

WATER-QUALITY AND FLOW DATA FOR THE JOHNSON CREEK BASIN, OREGON, APRIL 1988 TO JANUARY 1990

By Thomas K. Edwards

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ABSTRACT

Bottom-material and surface-water samples, and associated on-site , measurements, were obtained from sites in the Johnson Creek basin from April 1988 to January 1990 as part of a cooperative effort by the U.S. Geological Survey and the City of Portland, Bureau of Environmental Services, to characterize and assess the quality of water in the basin. Bottom-material samples were analyzed for trace elements and selected manmade organic compounds. Surface-water samples were analyzed for nutrients, trace elements, selected manmade organic compounds, suspended-sediment concentration and particle size. Field determinations made during low flow included water temperature, pH, alkalinity, specific conductance, fecal coliform and fecal streptococcal bacteria, dissolved oxygen, and turbidity.

Reconnaissance bottom-material and surface-water samples were collected from Johnson Creek in August 1988 to evaluate chemical characteristics of the resident sediment and to determine constituents of greatest concern for further study. Low-flow water samples were taken from August to October 1989 at eight Johnson Creek sites and two tributary sites to establish background levels for comparison. Storm-runoff samples were obtained at eight Johnson Creek sites, two tributary and two storm-drain, outfall sites over part of the storm-runoff events of December 4, 1989, and January 25, 1990. Water temperature, specific conductance, and turbidity data were collected during storm runoff in April 1988. Discharge measurements were made during low-flow sampling and at selected stream-stage conditions during storm flow.

INTRODUCTION

The U.S. Geological Survey (USGS), in cooperation with the City of Portland, Bureau of Environmental Services (PBES), collected discharge, physical, and chemical data from Johnson Creek and selected tributaries and outfalls to Johnson Creek during selected low-flow periods and storm-runoff events from April 1988 to January 1990. The purpose of this report is to present those data.

Documentation of methods used for the water-quality and associated sampling and analyses are as follows: determination of stream discharge (Buchanan and Somers, 1969; Buchanan and Somers, 1968; and Dalrymple and Benson, 1967), water temperature, pH, alkalinity, specific conductance, turbidity, dissolved oxygen, dissolved and suspended organic carbon (Skougstad and others, 1979; and Wershaw and others, 1987), suspended-sediment concentration and particle size (Guy, 1969), fecal coliform and fecal streptococcal bacteria (American Public Health Association and others, 1976), nutrients, trace elements (Skougstad and others, 1979), and selected manmade-organic compounds (Wershaw and others, 1987).

Bottom material collected during a low-flow reconnaissance survey was analyzed for total trace elements (Horowitz, 1985) and selected manmade-organic compounds (Wershaw and others, 1987) sorbed to sediment particles greater than 63 μm (micrometers) and less than 63 μm in size.

Acknowledgments

Special thanks to James Soli, and other members of PBES for assistance in reconnaissance, and water-quality sample collection during storm-runoff periods; and the Organics Section of the Oregon Department of Environmental Quality (DEQ) Laboratory, Portland, Oregon, for determination of manmade organic-compound concentrations in low-flow bottom-material samples.

Physiographic Setting

Johnson Creek flows in a westerly direction over its 24-mile length, through a heterogeneous mixture of land uses from a predominantly agricultural headwater area southeast of Gresham, Oregon, through the cities of Gresham, Portland and Milwaukie, where it discharges to the Willamette River (fig. 1). Johnson Creek drains an area of approximately 51 square miles and displays a hydrograph configuration typical of the local area with summer low flows graduating into high flows during winter rainstorm events, and flows between storms receding steadily until the next storm event.

The banks of Johnson Creek have been stabilized with hand-placed stone work throughout most of its length through the City of Portland. The stream slope varies markedly over its length, from approximately 14 ft/mi (feet per mile) in the upper basin, to 7 ft/mi in the mid-basin, and 31 ft/mi in the lowest 6-mile reach (fig. 2). The distribution of stream bottom-material particle sizes correlates with the channel slope and adjacent land use in this geomorphologically inverted basin, with finer bottom-material sizes in the upper basin reach and larger (large gravel and cobble size) material in the lower reach. Johnson Creek's bottom-material distribution is atypical; stream-channel bottom material is usually coarser in the headwater reaches grading to finer grained material in the lower reaches (Leopold, Wolman, and Miller, 1964), because most streams trend from steeper headwaters to less steep mouths.

METHODS OF SAMPLING AND ANALYSIS

Methods of sample collection and analysis for the physical characteristics and chemical constituents are documented in this section. Sample collection, preparation, and analysis followed standard USGS methods (Edwards and Glysson, 1986; Skougstad and others, 1979; Greeson and others, 1977; Guy, 1969; and American Public Health Association and others, 1976). Sampling site locations are shown in figure 1 and described in table 1. Analytical results of samples collected are listed in tables 2 through 16.

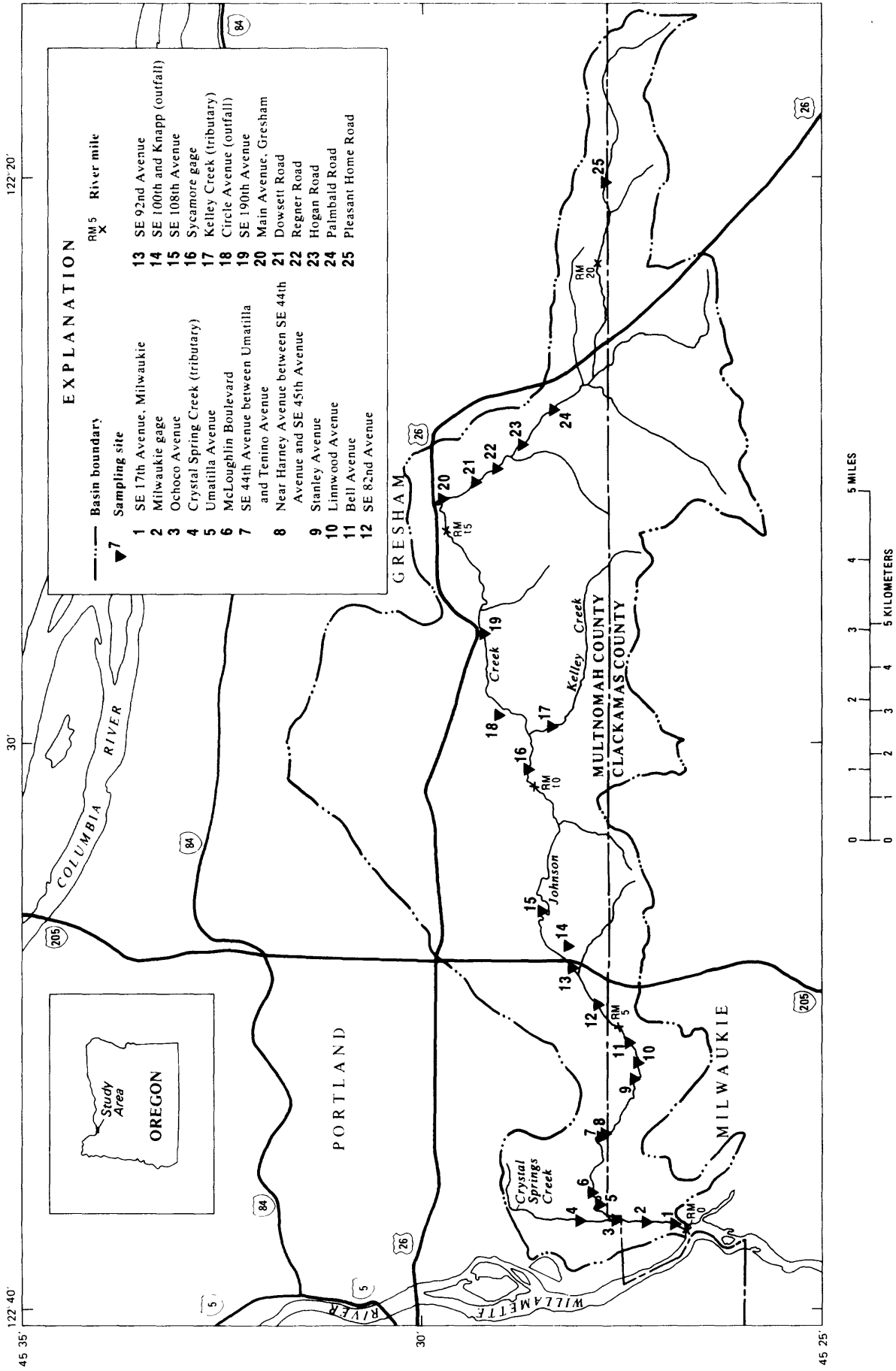


Figure 1.--Location of sampling sites in the Johnson Creek basin.

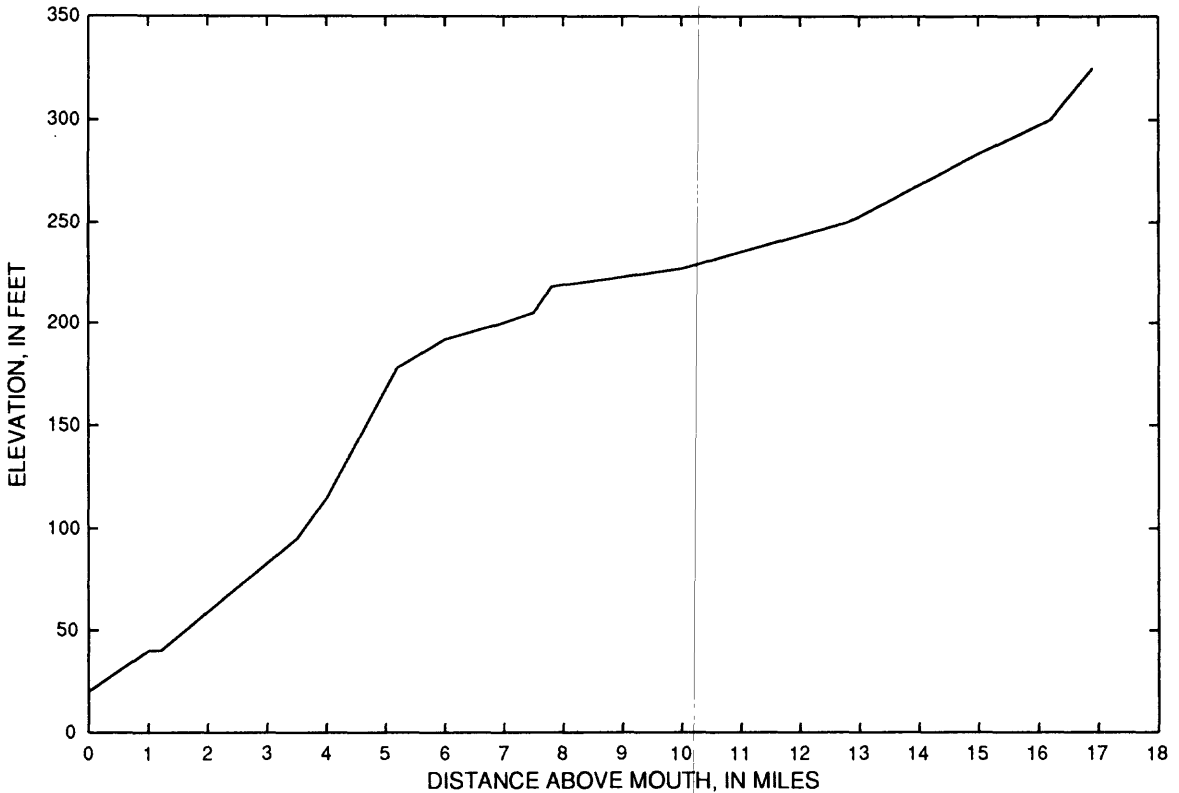


Figure 2.--Johnson Creek channel slope.

Physical and Chemical Water-quality Data

Water temperatures were measured in the field, using a mercury thermometer calibrated to an American Standard Thermometer¹. Field pH measurements were made using a Beckman model 11 pH meter and probe. All alkalinity determinations were made by incremental titration. Specific conductance was measured using a Yellow Springs Instrument Company (YSI) model 3000 conductance meter; readings were corrected to 25°C (25 degrees Celsius). Turbidity was measured using a Hach Turbidimeter, model 16800. Dissolved oxygen measurements were made with a YSI model 57 dissolved-oxygen meter.

Bottom-material subsamples were collected at 10 to 20 randomly selected points at each of nine sites in the main stem. At each site, subsamples were composited in large containers in the field, obtaining one composite per site. A glass beaker and watch glass were used to scoop a subsample from the top few centimeters of the streambed. Subsamples to be analyzed for trace elements were composited in plastic tubs while subsamples for organic analysis were composited in stainless-steel pans.

¹ Use of brand names in this report is for identification purposes only and does not constitute an endorsement by the U.S. Geological Survey.

Table 1.--Johnson Creek basin sampling sites

[b = bottom-material at low-flow site August 1988; s = surface water and suspended-sediment low-flow site August through October 1989; r = storm-runoff site December 1989 and January 1990; e = extra site storm runoff January 1990; q = quality-assurance and control sites; t = storm-reconnaissance site during storm April 1988; and d = low-flow dissolved-oxygen site October 1989]

Site number	Station number	Station name	Distance above mouth (miles)	Sample site type
1	452649122383000	SE 17th Avenue, Milwaukie	0.30	t
2	14211550	Milwaukie gage	.60	srdq
3	452735122382600	Ochoco Avenue	1.05	b
4	452746122382800	Crystal Spring Creek (tributary)	1.20	srd
5	452746122381700	Umatilla Avenue	1.37	b
6	452751122381400	McLoughlin Boulevard	1.50	srd
7	452750122370000	SE 44th Avenue between Umatilla Avenue and Tenino Avenue	2.60	bet
8	452744122370000	Near Harney Avenue between SE 44th Avenue and SE 45th Avenue	2.70	b
9	452722122361100	Stanley Avenue	3.60	srd
10	452717122355200	Linnwood Avenue	3.85	b
11	452731122353000	Bell Avenue	4.20	srd
12	452717122344000	SE 82nd Avenue	5.5	bsrd
13	452806122340300	SE 92nd Avenue	5.82	b
14	452911122291200	SE 100th and Knapp (outfall)	6.25	r
15	452804122330300	SE 108th Avenue	7.10	td
16	14211500	Sycamore gage	10.25	bsrtdq
17	452837122295000	Kelley Creek (tributary)	10.70	srd
18	452810122332700	Circle Avenue (outfall)	11.60	r
19	452917122275700	SE 190th Avenue	12.60	srd
20	452945122254700	Main Avenue, Gresham	15.45	t
21	452941122253800	Dowsett Road	16.15	t
22	452910122251500	Regner Road	16.30	srd
23	452847122244500	Hogan Road	17.40	bt
24	452823122240900	Palmbald Road	18.25	t
25	452725122200800	Pleasant Home Road	22.55	t

Water-column samples were collected by the equal-width-increment (EWI) method (Edwards and Glysson, 1986). Samples for nutrient, trace element, and suspended-sediment determinations were obtained using an epoxy-coated sampler fitted with a nylon nozzle, and acid-rinsed glass or plastic bottles. Samples for organic-constituent determinations were collected using a standard sampler not coated with epoxy, and fitted with a brass nozzle and baked glass bottle.

Turbidity samples were diluted as necessary to obtain midrange readings on the turbidimeter; correct turbidity values were computed using a dilution factor. The turbidimeter was checked for calibration using nephelometric turbidity unit (NTU) standards prior to each sample reading.

The pH meter was calibrated with standard pH buffers reading 4.0, 7.0, and 10.0. Meter calibration was done at each sampled site prior to measuring the stream pH and performing the alkalinity titration.

The specific conductance meter was checked for calibration against known specific conductance standards that bracketed the expected field specific conductance. All specific conductance readings were then temperature corrected to obtain specific conductance.

The dissolved oxygen (DO) meter was calibrated to 100 percent DO saturation by measuring the water temperature, reading the barometric pressure, interpolating the DO concentration at 100-percent saturation from the appropriate calibration table, and setting the meter to the calibration concentration while the probe is held in a calibration chamber at stream temperature and local barometric pressure. DO meter calibration was done at the beginning of each field day with intermediate calibration checks during the course of the day.

Samples for fecal coliform and fecal streptococcal bacteria determinations were obtained by dipping a sterile (autoclaved) bottle at midstream, immediately capping it, and placing it in an ice chest until filtering could be accomplished (usually within an hour of sample collection). Four to five subsamples of varying volumes were then filtered through a 0.45 μm pore-size membrane filter for each sample site. After filtering each subsample, the membrane was removed from the filter unit and placed in a petri dish with the proper sample media. The petri dishes were, in turn, placed in aluminum-block incubators set at either 35.0°C or 44.5°C and left for 24 to 48 hours, depending on whether fecal coliform or fecal streptococci bacteria were to be grown. After the proper incubation period, the number of colonies on each plate were counted and recorded with the subsample volume filtered. The number of colonies per 100 ml (milliliter) of subsample were then computed.

Samples for dissolved organic carbon (DOC) and suspended organic carbon (SOC) analysis were prepared according to standard methods (Wershaw and others, 1987). Sample volumes of 100 ml were placed in a stainless-steel filter unit fitted with a 0.45 μm pore-size silver-membrane filter. The stainless-steel unit was then connected to a regulated, pressurized, nitrogen tank and the nitrogen released at approximately 30 psi (pounds per square inch) to push the sample through

the silver-membrane filter and into a DOC bottle. The silver-membrane containing the SOC sample was removed from the stainless-steel unit and folded over inside a petri dish to keep the sample side of the silver-membrane filter from contacting the plastic of the petri dish. Both samples were then preserved for analysis at 4°C.

Sample Preparation for Analysis

Reconnaissance Samples

Bottom-material samples were sieved with a screen of 63 μm mesh size, and separate analyses were performed on the resultant size fractions of greater than 63 μm and less than 63 μm . Samples to be analyzed for trace elements were sieved through a nylon mesh screen; samples to be analyzed for organic compounds were sieved using a stainless-steel mesh screen crimped to the casing barrel (rather than attached using solder which is a potential source of sample bias). Native water was obtained from each sample site during bottom-material sampling to perform the wet-sieve separation.

Bottom-material trace-element determinations were analyzed by Dr. Arthur J. Horowitz at a U.S. Geological Survey research laboratory in Atlanta, Georgia. Organic compounds were determined by the Organics Section of the DEQ laboratory at Portland State University in Portland, Oregon.

Water samples taken during the bottom-material sampling also were submitted to the DEQ laboratory for selected organic-compound determinations.

Low-flow Samples

Samples taken during the low flow period August to October 1989 were prepared for determination of dissolved and total nutrients, dissolved trace elements, total recoverable organochlorine pesticides and polychlorinated biphenyls (PCBs), suspended sediment, and particle size. Separate sample composites were obtained for inorganic and organic-compound determinations. Whole-water samples to be analyzed for total or total recoverable constituents were subsampled from the appropriate whole-water-sample composite prior to removal of a subsample for dissolved constituent determination. Samples were preserved as prescribed in the U.S. Geological Survey, National Water Quality Laboratory, Services Catalog (1985). Samples to be analyzed for dissolved constituents were filtered through a 0.45 μm pore size membrane filter and preserved as prescribed in the U.S. Geological Survey, National Water Quality Laboratory, Services Catalog (1985). Suspended sediment for total trace-element determination was removed from each composite using an International Equipment Company Centra-8 centrifuge, to simulate particle settling according to Stoke's Law by computing the centrifuge spin rate and time required to settle all particles greater than 0.45 μm in size through a 4-inch water column. Suspended sediment from each of the two low-flow sampling periods were composited site by site to obtain the required sample mass for total trace-element determinations.

Storm-runoff Samples

Subsamples obtained during each of the two storm-runoff events were composited. At three sites, subsamples were composited to represent the storm hydrograph's rise, peak, and recession. Subsamples were composited proportional to percent of the total sample weight represented by each subsample. Subsamples representing the rise, peak and recession of the storm hydrographs were selected on the basis of turbidity, specific conductance, and timing relative to the hydrograph plot and were composited in the same manner as previously described. After representative composites were obtained, the samples were handled and preserved as described for the low-flow samples. Water samples were obtained for determination of total and dissolved nutrients, dissolved trace elements, total recoverable organochlorine pesticides and PCBs, suspended sediment and particle size.

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ADDITIONAL DATA

Table 2.--Field data obtained during low-flow sampling, August 15-18, 1988

[°C = degrees Celsius; CaCO₃ = calcium carbonate; mg/L = milligrams per liter; μS/cm = microsiemens per centimeter at 25 degrees Celsius; mm = millimeters; mL = milliliters; K = results based on colony counts outside the acceptable range (non-ideal colony count; and > = greater than because results are based on estimated count from densely populated colony growths; μm-mf = micrometer-membrane filter)]

Station name	River mile	Date	Time	Temperature (°C)	pH (standard units)	Alkalinity (mg/L as CaCO ₃)	Specific conductivity (μS/cm)	Barometric pressure (mm mercury)	Dissolved oxygen (mg/L)	Dissolved oxygen (percent saturation)	Coliform, fecal, μm-mf (colonies per 100 mL)	Streptococci fecal, KF Agar (colonies per 100 mL)
Ochoco Ave.	1.05	8/18	1430	19.5	7.4	57	206	767	12.4	131	510	1200
Umatilla Ave.	1.37	8/18	1330	17.5	7.7	53	178	768	11.3	115	K130	K100
S.E. 44th at Umatilla below fish ladder	2.60	8/17	1515	17.0	6.6	59	220	763	9.5	97	3700	K280
S.E. 44th near Harney above fish ladder	2.70	8/17	1120	16.5	6.9	52	181	763	9.1	93	930	430
Linnwood Ave.	3.85	8/16	1500	20.0	7.5	24	63	758	9.8	107	>6000	1200
S.E. 82nd Ave.	5.15	8/16	1000	17.0	7.3	23	57	758	9.1	95	890	870
S.E. 92nd Ave.	5.82	8/15	1430	17.0	7.1	18	48	758	9.8	102	1200	780
Sycamore gage	10.25	8/19	1245	17.0	6.7	67	159	757	9.2	96	340	630
Hogan Rd.	17.40	8/19	1630	19.5	7.1	47	132	754	9.2	99	300	K240

Table 3.--Trace-element concentrations in Johnson Creek bottom materials, August 1988

[μm = micrometer; ppm = parts per million; WT% = weight percent (1.0 WT% = 10,000 ppm); m²/g = square meters per gram; TOC = total organic carbon; > = greater than; and < = less than]

Sample site	River mile	Date	Size (μm)	Copper	Lead	Zinc	Nickel	Cobalt	Cadmium	Chromium	Aluminum	Iron	Manganese	Titanium	Mercury	Selenium	Antimony	Arsenic	TOC (WT%)	Surface area (m ² /g)
Ochoco Avenue	1.05	8/18	>63 <63	27 40	47 71	147 195	30 42	24 18	<0.5 <.5	52 80	6.9 8.0	6.0 4.6	0.10 .08	1.04 .77	0.02 .14	<0.1 .2	4.1 1.0	3.5 3.6	0.4 2.4	15.1 15.4
Umatilla Avenue	1.37	8/18	>63 <63	29 71	51 110	170 350	36 96	22 23	<.5 1.5	63 145	8.8 7.1	5.8 4.7	.10 .10	.71 .73	<.01 .11	<.1 .1	1.5 1.1	2.3 4.1	.8 4.2	14.9 17.5
S.E. 44th at Umatilla	2.60	8/17	>63 <63	34 140	48 150	300 640	350 1300	34 83	<.5 1.2	230 810	7.3 7.3	5.2 5.3	.08 .12	.99 .94	<.01 0.20	<.1 0.3	.7 2.0	2.1 4.1	.6 4.9	13.2 13.6
S.E. 44th above Harney	2.70	8/17	>63 <63	40 41	62 86	175 290	43 55	20 19	<.5 1.2	72 90	7.3 7.5	4.0 4.3	.10 .10	.57 .62	.08 .07	<.1 <.1	.5 .8	1.6 3.1	4.4 3.8	10.9 13.9
Linnwood Avenue	3.85	8/16	>63 <63	24 54	82 325	150 430	25 45	23 26	<.5 2.2	48 91	7.1 7.0	5.6 4.9	.10 .20	.74 .66	<.01 .20	<.1 .1	.5 1.3	1.5 3.5	.7 4.5	6.6 12.9
S.E. 82nd Avenue	5.15	8/16	>63 <63	20 50	19 105	170 340	30 42	29 32	<.5 1.9	62 93	8.5 8.4	6.9 6.1	.20 .30	.77 .71	.02 .15	.1 .1	.4 1.0	4.1 2.4	.4 3.5	32.5 21.2
S.E. 92nd Avenue	5.82	8/15	>63 <63	30 42	100 105	200 235	29 30	23 20	<.5 <.5	58 75	7.0 8.6	5.0 4.6	.11 .11	.83 .66	.04 .09	.1 .2	.8 1.0	2.6 3.0	3.7 3.2	8.1 15.0
Sycamore gage	10.25	8/19	>63 <63	17 25	13 23	125 150	23 25	21 17	<.5 .7	51 75	8.5 7.0	4.9 4.0	.12 .12	.48 .68	.17 1.20	<.1 .1	.4 .6	3.2 3.0	.9 2.2	21.5 14.6
Hogan Road	17.40	8/19	>63 <63	16 21	10 21	83 115	21 22	20 17	<.5 <.5	42 67	8.3 7.2	4.4 3.4	.09 .08	.56 .62	.04 .05	.1 .2	.4 .6	2.0 2.1	1.9 1.8	16.7 15.9
Sycamore Replicate	10.25	8/19	>63 <63	16 23	12 31	105 140	25 21	19 17	<.5 <.5	45 73	8.2 6.7	4.5 3.7	.11 .12	.47 .67	.17 1.10	<.1 .2	.3 .6	3.6 2.4	1.1 2.1	13.5 13.9

Table 5.--Acid-base/neutral extractable compounds in bottom material sampled during low flow, August 1988

[ppm = parts per million; μm = micrometers; > = greater than; < = less than; and LD = less than analytical detection (detection limit for all constituents is at 0.10 ppm)]

Sample site	River mile	Date	Size (μm)	Phenanthrene	Di-N-butyl-phthalate	Fluoranthene	Pyrene	Benzo(A)-anthracene (ppm)	Chrysene	Benzo(B)-fluoranthene	Bis-(2-ethyl-hexyl)-phthalate
Ochoco Avenue	1.05	8/18	>63 <63	LD LD	LD 0.3	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD
Umatilla Avenue	1.37	8/18	>63 <63	0.6 LD	LD LD	1.0 LD	0.9 LD	0.4 LD	0.7 LD	0.4 LD	LD LD
S.E. 44th Umatilla	2.60	8/17	>63 <63	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD
S.E. 44th above Harney	2.70	8/17	>63 <63	LD LD	.3 .3	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD
Linnwood Avenue	3.85	8/16	>63 <63	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD
S.E. 82nd	5.15	8/16	>63 <63	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD
S.E. 92nd	5.82	8/15	>63 <63	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD
Sycamore gage	10.25	8/19	>63 <63	.1 LD	.2 LD	.1 LD	.1 LD	.1 LD	.1 LD	LD LD	0.3 LD
Hogan Road	17.40	8/19	>63 <63	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD
Sycamore gage Quality assurance replicate	10.25	8/19	>63 <63	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD	LD LD

Table 6.--Organic compounds in water during low flow, August 1988

[mg/L = milligrams per liter; $\mu\text{g/L}$ = micrograms per liter; and LD = less than analytical detection (detection limit for acid-base/neutral extractables ranges from 0.001 to 0.005 mg/L depending on the constituent identified)]

Sample site	River mile	Date	Volatile organics (1,1,2,2-Tetra-chloro-ethylene, in, mg/L)	Acid-base/neutral extractable organics (all constituents, in mg/L)	Herbicides (all constituents, in mg/L)	Carbamate insecticides (carbaryl, in $\mu\text{g/L}$)	Organic carbon Dis-solved (mg/L)	Sus-pended (mg/L)
S.E. 44th at Umatilla	2.60	8/17	0.002	LD	<0.002	0.031	2.6	0.3
S.E. 82nd Avenue	5.15	8/16	<.001	LD	<.002	.026	2.3	.9
Sycamore gage	10.25	8/19	<.001	LD	<.002	.022	4.3	.8

Table 7.--Total trace-element concentrations on suspended-sediment particles less than 63 micrometers in size, during low flow, August 1989

$3 \text{ ft}^3/\text{s}$ = cubic feet per second; m^2/g = square meters per gram; ppm = parts per million; WT.% = percent by weight (1.0 WT.% = 10,000 ppm); mg/L = milligrams per liter; ND = not determined due to lack of sample mass; DOC = dissolved organic carbon; and SOC = suspended organic carbon; Blvd. = boulevard

Station name	Stream discharge $3 \text{ ft}^3/\text{s}$ (m^3/s)	Sur-face area	Sediment concentration	Cop-per	Lead	Zinc	Nic-kel	Co-balt	Cad-mium	Chro-mium	Mer-cury	Ar-senic	Anti-mony	Sel-en-ium	Iron	Man-gan-ese	Alu-min-ium	Ti-tan-ium	DOC plus SOC
	(ft^3/s) (m^3/s)	(m^2/g)	(mg/L)	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	.....(ppm).....	(WT.%)	(WT.%)	(WT.%)	(WT.%)	(mg/L)
Milwaukee gage	17.0	10.8	10	160	< 10	350	50	20	< 5	110	ND	4	< 1	< 1	4.2	0.19	5.1	0.60	2.5
McLoughlin Blvd.	4.2	18.3	21	180	10	580	140	20	14	220	ND	6	< 1	< 1	6.1	.32	3.2	.60	3.2
Stanley Avenue	1.9	20.2	14	130	100	580	50	40	< 5	80	ND	8	< 1	< 1	6.4	.55	5.9	.60	4.4
Bell Avenue	1.8	24.3	9	170	130	430	40	40	< 5	70	ND	10	< 1	< 1	7.6	.62	6.8	.60	4.9
SE 82nd Avenue	1.6	21.2	13	100	130	430	40	40	< 5	80	ND	9	< 1	< 1	7.2	.70	7.2	.80	5.8
Sycamore gage	1.1	21.7	24	60	20	240	40	30	< 5	70	.30	6	< 1	< 1	5.8	.58	6.9	.60	5.4
S.E. 190th Avenue	1.3	33.2	12	160	< 10	300	30	50	< 5	70	ND	10	< 1	< 1	8.4	1.25	7.2	.60	6.8
Regner Road	.55	23.4	10	90	160	310	50	30	< 5	90	ND	6	< 1	< 1	6.0	.40	7.8	.70	5.6
Crystal Spring	13.0	12.7	9	160	60	210	40	10	< 5	60	ND	4	< 1	< 1	4.3	.09	4.6	.50	1.6
Kelley Creek	.25	30.7	9	90	20	390	40	40	10	60	ND	10	< 1	< 1	8.5	1.07	5.2	.50	3.6

Table 8... Total trace-element concentrations on suspended sediment particles greater than 0.45 micrometers in size, during storm runoff, December 1999

(ND = not detected; ... = no data; μm = micrometers; ft^3/s = cubic feet per second; m/g = square meters per gram; ppm = parts per million; WT. \% = weight percent (1.0 WT. \% = 10.00 ppm); mg/L = milligrams per liter; Rise = rising limb of the storm hydrograph; Peak = peak of the storm hydrograph; Recession = falling limb of the storm hydrograph; Storm* = the storm sample broken into the various particle-size fractions; Storm = the sample representing the entire storm runoff; < = less than analytical detection (variable detection limits reported for a given constituent result from analysis of inadequate sample mass of particle-size fractions); and > = greater than; QA = quality assurance)

Station name	Sample size (um)	Stream discharge (ft^3/s)	Sur-face area (m^2/g)	Cop-per	Lead	Zinc	Nio-bel	Cob-alt	Cadm-ium	Chro-mium	Mer-cury	Sul-phur	Anti-mony	Sel-en-ium	Iron	Man-gan-ese	Alu-minum	Tot-als (WT.%)	Sedi-ment con-cen-tration (mg/L)	Particle size, in micrometers
Milwaukee gage	Rise > .63	630	14.6	62	92	240	68	18	1.0	88	0.20	5.0	1.6	0.4	4.2	0.15	7.2	5.8	ND	ND
	Rise .45 - .16	56	23.7	56	76	245	52	22	1.8	90	.15	7.9	1.2	0.4	4.8	.15	8.2	3.1	ND	ND
	Peak > .63	850	9.8	90	110	350	50	30	< 5.0	100	ND	13.0	1.0	< 1.4	8.8	.16	12.5	ND	ND	ND
	Peak .45 - .16	120	26.0	66	230	42	24	1.8	84	< 15	84	.18	7.2	2.2	5.3	.18	7.6	ND	ND	ND
	Storm* > .63	740	24.4	75	85	208	59	19	1.8	81	ND	4.6	1.6	< 1.1	4.1	.13	7.4	ND	ND	ND
McLoughlin Blvd. Storm	Storm* .45 - .16	740	123.7	98	105	341	45	34	< 10	99	ND	17	1.4	< 2.5	5.1	.15	13.0	ND	ND	ND
	Storm > .45	740	123.7	98	89	280	49	27	< 5	90	ND	9.3	1.3	< 2.2	6.2	.16	10.1	ND	1077	1DD 99 97 38
	Storm > .45	740	25.5	54	70	240	47	22	1.5	87	.10	8.9	.9	.4	5.0	.18	8.4	3.8	615	.. .. .
	Storm > .45	750	25.4	64	70	230	36	22	3.1	83	.15	9.3	.9	.4	4.9	.18	8.8	3.8	592	.. .. .
	Storm > .45	750	25.6	51	63	212	34	20	< .5	82	.13	7.8	.9	.4	4.9	.18	8.5	3.7	595	.. .. .
S.E. 82nd Avenue Storm	Storm > .45	750	22.8	89	155	220	32	18	< .5	88	.13	7.8	.6	.3	4.7	.17	8.4	3.5	555	.. .. .
	Rise > .63	570	14.7	40	30	160	26	16	< 1	58	.13	4.6	1.0	< 2	3.8	.15	7.3	4.4	ND	ND
	Rise .45 - .16	31.0	23.0	46	20	200	25	15	< 2.5	100	.14	7.0	1.8	< .3	7.9	.11	12.7	ND	ND	ND
	Peak > .63	820	11.8	35	25	140	10	10	< 2.5	55	.10	3.5	.5	< .5	3.8	.13	7.8	ND	ND	ND
	Peak .45 - .16	26.7	20.6	43	19	33	18	< 5	< 5	83	.06	6.0	.5	< .5	4.6	.16	8.6	3.1	ND	ND
Sycamore gage	Peak > .63	820	24.9	70	30	260	40	< 10	< 5	50	ND	3.0	.5	< .5	3.5	.07	7.9	ND	ND	ND
	Recession > .63	820	24.9	70	30	260	40	< 10	< 5	50	ND	3.0	.5	< .5	3.5	.07	7.9	ND	ND	ND
	Recession .45 - .16	21.0	21.0	74	< 20	260	56	< 20	< 10	90	.10	6.0	1.0	< 1.0	7.2	.11	12.3	ND	ND	ND
	Storm* > .63	740	51.4	53	< 29	203	< 25	< 15	< 2.5	77	ND	9.5	.8	< 1	6.5	.11	12.2	ND	ND	ND
	Storm* .45 - .16	83.7	70	40	218	38	16	< 2.5	91	ND	8.9	1.1	< 1	< 1	5.4	.13	9.8	ND	ND	ND
S.E. 190th Avenue	Storm > .45	740	190.6	61	< 35	207	< 35	< 15	< 5	84	ND	7.7	1.1	< 1	5.6	.12	10.1	ND	1160	100 1DD 98 33
	Storm > .45	660	22.5	45	49	200	33	17	< .5	82	.26	6.8	.7	.4	4.3	.14	8.5	3.3	625	.. .. .
	Rise > .63	437	17.4	40	10	150	25	15	< 2.5	60	.20	3.5	.5	< .5	4.1	.19	8.4	ND	ND	ND
	Rise .45 - .16	27.0	27.0	66	< 25	290	< 20	< 25	< 10	111	.10	8.8	< 2	< 2	4.0	.12	8.0	ND	ND	ND
	Peak > .63	624	15.4	60	25	135	20	10	< 2.5	55	.30	2.3	.5	< .5	3.4	.13	13.9	ND	ND	ND
Regner Road	Peak .45 - .16	443	13.4	35	< 16	290	64	< 16	< 8	128	.17	6.6	< 2	< 2	4.4	.14	8.9	ND	ND	ND
	Recession > .63	443	13.4	35	< 16	290	64	< 16	< 8	128	.17	6.6	< 2	< 2	4.4	.14	8.9	ND	ND	ND
	Recession .45 - .16	28.8	28.8	80	< 30	180	30	< 15	< 2.5	45	.25	3.0	.5	< .5	3.5	.16	8.2	ND	ND	ND
	Storm* > .63	500	66.2	51	18	139	25	13	< 2.5	54	.25	6.2	.5	< .5	3.7	.17	8.8	ND	ND	ND
	Storm* .45 - .16	78.3	78.3	55	< 20	277	< 30	< 25	< 8	111	ND	10.1	< 2	< 2	7.6	.15	13.6	ND	ND	ND
Crystal Spring	Storm > .45	500	199.3	51	< 25	205	< 40	< 20	< 5	84	ND	7.0	< 2	< 1	5.5	.13	10.5	ND	1289	100 100 97 21
	Storm > .45	12.4	13.6	250	720	340	30	20	5.0	70	ND	12.0	16.0	< 1	4.8	.11	6.3	50	ND	29
	Storm > .45	260	19.7	38	28	142	29	17	< .5	73	.06	6.4	.6	.3	4.2	.14	7.8	3.2	871	.. .. .
	Storm > .45	11.0	18.8	31	36	144	30	18	< .5	74	.07	4.5	.7	.2	4.0	.13	7.5	2.6	884	.. .. .
	Storm* > .63	740	20.7	112	72	215	30	17	< .5	74	.13	6.3	.8	< .3	4.4	.14	7.8	3.1	ND	ND
Sycamore gage (QA Replicate)	Storm* .45 - .16	10.7	21.0	90	60	210	50	20	< 5	80	.18	6.0	1.0	< 1	5.3	.15	9.9	ND	ND	ND
	Storm > .45	740	52.4	103	61	224	38	< 20	< 5	76	.17	5.9	1.1	< 1	4.9	.13	9.0	ND	1160	100 100 98 33
	Storm > .45	3.3	28.6	62	42	210	30	22	< 1	66	.10	6.0	1.2	< 2	6.6	.10	9.5	76	2.2	269
	Storm > .45	660	22.5	45	49	200	33	17	< .5	82	.26	6.8	.7	.4	4.3	.14	8.5	3.3	625	.. .. .
	Storm > .45	437	17.4	40	10	150	25	15	< 2.5	60	.20	3.5	.5	< .5	4.1	.19	8.4	ND	ND	ND

Table 9. Total trace-element concentrations on suspended-sediment particles greater than 0.45 micrometers in size, during storm runoff, January 1990

[ND not detected; -- = no data; μm = micrometers; ft^3/s = cubic feet per second; m^2/g = square meters per gram; ppm = parts per million; WT.% = weight percent (1.0 WT.% = 10.00 ppm); mg/L = milligrams per liter; Storm * = the storm sample broken into the various particle-size fractions; Storm = the sample representing the entire storm runoff; < = less than analytical detection (variable detection limits reported for a given constituent result from analysis of inadequate sample mass of particle-size fractions); and > = greater than]

Station name	Sample representative	Particle size (μm)	Stream discharge (ft^3/s)	Surface area (m^2/g)	Copper	Lead	Zinc	Nickel	Cadmium	Chromium	Mercury	Ar-selenium	Iron	Manganese	Aluminum	Titanium	TOC	Sediment concentration (MG/L)	Particle size, in micrometers 250-62
Milwaukie gage	Storm*	> .63	380	8.57	45	80	210	35	<2.5	75	0.40	4.0	4.7	0.14	7.6	0.55	7.0	ND	ND
	Storm*	16 - .63	--	18.87	40	57	218	38	.5	84	.18	7.4	4.6	.12	8.7	.62	3.4	ND	ND
	Storm*	> .45	380	50.37	60	63	310	40	<5	80	.33	11.0	8.2	.13	10.8	.70	ND	ND	ND
McLoughlin Blvd.	Storm	> .45	390	22.93	40	55	207	38	.4	85	.12	7.3	4.6	.12	8.8	.62	3.6	172	--
	Storm	> .45	400	25.19	37	41	187	33	<.5	84	.14	7.8	4.4	.12	8.9	.61	3.5	174	--
Bell Avenue	Storm	> .45	305	24.98	38	46	198	50	<.5	154	.11	7.6	4.5	.11	9.3	.62	3.4	170	--
	Storm	> .45	360	24.16	39	38	198	47	.6	126	.17	7.8	4.5	.12	9.3	.65	3.5	145	--
Sycamore gage	Storm*	> .63	360	9.17	35	25	160	25	2.0	40	.35	3.0	3.9	.13	7.7	.45	5.1	ND	ND
	Storm*	16 - .63	--	18.52	50	33	177	32	.4	82	.15	6.6	4.3	.11	8.7	.57	3.2	ND	ND
	Storm*	> .45	360	20.17	60	30	260	40	<5	90	.35	9.0	7.5	.13	11.5	.70	ND	ND	ND
SE 190th Avenue	Storm	> .45	360	47.86	51	30	209	34	<2.5	77	.27	6.9	5.6	.12	9.7	.60	ND	216	100
	Storm	> .45	330	24.51	35	30	184	29	<.5	83	.17	7.1	4.1	.11	8.8	.56	ND	155	--
Regner Road	Storm*	> .63	105	9.84	45	20	130	25	<2.5	50	.50	3.5	3.8	.13	7.8	.40	ND	ND	ND
	Storm*	16 - .63	--	21.72	48	28	188	32	.8	87	.19	7.7	4.2	.11	9.4	.57	3.5	ND	ND
	Storm*	> .45	105	18.96	70	40	290	30	2.0	80	ND	0.9	4.6	.13	11.8	.70	ND	ND	ND
Crystal Spring	Storm	> .45	12.4	11.02	65	115	275	20	9.0	65	ND	10.5	5.3	0.15	6.2	0.50	ND	25	--
	Storm	> .45	85	22.19	35	26	164	30	.6	76	.10	7.4	4.3	.11	9.0	.59	3.2	303	--
SE 100th/Knapp	Storm	> .45	2.9	26.68	29	38	166	31	<.1	81	.18	5.5	4.7	.13	8.1	.55	2.7	392	--
	Storm	> .45	105	25.56	42	61	223	38	.9	95	.17	7.5	4.4	.12	8.7	.54	3.4	176	100
Sycamore gage (QA Replicate)	Storm	> .45	330	21.32	36	38	191	34	<.5	83	.14	6.4	4.1	.11	9.0	.59	3.5	155	--
	Storm	> .45	1.7	20.51	32	63	209	28	<.1	58	.10	4.0	4.8	.10	8.0	.56	2.4	494	--

Table 10.--Dissolved oxygen and temperature measurements,
October 5, 1989

[°C = degrees Celsius; mm Hg = millimeters mercury;
mg/L = milligrams per liter; % = percent]

Station name	Time	Water temperature (°C)	Barometric pressure (mm Hg)	Dissolved oxygen reading (mg/L)	Percent of saturation
Milwaukie gage	0548	14.0	765	10.4	100.4
	1308	15.5	763	10.0	99.4
	2036	16.5	762	9.8	100.1
McLoughlin Blvd.	0604	14.0	763	10.0	96.8
	1253	15.5	762	10.4	104.8
	2023	15.5	761	9.4	95.1
Stanley Avenue	0617	13.5	762	8.5	81.9
	1242	14.5	760	9.6	94.4
	2011	16.5	759	8.7	89.0
Bell Avenue	0625	13.5	761	9.2	88.0
	1235	14.5	759	10.0	98.0
	2004	15.5	759	9.9	99.8
S.E. 82nd Avenue	0634	13.5	760	8.3	79.8
	1226	14.5	758	8.8	86.8
	1956	15.5	758	9.6	96.5
S.E. 108th Avenue	0647	12.5	759	7.7	72.2
	1213	12.5	757	7.9	74.7
	1943	14.0	757	8.4	81.3
Sycamore gage	0656	12.0	758	10.2	96.0
	1203	12.5	757	8.6	80.9
	1848	13.5	757	9.5	91.5
S.E. 190th Avenue	0717	12.0	757	7.7	72.0
	1137	12.5	757	8.2	77.1
	1907	13.5	755	8.6	83.0
Regner Road	0733	11.5	756	9.6	88.2
	1120	11.5	756	10.8	99.5
	1920	13.0	754	9.8	94.6
Crystal Spring	0556	14.0	765	9.4	90.7
	1300	15.0	762	10.6	104.8
	2029	16.0	761	11.0	112.0
Kelley Creek	0705	13.5	757	8.6	82.6
	1156	14.0	758	9.2	77.1
	1856	15.0	757	9.1	91.0

Start date: 10-05-89; Start time: 0540
End date: 10-05-89; End time: 2036
Sunrise: 0725 (Sun not on Regner Rd. site at 0732.); Sunset: 1815

Initial calibration: Barometric Pressure = 765 mm Hg; Mercury thermometer water temperature = 14.0 °C; Dissolved oxygen meter water temperature = 12.9 °C; and 100% dissolved oxygen saturation = 10.4 mg/L. Meter reading 10.6 mg/L, meter correction = -0.2 mg/L. Subsequent calibrations were checked prior to each measurement over the course of the dissolved oxygen readings throughout the basin.

Table 11.--Nutrient concentrations during low flow and storm runoff from August 1989 through January 1990

[N = nitrogen, P = phosphorus, QA = quality assurance, ND = not detected]

Station name	Date	Time	Nitro- gen, organic total (mg/L as N)	Nitro- gen, ammonia dis- solved (mg/L as N)	Nitro- gen, ammonia total (mg/L as N)	Nitro- gen, nitrite dis- solved (mg/L as N)	Nitro- gen, ammonia plus organic total (mg/L as N)	Nitro- gen, NO ₂ +NO ₃ dis- solved (mg/L as N)	Phos- phorus total (mg/L as P)	Phos- phorus dis- solved (mg/L as P)	Phos- phorus ortho, dis- solved (mg/L as P)
Milwaukie gage	09-06-89	1345	0.38	0.05	0.02	0.05	0.4	4.70	0.09	0.08	0.08
	10-02-89	1100	.26	.05	.04	.02	.3	4.60	.11	.09	.09
	12-04-89	2015	1.9	.02	.06	< .01	2.0	2.40	.60	.02	.03
	12-05-89	0130	1.7	.02	.05	< .01	1.7	2.80	.37	.03	.03
	01-25-90	2100	1.1	.03	.07	.01	1.2	2.10	.24	.03	.03
	01-26-90	0155	.44	.03	.06	.01	.5	1.70	.28	.03	.03
	01-26-90	0815	1.1	.04	.08	.02	1.2	2.20	.24	.03	.03
McLoughlin Boulevard	09-05-89	1500	.67	.06	.03	.02	.7	4.80	.08	.07	.07
	10-03-89	1430	.37	.02	.03	< .01	.4	4.20	.09	.05	.03
	12-04-89	2400	1.4	.04	.10	< .01	1.5	2.50	.43	.02	.02
	01-25-90	2130	1.3	.03	.11	.02	1.4	1.80	.39	.03	.03
Stanley Avenue	09-05-89	1200	.37	.07	.03	.03	.4	1.50	.05	.04	.04
	10-04-89	1100	.67	.03	.03	< .01	.7	1.40	.07	.04	< .01
	12-04-89	2400	2.2	.07	.07	.01	2.3	2.50	1.20	.02	.03
	01-25-90	2215	.96	.06	.14	.01	1.1	1.70	.41	.05	.03
Bell Avenue	09-05-89	0945	.27	.05	.03	.04	.3	.92	.05	.03	.03
	10-04-89	1430	.58	.02	.02	< .01	.6	.65	.07	.03	.04
	12-04-89	2300	2.2	.07	.07	.01	2.3	2.50	.95	.03	.03
	01-25-90	2210	.72	.04	.08	.01	.8	1.70	.19	.02	.02
S.E. 82nd Avenue	09-01-89	1400	.53	.09	.07	.02	.6	.41	.08	.05	.04
	10-06-89	1100	.45	.06	.05	.01	.5	.38	.07	.06	.04
	12-04-89	2215	2.1	.05	.08	.02	2.2	2.60	1.00	.04	.03
	01-25-90	2210	.61	.04	.29	.01	.9	1.80	.35	.02	.02
Sycamore gage	08-31-89	1400	.46	.07	.04	.02	.5	.86	.08	.04	.04
	10-05-89	1815	.46	.05	.04	.01	.5	.63	.10	.03	.03
	12-04-89	1800	3.2	.02	.07	< .01	3.3	2.20	1.40	.04	.05
	12-04-89	2125	2.3	.02	.04	.01	2.3	2.60	.89	.04	.03
	12-04-89	2400	1.7	.03	.07	.03	1.8	3.20	.47	.04	.05
	01-25-90	1815	.62	.06	.08	.01	.7	1.70	.30	.05	.04
	01-25-90	2230	.84	.07	.16	.02	1.0	1.60	.42	.04	.04
	01-26-90	0156	.94	.08	.16	.01	1.1	1.90	.48	.05	.04
S.E. 190th Avenue	08-31-89	1000	.44	.08	.06	.02	.5	.95	.09	.04	.03
	10-05-89	1500	.65	.05	.05	.01	.7	.77	.11	.06	.06
	12-04-89	2130	2.3	.06	.08	.01	2.4	2.90	.89	.02	.03
	01-25-90	2030	.6	.05	.10	.01	.7	1.90	.33	.03	.03
Regner Road	08-30-89	1200	.47	.07	.03	< .01	.5	.84	.09	.06	.05
	10-05-89	0945	.87	.04	.03	< .01	.9	1.00	.10	.05	.06
	12-04-89	1730	3.5	.02	.05	< .01	3.5	2.70	2.00	.06	.04
	12-04-89	2100	2.6	.05	.10	.02	2.7	3.50	.65	.03	.04
	12-04-89	2350	1.4	.04	.07	.03	1.5	4.40	.52	.05	.04
	01-25-90	1650	.62	.03	.08	.01	.7	2.40	.27	.02	.02
	01-25-90	2145	1.4	.10	.14	.02	1.5	2.20	.35	.05	.04
	01-26-90	0115	1.0	.14	.17	.01	1.2	2.80	.28	.03	.03
Crystal Spring	09-06-89	1000	.36	.06	.04	.04	.4	5.60	.12	.09	.08
	10-03-89	1030	.14	.08	.06	.04	.2	5.50	.12	.13	.10
	12-04-89	2400	.41	.07	.09	.02	.5	5.20	.19	.14	.12
	01-25-90	2245	.35	.04	.05	.02	.4	5.50	.12	.08	.10
Kelley Creek	09-01-89	1030	.69	.36	.31	.04	1.0	.54	.19	.06	.06
	10-06-89	1330	.07	.15	.13	.02	.2	.38	.07	.04	.04
	12-04-89	2030	2.9	.05	.09	.01	3.0	2.90	1.70	.07	.07
	01-25-90	2105	.79	.07	.11	.01	.9	1.30	.42	.08	.07
Circle Avenue	12-04-89	1730	.77	.01	.03	< .01	.8	.39	.44	.02	.03
	01-25-90	1810	.48	.01	.12	< .01	.6	.40	.24	.02	.02
S.E. 100th and Knapp	12-04-89	1900	1.6	.04	.06	< .01	1.7	1.30	.68	.06	.06
	01-25-90	2000	1.3	.03	.06	< .01	1.4	.56	.26	.08	.05
Milwaukie gage (QA Replicate)	01-25-90	2100	1.2	.03	.07	.02	1.3	2.20	.37	.02	.03
	01-26-90	0155	.72	.03	.08	.02	.8	1.70	.43	.03	.03
	01-26-90	0815	.28	.04	.12	.02	.4	2.20	.28	.03	.03
S.E. 44th at Umatilla below fish ladder (single sample)	01-25-90	2315	ND	< .01	< .01	.01	.7	5.60	.08	.04	.05

Table 12.--Major ions and dissolved trace-element concentrations during low flow and storm runoff, August 1989 through January 1990

[-- = not determined; < = less than; and > = greater than]

Station name	Date	Time	Hardness total (mg/L as CaCO ₃)	Calcium dissolved (mg/L as Ca)	Magnesium dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Sodium adsorption ratio	Silica, dissolved (mg/L as SiO ₂)	Barium dissolved (µg/L as Ba)
Milwaukie gage	09-06-89	1345	84	19	8.8	7.4	0.4	55	12
	10-02-89	1100	75	17	7.8	6.6	.3	50	15
	12-04-89	2015	26	6.4	2.3	3.4	.3	11	25
	12-05-89	0130	23	5.7	2.1	3.2	.3	9.9	24
	01-25-90	2100	--	.5	2.3	3.4	--	13	16
	01-26-90	0155	--	5.5	2.0	3.1	--	10	16
	01-26-90	0815	--	6.2	2.4	3.5	--	12	19
McLoughlin Boulevard	09-05-89	1500	78	18	8.0	8.0	.4	40	21
	10-03-89	1430	69	16	7.1	6.6	.3	37	21
	12-04-89	2400	21	5.4	1.9	3.1	.3	8.9	23
	01-25-90	2130	23	5.7	2.0	3.2	.3	9.8	17
Stanley Avenue	09-05-89	1200	52	12	5.4	6.7	.4	23	23
	10-04-89	1100	52	12	5.2	5.7	.3	21	24
	12-04-89	2400	21	5.4	1.9	3.2	.3	8.7	23
	01-25-90	2215	21	5.3	1.9	3.1	.3	9.3	19
Bell Avenue	09-05-89	0945	41	9.5	4.1	5.9	.4	18	23
	10-04-89	1430	37	9.0	3.6	4.8	.3	15	20
	12-04-89	2300	21	5.3	1.9	3.2	.3	8.5	22
	01-25-90	2210	--	5.3	1.8	3.0	--	9.2	19
S.E. 82nd Avenue	09-01-89	1400	38	8.9	3.8	4.9	.3	16	19
	10-06-89	1100	36	8.5	3.5	4.2	.3	14	21
	12-04-89	2215	21	5.2	1.9	3.2	.3	8.3	20
	01-25-90	2210	--	5.3	1.9	3.2	--	9.5	17
Sycamore gage	08-31-89	1400	44	10	4.5	6.2	.4	21	22
	10-05-89	1815	43	10	4.3	5.6	.4	20	22
	12-04-89	1800	20	5.0	1.8	3.0	.3	8.1	21
	12-04-89	2125	21	5.1	1.9	2.9	.3	8.1	26
	12-04-89	2400	21	5.2	2.0	3.0	.3	8.4	29
	01-25-90	1815	19	4.8	1.7	3.0	.3	8.7	16
	01-25-90	2230	19	4.7	1.7	2.9	.3	8.4	19
	01-26-90	0156	20	5.0	1.8	3.1	.3	9.4	20
	S.E. 190th Avenue	08-31-89	1000	54	12	5.7	7.5	.4	24	32
10-05-89		1500	55	12	6.1	7.5	.4	24	35
12-04-89		2130	20	5.0	1.9	2.9	.3	7.9	25
01-25-90		2030	--	4.5	1.6	2.7	--	8.3	18
Regner Road	08-30-89	1200	42	8.7	5.0	7.3	.5	23	30
	10-05-89	0945	46	9.6	5.4	7.3	.5	24	35
	12-04-89	1730	20	4.8	1.9	3.0	.3	7.8	27
	12-04-89	2100	21	5.0	2.0	3.0	.3	7.7	31
	12-04-89	2350	24	5.9	2.3	3.4	.3	8.5	36
	01-25-90	1650	--	4.6	1.8	3.2	--	8.8	18
	01-25-90	2145	--	4.3	1.7	3.0	--	7.8	19
	01-26-90	0115	--	4.9	1.9	3.3	--	9.1	25
Crystal Spring	09-06-89	1000	83	19	8.7	7.1	.3	59	10
	10-03-89	1030	83	19	8.7	6.9	.3	59	13
	12-04-89	2400	73	17	7.5	6.4	.3	49	18
	01-25-90	2245	74	17	7.7	6.4	.3	53	12
Kelley Creek	09-01-89	1030	51	12	5.0	7.1	.4	20	44
	10-06-89	1330	51	12	5.0	6.8	.4	19	21
	12-04-89	2030	24	6.1	2.2	3.6	.3	9.1	22
	01-25-90	2105	20	5.1	1.7	3.4	.3	9.1	16
Circle Avenue	12-04-89	1730	6	1.7	0.4	.9	.2	3.4	3
	01-25-90	1810	11	3.0	0.8	1.3	.2	6.4	7
S.E. 100th/Knapp	12-04-89	1900	32	8.5	2.6	3.5	.3	9.6	16
	01-25-90	2000	--	7.7	2.2	2.9	--	8.8	15
Milwaukie gage (QA Replicate)	01-25-90	2100	--	6.6	2.4	3.4	--	13	16
	01-26-90	0155	--	5.4	2.0	3.1	--	10	15
	01-26-90	0815	--	6.4	2.3	3.4	--	13	19
S.E. 44th at Umatilla below fish ladder (single sample)	01-25-90	2315	--	17	7.9	6.1	--	44	8

Table 12.--Major ions and dissolved trace-element concentrations during low flow and storm runoff,
August 1989 through January 1990--Continued

Station name	Date	Beryllium, dis- solved (µg/L as Be)	Cadmium dis- solved (µg/L as Cd)	Chro- mium, dis- solved (µg/L as Cr)	Cobalt, dis- solved (µg/L as Co)	Copper, dis- solved (µg/L as Cu)	Iron, dis- solved (µg/L as Fe)	Lead, dis- solved (µg/L as Pb)	Mercury, dis- solved (µg/L as Hg)	Manga- nese, dis- solved (µg/L as Mn)
Milwaukie gage	09-06-89	< 0.5	< 1	< 5	< 3	< 10	93	< 10	< 0.1	22
	10-02-89	< .5	< 1	< 5	< 3	< 10	120	< 10	< .1	9
	12-04-89	< .5	< 1	< 5	< 3	< 10	190	< 10	.3	3
	12-05-89	< .5	< 1	< 5	< 3	10	170	< 10	.3	2
	01-25-90	1	1	< 5	< 3	< 10	66	< 10	< .1	1
	01-26-90	< .5	< 1	< 5	< 3	< 10	82	< 10	.1	1
01-26-90	< .5	< 1	< 5	< 3	< 10	95	< 10	< .1	< 1	
McLoughlin Boulevard	09-05-89	< .5	< 1	< 5	< 3	< 10	130	< 10	< .1	13
	10-03-89	< .5	< 1	< 5	< 3	< 10	190	< 10	< .1	10
	12-04-89	< .5	< 1	< 5	< 3	< 10	210	< 10	.6	7
	01-25-90	< .5	< 1	< 5	< 3	< 10	58	< 10	.1	< 1
Stanley Avenue	09-05-89	< .5	< 1	< 5	< 3	< 10	260	< 10	< .1	28
	10-04-89	< .5	1	< 5	< 3	< 10	340	< 10	.1	25
	12-04-89	< .5	< 1	< 5	< 3	< 10	150	< 10	.5	9
	01-25-90	< .5	< 1	< 5	< 3	< 10	100	< 10	.1	2
Bell Avenue	09-05-89	< .5	< 1	< 5	< 3	< 10	320	< 10	< .1	27
	10-04-89	< .5	< 1	< 5	< 3	< 10	410	< 10	.1	20
	12-04-89	< .5	< 1	< 5	< 3	20	110	< 10	.5	7
	01-25-90	1	< 1	< 5	< 3	< 10	160	< 10	.1	14
S.E. 82nd Avenue	09-01-89	< .5	< 1	< 5	< 3	< 10	450	< 10	< .1	63
	10-06-89	< .5	< 1	< 5	< 3	< 10	480	< 10	< .1	50
	12-04-89	< .5	< 1	< 5	< 3	10	67	< 10	.5	7
	01-25-90	< .5	1	< 5	< 3	< 10	110	< 10	.1	8
Sycamore gage	08-31-89	< .5	< 1	< 5	< 3	< 10	560	< 10	< .1	67
	10-05-89	< .5	< 1	< 5	< 3	< 10	180	< 10	.2	60
	12-04-89	< .5	< 1	< 5	< 3	< 10	130	< 10	.2	2
	12-04-89	< .5	< 1	< 5	< 3	< 10	99	< 10	.3	2
	12-04-89	< .5	< 1	< 5	< 3	< 10	160	< 10	.2	4
	01-25-90	< .5	2	< 5	< 3	< 10	130	< 10	< .1	< 1
	01-25-90	< .5	< 1	< 5	< 3	< 10	150	< 10	.1	3
01-26-90	1	< 1	< 5	< 3	< 10	140	< 10	.1	4	
S.E. 190th Avenue	08-31-89	< .5	< 1	< 5	< 3	< 10	660	< 10	< .1	200
	10-05-89	< .5	< 1	< 5	< 3	< 10	1100	< 10	< .1	190
	12-04-89	< .5	< 1	< 5	< 3	< 10	95	< 10	.5	19
	01-25-90	.8	< 1	< 5	< 3	< 10	110	< 10	.1	2
Regner Road	08-30-89	< .5	< 1	< 5	< 3	< 10	440	< 10	< .1	22
	10-05-89	< .5	< 1	< 5	< 3	< 10	570	< 10	.1	23
	12-04-89	< .5	< 1	< 5	< 3	< 10	110	< 10	.3	2
	12-04-89	< .5	< 1	< 5	< 3	< 10	120	< 10	.3	5
	12-04-89	< .5	< 1	< 5	< 3	< 10	110	< 10	.2	5
	01-25-90	1	< 1	< 5	< 3	< 10	65	< 10	< .1	1
	01-25-90	< .5	2	< 5	< 3	< 10	70	< 10	.1	1
	01-26-90	< .5	3	< 5	< 3	< 10	110	< 10	.1	5
Crystal Spring	09-06-89	< .5	< 1	< 5	< 3	< 10	53	< 10	< .1	8
	10-03-89	< .5	< 1	< 5	< 3	< 10	38	< 10	< .1	7
	12-04-89	< .5	< 1	< 5	< 3	10	50	10	.2	7
	01-25-90	< .5	< 1	< 5	< 3	< 10	22	< 10	.1	< 1
Kelley Creek	09-01-89	< .5	< 1	< 5	< 3	< 10	390	20	< .1	150
	10-06-89	< .5	< 1	< 5	< 3	< 10	540	< 10	< .1	110
	12-04-89	< .5	< 1	< 5	< 3	< 10	94	< 10	.4	6
	01-25-90	< .5	< 1	< 5	< 3	< 10	190	< 10	.1	2
Circle Avenue	12-04-89	< .5	< 1	< 5	< 3	< 10	37	< 10	.2	1
	01-25-90	< .5	2	< 5	< 3	< 10	300	< 10	.1	5
S.E. 100th/Knapp	12-04-89	< .5	< 1	< 5	< 3	< 10	100	< 10	.4	8
	01-25-90	< .5	4	< 5	< 3	< 10	220	< 10	.1	4
Milwaukie gage (QA Replicate)	01-25-90	< .5	2	< 5	< 3	< 10	41	< 10	.1	< 1
	01-26-90	< .5	< 1	< 5	< 3	< 10	83	< 10	< .1	1
	01-26-90	< .5	2	< 5	< 3	< 10	120	< 10	< .1	2
S.E. 44th at Umatilla below fish ladder (single sample)	01-25-90	< .5	2	< 5	< 3	< 10	45	20	.1	8

Table 12.--Major ions and dissolved trace-element concentrations during low flow and storm runoff, August 1989 through January 1990--Continued

Station name	Date	Molybdenum, dissolved ($\mu\text{g/L}$ as Mo)	Nickel, dissolved ($\mu\text{g/L}$ as Ni)	Silver, dissolved ($\mu\text{g/L}$ as Ag)	Strontium, dissolved ($\mu\text{g/L}$ as Sr)	Vanadium, dissolved ($\mu\text{g/L}$ as V)	Zinc, dissolved ($\mu\text{g/L}$ as Zn)	Lithium, dissolved ($\mu\text{g/L}$ as Li)	Carbon, organic dissolved (Mg/L as C)	Carbon, organic suspended total (Mg/L as C)
Milwaukie gage	09-06-89	< 10	< 10	< 1	88	< 6	13	< 4	2.0	0.3
	10-02-89	< 10	< 10	< 1	86	< 6	17	< 4	2.3	.4
	12-04-89	< 10	< 10	< 1	54	< 6	13	< 4	4.7	> 5
	12-05-89	< 10	< 10	< 1	49	< 6	14	< 4	4.8	> 5
	01-25-90	< 10	< 10	< 1	57	< 6	14	< 4	2.5	> 5
	01-26-90	< 10	< 10	< 1	49	< 6	14	< 4	2.9	> 5
	01-26-90	< 10	< 10	< 1	56	< 6	< 3	< 4	3.2	4.4
McLoughlin Boulevard	09-05-89	< 10	< 10	< 1	110	< 6	19	< 4	2.7	.2
	10-03-89	< 10	< 10	< 1	99	< 6	12	< 4	3.1	.3
	12-04-89	< 10	< 10	< 1	50	< 6	14	< 4	4.8	> 5
	01-25-90	< 10	< 10	< 1	52	< 6	9	< 4	2.8	> 5
Stanley Avenue	09-05-89	< 10	< 10	< 1	98	< 6	10	< 4	3.6	.3
	10-04-89	< 10	< 10	< 1	94	< 6	28	< 4	4.5	.3
	12-04-89	< 10	< 10	< 1	51	< 6	11	< 4	4.8	> 5
	01-25-90	< 10	< 10	< 1	51	< 6	11	< 4	2.8	> 5
Bell Avenue	09-05-89	< 10	< 10	< 1	87	< 6	10	< 4	3.7	.3
	10-04-89	< 10	< 10	< 1	81	< 6	6	< 4	5.5	.3
	12-04-89	< 10	< 10	< 1	50	< 6	10	< 4	4.5	> 5
	01-25-90	< 10	< 10	< 1	51	< 6	12	< 4	2.9	> 5
S.E. 82nd Avenue	09-01-89	< 10	< 10	< 1	87	< 6	11	< 4	5.4	.4
	10-06-89	< 10	< 10	< 1	80	< 6	8	< 4	5.3	.4
	12-04-89	< 10	< 10	< 1	49	< 6	6	< 4	4.5	> 5
	01-25-90	< 10	10	< 1	52	< 6	< 3	< 4	3.0	> 5
Sycamore gage	08-31-89	< 10	< 10	< 1	95	< 6	13	< 4	4.2	.4
	10-05-89	< 10	< 10	< 1	92	< 6	9	< 4	5.6	.6
	12-04-89	< 10	< 10	< 1	47	< 6	11	< 4	3.9	> 5
	12-04-89	< 10	< 10	< 1	49	< 6	9	< 4	4.5	> 5
	12-04-89	< 10	< 10	< 1	52	< 6	7	< 4	4.6	> 5
	01-25-90	< 10	< 10	< 1	45	< 6	3	< 4	2.3	> 5
	01-25-90	< 10	< 10	< 1	45	< 6	< 3	< 4	2.9	> 5
	01-26-90	< 10	< 10	< 1	49	< 6	23	< 4	3.1	> 5
S.E. 190th Avenue	08-31-89	< 10	< 10	1	110	< 6	10	< 4	5.1	.6
	10-05-89	< 10	< 10	< 1	110	< 6	16	< 4	7.4	.4
	12-04-89	< 10	< 10	< 1	50	< 6	4	< 4	4.2	> 5
	01-25-90	< 10	< 10	< 1	45	< 6	7	< 4	2.6	> 5
Regner Road	08-30-89	< 10	< 10	2	96	< 6	16	< 4	4.3	.5
	10-05-89	< 10	< 10	< 1	100	< 6	< 3	< 4	6.1	.3
	12-04-89	< 10	< 10	< 1	49	< 6	8	< 4	5.3	> 5
	12-04-89	< 10	< 10	< 1	53	< 6	17	< 4	4.6	> 5
	12-04-89	< 10	< 10	< 1	64	< 6	14	< 4	4.4	--
	01-25-90	< 10	< 10	< 1	51	< 6	4	< 4	2.1	> 5
	01-25-90	< 10	< 10	< 1	46	< 6	16	< 4	2.8	> 5
	01-26-90	< 10	< 10	< 1	52	< 6	< 3	< 4	2.5	2.7
Crystal Spring	09-06-89	< 10	< 10	< 1	84	9	11	< 4	1.3	.3
	10-03-89	< 10	< 10	3	83	8	11	< 4	1.3	.3
	12-04-89	< 10	< 10	1	79	7	61	< 4	2.3	1.0
	01-25-90	< 10	20	< 1	76	< 6	< 3	< 4	1.2	.7
Kelley Creek	09-01-89	< 10	< 10	< 1	100	< 6	17	< 4	3.2	.5
	10-06-89	< 10	< 10	< 1	100	< 6	16	< 4	3.2	.2
	12-04-89	< 10	< 10	1	55	< 6	< 3	< 4	5.9	> 5
	01-25-90	< 10	10	< 1	46	< 6	< 3	< 4	3.7	> 5
Circle Avenue	12-04-89	< 10	< 10	< 1	16	< 6	12	< 4	1.3	2.6
	01-25-90	< 10	< 10	< 1	22	< 6	18	< 4	1.1	3.0
S.E. 100th/Knapp	12-04-89	< 10	< 10	< 1	56	< 6	7	< 4	5.1	> 5
	01-25-90	< 10	< 10	< 1	50	< 6	5	< 4	4.4	4.3
Milwaukie gage (QA Replicate)	01-25-90	< 10	< 10	< 1	56	< 6	< 3	< 4	2.6	> 5
	01-26-90	< 10	< 10	< 1	46	< 6	< 3	< 4	3.2	> 5
	01-26-90	< 10	< 10	< 1	56	< 6	11	< 4	3.3	4.0
S.E. 44th at Umatilla below fish ladder (single sample)	01-25-90	< 10	< 10	< 1	81	< 6	63	< 4	1.6	.6

Table 13.--Total recoverable organochlorine pesticide and polychlorinated biphenyl concentrations in water during low flow and storm runoff, August 1989 through January 1990

[DEF = S,S,S-tributylphosphorotrithioate, DDD = dichlorodiphenyldichloroethane, DDE = dichlorodiphenyldichloroethylene, and DDT = dichlorodiphenyltrichloroethane. All concentrations are reported in micrograms per liter]

Station name	Date	Time	Per- thane	DEF	Naph- tha- lenes, poly- chlor	Aldrin,	Lindane	Chlor- dane	DDD	DDE	DDT
Milwaukie gage	09-06-89	1345	<0.1	<0.01	<0.1	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01
	10-02-89	1100	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	2015	<.1	<.01	<.1	<.01	<.01	1.9	.01	.03	.07
	12-05-89	0130	<.1	<.01	<.1	<.01	<.01	<.1	.01	.04	.11
	01-25-90	2100	<.1	<.01	<.1	<.001	.001	<.1	.01	.013	.025
	01-26-90	0155	<.1	<.01	<.1	<.001	.001	<.1	.015	.018	.048
	01-26-90	0815	<.1	<.01	<.1	<.001	.001	<.1	.011	.011	.028
McLoughlin Boulevard	09-05-89	1500	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-03-89	1430	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	2400	<.1	<.01	<.1	<.01	<.01	<.1	.01	.03	.07
	01-25-90	2130	<.1	<.01	<.1	<.001	.001	<.1	.009	.014	.030
Stanley Avenue	09-05-89	1200	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-04-89	1100	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	2400	<.1	<.01	<.1	<.01	<.01	<.1	.01	.04	.10
	01-25-90	2215	<.1	<.01	<.1	<.001	.001	<.1	.012	.020	.040
Bell Avenue	09-05-89	0945	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-04-89	1430	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	2300	<.1	<.01	<.1	<.01	<.01	<.1	.01	.03	.25
	01-25-90	2210	<.1	<.01	<.1	<.001	.001	<.1	.011	.020	.042
S.E. 82nd Avenue	09-01-89	1400	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-06-89	1100	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	2215	<.1	<.01	<.1	<.01	<.01	<.1	.01	.02	.04
	01-25-90	2210	<.1	<.01	<.1	<.001	.001	<.1	.011	.020	.042
Sycamore gage	08-31-89	1400	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-05-89	1815	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	1800	<.1	<.01	<.1	<.01	<.01	<.1	.01	.01	.10
	12-04-89	2125	<.1	<.01	<.1	<.01	<.01	<.1	.05	.06	.17
	12-04-89	2400	<.1	<.01	<.1	<.01	<.01	<.1	.01	.03	.08
	01-25-90	1815	<.1	<.01	<.1	<.001	.001	<.1	.011	.026	.045
	01-25-90	2230	<.1	<.01	<.1	<.001	.001	<.1	.017	.028	.066
	01-26-90	0156	<.1	<.01	<.1	<.001	.002	<.1	.014	.021	.047
S.E. 190th Avenue	08-31-89	1000	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-05-89	1500	<.1	<.01	<.1	<.01	.01	<.1	<.01	<.01	<.01
	12-04-89	2130	<.1	<.01	<.1	<.01	<.01	<.1	.02	.07	.19
	01-25-90	2030	<.1	<.01	<.1	<.001	.003	.1	.018	.023	.056
Regner Road	08-30-89	1200	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-05-89	0945	<.1	<.01	<.1	<.01	.04	<.1	<.01	<.01	<.01
	12-04-89	1730	<.1	<.01	<.1	<.01	<.01	.1	.07	.16	.63
	12-04-89	2100	<.1	<.01	<.1	<.01	<.01	.1	.02	.06	.15
	12-04-89	2350	<.1	<.01	<.1	<.01	<.01	<.1	.01	.02	.04
	01-25-90	1650	<.1	<.01	<.1	<.001	.002	.1	.033	.042	.180
	01-25-90	2145	<.1	<.01	<.1	<.001	.002	.1	.020	.034	.085
	01-26-90	0115	<.1	<.01	<.1	<.001	.002	<.1	.013	.019	.042
Crystal Spring	09-06-89	1000	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-03-89	1030	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	2400	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	01-25-90	2245	<.1	<.01	<.1	<.001	<.001	<.1	<.001	<.001	<.001
Kelley Creek	09-01-89	1030	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	10-06-89	1330	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	12-04-89	2030	<.1	<.01	<.1	<.01	<.01	<.1	.01	.05	.08
	01-25-90	2105	<.1	<.01	<.1	<.001	<.001	<.1	.011	.029	.044
Circle Avenue	12-04-89	1730	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	01-25-90	1810	<.1	<.01	<.1	<.001	.001	<.1	<.001	.001	.001
S.E. 100th/Knapp	12-04-89	1900	<.1	<.01	<.1	<.01	<.01	<.1	<.01	<.01	<.01
	01-25-90	2000	<.1	<.01	<.1	<.001	.003	<.1	.007	.006	.002
Milwaukie gage (QA Replicate)	01-25-90	2100	<.1	<.01	<.1	<.001	.001	<.1	.007	.019	.033
	01-26-90	0155	<.1	<.01	<.1	<.001	.001	<.1	.015	.020	.050
	01-26-90	0815	<.1	<.01	<.1	<.001	.001	<.1	.013	.016	.042
S.E. 44th at Umatilla below fish ladder (single sample)	01-25-90	2315	<.1	<.01	<.1	<.001	<.001	<.1	.090	.010	.060

Table 13.--Total recoverable organochlorine pesticide and polychlorinated biphenyl concentrations in water during low flow and storm runoff, August 1989 through January 1990--Continued

Station name	Date	Di-eldrin	Endo-sulfan	Endrin	Tox-aphene	Hepta-chlor	Hepta-chlor epoxide	Meth-ox-y-chlor	Poly-chlor-inated-bi-phenyls	Mirex
Milwaukie gage	09-06-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-02-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.02	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-05-89	.03	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.012	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01
	01-26-90	.015	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01
McLoughlin Boulevard	09-05-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-03-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.02	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.012	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
Stanley Avenue	09-05-89	.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-04-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.03	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.016	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
Bell Avenue	09-05-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-04-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.02	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.016	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
S.E. 82nd Avenue	09-01-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-06-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.02	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.017	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
Sycamore gage	08-31-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-05-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.04	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.03	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.020	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
	01-25-90	.018	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
01-26-90	.025	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01	
S.E. 190th Avenue	08-31-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-05-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.04	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.020	<.001	<.001	< 1	<.001	.004	<.01	<.1	<.01
Regner Road	08-30-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-05-89	.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.06	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.03	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.02	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.020	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01
	01-25-90	.035	<.001	<.001	< 1	<.001	.002	<.01	<.1	<.01
	01-26-90	.029	<.001	<.001	< 1	<.001	.002	<.01	<.1	<.01
Crystal Spring	09-06-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-03-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.006	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01
Kelley Creek	09-01-89	.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	10-06-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	12-04-89	.05	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.028	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01
Circle Avenue	12-04-89	<.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.001	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01
S.E. 100th/Knapp	12-04-89	.01	<.01	<.01	< 1	<.01	<.01	<.01	<.1	<.01
	01-25-90	.018	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01
Milwaukie gage (QA Replicate)	01-25-90	.016	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
	01-26-90	.016	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
	01-26-90	.016	<.001	<.001	< 1	<.001	.001	<.01	<.1	<.01
S.E. 44th at Umatilla below fish ladder (single sample)	01-25-90	.010	<.001	<.001	< 1	<.001	<.001	<.01	<.1	<.01

Table 14.--Specific conductance, temperature, and turbidity measurements during storm runoff, April 21, 1988

[$\mu\text{S}/\text{cm}$ = microsiemens per centimeter at 25 degrees Celsius;
 $^{\circ}\text{C}$ = degrees Celsius; and NTU = nephelometric turbidity units]

Station location	River mile	Specific conductance ($\mu\text{S}/\text{cm}$)	Temperature ($^{\circ}\text{C}$)	Turbidity (NTU)
S.E. 17th Avenue	0.30	70	10.5	126.0
S.E. 44th Ave between Umatilla and Tenino	2.60	67	10.5	153.0
S.E. 108th Avenue	7.10	69	10.5	182.0
Sycamore gage	10.25	70	10.5	144.0
S.E. 190th Avenue	12.60	69	10.5	147.0
Main Avenue	15.45	67	10.5	159.0
Dowsett Avenue	16.15	69	10.0	216.0
Hogan Road	17.40	68	10.0	171.0
Palmbald Road	18.25	64	10.5	183.0
Pleasant Home Road	22.55	63	10.5	95.5

Table 15.--Specific conductance and turbidity measurements during storm runoff, December 4-5, 1989

[$\mu\text{S}/\text{cm}$ = microsiemens per centimeter at 25 degrees Celsius); and NTU = nephelometric turbidity units]

Station name	Date	Time	River mile	Specific conductance ($\mu\text{S}/\text{cm}$)	Turbidity (NTU)
Main Stream Sites					
Milwaukie gage	12-4-89	1835	0.60	80	304
	12-4-89	2015		76	520
	12-4-89	2250		68	500
	12-5-89	0050		71	440
	12-5-89	0250		74	400
McLoughlin Boulevard	12-4-89	1800	1.50	74	304
	12-4-89	1945		72	520
	12-4-89	2145		65	560
	12-4-89	2315		65	440
	12-5-89	0030		68	440
	12-5-89	0145		69	420
	12-5-89	0315		73	400
12-5-89	0500	76	370		
Stanley Avenue	12-4-89	1700	3.60	74	320
	12-4-89	1850		68	432
	12-4-89	2055		64	600
	12-4-89	2215		64	440
	12-4-89	2345		64	420
	12-5-89	0100		68	400
	12-5-89	0215		72	400
	12-5-89	0430		76	360
Bell Avenue	12-4-89	1730	4.20	72	400
	12-4-89	1900		68	464
	12-4-89	2045		63	352
	12-4-89	2200		64	336
	12-4-89	2330		66	420
	12-5-89	0100		69	400
	12-5-89	0230		72	400
	12-5-89	0430		76	350
S.E. 82nd Avenue	12-4-89	1640	5.15	77	256
	12-4-89	1830		70	432
	12-4-89	2000		63	512
	12-4-89	2130		63	320
	12-4-89	2300		66	410
	12-5-89	0030		68	400
	12-5-89	0200		71	380
	12-5-89	0400		76	360
Sycamore gage	12-4-89	1640	10.25	65	400
	12-4-89	1725		63	624
	12-4-89	1830		62	520
	12-4-89	1925		62	384
	12-4-89	2020		66	400
	12-4-89	2125		66	320
	12-4-89	2225		69	420
	12-4-89	2335		71	380
	12-5-89	0025		73	400
	S.E. 190th Avenue	12-4-89		1610	12.60	57	336
12-4-89		1750	58	480	
12-4-89		1950	63	540	
12-4-89		2050	66	500	
12-4-89		2210	70	460	
12-4-89		2320	73	460	
12-5-89		0020	78	350	
12-5-89		0130	82	280	
Regner Road		12-4-89	1650	16.30		64	688
	12-4-89	1845	66		512
	12-4-89	2020	70		580
	12-4-89	2140	74		480
	12-4-89	2250	79		350
	12-4-89	2350	83		290
	12-5-89	0100	87		250

Table 15.--Specific conductance and turbidity measurements during storm runoff, December 4-5, 1989--Continued

Station name	Date	Time	River mile	Specific conductance ($\mu\text{S}/\text{cm}$)	Turbidity (NTU)
Tributary and Outfall Sites					
Crystal Spring Creek	12-4-89	1925	1.20	184	40
	12-4-89	2150		194	30
	12-4-89	2355		201	20
	12-5-89	0205		206	15
	12-5-89	0400		207	20
S.E. 100th and Knapp	12-4-89	1450	6.25	48	992
	12-4-89	1600		50	720
	12-4-89	1700		68	420
	12-4-89	1800		68	250
	12-4-89	1900		67	310
	12-4-89	2000		94	180
	12-4-89	2100		120	130
	12-4-89	2200		128	85
	12-4-89	2300		136	65
Kelley Creek	12-4-89	1555	10.70	80	704
	12-4-89	1700		78	992
	12-4-89	1755		75	700
	12-4-89	1800		73	440
	12-4-89	1955		75	272
	12-4-89	2055		79	240
	12-4-89	2155		82	176
	12-4-89	2310		88	140
	12-4-89	2338		91	125
	Circle Avenue	12-4-89		1415	11.60	9.2	248
12-4-89		1530	5.4	112	
12-4-89		1630	9.2	280	
12-4-89		1730	14	210	
12-4-89		1830	11	200	
12-4-89		1930	18	160	
12-4-89		2030	51	140	

Table 16.--Specific conductance and turbidity measurements during storm runoff, January 25-26, 1990

[$\mu\text{S}/\text{cm}$ = microsiemens per centimeter at 25 degrees Celsius); and NTU = nephelometric turbidity units]

Station name	Date	Time	mile	Specific conductance ($\mu\text{S}/\text{cm}$)	Turbidity (NTU)
Main Stream Sites					
Milwaukie gage	1-25-90	1524	0.60	100	50
	1-25-90	1609		97	90
	1-25-90	1738		87	110
	1-25-90	1840		82	135
	1-25-90	2100		72	190
	1-25-90	2130		70	240
	1-25-90	2220		65	290
	1-25-90	2310		65	260
	1-25-90	2400		65	250
	1-26-90	0055		66	225
	1-26-90	0155		66	200
	1-26-90	0235		66	190
	1-26-90	0345		69	190
	1-26-90	1250		88	100
McLoughlin Boulevard	1-25-90	1545	1.50	82	105
	1-25-90	1800		80	125
	1-25-90	1930		71	180
	1-25-90	2100		64	230
	1-25-90	2225		58	310
	1-26-90	0015		61	210
	1-26-90	0125		61	190
	1-26-90	0300		62	200
Stanley Avenue	1-25-90	1700	3.60	78	120
	1-25-90	1845		70	170
	1-25-90	2015		62	240
	1-25-90	2125		57	320
	1-25-90	2255		59	215
	1-26-90	0030		60	220
	1-26-90	0200		61	200
	1-26-90	0345		64	205
Bell Avenue	1-25-90	1630	4.20	80	80
	1-25-90	1915		66	205
	1-25-90	2110		57	280
	1-25-90	2310		59	270
	1-26-90	0100		60	165
	1-26-90	0310		63	175
S. E. 82nd Avenue	1-25-90	1530	5.15	85	44
	1-25-90	1740		76	117
	1-25-90	2015		51	205
	1-25-90	2210		58	190
	1-26-90	0010		59	195
	1-26-90	0215		61	200
	1-26-90	0410		64	235
Sycamore gage	1-25-90	1515	10.25	69	160
	1-25-90	1725		58	235
	1-25-90	1915		57	210
	1-25-90	2025		57	210
	1-25-90	2150		57	210
	1-25-90	2319		60	205
	1-26-90	0045		62	250
	1-26-90	0156		--	--
	1-26-90	0245		--	--
	S. E. 190th Avenue	1-25-90		1445	12.60	55	84
1-25-90		1615	55	88	
1-25-90		1730	56	102	
1-25-90		1900	56	180	
1-25-90		2030	56	200	
1-25-90		2135	60	250	
1-25-90		2300	60	340	
1-26-90		0020	64	320	
1-26-90		0210	68	225	
Regner Road		1-25-90	1530	16.30		67	105
	1-25-90	1650	63		155
	1-25-90	1815	58		240
	1-25-90	1945	59		250
	1-25-90	2100	58		410
	1-25-90	2230	60		390
	1-25-90	2350	63		260
	1-26-90	0115	67		160

Table 16.--Specific conductance and turbidity measurements during storm runoff, January 25-26, 1990--Continued

Station name	Date	Time	mile	Specific conductance ($\mu\text{S}/\text{cm}$)	Turbidity (NTU)
Tributary and Outfall Sites					
Crystal Spring Creek	1-25-90	1646	1.20	203	12
	1-25-90	1910		196	15
	1-25-90	2150		200	16
	1-25-90	2335		197	15
	1-26-90	0115		200	10
	1-26-90	0305		207	12
S.E. 100th and Knapp	1-25-90	1600	6.25	52	175
	1-25-90	1700		55	200
	1-25-90	1815		56	290
	1-25-90	1900		60	200
	1-25-90	2000		68	120
	1-25-90	2100		74	105
	1-25-90	2230		96	72
	1-25-90	2330		102	58
	1-26-90	0030		106	52
	Kelley Creek	1-25-90		1600	10.70	75	230
1-25-90		1745	63	470	
1-25-90		1945	59	300	
1-25-90		2105	58	190	
1-25-90		2225	61	116	
1-25-90		2355	64	78	
1-26-90		0105	68	60	
Circle Avenue	1-25-90	1420	11.60	48	210
	1-25-90	1500		11.4	84
	1-25-90	1615		15.5	135
	1-25-90	1745		16	112
	1-25-90	1830		15	100
	1-25-90	1930		32	116
	1-25-90	2030		35	60
	1-25-90	2200		61	52