

CHEMICAL QUALITY OF SURFACE WATER

IN THE UMPQUA RIVER BASIN, OREGON

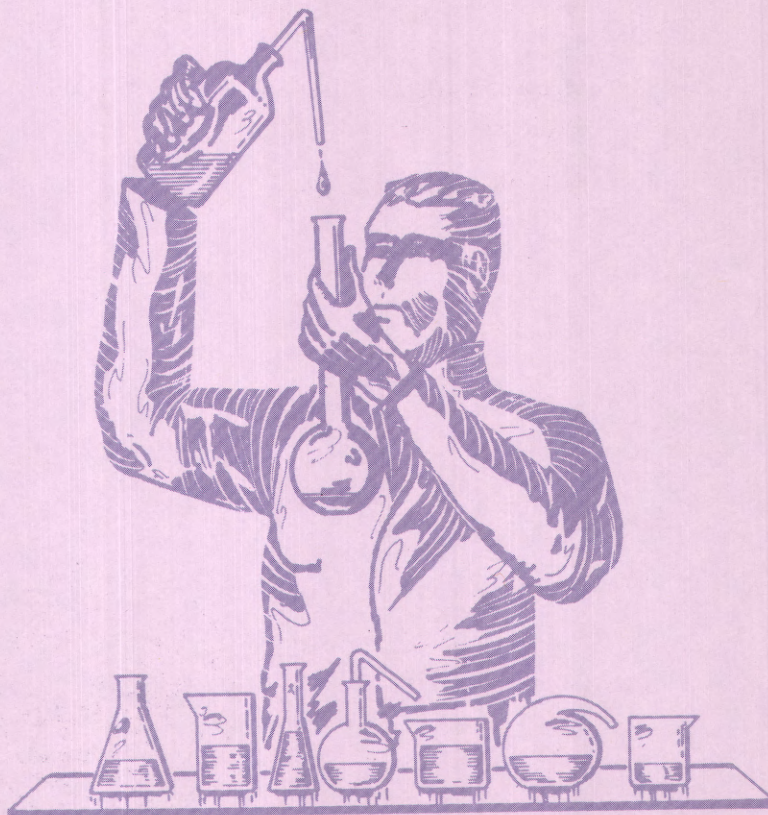


CHEMICAL QUALITY OF SURFACE WATER IN THE UMPQUA RIVER BASIN, OREGON

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in cooperation with
Douglas County

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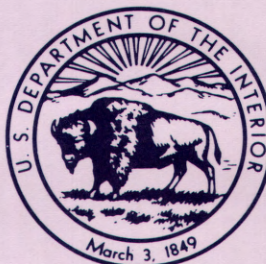
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NORTH UMPQUA RIVER

CHEMICAL QUALITY OF SURFACE WATER

IN THE UMPQUA RIVER BASIN, OREGON

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By D. A. Curtiss

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INTRODUCTION

Purpose and Scope of the Investigation

In July 1967, the U.S. Geological Survey, in cooperation with Douglas County, began a 2-year study of the chemical quality of surface water in the Umpqua River basin. The purpose of this report is to present an interpretive summary of the data collected, which will provide answers to the following questions:

What is the chemical quality of the water in the basin?

What areal and seasonal differences exist?

What causes the differences?

What chemical constituents, if any, are present in the water that would affect its usefulness for domestic, industrial, or agricultural purposes?

Data are presented on maps, graphs, and charts. All data collected and analyzed during the study period, together with historical data on file with the Geological Survey, are included in tables 3 through 6 (p. 14, 19, 23, 24).

All water samples were collected and analyzed by using standard U.S. Geological Survey methods (Rainwater and Thatcher, 1960) and "Standard methods for examination of water and waste water" (American Public Health Assoc. and others, 1965).

Acknowledgments

The report was prepared as a part of a cooperative program between the U.S. Geological Survey and Douglas County in Oregon, and the work was performed under the direction of Stanley F. Kapustka, district chief, U.S. Geological Survey. Special acknowledgment is due J. J. S. Yee, chemist, U.S. Geological Survey, for his technical assistance. Most of the water-quality samples were collected by the suboffices of the U.S. Geological Survey in Eugene and Medford, Oreg. All streamflow records and supplemental water-quality data were provided by the Survey.

Importance of Basic Data

Good-quality water in abundant supply is one of Douglas County's most valuable resources and is directly or indirectly used in nearly every major economic endeavour in the area. Because of this use by man, as well as the effects of natural phenomena, the water quality changes constantly. The magnitude and rate of these changes that result from water use and reuse must be determined.

Due to increasing population and urbanization and the accompanying industrial development, water managers, planners, and developers are facing problems of increasing complexity. Sound water management, based on a knowledge of the quality of water, is essential to cope with these problems and to preserve and develop the water resources most effectively.

Basic data, collected in a systematic manner, provide essential background information to describe current conditions, to delineate any problem area that may exist, and to aid in planning future water-use projects.

Previous Work and Related Investigations

No prior systematic study has been made of the chemical quality of surface water in Douglas County. Chemical-quality data are available for a daily station operated on the Umpqua River for 1 year during 1911-12 by the U.S. Geological Survey in cooperation with the Oregon State Engineer (Van Winkle, 1914, p. 46-48).

The Oregon State Sanitary Authority began a program in 1959 to collect and analyze water samples on a quarterly basis at various stations throughout the Umpqua River basin. During the period August 1961 to June 1963, a cooperative effort between the U.S. Geological Survey and the Oregon State Sanitary Authority was established for operation of chemical-quality stations in the basin.

Data concerning sediment transport in the Umpqua River basin are scarce, and the available data are insufficient to define accurately the water-sediment-discharge relationships needed for reliable computation of sediment yields (Onions, 1969).

A time-of-travel study was conducted by the U.S. Geological Survey in the Umpqua River basin in 1963 (Harris and Sanderson, 1968).

CHEMICAL QUALITY OF SURFACE WATER IN THE UMPQUA RIVER BASIN

General Chemical Quality

Six stations were established in August 1967 in the Umpqua River basin, where samples were collected at 6-week intervals. At two additional sites, samples were collected during high, medium, and low flows. Also, on each reconnaissance trip during high- and low-flow periods, about 26 spot samples were collected to determine chemical quality of the smaller tributaries and to help identify areal differences. The map (fig. 1, p. 4) shows the location of sampling sites and the frequency of sampling.

The concentrations of certain dissolved constituents and the total dissolved-solids concentration in a water supply determine its suitability for irrigation, domestic, or industrial use. The term "dissolved solids" is defined as the residue on evaporation and refers mainly to the dissolved minerals in the water. All concentrations are expressed in milligrams per liter, which is numerically equivalent to parts per million for water with low mineral content. Water with less than 500 mg/l (milligrams per liter) of dissolved solids is usually satisfactory for irrigation, domestic, and many industrial uses.

Dissolved-solids concentrations for streams in the Umpqua River basin range from less than 40 mg/l to 193 mg/l; most streams have concentrations of less than 100 mg/l. The water throughout the basin is soft, and the concentrations of all the constituents that were determined are well below the maximum limits recommended for drinking water by the U.S. Public Health Service (1962).

SAR (sodium-adsorption-ratio) is an expression of the ratio of the sodium content to the sum of calcium and magnesium in water. It is used as an index for determining the extent to which irrigation water will leave a harmful residue of exchangeable sodium in the soil. The water-classification system proposed by the U.S. Salinity Laboratory Staff (1954, p. 80) shows that all the surface water in the Umpqua River basin is in a very low sodium-hazard class, based on SAR and conductivity.

Because of the undesirable effect of boron on certain crops, water samples collected at various stations throughout the basin were analyzed for their boron content. Analyses indicate only traces of boron, too small to affect even the most boron-sensitive crops.

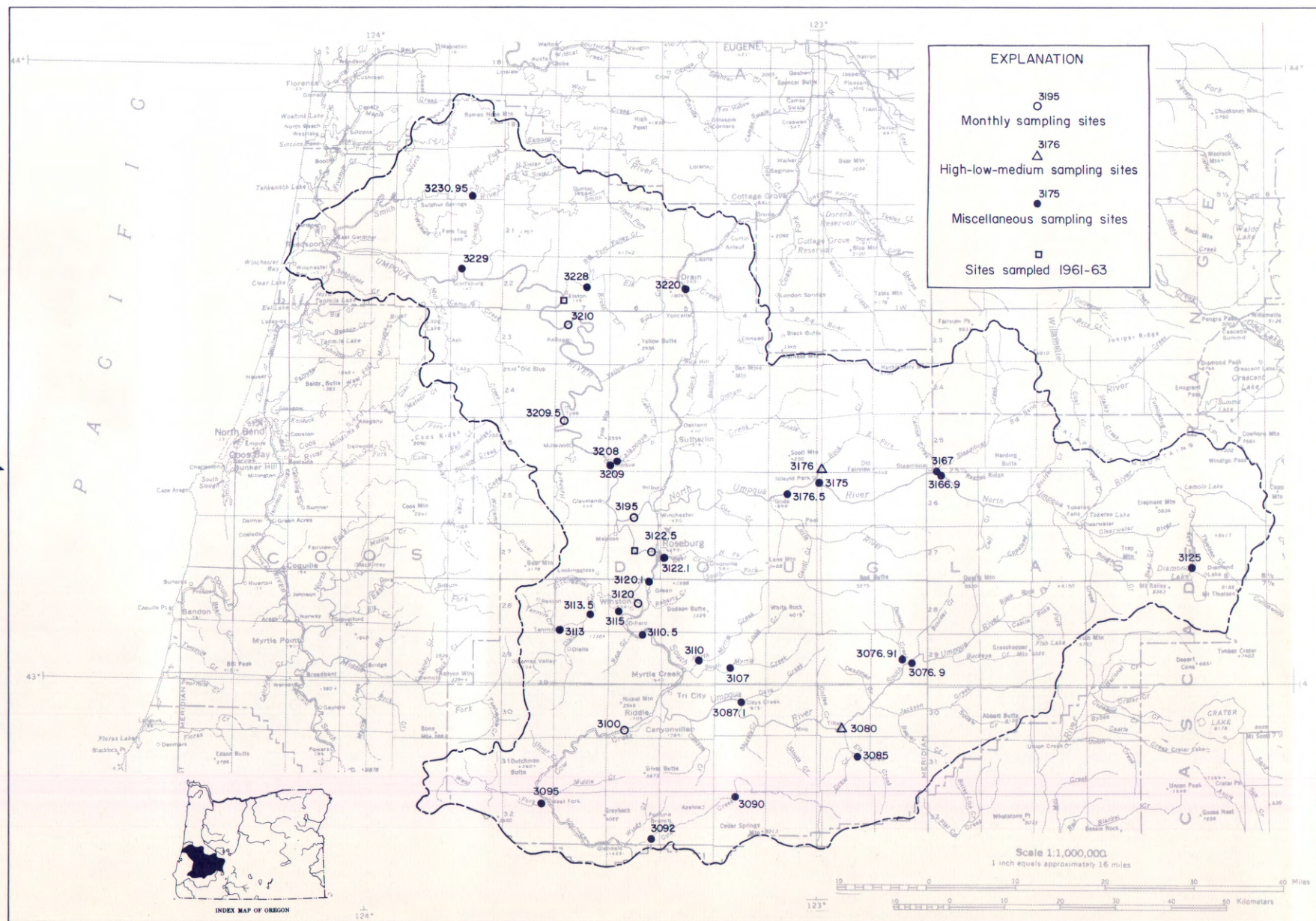


Figure 1.--Sites where samples of surface water were obtained during study period.

During the irrigation period April through October, a surveillance was made for evidence of pesticide and herbicide residues. Samples were collected on a monthly basis near Elkton on the Umpqua River and at Brockway on the South Umpqua. A small amount of DDT was present in the Umpqua River near Elkton in August 1967. Traces of DDT and Dieldrin were detected in October of the same year. No detectable amount of either pesticides or herbicides was found during the 1968 irrigation season. (See table 6, p. 24.)

High turbidity and color cause seasonal problems for some industrial and municipal water users. Moderately high color coincides with leaf fall from the deciduous vegetation in the area. Although color is undesirable in drinking water, it does not make the water unpotable. High turbidity during winter and spring runoff would require filtration of the water for municipal and for some industrial water uses.

Silica, one of the most abundant elements in the earth's crust, is a major constituent of many rocks, particularly volcanic rocks. In the Umpqua River basin, silica represents a large percentage of the dissolved-solids content of the water, with concentrations ranging from less than 10 to as much as 25 mg/l. Most industrial processes tolerate silica in this range, but it is particularly undesirable in boiler-feed water because it forms hard scale within boilers and pipes. Silica does not affect usefulness of water for irrigation or domestic purposes.

Geographic Variations

There are distinct areal differences of dissolved-solids patterns between the North Umpqua, South Umpqua, and Umpqua Rivers. The graph (fig. 2, p. 6) illustrates these differences and the changes in specific conductance^{1/} in the downstream direction.

North Umpqua River

The North Umpqua River drains about 1,300 square miles. Its entire 100-mile length is characterized by rugged precipitous slopes and steep stream gradients. The excellent chemical quality of the water, together with the natural beauty of the area, make the North Umpqua River a most attractive and popular stream for recreational use.

The dissolved-solids content of the river water is low, ranging from 40 to 63 mg/l. The small seasonal difference is related directly to the relatively uniform flow pattern that is characteristic of the North Umpqua. This flow pattern is due primarily to two factors:

^{1/} Specific conductance expressed in micromhos per centimeter at 25°C, is a measurement of the ability of water to conduct an electrical current. The specific conductance is related to the amount of dissolved solids in the water. In the Umpqua River basin, the dissolved-solids concentration generally is numerically about 0.55 to 0.60 times the specific conductance.

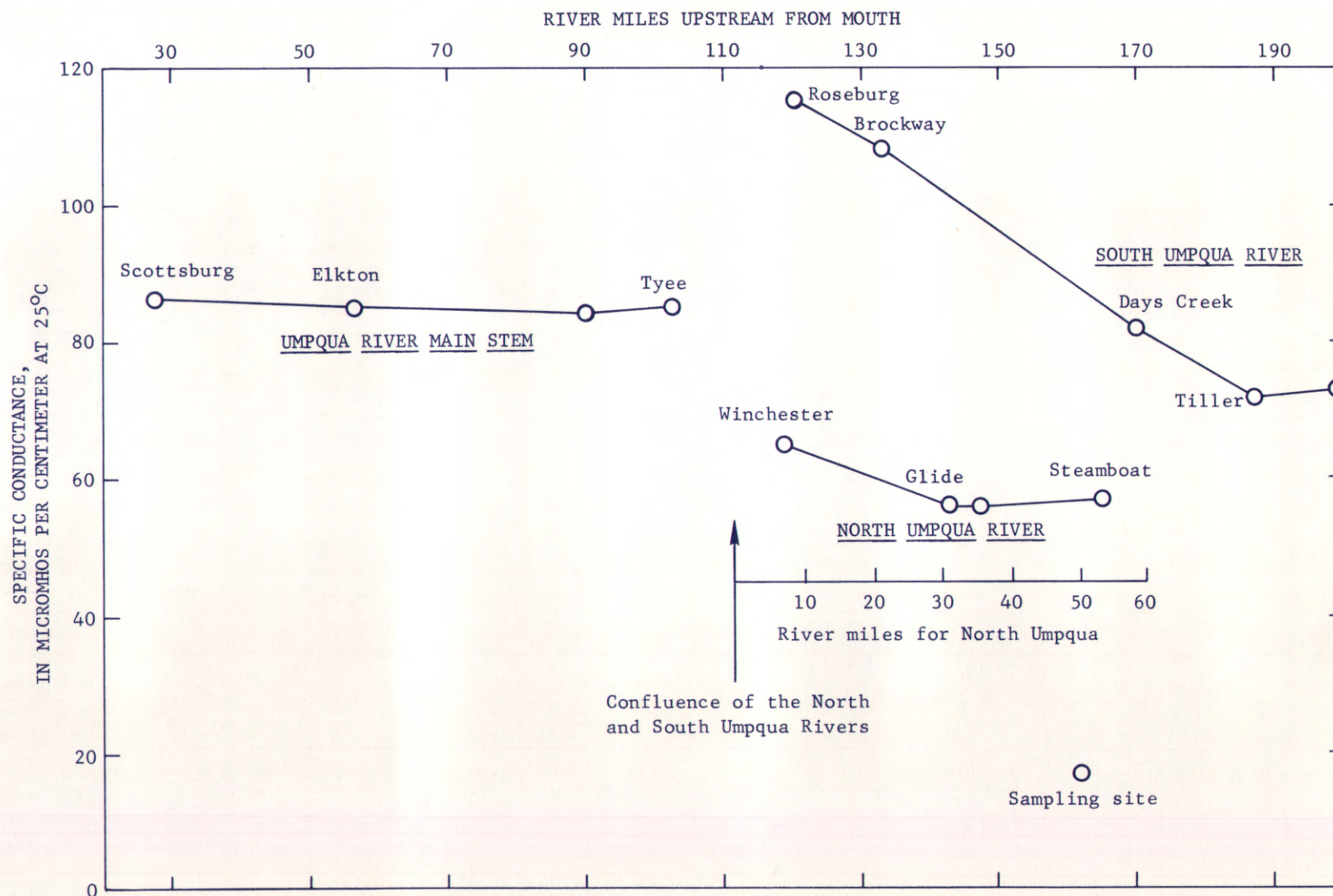


Figure 2.--Specific conductance of the Umpqua River main stem, the South Umpqua, and the North Umpqua River, obtained April 1968. (River miles based on Columbia Basin Inter-Agency Commission river mile index.)

(1) The porous volcanic rocks in the upper subbasin provide excellent ground-water storage; and (2) 20 percent of the subbasin is above 5,000 feet altitude and receives a large snowpack each year. The combination of ground-water discharge from the volcanic rocks and the prolonged period of snowmelt contribution maintains streamflow at a substantial rate during summer, with an associated low concentration of dissolved solids. The bar diagram in figure 3 (p. 8) illustrates the chemical makeup of the North Umpqua River and the relatively small difference between the high- and low-flow periods compared to the South Umpqua River. In the figure, the chemical constituents, except silica, are expressed in equivalents per liter^{2/}. Silica concentrations are expressed in milligrams per liter.

The water in the North Umpqua River is suitable for all uses, and no evidence of chemical-quality problems was noted.

South Umpqua River

The South Umpqua River is 114 miles long and drains about 1,760 square miles. The chemical quality of water in the South Umpqua subbasin differs from that of the North Umpqua subbasin largely because of differences in geology, topography, and climate between the two subbasins. Both rivers are about the same in length. Only about 3 percent of the South Umpqua subbasin lies above the 5,000-foot level, and most of the area is underlain by poorly permeable rocks that provide little natural storage. As a result, the South Umpqua is a "flashy" stream whose runoff follows very closely the precipitation pattern within the subbasin. The dissolved-solids content varies inversely with the flow pattern of the stream. During low flow, the dissolved-solids concentration is more than twice that during high flow (fig. 3).

The dissolved-solids content of water in the South Umpqua increases noticeably from Tillier to Roseburg. Also, the proportion of magnesium cations relative to total dissolved cations increases by as much as 13 percent within the same reach (table 1, p. 9). The increase in dissolved solids is illustrated in figure 4 (p. 10), by using specific-conductance values obtained during two reconnaissance trips. From this graph it can be seen that the increase is relatively constant during both high and low flows. This consistency throughout the year and the percentage increase of magnesium suggest that the changes in concentrations are caused by the geochemical influence of rocks in the Klamath-Siskiyou Range. That area contains much metamorphic sedimentary and volcanic rock, including magnesium-rich serpentine.

The water of the South Umpqua River is chemically suitable for most uses, but has a potential water-quality problem in the reach from Roseburg to the confluence with the North Umpqua. In a concentrated

^{2/} In water, one equivalent of a positively charged constituent (cation) will combine with one equivalent of a negatively charged constituent (anion); therefore, the total equivalents of cations equal the total equivalents of anions.

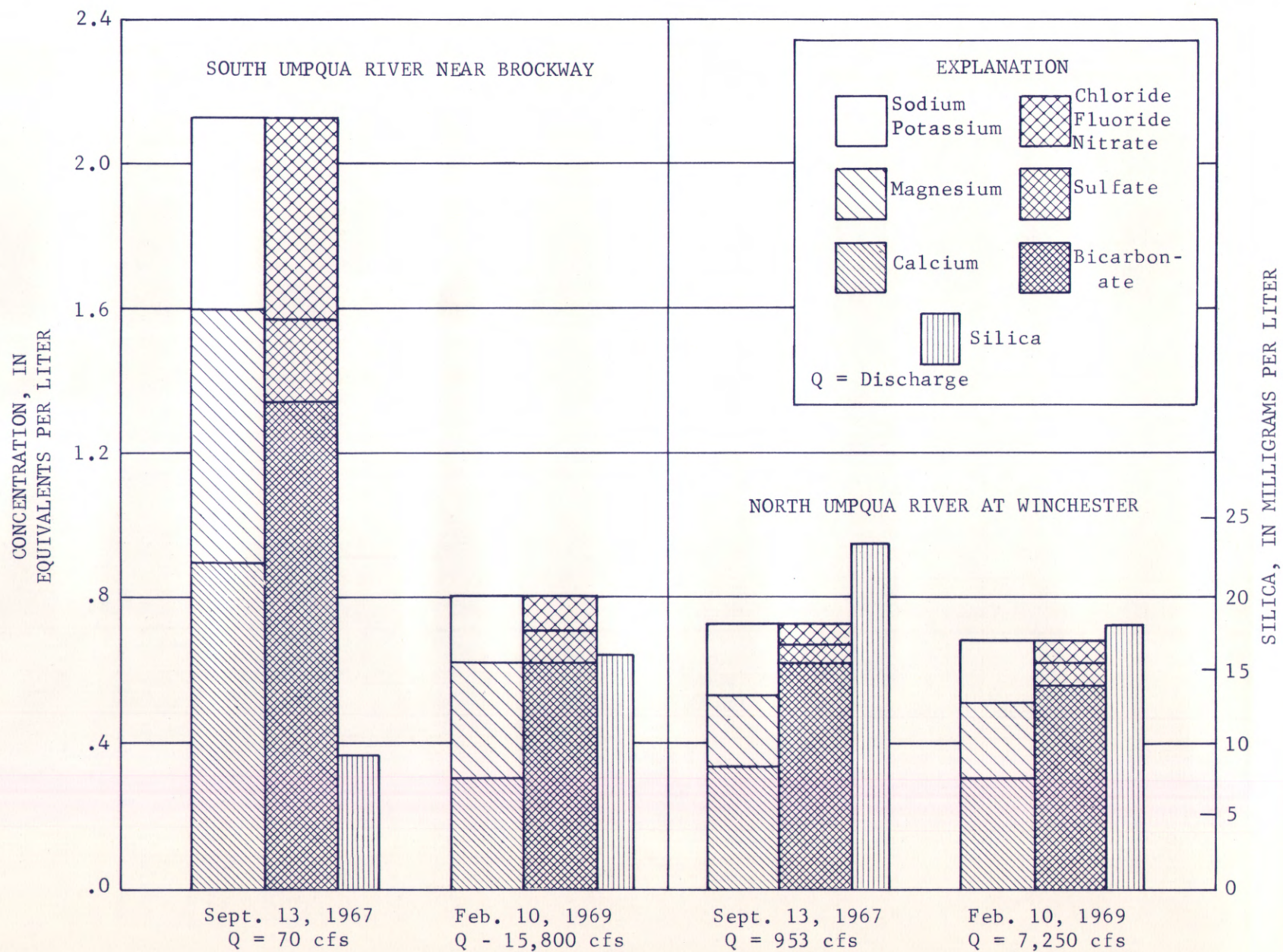


Figure 3.--Chemical composition of waters of the North and South Umpqua Rivers during high and low flows.

Table 1.--Percentage of major ions in solution during high and low flow
of the South Umpqua River

	Percentage of ions in solution					
	Cations			Anions		
	Ca	Mg	Na+K	HCO ₃	SO ₄	Cl+NO ₃
At Tillier						
August 16, 1967	54	19	27	63	17	20
April 17, 1968	55	21	24	78	14	8
Near Brockway						
August 15, 1967	45	30	25	67	11	22
April 17, 1968	46	34	20	80	10	10

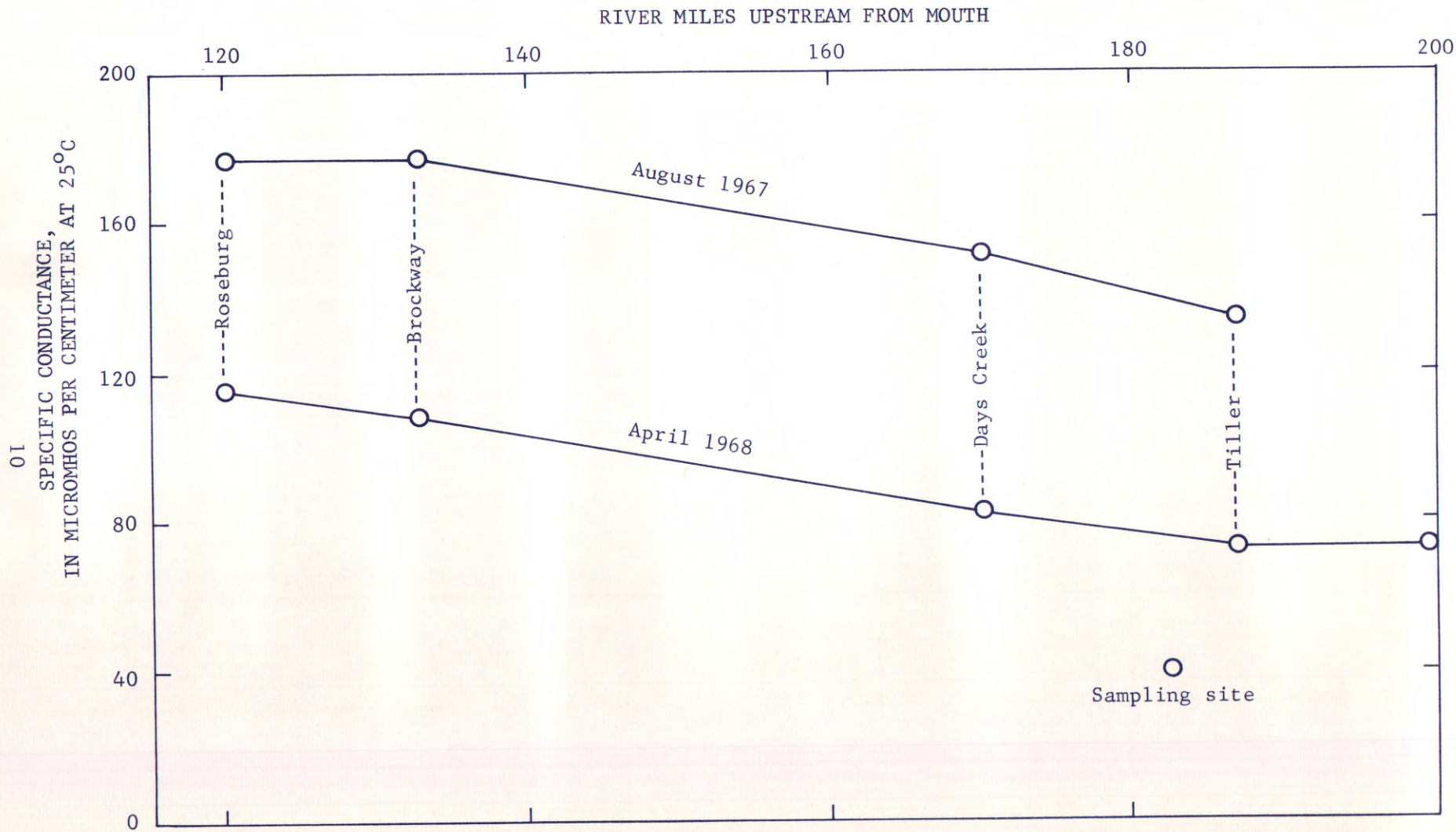


Figure 4.--Specific conductance of the South Umpqua River during high and low flows. (River miles based on Columbia Basin Inter-Agency Commission river mile index.)

area near Roseburg, industrial, agricultural, and municipal water users make heavy demands on the South Umpqua River. These heavy demands, together with (1) insufficient discharge during low-flow periods, (2) slow velocity due to the low gradient within the reach, and (3) high temperatures during summer indicate that water-quality degradation could occur.

The South Umpqua River and its major tributary, Cow Creek, are similar in their chemical makeup. Cow Creek drains an area quite similar geologically to the area drained by the South Umpqua between Tiller and Brockway. Although not so pronounced as the South Umpqua, the dissolved-solids content and percentage of magnesium increase downstream in Cow Creek.

Because mining is the predominant industry in the area around Riddle, a water sample, to be analyzed for trace metals, was collected from Cow Creek near Riddle during low flow. Only trace amounts of copper, zinc, and strontium were detected. (See table 5.)

Umpqua River Main Stem

The main stem of the Umpqua River is that part of the Umpqua system below the confluence of the North and South Umpqua Rivers. The main stem receives direct drainage from an area of about 1,500 square miles. Because the terrain of the area is quite rugged and the Umpqua River is generally confined to a narrow canyonlike valley, potential for agricultural and urban development is limited to the narrow benchland adjacent to the river.

The North and South Umpqua Rivers contribute almost 90 percent of the mean flow of Umpqua River near Elkton; therefore, the chemical characteristics of the main stem of the Umpqua River are almost entirely a combination of the chemical characteristics of the two tributaries. During low-flow periods, the chemical characteristics of the main stem approach those of the North Umpqua, because during those periods that river contributes more than 80 percent of the discharge at the Elkton station.

The Geological Survey maintained a daily chemical station on the Umpqua River near Elkton for 1 year during 1911-12 (Van Winkle, 1914). The daily samples were composited every 10 to 30 days and analyzed. (See table 2, p. 12.)

A comparison of the data in table 2 with the data collected during this study shows that the chemical character of the Umpqua River has not changed appreciably in almost 60 years.

Table 2.--Analytical data collected by Van Winkle, Umpqua River near Elkton, 1911-12

[Parts per million except as otherwise designated.] 1/

Date.	Turbidity.	Suspended matter.	Coefficient of fineness.	Color.	Silica (SiO ₂).	Iron (Fe).	Calcium (Ca).	Magnesium (Mg).	Sodium and potassium (Na+K).	Carbonate radicle (CO ₃).	Bicarbonate radicle (HCO ₃).	Sulphate radicle (SO ₄).	Nitrate radicle (NO ₃).	Chlorine (Cl).	Dissolved solids.	Mean gage height (feet).	Mean discharge (second-foot).	Suspended matter (tons per day).	Dissolved matter (tons per day).
																	<u>2/</u>		
Aug. 1-10.....	1	2.4	2.40	4	30	0.06	7.0	1.6	12	0.0	43	7.2	0.48	3.2	86	0.37	1,123	7.3	261
Aug. 11-20.....	4	2.8	.70		21	.08	10	3.3		.0	35	7.0			68	.28	1,047	7.9	192
Aug. 21-30.....	1	.0		Tr.	22	.05	8.9	2.8			32	7.6	1.1	3.1	70	.20	980	0	185
Aug. 31-Sept. 9.....	3	3.0	1.00		20	.05	8.3	3.5		.0	35	4.3	.28	3.3	65	.51	1,273	10.4	223
Sept. 10-19.....	3	1.6	.53	4	20	.08	9.4	2.8		.0	38	4.9	.44	5.3	67	.56	1,303	5.6	236
Sept. 20-29.....	2	4.4	2.20	4	20	.05	9.2	3.6		.0	42	7.2	.40	4.3	71	.64	1,397	18.6	268
Sept. 30-Oct. 9.....	1	4.4	4.40	2	20	Tr.	7.3	3.6		.0	41	5.9	.24	4.8	74	.78	1,525	18.1	305
Oct. 10-19.....	1	2.4	2.40	4	18	.04	11	2.8		.0	39	9.0	.41	4.1	73	.86	1,613	10.5	317
Oct. 20-29.....	2	3.2	1.60	0	18	.02	7.5	2.6		.0	40	7.8	.68	4.7	71	.41	1,160	10.0	223
Oct. 30-Nov. 8.....	Tr.	2.4		0	18	.03	10	2.2		.0	39	8.5	.32	4.0	71	.52	1,311	8.5	251
Nov. 9-18.....	15	45.2	3.01	40	18	.23	11	2.8		.0	39	6.7	.54	3.3	75	6.4	12,798	1,560	2,585
Nov. 19-28.....	5	2.8	.56	18	14	.15	7.8	2.0		.0	31	5.6	.38	2.5	59	4.7	8,392	63.5	1,336
Nov. 29-Dec. 8.....	5	3.6	.72	4	14	.04	8.4	1.0		.0	31	3.5	.28	3.3	57	2.7	4,133	40	637
Dec. 9-31.....	20	16	.80	47	16	.30	8.4	1.4		.0	35	5.3	.18	3.8	64	3.4	5,681	245	983
Jan. 1-31.....	60	75	1.25	44	16	.25	6.3	1.3		.0	29	5.0	.24	2.3	59	9.6	22,614	4,575	3,595
Feb. 1-29.....	15	17	1.13	17	16	.09	8.7	1.4		.0	33	3.0	.33	2.3	70	8.3	18,478	847	3,501
Mar. 1-31.....	10	13	1.30	16	17	.12	7.3	1.7		.0	35	3.9	.12	2.8	66	5.6	10,518	369	1,870
Apr. 1-31.....	10	17	1.70	10	25	.05	9.0	1.9		.0	28	4.8	.30	2.8	76	3.7	5,928	272	1,216
May 1-31.....	10	8.9	.89	12	23	.15	6.3	2.0		.0	32	2.9	.22	2.3	62	5.9	11,752	282	1,963
June 1-30.....	8	13	1.62	8	14	.01	5.9	2.0		.0	19	8.2	.34	1.8	58	4.0	6,661	234	1,041
July 1-31.....	4	6.0	1.50	8	18	.01	6.7	2.3		.0	40	4.0	.40	4.0	63	1.6	2,495	40	425
Aug. 1-15.....	4	6.0	1.50	5	17	.15	8.0	3.6		.0	39	4.3	.06	2.8	67	.75	1,487	24	269
Mean.....	12	15	1.25	14	18	.10	7.9	2.2	b5.7 b1.6	.0	36	5.2	.30	3.0	67			c217, 400	c488, 500
Percentage of anhydrous residue.....					29.0	d.2	12.7	3.6	b9.2 b2.6	29.0		8.4	.5	4.8					

^a Abnormal; computed to HCO₃ in average.^b Sodium and potassium, determined on the combined alkali residues.^c Total annual denudation.^d Fe₂O₃.

1/ Values in parts per million are numerically equivalent to mg/l for water analyses reported in this table.

2/ A second foot of discharge is equivalent to 1 cfs (cubic foot per second), now used to report discharge.

ADEQUACY OF EXISTING CHEMICAL-QUALITY DATA

The data collected during the 2-year study provide a basic definition of the chemical quality of the surface water in the Umpqua River basin. Because of the short study period, however, seasonal variations of the chemical concentrations cannot be adequately defined.

SUMMARY

During the study, samples were collected at 32 sites in the Umpqua River basin; six of these sites were sampled and analyzed at 6-week intervals. These samples show the surface water to be of generally excellent chemical quality throughout the basin. Analysis of water samples from two selected sites in the basin revealed detectable amounts of pesticides during the summer and fall of 1967. Herbicides were not detected during the study period. All surface water within the basin has a low sodium hazard and only traces of boron, and is therefore excellent for irrigation.

A potential problem area exists on the South Umpqua River downstream from Roseburg. Because heavy organic enrichment, insufficient discharge during low-flow periods, and high temperatures during summer could cause water-quality problems, the water quality in this reach of the river should be monitored on a regular basis.

Table 3.--Chemical analyses of surface water in Douglas County

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	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)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific conductance (micro-mhos at 25°C)	pH	Color	Temperature (°C)	Percent Sodium	Sodium adsorption ratio (SAR)
																mg/l	Tons per acre-foot	Calcium magnesium	Non-carbonate						
14-3080. South Umpqua River at Tiller, Oreg.																									
Aug. 16, 1967	59	13		14	2.9	7.6	0.9	49	0	10	9.0	0.1	0.2	1/0.05	0.06	84	0.11	47	7	134	7.7	0	23	26	0.5
Oct. 9	83	14	.71	11	6.0	6.2	1.6	60	0	6.0	8.0	.1	.3	.04	.04	78	.11	52	3	131	7.7	5	--	20	.4
Feb. 29	1,190	16	--	6.2	1.5	3.1	.6	30	0	3.0	1.0	.1	.5	.04	.00	54	.07	22	0	57	7.4	10	--	22	.3
Apr. 16	389	16	--	7.9	1.8	3.7	.5	35	0	4.6	2.0	.0	.1	.04	.00	58	.08	27	0	72	7.6	0	7.5	23	.3
Oct. 4	51	14	--	16	3.1	8.4	.8	52	0	12	11	.1	.2	.03	.04	93	.13	53	10	143	7.4	5	14	26	.5
14-3100. Cow Creek near Riddle, Oreg.																									
Aug. 15, 1967	29	9.6	.04	12	8.0	7.8	1.1	66	3	5.8	11	.1	.3	1/.05	.01	95	.12	63	4	160	8.6	0	27	21	.4
Oct. 6	119	14	.06	14	3.0	6.7	1.3	50	0	10	7.0	.1	.1	.04	.04	80	.11	48	6	122	7.9	5	--	24	.4
Nov. 22	78	13	--	12	6.7	6.5	.7	64	0	6.0	8.5	.1	.1	--	.01	86	.12	58	5	143	7.8	5	--	19	.4
Jan. 4, 1968	411	14	--	7.4	5.3	3.6	.5	48	0	4.8	4.0	.1	.3	.03	.01	62	.08	40	1	97	7.6	10	--	16	.3
Feb. 16	793	15	--	6.1	4.2	3.2	.6	40	0	3.2	2.0	.1	.7	.02	.00	51	.07	32	0	79	7.7	5	--	17	.2
Mar. 29	1,000	15	--	6.4	4.5	3.2	1.6	44	0	3.2	2.0	.3	.1	.01	.06	61	.08	34	0	83	7.5	0	--	16	.2
Apr. 16	306	16	--	7.9	5.2	4.1	.6	53	0	4.2	3.0	.0	.1	.02	.00	68	.09	41	0	101	7.8	0	12	18	.3
July 25	34	10	--	11	7.3	7.7	2.1	69	0	5.8	11	.1	.1	.03	.00	91	.12	58	1	156	8.2	5	26	22	.4
Aug. 30	64	12	--	12	7.0	7.3	1.0	71	0	6.2	7.5	.1	.2	.02	.06	88	.12	59	1	150	7.5	5	22	21	.4
Nov. 18	669	15	--	7.4	6.5	3.8	.7	56	0	4.8	3.5	.1	.4	.04	.04	64	.09	45	0	108	7.4	20	--	16	.3
Dec. 12	3,480	14	--	5.5	4.4	3.6	1.2	39	0	3.0	3.5	.1	1.4	.05	.00	60	.08	32	0	81	6.9	10	8	20	.3
Jan. 14, 1969	1,780	15	--	4.6	3.9	2.7	1.0	34	0	2.6	2.0	.1	1.0	.14	.02	49	.07	28	0	65	7.3	10	--	17	.2
Apr. 11	620	15	--	5.9	3.8	3.3	.6	42	0	3.0	2.0	.0	.0	.11	.05	51	.07	30	0	77	7.4	5	12	18	.3
May 16	256	16	--	7.6	4.9	4.1	.4	52	0	3.6	3.0	.2	.0	.00	.04	63	.09	39	0	98	7.6	5	19	19	.3
14-3120. South Umpqua River near Brockway, Oreg.																									
Aug. 15, 1967	72	9.4	0.09	16	6.5	9.4	1.3	73	0	9.2	13	.1	.4	1/.19	.05	104	.14	66	6	177	7.9	5	26	23	.5
Sept. 13	70	9.3	.02	18	8.4	11	1.5	82	0	11	18	.1	.7	1/.27	.08	112	.15	80	12	207	7.6	5	--	23	.5
Oct. 23	309	13	--	18	7.1	9.1	1.7	78	0	10	14	.1	.4	--	.00	114	.16	74	10	189	7.7	5	14	21	.5
Dec. 1	85	12	2/.28	12	5.5	6.2	1.4	52	0	9.6	9.5	.1	.7	.02	.00	85	.12	52	10	135	7.3	15	--	20	.4
Jan. 10, 1968	11,800	14	--	6.5	3.2	3.7	.6	34	0	4.0	3.0	.1	.5	.12	.00	57	.08	29	1	73	6.9	30	--	21	.3

See footnotes at end of table.

Table 3.--Chemical analyses of surface water in Douglas County--Continued

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potas- sium (K)	Bicar- bonate (HCO ₃)	Car- bonate (CO ₃)	Sul- fate (SO ₄)	Chlo- ride (Cl)	Fluo- ride (F)	Ni- trate (NO ₃)	Phos- phate (PO ₄)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific con- ductance (micro- mhos at 25°C)	pH	Color	Tem- per- ature (°C)	Per- cent Sodium	So- dium ad- sor- ption ratio (SAR)
																mg/l	Tons per acre- foot	Calcium mag- nesium	Non-carbon- ate						
14-3120. South Umpqua River near Brockway, Oreg.--Continued																									
Feb. 27, 1968	5,370	16	--	7.0	3.5	3.4	0.6	40	0	3.6	2.0	0.1	0.7	0.07	0.00	54	0.07	32	0	78	7.4	25	11	19	0.3
Apr. 5	1,580	16	--	9.1	4.4	4.3	1.8	50	0	4.8	4.0	.3	.1	.02	.04	75	.10	40	0	100	7.5	0	--	18	.3
Apr. 17	963	16	--	10	4.5	4.7	.6	54	0	5.4	4.0	.0	.1	.02	.00	75	.10	44	0	108	7.8	0	6.6	18	.3
May 28	800	14	--	11	4.2	5.2	.7	54	0	5.6	5.0	.0	.2	--	--	66	.09	45	0	111	7.5	0	19	20	.3
Aug. 20	258	8.4	--	18	7.2	10	1.2	75	0	11	16	.1	.4	.18	.04	110	.11	74	13	197	7.2	5	19	22	.5
Sept. 30	136	11	--	16	6.9	9.7	1.1	76	0	9.6	14	.1	.4	.18	.02	107	.15	68	6	183	7.4	0	17	23	.5
Nov. 4	1,240	14	--	11	4.2	5.6	.9	50	0	7.0	6.0	.1	.4	.09	.02	78	.11	45	4	114	7.2	10	--	21	.4
Dec. 17	10,100	15	--	6.7	3.8	3.6	.8	40	0	3.6	2.5	.1	.4	.02	.02	62	.08	32	0	78	7.1	10	--	20	.3
Feb. 10, 1969	15,600	16	--	6.1	3.9	3.4	1.1	38	0	3.4	2.5	.1	.6	.15	.04	51	.07	31	0	74	7.2	15	6	19	.3
Apr. 1	5,750	14	--	5.4	2.1	3.0	.6	32	0	3.0	2.0	.0	.2	.04	.06	50	.07	22	0	59	7.4	5	8	22	.3
May 13	4,430	14	--	5.9	2.1	3.1	.2	32	0	3.4	2.0	.0	.2	.01	.02	50	.07	23	0	63	7.2	5	--	22	.3
14-3122.5. South Umpqua River at Roseburg, Oreg. (lat 43°13'05", long 123°21'55")																									
Aug. 17, 1967	--	9.1	2/.04	15	6.5	9.1	1.3	74	0	8.8	12	.1	.3	1/.14	.06	91	.13	64	4	177	8.2	0	26	23	.5
Sept. 14	40	--	--	17	8.4	12	--	80	0	--	--	--	--	--	--	117	.16	77	12	209	7.6	--	--	--	--
Oct. 20	164	--	--	17	6.5	8.9	--	75	0	--	--	--	--	--	--	115	.16	69	8	183	7.5	--	--	--	--
Dec. 1	895	--	--	15	7.0	7.5	--	67	0	--	--	--	--	--	--	116	.16	66	12	168	7.5	--	--	--	--
Jan. 12, 1968	236	--	--	7.5	4.0	3.8	--	41	0	--	--	--	--	--	--	63	.09	35	2	86	7.6	--	--	--	--
Feb. 26	6,810	--	--	7.0	3.4	3.4	--	39	0	--	--	--	--	--	--	61	.08	32	0	77	7.4	--	--	--	--
Apr. 5	1,610	--	--	9.4	5.1	5.0	--	53	0	--	--	--	--	--	--	68	.13	44	1	106	7.8	--	--	--	--
Apr. 17	--	--	--	10	5.3	5.3	--	54	0	--	--	--	--	--	--	80	.11	47	2	115	7.8	--	13	--	--
May 29	765	--	--	11	4.4	5.4	--	54	0	--	--	--	--	--	--	72	.10	46	1	115	7.0	--	18	--	--
July 11	--	12	--	14	6.1	8.7	1.9	71	0	8.0	12	.1	.4	.08	.03	97	.13	60	2	167	7.4	5	26	23	.5
Aug. 20	--	--	--	17	7.5	11	--	78	0	--	19	--	--	--	--	113	.15	74	10	207	6.8	00	19	--	--
Sept. 30	--	--	--	16	6.6	9.7	--	76	0	--	16	--	--	--	--	100	.14	67	4	185	7.8	--	17	--	--
Nov. 4	--	--	--	10	4.6	5.3	--	50	0	--	--	--	--	--	--	79	.11	44	3	113	7.5	--	--	--	--
Dec. 18	--	--	--	7.1	4.1	3.8	--	42	0	--	--	--	--	--	--	64	.09	34	0	85	7.2	--	--	--	--
Feb. 11, 1969	--	--	--	5.7	3.9	3.2	--	36	0	--	--	--	--	--	--	55	.07	30	0	68	7.1	--	7	--	--
Apr. 1	--	--	--	5.8	2.4	2.6	--	33	0	--	--	--	--	--	--	57	.08	24	0	61	7.2	--	9	--	--

See footnotes at end of table.

Table 3.--Chemical analyses of surface water in Douglas County--Continued

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calc-ium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO ₃)	Car-bonate (CO ₃)	Sul-fate (SO ₄)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO ₃)	Phos-phate (PO ₄)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific con-ductance (micro-mhos at 25°C)	pH	Color	Tem-per-ature (°C)	Per-cent Sodium	So-dium ad-sorp-tion ratio (SAR)
																mg/l	Tons per acre-foot	Calcium mag-nesium	Non-carbon-ate						
14-3176. Rock Creek near Glide, Oreg.																									
Aug. 16, 1967	22	14	0.04	7.8	2.1	3.7	0.5	36	0	7.2	1.0	0.1	0.2	1/0.05	0.00	59	0.08	28	0	78	7.9	0	22	22	0.3
Oct. 17	27	13	.07	7.8	2.2	3.5	1.3	34	0	7.2	1.0	0.0	.1	.03	.02	48	.07	28	0	76	7.6	0	--	20	.3
Mar. 27, 1968	473	14	--	4.5	1.4	2.3	.6	23	0	2.2	.5	.1	.2	.03	.00	34	.05	17	0	43	7.3	5	--	22	.2
Apr. 17	138	--	--	5.5	1.6	2.5	--	26	0	--	--	--	--	--	--	46	.06	20	0	52	7.4	--	7	--	--
Aug. 29	51	14	--	7.2	1.9	3.5	.5	33	0	6.0	1.0	.1	.2	.02	.00	50	.07	26	0	69	7.2	5	20	22	.3
Jan. 16, 1969	720	14	--	4.0	1.1	2.2	.4	21	0	2.0	1.5	.1	.1	.03	.04	32	.04	14	0	41	7.1	5	--	25	.3
14-3195. North Umpqua River at Winchester, Oreg.																									
Aug. 16, 1967	854	23	.06	5.3	1.9	5.0	1.2	37	0	1.8	1.5	.1	.2	--	--	--	--	21	0	69	7.5	0	23	33	.5
Sept. 13	953	24	.02	6.7	2.4	3.9	1.0	38	0	2.4	3.0	.1	.2	1/.10	.05	58	.08	26	0	72	7.7	0	--	23	.3
Oct. 18	1,100	23	--	5.3	2.1	4.8	1.8	36	0	1.6	2.0	.1	.1	--	.00	55	.07	22	0	67	7.5	5	--	30	.5
Dec. 1	1,640	18	2/1.4	6.5	2.4	4.2	1.1	35	0	3.2	3.5	.1	.2	.03	.01	55	.07	26	0	71	7.5	15	--	25	.4
Jan. 10, 1968	8,230	15	--	5.4	1.9	3.3	.6	26	0	2.4	2.5	.2	.2	.07	.10	47	.06	22	0	56	7.1	20	--	24	.3
Feb. 26	7,180	16	--	4.7	1.5	2.7	.5	26	0	1.8	1.5	.1	.5	.04	.00	40	.05	18	0	48	7.4	20	--	25	.3
Apr. 4	2,320	19	--	5.8	2.0	3.7	.9	33	0	2.2	2.5	.2	.2	.06	.01	55	.08	22	0	62	7.5	5	--	25	.3
Apr. 17	2,030	--	--	5.9	2.2	4.0	--	34	0	--	--	--	--	--	--	67	.09	24	0	65	7.5	--	10	--	--
May 28	2,900	17	--	5.9	1.7	3.2	.6	32	0	1.2	2.0	.0	.1	--	.02	47	.06	22	0	55	7.4	5	--	24	.3
July 11	846	24	--	5.7	2.1	5.0	1.7	36	0	2.0	3.0	.1	.2	.08	.00	60	.08	22	0	70	7.2	5	24	31	.5
Aug. 20	1,330	21	--	6.0	2.1	4.6	1.3	36	0	3.2	1.5	.1	.2	.23	.03	58	.08	24	0	74	6.9	5	16	29	.4
Sept. 30	832	23	--	6.3	2.2	5.4	1.0	38	0	2.0	3.0	.2	.1	.09	.02	59	.08	24	0	74	7.3	0	16	31	.5
Nov. 4	2,770	17	--	6.0	1.8	3.9	.8	32	0	2.6	3.0	.0	.2	.06	.02	50	.07	22	0	64	7.4	5	--	27	.4
Dec. 17	6,540	16	--	5.7	2.3	3.4	.7	33	0	2.0	2.0	.1	.2	.06	.01	52	.07	24	0	61	7.7	20	--	23	.3
Feb. 10, 1969	7,310	18	--	6.1	2.6	3.5	.8	34	0	2.8	2.0	.1	.3	.12	.04	58	.08	26	0	65	7.3	15	--	22	.3
Apr. 2	6,670	15	--	4.3	1.2	2.7	.3	24	0	1.0	1.0	.1	.0	.10	.04	34	.05	16	0	44	7.4	5	7	27	.3
May 13	6,920	15	--	3.8	1.1	2.5	.3	23	0	.4	1.5	.1	.0	.03	.02	37	.05	14	0	40	7.2	5	--	28	.3
14-3209.5. Umpqua River near Tyee, Oreg. (lat 43°25'55", long 123°33'55")																									
Aug. 17, 1967	--	22	.04	5.9	2.4	5.2	1.1	40	0	2.2	2.0	.1	.2	1/.17	.04	68	.08	24	0	77	7.7	0	24	31	.5
Sept. 20	845	--	--	6.8	3.0	5.7	--	42	0	--	--	--	--	--	--	68	.09	30	0	84	7.7	--	--	--	--

See footnotes at end of table.

Table 3.--Chemical analyses of surface water in Douglas County--Continued

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potas- sium (K)	Bicar- bonate (HCO ₃)	Car- bonate (CO ₃)	Sul- fate (SO ₄)	Chlo- ride (Cl)	Fluo- ride (F)	Ni- trate (NO ₃)	Phos- phate (PO ₄)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific con- ductance (micro- mhos at 25°C)	pH	Color	Tem- per- ature (°C)	Per- cent Sodium	So- dium ad- sor- ption ratio (SAR)
																mg/l	Tons per acre- foot	Calcium mag- nesium	Non- carbon- ate						
14-3209.5. Umpqua River near Tyee, Oreg. (Lat 43°25'55", long 123°33'55")--Continued																									
Oct. 24, 1967	2,410	--	--	7.1	2.7	5.0	--	41	--	--	--	--	--	--	--	69	0.09	28	0	84	7.4	--	12	--	--
Dec. 1	--	--	--	10	4.0	6.0	--	50	0	--	--	--	--	--	--	91	.12	42	0	116	7.4	--	--	--	--
Jan. 17, 1968	--	--	--	5.9	3.0	3.2	--	31	0	--	--	--	--	--	--	58	.08	27	2	66	7.4	--	--	--	--
Feb. 21	--	--	--	6.2	2.7	3.4	--	32	0	--	--	--	--	--	--	59	.08	26	0	66	7.0	--	--	--	--
Apr. 1	--	--	--	7.3	3.4	4.2	--	40	0	--	--	--	--	--	--	63	.09	32	0	80	7.4	--	--	--	--
Apr. 18	--	--	--	7.3	3.3	4.5	--	41	0	--	--	--	--	--	--	65	.09	32	0	84	7.5	--	--	--	--
May 29	--	--	--	6.3	2.4	3.9	--	36	0	--	--	--	--	--	--	57	.08	26	0	71	7.4	--	--	--	--
July 11	--	21	--	6.5	2.7	5.3	2.0	40	0	2.8	4.0	0.1	0.2	0.13	0.03	59	.08	27	0	81	7.3	0	24	28	0.4
Sept. 30	--	--	--	7.2	2.9	5.8	--	45	0	--	5.0	--	--	--	--	60	.08	30	0	93	7.6	--	17	--	--
Nov. 4	--	--	--	8.5	3.3	5.0	--	42	0	--	--	--	--	--	--	63	.09	34	0	94	7.0	--	--	--	--
Dec. 17	--	--	--	6.2	3.2	3.6	--	36	0	--	--	--	--	--	--	62	.08	28	0	72	7.7	--	--	--	--
Apr. 1, 1969	--	--	--	5.0	1.6	2.0	--	26	0	--	--	--	--	--	--	40	.05	19	0	50	7.1	--	9	--	--
14-3210. Umpqua River near Elkton, Oreg.																									
Dec. 29, 1965	46,100	12	2/13	6.4	1.8	3.6	.7	26	0	2.4	5.5	.2	1.2	--	--	41	--	23	2	61	6.6	--	--	--	--
Jan. 31, 1966	11,200	16	2/50	6.0	3.0	4.3	.6	36	0	3.2	3.0	.1	.3	--	--	60	--	27	0	74	7.4	--	--	--	--
Feb. 28	6,250	16	--	6.0	2.7	3.7	3.4	36	0	3.0	2.8	.1	.2	1/11	--	53	.07	26	0	71	7.3	--	--	--	--
Apr. 1	15,600	14	--	5.2	1.7	3.7	.6	28	0	2.0	1.2	.1	.1	1/11	--	44	.06	20	0	53	7.3	--	--	--	--
Apr. 29	4,430	16	2/.08	6.4	2.0	3.5	.8	34	0	2.6	1.8	.1	.1	.04	--	46	.06	24	0	66	7.2	--	--	--	--
May 30	2,470	17	.07	5.8	2.2	4.2	.6	35	0	2.6	2.0	.1	.0	1/.00	--	52	.07	24	0	70	7.1	--	--	--	--
June 30	1,330	11	.04	7.2	1.8	5.0	1.0	34	2	2.4	3.5	.1	.0	1/.03	--	47	.06	26	0	77	8.6	--	--	--	--
July 29	1,160	12	--	5.6	2.5	5.4	1.2	38	0	2.4	3.0	.1	.3	1/.06	--	48	.07	24	0	76	7.1	--	--	--	--
Sept. 1	1,030	17	--	5.7	2.7	5.5	1.2	38	0	2.8	4.0	.2	.3	1/.12	--	64	.09	25	0	77	7.1	--	--	--	--
Sept. 28	1,140	16	--	7.6	3.3	6.1	1.3	44	0	4.4	6.0	.2	.1	1/.13	--	71	.10	32	0	96	7.0	--	--	--	--
Oct. 27	1,990	14	--	10	3.6	5.3	1.0	44	0	6.0	6.0	.1	.5	1/.16	--	73	.10	40	4	105	7.0	10	--	--	--
Nov. 29	8,220	15	--	7.8	3.0	3.9	.5	36	0	4.6	3.0	.1	.4	1/.12	--	60	.08	32	2	75	7.0	5	--	--	--
Dec. 29	5,110	16	--	7.1	3.1	4.1	.4	40	0	4.0	2.0	.1	.4	1/.09	--	60	.08	30	0	80	7.0	10	--	--	--
Jan. 27, 1967	33,900	14	--	6.1	2.9	3.8	1.3	34	0	3.2	3.0	.0	.2	1/.10	--	50	.07	27	0	68	7.3	25	--	--	--
Feb. 27	7,730	17	--	7.1	2.8	3.9	.6	38	0	3.6	3.0	.0	.2	1/.09	--	60	.08	29	0	74	7.5	15	--	--	--

See footnotes at end of table.

Table 3.--Chemical analyses of surface water in Douglas County--Continued

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	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)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific conductance (micro-mhos at 25°C)	pH	Color	Temperature (°C)	Percent Sodium	Sodium adsorption ratio (SAR)
																mg/l	Tons per acre-foot	Calcium magnesium	Non-carbonate						
14-3210. Umpqua River near Elkton, Oreg.--Continued																									
Mar. 29, 1967	8,140	17	--	6.7	2.7	3.8	0.9	36	0	2.8	4.0	0.1	0.1	1/0.05	--	58	0.08	28	0	74	7.5	5	--	--	--
Apr. 27	7,920	17	--	6.9	2.7	4.0	.9	38	0	3.2	3.0	.1	.1	1/0.09	--	60	.08	28	0	77	7.5	5	--	--	--
May 29	4,720	16	--	5.5	2.0	3.1	.8	32	0	2.2	1.5	.1	.1	1/0.06	--	52	.07	22	0	61	7.5	0	--	--	--
June 28	2,280	16	--	6.9	2.1	4.0	1.1	36	0	2.4	3.0	.1	.2	1/0.08	--	52	.07	26	0	72	7.3	5	--	--	--
July 27	1,200	17	--	5.9	2.4	5.1	1.0	38	0	2.4	2.5	.1	.3	1/0.07	--	60	.08	24	0	77	7.4	0	--	--	--
Aug. 17	951	16	0.06	5.8	2.4	5.5	1.1	32	4	2.0	2.5	.1	.2	1/0.08	0.05	57	.08	24	0	77	9.0	0	27	32	0.5
Aug. 29	904	16	--	6.0	2.5	5.5	1.4	39	0	2.4	3.0	.1	.7	1/0.11	--	60	.08	26	0	78	7.0	5	--	--	--
Sept. 20	1,000	19	--	6.7	2.7	5.6	1.4	41	0	4.0	4.0	.2	.1	1/0.14	--	61	.08	28	0	81	7.9	5	--	--	--
Oct. 23	2,010	20	--	6.9	2.8	5.5	1.7	40	0	2.8	4.0	.1	.2	1/0.20	.02	59	.08	28	0	84	7.5	5	--	28	.4
Nov. 28	1,260	19	--	7.8	2.9	5.5	1.0	43	0	3.8	4.5	.1	.1	1/0.13	.03	65	.09	32	0	91	7.4	0	--	27	.4
Jan. 16, 1968	38,000	13	--	5.1	2.2	3.3	1.0	25	0	3.0	2.5	.3	.5	1/0.02	.00	46	.06	22	1	56	6.8	25	--	23	.3
Feb. 19	5,340	17	--	7.1	3.1	4.1	.7	39	0	3.6	3.5	.1	.2	1/0.05	--	64	.09	30	0	81	7.5	10	--	22	.3
Feb. 27	14,000	16	--	6.0	2.6	3.3	.8	32	0	3.2	1.0	.1	.7	1/0.06	--	49	.07	26	0	64	7.5	5	10	21	.3
Apr. 1	5,500	17	--	7.0	3.0	4.0	.9	40	0	3.4	2.5	.1	.2	1/0.09	.02	61	.08	30	0	78	7.6	5	--	22	.3
Apr. 18	3,160	--	--	7.7	3.4	4.5	--	42	0	--	--	--	--	1/0.09	--	70	.10	33	0	85	7.5	--	12	--	--
May 29	3,580	15	--	6.6	2.4	3.9	.7	36	0	3.2	3.0	.1	.2	1/0.04	.02	49	.07	26	0	72	7.4	0	--	24	.3
June 26	1,220	17	--	6.3	2.7	5.1	1.0	40	0	2.8	3.0	.1	.1	1/0.09	.00	64	.09	26	0	81	7.4	0	--	27	.4
Aug. 20	1,520	20	--	6.3	2.6	5.9	1.2	40	0	2.8	4.0	.1	.5	1/0.13	--	67	.09	26	0	81	7.0	0	21	--	--
Sept. 30	1,030	17	--	7.9	3.0	6.0	1.0	44	0	3.6	6.0	.1	.3	1/0.11	--	67	.09	32	0	94	7.4	0	18	--	--
Nov. 4	4,950	18	--	8.0	2.9	5.2	.9	42	0	4.2	4.0	.0	.1	1/0.11	--	68	.09	32	0	91	7.5	5	--	--	--
Nov. 25	10,900	16	--	6.7	2.6	4.0	.8	36	0	3.6	3.0	.1	.2	1/0.06	--	60	.08	27	0	74	7.5	20	8	--	--
Dec. 26	24,800	15	--	5.6	3.0	3.4	.8	33	0	2.8	2.0	.1	.4	1/0.16	--	51	.07	26	0	65	7.1	10	--	--	--
Jan. 29, 1969	9,990	17	--	6.8	3.3	3.8	.6	40	0	4.2	2.5	.1	.3	1/0.12	--	65	.09	30	0	76	7.2	20	3	21	.3
Mar. 25	9,300	16	--	5.6	2.1	3.5	.3	32	0	2.2	2.0	.0	.0	--	--	54	.07	22	0	61	7.4	5	9	25	.3

1/ Total phosphate (as PO₄)

2/ Total in solution and sediments

Table 4.--Chemical analyses of waters from miscellaneous sites on streams in Douglas County

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	Calc-ium (Ca)	Magne-sium (Mg)	Sodium (Na)	Po-tas-sium (K)	Bicar-bonate (HCO ₃)	Car-bonate (CO ₃)	Sul-fate (SO ₄)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO ₃)	Phos-phate (PO ₄)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific con-ductance (micro-mhos at 25°C)	pH	Color	Tem-per-ature (°C)	Per-cent Sodium	So-dium ad-sorp-tion ratio (SAR)	
																mg/l	Tons per acre-foot	Calcium mag-nesium	Non-carbon-ate							
14-3076.90. South Umpqua River above Dumont Creek, Oreg. (Lat 43°02'11", long 122°45'35")																										
Apr. 16, 1968	--	--	--	8.2	2.0	3.4	--	33	0	--	--	--	--	--	--	64	0.09	28	2	73	7.5	--	6.5	--	--	
14-3076.91. Dumont Creek near Tiller, Oreg. (Lat 43°02'11", long 122°48'38")																										
Apr. 16, 1968	--	--	--	7.6	2.0	4.0	--	36	0	--	--	--	--	--	--	65	.09	27	0	71	7.6	--	6.5	--	--	
14-3085. Elk Creek near Drew, Oreg.																										
Apr. 16, 1968	21	19	--	11	2.4	5.1	0.5	55	0	0.2	3.0	0.0	0.1	0.07	0.00	64	.09	38	0	97	7.7	0	7.5	22	0.4	
14-3087.1. South Umpqua River near Days Creek, Oreg. (Lat 42°58'23", long 123°10'13")																										
Nov. 9, 1961	--	18	--	9.5	2.6	5.2	.8	45	0	4.8	3.5	.1	.1	.06	--	71	--	34	0	92	7.5	15	6	--	--	
Feb. 6, 1962	--	18	2/0.00	8.0	1.7	3.6	.7	36	0	3.4	2.0	.1	.6	.07	--	64	--	27	0	71	7.2	10	6	--	--	
June 19	--	16	.04	9.0	2.2	4.3	.6	41	0	4.8	2.8	.0	.0	.05	--	65	--	32	0	85	7.5	5	21	--	--	
Aug. 6	--	14	.04	14	3.3	7.5	.9	56	0	9.0	8.5	.1	.1	.02	--	87	--	48	2	136	7.8	5	22	--	--	
Nov. 21	--	16	2/.39	8.5	1.5	3.8	.6	39	0	4.0	2.0	.1	.1	.10	--	60	--	28	0	71	7.2	40	10	--	--	
Feb. 4, 1963	--	15	.63	6.0	1.4	3.0	.4	30	0	3.0	1.2	.1	.3	.09	--	60	--	21	0	52	7.4	40	9	--	--	
June 25	--	15	.11	11	2.4	5.0	.9	50	.0	4.0	3.2	.1	.3	.04	--	70	--	37	0	96	7.9	5	20	--	--	
Aug. 16, 1967	--	--	--	14	3.9	8.2	--	57	0	--	--	--	--	--	--	92	.13	51	4	151	7.3	--	24	--	--	
Apr. 16, 1968	--	17	--	8.3	2.4	4.1	.5	41	0	4.4	2.5	.0	.0	.04	.00	56	.08	30	0	82	7.7	0	10	22	.3	
14-3090. Cow Creek near Azalea, Oreg.																										
Aug. 15, 1967	8.5	--	--	11	6.8	6.2	--	77	0	--	--	--	--	--	--	85	.12	56	0	136	8.0	--	27	--	--	
Apr. 16, 1968	52	21	--	8.7	5.4	3.9	.7	59	0	3.0	2.0	.0	.1	.03	.00	72	.10	44	0	104	7.6	0	6.5	16	.3	
14-3092. Cow Creek near Glendale, Oreg. (Lat 42°44'57", long 123°22'18")																										
Apr. 16, 1968	--	--	--	8.3	7.4	3.6	--	62	0	--	--	--	--	--	--	83	.11	51	0	111	7.5	--	8	--	--	
14-3095. West Fork Cow Creek near Glendale, Oreg.																										
Aug. 15, 1967	11	--	--	10	3.7	6.3	--	51	1	--	--	--	--	--	--	77	.10	40	0	114	8.3	--	26	--	--	

See footnotes at end of table.

Table 4.--Chemical analyses of waters from miscellaneous sites on streams in Douglas County--Continued

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	Cal- cium (Ca)	Magne- sium (Mg)	Sodium (Na)	Po- tas- sium (K)	Bicar- bonate (HCO ₃)	Car- bonate (CO ₃)	Sul- fate (SO ₄)	Chlo- ride (Cl)	Fluo- ride (F)	Ni- trate (NO ₃)	Phos- phate (PO ₄)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific con- ductance (micro- mhos at 25°C)	pH	Color	Tem- per- ature (°C)	Per- cent Sodium	So- dium ad- sor- p- tion ratio (SAR)
																mg/l	Tons per acre- foot	Calcium mag- nesium	Non- carbon- ate						
14-3107. South Myrtle Creek near Myrtle Creek, Oreg.																									
Aug. 15, 1967	1.7	--	--	28	8.4	8.1	--	126	0	--	11	--	--	--	--	153	0.21	104	1	248	7.8	--	23	--	--
Apr. 16, 1968	22	20	--	18	5.1	5.2	0.7	80	0	7.6	4.5	0.0	0.1	0.01	0.05	98	.13	66	0	154	8.0	5	6.5	15	0.3
14-3110. North Fork Myrtle Creek near Myrtle Creek, Oreg.																									
Aug. 15, 1967	1.9	--	--	22	9.8	11	--	95	0	--	26	--	--	--	--	158	.21	96	18	253	7.9	--	23	--	--
Apr. 16, 1968	23	21	--	18	9.8	7.1	.4	92	0	9.0	12	.0	.1	.01	.03	117	.16	86	10	198	8.0	5	9.5	15	.3
14-3110.5. South Umpqua River near Dillard, Oreg. (Lat 43°04'52", long 123°23'08")																									
Aug. 15, 1967	--	--	--	14	6.4	8.4	--	70	0	--	--	--	--	--	--	93	.13	62	4	168	7.4	--	25	--	--
14-3113. Ten Mile Creek at Ten Mile, Oreg.																									
Apr. 17, 1968	15	--	--	6.9	3.8	5.4	--	42	0	--	--	--	--	--	--	66	.09	32	0	88	7.5	--	--	--	--
14-3113.5. Olalla Creek near Brockway, Oreg. (Lat 43°06'48", long 123°30'24")																									
Aug. 15, 1967	--	--	--	11	7.1	7.2	--	77	0	--	--	--	--	--	--	86	.12	56	0	148	7.0	--	23	--	--
Apr. 17, 1968	--	--	--	7.2	5.4	5.1	--	48	0	--	--	--	--	--	--	68	.09	40	0	99	7.4	--	--	--	--
14-3115. Lookingglass Creek near Brockway, Oreg.																									
Apr. 17, 1968	52	12	--	7.6	4.8	5.2	.6	50	0	5.8	3.5	.0	.1	.01	.00	61	.08	38	0	105	7.5	0	7.0	23	.4
14-3120.1. South Umpqua River near Roseburg, Oreg. (Lat 43°10'10", long 123°22'00")																									
Aug. 15, 1967	--	--	--	15	6.8	9.3	--	72	0	--	--	--	--	--	--	102	.14	66	6	179	7.3	--	26	--	--
South Umpqua River at Roseburg, Oreg. (Lat 43°12'55", long 123°24'30")																									
Nov. 9, 1961	--	16	$\frac{2}{2}$ 0.21	11	4.0	5.7	.8	51	0	5.6	6.2	.1	.6	.25	--	80	--	44	2	114	7.3	20	8	--	--
Feb. 6, 1962	--	17	.16	9.5	3.4	4.5	.8	47	0	4.4	3.8	.1	.6	.10	--	74	--	38	0	95	7.4	10	7	--	--
June 19	--	16	.06	12	3.8	5.9	.8	56	0	4.4	5.8	.0	.6	.29	--	79	--	46	0	118	7.4	5	26	--	--
Aug. 6	--	10	.05	15	5.8	10	1.5	72	0	8.4	13	.2	.3	.67	--	104	--	62	2	177	8.0	5	25	--	--
Nov. 21	--	17	$\frac{2}{2}$.21	10	4.3	5.0	.7	53	0	5.0	4.2	.1	.2	.15	--	76	--	43	0	107	7.4	35	11	--	--

See footnotes at end of table.

Table 4.--Chemical analyses of waters from miscellaneous sites on streams in Douglas County--Continued

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	Cal- cium (Ca)	Magne- sium (Mg)	Sodium (Na)	Po- tas- sium (K)	Bicar- bonate (HCO ₃)	Car- bonate (CO ₃)	Sul- fate (SO ₄)	Chlo- ride (Cl)	Fluo- ride (F)	Ni- trate (NO ₃)	Phos- phate (PO ₄)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific con- ductance (micro- mhos at 25°C)	pH	Color	Tem- per- ature (°C)	Per- cent Sodium	So- dium ad- sorp- tion ratio (SAR)
																mg/l	Tons per acre- foot	Calcium mag- nesium	Non-carbon- ate						
South Umpqua River at Roseburg, Oreg.--Continued																									
Feb. 4, 1963	--	15	2/2.0	6.5	2.5	3.7	0.6	34	0	3.6	1.8	0.1	0.5	0.11	--	69	--	26	0	62	7.4	40	9	--	--
June 25	--	15	2/2.10	12	5.4	5.4	.9	66	0	5.0	5.8	.1	.6	.18	--	84	--	52	0	131	7.8	5	20	--	--
14-3122.1. Deer Creek at Roseburg, Oreg. (Lat 43°12'37", long 123°19'24")																									
Apr. 17, 1968	17	--	--	20	12	8.9	--	104	0	--	--	--	--	--	--	144	0.20	100	14	225	7.9	--	--	--	--
14-3125. Lake Creek at Diamond Lake, Oreg. (Lat 43°11'10", long 122°09'50")																									
Jan. 16, 1968	--	1.2	.04	2.7	1.2	3.5	1.0	24	0	.0	.5	.1	.0	.00	--	18	--	12	0	40	7.6	0	0	--	--
Apr. 30, 1969	--	1.1	.03	1.7	.8	2.7	.7	17	0	.2	.5	.0	.1	.36	0.03	17	--	8	0	30	7.0	0	--	--	--
14-3166.9. North Umpqua River near Steamboat, Oreg. (Lat 43°20'30", long 122°44'01")																									
Apr. 17, 1968	--	--	--	4.7	1.9	4.0	--	30	0	--	--	--	--	--	--	56	.08	20	0	57	7.5	--	--	--	--
14-3167. Steamboat Creek near Glide, Oreg.																									
Apr. 17, 1968	231	--	--	5.6	1.5	2.6	--	26	0	--	--	--	--	--	--	44	.06	20	0	53	7.3	--	--	--	--
14-3175. North Umpqua River near Idleld Park, Oreg. (Lat 43°19'57", long 123°00'07")																									
Apr. 17, 1968	--	--	--	5.0	1.8	3.7	--	29	0	--	--	--	--	--	--	47	.06	20	0	56	7.5	--	7	--	--
14-3176.5. North Umpqua River near Glide, Oreg. (Lat 43°18'35", long 123°04'21")																									
Nov. 9, 1961	--	22	.05	5.5	1.7	4.2	.9	32	0	2.8	1.8	.1	.0	.09	--	53	--	20	0	61	7.4	5	6	--	--
Feb. 6, 1962	--	20	.03	5.5	.9	3.3	.8	28	0	1.8	1.5	.1	.1	.22	--	56	--	18	0	53	7.3	5	7	--	--
June 19	--	21	2/.03	5.0	1.0	3.7	.9	28	0	.0	1.5	.0	.1	.09	--	52	--	17	0	53	7.1	5	--	--	--
Aug. 6	--	24	.03	5.5	1.6	4.6	1.0	34	0	2.4	1.5	.0	.0	.11	--	60	--	20	0	65	7.7	5	18	--	--
Nov. 21	--	15	2/2.27	5.5	.6	2.7	.4	25	0	1.8	.5	.1	.2	.09	--	40	--	16	0	44	7.1	25	9	--	--
Feb. 4, 1963	--	14	.32	4.0	.9	2.2	.2	22	0	2.0	.8	.0	.2	.06	--	45	--	14	0	37	7.3	20	8	--	--
June 25	--	20	.07	5.5	1.4	3.7	.9	32	0	1.8	1.0	.1	.3	.08	--	52	--	19	0	56	7.7	5	16	--	--
Aug. 16, 1967	--	--	--	5.5	2.0	4.9	--	36	0	--	--	--	--	--	--	64	.09	22	0	68	7.4	--	19	--	--
Apr. 17, 1968	--	--	--	5.0	1.8	3.7	--	30	0	--	--	--	--	--	--	43	.04	20	0	56	7.5	--	--	--	--

See footnotes at end of table.

Table 4.--Chemical analyses of waters from miscellaneous sites on streams in Douglas County--Continued

[Analyses, in milligrams per liter, by U.S. Geological Survey]

Date of collection	Dis-charge (cfs)	Silica (SiO ₂)	Iron (Fe)	Cal- cium (Ca)	Magne- sium (Mg)	Sodium (Na)	Po- tas- sium (K)	Bicar- bonate (HCO ₃)	Car- bonate (CO ₃)	Sul- fate (SO ₄)	Chlo- ride (Cl)	Fluo- ride (F)	Ni- trate (NO ₃)	Phos- phate (PO ₄)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)		Hardness as CaCO ₃		Specific con- ductance (micro- mhos at 25°C)	pH	Color	Tem- per- ature (°C)	Per- cent Sodium	So- dium ad- sor- ption ratio (SAR)
																mg/l	Tons per acre- foot	Calcium mag- nesium	Non- carbon- ate						
14-3208. Calapooya Creek near Umpqua, Oreg. (Lat 43°22'02", long 123°27'35")																									
Aug. 17, 1967	--	--	--	8.2	4.4	8.4	--	54	0	--	--	--	--	--	--	76	7.10	38	0	117	7.5	--	22	--	--
Apr. 18, 1968	--	15	--	9.5	4.5	5.7	0.4	45	0	5.8	8.0	0.0	0.1	0.08	0.00	68	.09	42	5	108	7.7	5	--	23	0.4
14-3209. Umpqua River at Umpqua, Oreg. (Lat 43°21'58", long 123°28'03")																									
Apr. 18, 1968	--	--	--	7.8	3.4	4.6	--	42	0	--	--	--	--	--	--	69	.09	34	0	85	7.5	--	--	--	--
Umpqua River at Elkton, Oreg. (Lat 43°37'57", long 123°33'57")																									
Nov. 9, 1961	--	17	2/0.19	7.0	2.7	4.2	.8	36	0	4.2	3.2	.1	.2	.10	--	64	--	28	0	78	7.5	20	10	--	--
Feb. 6, 1961	--	17	2/.13	8.0	1.8	4.0	.8	37	0	3.6	2.2	.0	.3	.07	--	63	--	27	0	74	7.5	15	8	--	--
June 19	--	19	.05	7.0	2.1	4.7	.9	37	0	1.6	3.2	.0	.1	.07	--	56	--	26	0	75	7.2	5	25	--	--
Aug. 6	--	18	.06	6.5	1.9	5.2	1.0	38	0	3.2	3.0	.0	.2	.03	--	55	--	24	0	73	7.9	5	22	--	--
Nov. 21	--	17	2/.22	8.5	2.3	4.2	.6	40	0	4.8	2.5	.1	.2	.14	--	62	--	30	0	80	7.5	40	11	--	--
Feb. 4, 1963	--	14	2/1.4	6.0	1.5	3.8	.6	28	0	3.2	2.5	.1	.5	.05	--	60	--	21	0	54	7.3	40	11	--	--
June 26	--	17	.15	8.0	2.7	4.8	.9	45	0	2.6	3.5	.1	.3	.06	--	65	--	31	0	85	7.8	5	19	--	--
14-3220. Elk Creek at Drain, Oreg.																									
Aug. 14, 1967	1.5	--	--	32	6.4	20	--	72	0	--	46	--	--	--	--	178	.24	106	48	271	7.8	--	28	--	--
Apr. 18, 1968	63	17	--	13	3.4	6.6	.5	50	0	3.4	13	.0	.1	.01	.00	78	.11	46	6	131	7.8	5	--	24	.4
14-3228. Elk Creek near Elkton, Oreg. (Lat 43°38'48", long 123°31'22")																									
Aug. 14, 1967	--	2.6	2/.57	8.3	3.2	9.4	1.7	40	0	1.2	16	.1	.3	1/.10	.02	68	.09	34	0	123	7.5	5	31	37	.7
Apr. 18, 1968	--	16	--	10	2.7	5.9	.7	44	0	2.8	9.0	.0	.1	.04	.00	71	.10	36	0	103	7.7	0	--	26	.4
14-3229. Umpqua River at Scottsburg, Oreg.																									
Aug. 14, 1967	1,050	--	--	5.8	2.6	5.3	--	38	0	--	--	--	--	--	--	60	.08	25	0	77	7.8	--	27	--	--
Apr. 18, 1968	3,610	--	--	7.9	3.3	4.6	--	41	0	--	--	--	--	--	--	72	.10	33	0	86	7.6	--	--	--	--
14-3230.95. Smith River near Scottsburg, Oreg. (Lat 43°47'36", long 123°46'32")																									
Aug. 14, 1967	--	9.4	.12	4.1	1.6	5.8	1.1	25	0	.2	6.0	.1	.3	1/.04	.05	44	.06	16	0	66	7.5	5	27	41	.6
Apr. 18, 1968	--	13	--	3.6	1.3	4.0	.7	22	0	1.0	4.0	.0	.1	.00	.00	36	.05	14	0	50	7.3	0	9	35	.4

1/ Total phosphate (as PO₄).

2/ Total in solution and sediments.

Table 5.--Trace-metal analyses of surface water from Douglas County/Analyses, in milligrams per liter, by U.S. Geological Survey/

Date of collection	Man- gan- ese (Mn)	Nic- kel (Ni)	Chro- mium (Cr)	Cop- per (Cu)	Zinc (Zn)	Arse- nic (As)	Lith- ium (Li)	Stron- tium (Sr)
14-3100. Cow Creek near Riddle, Oreg.								
Aug. 15, 1967	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.19
14-3220. Elk Creek near Drain, Oreg.								
Aug. 17, 1967	.06	.00	.00	.01	.01	.00	.00	.28

Table 6.--Pesticide analyses of surface water from Douglas County

[Analyses, in ^{micrograms} per liter, by U.S. Geological Survey]

Date of collection	Insecticide									Herbicide		
	Aldrin	DDD	DDE	DDT	Dieldrin	Endrin	Heptachlor	Heptachlor Epoxide	Lindane	2,4-D	Silvex	2,4,5-T
14-3120. South Umpqua River near Brockway, Oreg.												
Aug. 15, 1967	a	a	a	a	a	a	a	a	a	a	a	a
Sept. 13	a	a	a	a	a	a	a	a	a	a	a	a
Oct. 23	a	a	a	0.01	a	a	a	a	a	a	a	a
Apr. 16, 1968	a	a	a	a	a	a	a	a	a	a	a	a
May 28	a	a	a	a	a	a	a	a	a	a	a	a
July 10	a	a	a	a	a	a	a	a	a	a	a	a
Aug. 20	a	a	a	a	a	a	a	a	a	a	a	a
Sept. 30	a	a	a	a	a	a	a	a	a	a	a	a
Nov. 4	a	a	a	a	a	a	a	a	a	a	a	a
14-3210. Umpqua River near Elkton, Oreg.												
Aug. 17, 1967	a	a	a	0.07	a	a	a	a	a	a	a	a
Sept. 20	a	a	a	a	a	a	a	a	a	a	a	a
Oct. 23	a	a	a	a	0.01	a	a	a	a	a	a	a
Apr. 18, 1968	a	a	a	a	a	a	a	a	a	a	a	a
May 29	a	a	a	a	a	a	a	a	a	a	a	a
June 26	a	a	a	a	a	a	a	a	a	a	a	a
July 11	a	a	a	a	a	a	a	a	a	a	a	a
Aug. 20	a	a	a	a	a	a	a	a	a	a	a	a
Sept. 30	a	a	a	a	a	a	a	a	a	a	a	a
Nov. 4	a	a	a	a	a	a	a	a	a	a	a	a

a Below detectable limit.

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