinity Laboratory (1954) show that a SAR of less than 10 is considered low, 10 to 18 is medium, 18 to 26 is high, and more than 26 is very high.

Local Water Quality

Available water-quality data are listed in the chemical-analysis table. Results of chemical analyses of water from streams are included for comparison with the mineral concentration in ground water.

Iron and manganese are slightly excessive in some ground water that is otherwise of good quality and are significantly excessive in some ground water that has other constituents in excess.

There is excessive sulfate or chloride in some of the water; it occurs in water in which dissolved solids are also excessive. Such water is likely to be unpalatable to many people.

Fluoride was not excessive in any of the samples.

No case of excessive nitrate concentration was noted. However, a significant concentration (even though it is less than recommended limits) is sometimes an indication of possible bacterial pollution. Bacterial pollution can occur if a well is improperly located or constructed. (See current well-drilling regulations of the Oregon State Engineer.)

In one sample, arsenic exceeded the upper limit of 0.05 mg/l, which is considered to be grounds for rejection of the supply. In three other samples, arsenic exceeded 0.01 mg/l, a suggested limit to be used where more suitable supplies can be made available (U.S. Public Health Service, 1962).

Six of the samples had more than 1 mg/l of boron – enough to be unsuitable for sensitive plants.

Eight samples exceeded recommended limits for dissolved solids, and 10 were either hard or very hard.

Temperatures reasonably representative of waters in the formations are sometimes difficult to obtain. In the table the range is from 52° to 70°F (11° to 21°C). The average water temperature reported by drillers has been 54°F (12°C); as expected, it is almost the same as the mean annual air temperature at Roseburg (53°F, 12°C).

The SAR values range from very low to very high, but clogging of the soil may not be a problem if drainage is good.

Water from well 25S/4W-17abb was analyzed for mercury; the well is within 1 mile (1.6 km) of the Bonanza mercury mine (inactive). The water contained 0.0006 mg/l of mercury, which is less than the limit of 0.005 mg/l that is proposed by the U.S. Public Health Service. However, the water did contain excessive arsenic, iron, and manganese.

In many places in the Sutherlin area the chemical quality of water varies considerably within a very short distance; therefore, interpolation of the quality between sampled wells is not justified.

AVAILABILITY AND QUALITY OF GROUND WATER IN THE SUTHERLIN AREA, DOUGLAS COUNTY, OREGON

By J. H. Robison, 1974