WATER QUALITY IN

JOHNSON CREEK

1970 - 1975

State of Oregon

Department of Environmental Quality

December, 1975

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INTRODUCTION

The following study was initiated at the request of the Metropolitan Service District to act as a guideline for the water quality part of the proposed drainage management program for the Johnson Creek basin. It contains a summary and an analysis of the water quality problems associated with the Johnson Creek drainage basin and recommendations for the enhancement of water quality in Johnson Creek.

DESCRIPTION

Johnson Creek, a small tributary of the lower Willamette River, flows westerly through Multnomah and Clackamas Counties emptying into the Willamette at Milwaukie, Oregon. It has a total drainage area of 54 square miles. Elevations in the basin range from a maximum of 1,129 feet southeast of Gresham to near mean sea level at its mouth. It has ten minor tributaries in the upper reach and one major tributary (Crystal Springs) at river mile one. Groundwater discharge from the local flow systems is a significant contributor to the total flow during summer. The major source of winter flow is storm water runoff from urban lands. The watershed is composed of 16% forestland, 24% cropland, 10% pastureland, and 50% urban, industrial and other uses.

THE PROBLEM

Johnson Creek has been the source of considerable concern and controversy for many years. The problems are numerous and interrelated, however, they all revolve around the extensive impact of urban development on a natural stream system. The water quantity-quality problems include:

1. Flooding:

   A combination of poor drainage, stream bed encroachment, and excess runoff caused by a high percentage of impervious surfaces such as roads, parking lots, and various commercial and residential developments have made local ponding and flooding usual occurances during periods of high rainfall.

2. Erosion - Siltation:

   With as much as one-third of the original stream channel restricted by property improvements in the form of retaining walls, earth fills, piers, etc. the remaining channel must carry more load and is subject to severe erosion during high flow and subsequent siltation and channel clogging.

3. Storm Drains:

   During high rainfall, storm sewers carry runoff to the overtaxed system. See page 16 for description for known storm sewers.

4. Low Flow, Poor Quality Water in Summer:

   Channel restrictions, debris, refuse, etc. have impeded the stream at low flow periods causing ponding and stagnation with resulting poor water quality conditons.

5. Subsurface Sewage Systems:

Most of central Multnomah County is unsewered. During high rainfall the grounds are saturated causing septic tank effluent to move laterally to the stream and/or rise to the surface.

BACKGROUND

In order to understand the system more completely we should examine a river under natural conditions. In this area of the Pacific Northwest, streams and rivers were naturally surrounded by forested lands. The forest acts as a stablizer of river characteristics. The tree canopy keeps summer temperatures low and provides food for aquatic organisms in the form of organic debris and terrestrial insects. Although the geology of the stream basin determines chemical characteristics, the forest acts as a sort of buffer preventing large fluctuations in the water quality. The soil and vegetation acts as a sump, soaking up excess moisture and preventing massive floods during rainy periods of the year. As a result, we have a stable environment which provides a good home for aquatic and terrestrial insects, fish, birds, and other animals that inhabit the watershed. In terms of erosion, runoff, hydrology, nutrients, etc., this is a relatively predictable environment.

When the trees and vegetation are removed to be replaced by roads, houses, industries, etc., the balance of the natural stream system is altered and the ability of the stream to absorb seasonal changes is greatly taxed, especially a small stream such as Johnson Creek. As a result, the stream becomes subject to severe fluctuations in chemical, physical and biological properties such as flooding in winter, reduced flow in summer, various forms of pollution, algal blooms, and high temperatures. With only 16% of its natural environment left, the Johnson Creek drainage basin has serious problems.

GENERAL WATER QUALITY

In an attempt to define the water quality problems associated with Johnson Creek, the Department of Environmental Quality has been taking routine chemical and bacteriological samples since 1970 and has periodic data for several years previous to that. Sixteen sample stations were established from the mouth up to the upper reach east of Gresham (see diagram page 21). The data from these surveys is summarized and presented on pages 18, 19 and 20.

In general terms, the data reveals that Johnson Creek has two very different water quality regimes associated with water quantity. During low flow the water characteristics are similar to groundwater, whereas during high flow the characteristics are more similar to surface water. Snow melt water, which is important to other systems, is of little significance to a low elevation stream such as Johnson Creek. As a result, drastically reduced summer flow causes localized ponding and stagnant conditions. The problems of summer-winter fluctuations have been greatly magnified by urbanization and its consequences.

CHEMICAL QUALITY OF JOHNSON CREEK ABOVE THE CONFLUENCE OF CRYSTAL SPRINGS CREEK

Ground water is characterized by high concentrations of various mineralized salts, hardness, conductivity, pH, alkalinity, etc. as compared to surface water which tends to be significantly lower because of its short ground contact time.

The range of concentrations for the four basic stations upstream of the confluence with Crystal Springs Creek are as follows:

parameter	concentration range
pH	6.2 - 8.4
conductivity	66.0 - 275.0 umhos
total dissolved solids	89.0 - 163.0 mg/liter
alkalinity	10.0 - 91.0 mg/liter
hardness	16.7 - 84.0 mg/liter
chloride	2.6 - 10.1 mg/liter
sodium	2.0 - 11.1 mg/liter
potassium	0.9 - 3.8 mg/liter

With respect to the above parameters, the water quality of Johnson Creek is generally good, the concentrations do not exceed the desirable limits for natural bodies of water. The wide range of values can be directly attributed to the seasonal change in flow patterns.

A. Nutrients

Johnson Creek represents a chemically fertile stream, in most cases, exceeding the desireable limits of a balanced system.

1. NH_3N: Ammonia nitrogen, which occurs naturally from the decomposition of organic matter, occurs upstream in values ranging from less than 0.01 mg/liter to 0.4 mg/liter, having its highest concentration during low flow. The higher values are due in part to organic decomposition and possible sewage contamination. It is reported that uncontaminated water generally has a NH_3N concentration of less than 0.2 mg/liter and that trout are stressed by concentrations of 0.5 mg/liter at pH 7.5.

2. Ortho-PO_4: Ortho-phosphate concentrations parallel those of ammonia nitrogen and range from 0.09-0.21 mg/liter. The above concentrations are more than sufficient to support undesirable growths of algae and aquatic weeds.

3. NO_3N: Nitrate-nitrogen, generally not abundant in natural waters, is considered a good indicator of groundwater enrichment by subsurface sewage, urban runoff or agricultural runoff since it tends to remain intact throughout the groundwater system. During high flow periods the NO_3N concentration ranges from 1.20 to 1.95 mg/liter which indicates moderately high concentrations in the runoff water. The highest cencentration was found at Regner Road above Gresham suggesting that agricultural runoff containing fertilizer residuals may be a significant source of nutrient

loading. Runoff from rain saturated soils may contribute to the load by passing septic tank effluent to the streams from the central Mulnomah County area. Bacteriological data suggests a possible source of contamination above SE 45th (see page 19).

During low flow, the nitrate-nitrogen values are fairly low, however, the samples taken at SE 45th indicate a substantial source of groundwater enters the system upstream from there and as stated above, it appears to be contaminated. The nitrate-nitrogen concentration ranges from 3.4 to 6.4 mg/liter at this location.

4. Total PO_4: Total phosphorus, a measure of all phosphorus compounds present, is essential to organic growth but detrimental in high concentrations. In Johnson Creek, the concentration ranges from 0.1 to 0.8 mg/liter which is high enough to suspect outside enrichment. As with nitrate-nitrogen the source is probably a combination of argricultural and urban runoff and septic tank effluent. The concentrations remain fairly stable throughout the year suggesting that surface runoff and groundwater flow may contain nearly equal quantities.

B. Dissolved Oxygen

The dissolved oxygen is high during high flow and lower during low flow, reflecting seasonal differences in temperature and saturation levels:

Maximum saturation	Minimum saturation	General Range
165%	57%	90 - 110%

Both the minimum and maximum dissolved oxygen saturation levels occurred during late summer, July - October, aggravated by stagnant conditions. The highest values occurred at Main Street in Gresham, where large algal blooms commonly occur. The lowest saturation values occurred between SE 92nd and SE 190th where there was likely a high oxygen demand caused by decomposing organics in stagnant pools. The minimum values could be a serious problem for aquatic organisms and suggest the need for augmented flow in the summer.

C. Biological Oxygen Demand (BOD)

Upstream above Stanley Avenue, river mile 4.0, the BOD tends to be higher during low flow aggravated by stagnant water and high nutrients from subsurface runoff. Downstream, the BOD is higher during high flow, probably due to increased organics flushed from upstream deposits. Once again, the values indicate considerable enrichment of the system.

D. Bacteriological Quality

The coliform bacteria concentrations (see Table IV, page 19) substantiate that contamination problems exist in Johnson Creek. During high flow, the concentrations of both total and fecil coliform were very high. A review of our data from 1966 to the present indicates little improvement in this situation. In terms of fecal coliform, an indicator of sewage contamination, high concentrations were found throughout the system during high flow. The SE 45th station with a median concentration of 13,000 fecal coliform/100 mls. and the SE 100th station with a median of 4650 fecal coliform/100 mls. are the areas where the most serious problems exist. Surface and ground water runoff carrying septic tank effluent are the probable sources of this contamination.

The Oregon Revised Statutues (ORS) regulations No. 41-045 for the water quality of the main stem of the Willamette River state that: organisms of the coliform group associated with fecal sources shall not exceed an average concentration of 1000/100 mls. with 20% of the samples not to exceed 2400/100 mls. The median values for Johnson Creek exceed those limits at all stations during both high and low flow. Total coliform concentrations of 70,000/100 mls. are not uncommon during winter flows. As a result water contact sports in Johnson Creek would not be recommended.

E. Heavy Metals and others

The concentrations of lead, iron, zinc, phenols, oil and grease were measured during high and low flows. The concentrations of lead, zinc and phenols were within acceptable limits at all times. At two locations, however, the concentration of iron exceeded 1.0 mg/liter. This can probably be attributed to groundwater sources. The concentrations of oil and grease exceeded 1.0 mg/liter at three locations and can probably be associated with pavement runoff.

CRYSTAL SPRINGS

Crystal Springs Creek originates as a series of springs below Reed College, which flow into a shallow lake at the Eastmoreland Golf Links and eventually flows through mostly residential areas to the lower end of Johnson Creek at Johnson Creek Park, river mile one. The flow is fairly uniform the year-round (10 - 15 cfs), as are the chemical characteristics. As expected for spring water, the total dissolved solids, dissolved salts, conductivity and sulfates are high in concentration. Unexpectedly, nitrates, ortho-phosphate and total phosphorus are also quite high. Since the samples were taken at Johnson Creek Park, an additional sample was taken at the spring source to determine if the nutrients were part of the groundwater system or introduced after it left the ground. A nitrate concentration of 5.70 mg/liter and an ortho-phosphate concentration of 0.40 mg/liter was found. This tends to substantiate earlier suggestions that the local groundwater system in the area appears to be contaminated by domestic wastes from septic tank failures.

JOHNSON CREEK BELOW THE CONFLUENCE OF CRYSTAL SPRINGS CREEK

Crystal Springs Creek contributes more than one half of the total flow of Johnson Creek below river mile one during low flow periods. As a result, the chemical quality during summer and fall tends to be more similar to that of the springs. During high flow periods, however, the influence of Crystal Springs Creek is negated somewhat and the water quality in the lower one mile closely resembles that of the upper portion of Johnson Creek.

OTHER POLLUTION SOURCES

Periodic point discharges through the storm sewer system and actual direct discharges and spillage constitute a very damaging, but unmeasurable, entity. Such discharges cause extreme stress to aquatic organisms such as fish, but are difficult to pinpoint and measure. The data presented here does not reflect this problem. However, the files of the DEQ have numerous entries detailing oil, gas, chemical and other spills and discharges of unknown orgin resulting in fish kills and various complaints.

It seems that Johnson Creek has also been periodically used as a receptacle for old tires, lumber, household appliances, etc. Besides being aesthetically offensive, such refuse contributes to the stagnant conditions which prevail upstream from Luther Road.

BIOLOGY

The biology of Johnson Creek has not been extensively studied. However, the available data collected during the summer suggests that it is inhabited by organisms characteristic of fair to good quality water such as: snails, scuds, crayfish, dace, and shinners. The large, unattractive growths of algae are directly related to the high nutrient levels found in the system. In the free flowing sections of the stream, the water appeared generally clear and of good quality. In the stagnant sections, however, the water was warm and turbid due to high concentrations of planktonic algae.

The fish population of Johnson Creek varies from summer to winter reflecting the different flow regimes. Salmon, steelhead and trout are absent from the lower reaches below Gresham in the summer, apparently excluded by low flows and high temperatures. Salmon and steelhead are known to migrate upstream in the winter, however, and legal trout are planted in the spring.

The summer fish populations below Gresham include: redside shinners, blacksided dace, squawfish, sculpins and suckers. Above Gresham there is a small resident cutthroat trout population.

A general biological reconnaissance of the 16 sample stations was done in August 1975 and the results are tabulated on page 15.

SUMMARY AND CONCLUSIONS

At the present time, fifty percent of the Johnson Creek watershed has been urbanized to some degree and some 84% has been altered from natural conditions. It is estimated that up to 1/3 of the original stream channel has been restricted by various developments. Drainage throughout the basin is poor and the existing storm drains aggravate the runoff problem by directing additional flow to the stream at critical times. As a result, the runoff during the rainy season often exceeds bankfull capacity of the stream and floods are nearly a yearly occurance.

During the dry months, channel restrictions and lack of flow cause local ponding and stagnation. Our chemical data show wide variations in chemical characteristics describing two different flow regimes. In the summer - low flow period, groundwater is the predominate source of water whereas in the winter, rain and runoff waters are the predominate source.

Nutrient loading from agricultural runoff, urban runoff and septic tank effluent is a problem in Johnson Creek. During high flow, the nitrate-nitrogen concentrations are high enough to indicate that fertilizers from agricultural operations and septic tank effluent are being washed into the system. During low flow substantial inputs of nutrients occurs from groundwater sources near SE 45th and Crystal Springs Creek. Both of which drain the unsewered, central Multnomah County area. The concentrations of phosphorus and nitrate-nitrogen are sufficient to account for the massive, unsightly algal growths. In their decomposing state, such algal masses often cause odor problems.

Our data indicates that the bacterial concentrations in the waters of Johnson Creek usually exceed the limits imposed by the Oregon Water Quality Standards. The fecal coliform concentrations are generally high during high flow and excessively high at SE 45th.

Other pollution sources include periodic discharges and spills of unknown origin which have stressed the environment to varying degrees, in some cases resulting in large fish losses. Such discharges can destroy all efforts to improve a stream system.

Biologically, the creek supports a population of aquatic organisms indicative of fair to good water quality. Large numbers of non-game fish flourish, however, it appears that high temperatures and low flows during the summer months have made the portion downstream from Gresham unsuited to trout, salmon and steelhead.

In general terms, the water quality of Johnson Creek is good, however, the problems of low flow, excessive nutrients, periodic uncontrolled discharges and some bacterial contamination are problems that must be met and solved in order to preserve and enhance water quality in Johnson Creek.

RECOMMENDATIONS

I. A plan, for augmentation of the stream flow to a minimum of four to five cubic feet per second, as recommended by the Oregon Department of Fish and Wildlife, during low flow periods should be developed.

II. Clackamas County, City of Gresham, Multnomah County and the City of Portland should cooperatively implement a long - range program to provide public sewerage service and to eliminate all existing subsurface sewage disposal systems in the drainage basin by 1985.

III. All point discharges and spillages from commercial and industrial areas should be controlled and/or eliminated.

IV. A yearly program of stream maintenance to eliminate excess debris accumulation should be implemented.

V. A program to prevent future streamside development which encroaches on the stream channel should be established.

VI. A feasibility study of local retention ponds for excess runoff should be developed.

RELATIVE ABUNDANCE OF AQUATIC ORGANISMS

JOHNSON CREEK DRAINAGE BASIN

Sample Stations

Organisms	Upstream from Crystal Springs Creek riffles	Upstream from Crystal Springs Creek pools	Crystal Springs Creek riffles	Downstream from Crystal Springs Creek riffles
Algae (Benthic)	1			1
Algae (Planktonic)	2	1		2
Shinners				2
Dace	1	1		
Sculpins	2		2	
Squawfish			1	
Midgeflys				2
Mayflys	1			
Hellgramittes				2
Snails			1	1
Seuds				1
Crayfish	2			

abundant = 1

.ew = 2

STORM DRAINS

(available information)

I. City of Gresham

A. Twenty-seven storm drain discharges from stream side housing developments

B. Two 48" pipes carry downtown runoff into the stream

C. Possibility for incidental spills to enter the creek through storm drains

II. Multnomah County

A. 108 - 115th Avenues - Seven foot pipe used as a bypass for flooding

B. Six storm drains at I - 205 and 92nd and Flavel

1. 24" pipe - freeway drainage
2. 12" pipe - storm drain
3. 60" pipe - diverts water from the small creek to Johnson Creek
4. 18" pipe - drain under overpass
5. 36" pipe - from Mt. Scott Boulevard
6. 27" pipe - under bridge

C. 82nd and Harney - 54" storm drain

D. 81st and Harney - 72" storm drain

SUMMARIZED WATER QUALITY DATA - JOHNSON CREEK

	River Mile	Flow	Temp C.	pH	D.O. Dissolved Oxygen mg/l	BOD Biochemical Oxygen Demand mg/l	color units	turbidity in JTU's	TDS Total Dissolved Solids mg/l	Alkalinity mg/l	Hardness mg/l	SO_4 Sulfate mg/l	NH_3-N Ammonia Nitrogen mg/l	NO_3-N Nitrate-Nitrogen mg/l	PO_4 Phosphate mg/l	Cl^- Chloride mg/l	Na Sodium mg/l	K Potassium mg/l	TOT. PO_4 Phosphorus mg/l	Conductivity umhos
Mouth	0.0	H	5.5-16	7.3	10.7-12.5	3.1-3.2	2-30	2-29	109-219	28-34	38-100.5	6.2-16.5	0.03-0.18	2.5-5.4	0.09-0.20	5.9-13.2	4.3-14.0	1.8-2.8	0.3-0.8	150-218
		L	11.5-15	6.4-7.7	10.5-10.7	0.8-1.6	0-<1	1-4	136-266	58	105-115	14.5-17.4	0.01-0.06	4.8-8.8	0.22-0.24	30.4-35.1	8.7-9.5	3.7-3.9	0.2-0.69	358-370
Ochoco Ave.	1.0	H	5.5-11	6.2-7.7	9.2-12.5	0.2-3.1	3-15	3-42	93-129	12-38	23-58	1.4-12.0	0.04-0.09	1.6-3.0	0.05-0.09	3.6-5.9	---	---	---	66-130
		L	12-19	7.1-8.2	10.1-12.2	0.9-2.1	0-1	3-4	183-190	54-56	90-91	16.6	0.01-0.05	0.03-6.0	0.16-0.19	7.6-8.9	---	---	---	210-225
Crystal Springs Creek	1.1	H	7.5-10	6.2-7.1	10.3-11.6	1.3-1.5	3	2.5-5	209	52-53	79.6-80.4	14.6-16.9	0.10-0.11	5.22-5.51	0.23-0.30	7.7-9.3	5.0-5.7	2.9-4.0	0.2-0.5	237-250
		L	12-15	7.0-7.3	10.0-10.2	0.6-1.0	0-1	2-5	182-184	54-61	81.1-81.9	16.4	0.01-0.03	5.5-5.9	0.19-0.26	7.5-16.7	6.8-7.5	3.8-4.3	0.7-0.5	258-260
Johnson Park	1.2	H	5.0-16	6.4-8.3	10.8	2.9	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	11.5-15	7.3-7.5	10.5-10.6	0.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S.E. 45th	3.5	H	5.0-16	6.2-7.5	10.4-12.6	1.6-2.8	10-40	32-33	69-116	18-24	27-27.1	3.0-7.6	0.10-0.13	1.22-1.76	0.07-0.18	3.6-4.4	3.4-4.5	1.1-2.0	0.2-0.5	95-100
		L	11.5-14	7.3	10.8-11.1	0.4-1.5	0-5	4-8	167.5-172	60-71	81.5-83.7	10.9-16.0	0.01-0.80	3.4-6.4	0.02-0.24	8.2-9.2	7.4-8.6	3.8	0.2-0.62	260-275
Stanley Ave.	4.0	H	5.0-17	6.2-7.3	10.4-12.4	1.7-2.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	11.5-14	6.8-7.1	8.8-9.7	0.5-0.9	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Luther Road	5.2	H	4.5-18	6.2-7.3	10.3-12.0	0.8-2.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	11-19	7.3-8.2	7.4-10.0	1.5-5.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S.E. 92nd	6.0	H	4-20	6.2-8.4	11.0	1.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	12-26	7.5-8.2	7.7-9.4	2.4-7.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S.E. 100th	7.0	H	4.5-17	6.2-7.3	10.3-12.1	1.0-3.7	40	37	60	14	19.6	6.1	0.13	1.56	0.08	3.9	3.1	1.0	0.4	69
		L	16.5-27	6.6-7.1	4.5-7.7	0.7-2.4	30	10	108	63	57.4	2.9	<0.01	0.54	0.17	4.7	8.5	2.0	0.5	170
S.E. 110th	7.5	H	4.5-17	6.2-7.3	10.9-12.8	1.3-2.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	11.5-21	7.0-7.3	7.9-8.6	0.9-6.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S.E. 122nd	7.8	H	4.5-17	6.2-7.3	11.3-12.8	1.6-2.1	---	---	---	---	---	---	---	---	---	---	---	---	---	[illegible]
		L	10.5-18	7.2-7.3	7.7-9.4	1.0-1.6	---	---	---	---	---	---	---	---	---	---	---	---	---	[illegible]
Foster Road	10.0	H	4.5-17	6.2-7.3	11.0-12.8	1.2-2.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	10-17	7.3	7.3-8.2	1.6-2.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S.E. 190th	12.8	H	4.5-17	6.2-7.3	11.0-13.1	1.5-2.0	20-25	13-27	50	12-18	16.7-19.9	2.3-3.9	0.11-0.12	1.20-1.76	0.05	3.9-4.1	2.9-3.0	1.0-2.0	0.2-0.3	76-78
		L	11.5-16.5	7.1-7.2	6.9-7.9	1.3-2.3	20-25	12	157-163	82-91	72.6-84.2	2.5-2.8	0.03-0.28	0.22-0.23	0.11-0.19	5.7-10.1	9.5-11.1	2.4-2.5	0.2-0.26	216-250
Main Street	15.1	H	4.5-17	6.2-7.3	11.6-13.0	1.5-2.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	15.5-21	6.9-7.6	11.0-14.9	1.3-6.1	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Regner Road	16.2	H	4.5-17	6.2-7.3	11.5-13.4	1.3-1.9	20-30	15-26	60	10-14	17.9-18	1.5-1.6	0.25-0.50	1.41-1.95	0.03-0.15	3.1-4.4	2.0-2.7	0.9-2.0	0.4-0.7	168-180
		L	11.5-18	7.3	9.1-9.5	1.7-2.5	20	4-7	105.5-133	71	52.6-60.2	1.6-5.4	0.08-0.11	0.07-0.16	0.06-0.14	2.4-2.6	8.9-9.0	1.8-2.2	0.02-0.1	66-7[illegible]
Hogan Road	16.9	H	9.5-16	6.2-7.3	11.5-13.1	1.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		L	4.5-17	7.2	7.2-9.3	1.7-3.0	---	---	---	---	---	---	---	---	---	---	---	---	---	---

NOTE:

H - High Flow

L - Low Flow

III. City of Portland

A. 44th and Umatilla - 48" storm darin

B. other outfalls not located

BACTERIOLOGICAL DATA - JOHNSON CREEK

Total and Fecal Coliforms per 100 mls of Sample

		Low Flow				High Flow			
		Total Coliform		Fecal Coliform		Total Coliform		Fecal Coliform	
Station	RM	range	median	range	median	range	median	range	median
Mouth	0.0	600-2,400	1,300	460-600	530	6,200-24,000	7,000	<450-2,300	1,375
Ochoco Ave.	1.0	2,300-6,200	2,400	620-6,200	2,400	<450-13,000	6,200	<450-6,200	620
Crystal Springs	1.1	230-2,300	1,265	60-<450	205	2,300	2,300	2,300	2,300
Johnson Park	1.2	600-2,400	2,300	600	600	2,300-24,000	2,400	600-2,400	2,300
S. E. 45th	3.5	2,300-7,000	6,200	450-7,000	600	6,200-70,000	24,000	2,300-24,000	13,000
Stanley Ave.	4.0	600-24,000	7,000	600-6,200	2,400	6,200-24,000	6,200	600-2,300	600
Luther Rd.	5.2	<450-24,000	4,500	<450-4,500	2,300	6,200-70,000	38,500	1,300-7,000	2,300
S. E. 92nd	6.0	<450-6,200	3,450	<450- 4,500	<450	2,400-70,000	13,000	600-7,000	2,300
S. E. 100th	7.0	<450-7,000	6,200	<450-2,300	620	2,300-70,000	24,000	1,300-24,000	4,650
S. E. 110th	7.5	1,300-2,400	1,300	60-600	<450	1,300-24,000	2,300	450-2,300	610
S. E. 122nd	7.8	2,300-6,000	2,400	620-3,300	2,300	1,300-24,000	10,000	<450-7,000	1,425
Foster Rd.	10.0	2,300-6,200	4,200	<450-6,200	3,325	7,000-70,000	13,000	<450-7,000	2,300
S. E. 190th	12.8	450-2,300	1,375	<450	<450	<6,200-70,000	<7,000	<450-2,300	2,300
Main Street	15.1	6,200-70,000	47,000	<450-1,300	600	600-24,000	2,400	2,300-6,000	2,300
Regner Rd.	16.2	<450-600	525	<450	<450	2,400-24,000	24,000	460-2,300	620
Hogan Rd.	16.9	<450-600	525	<450	<450	620-24,000	6,200	600-2,300	620

HEAVY METALS, PHENOLS, OIL AND GREASE
JOHNSON CREEK

Station	River Mile	Flow	mg/l Zinc	mg/l Iron	mg/l Lead	mg/l Phenol	mg/l Oil & Grease
Mouth	0.0	L	0.01	0.20	0.01	<0.01	1.6
		H	0.05	1.10	0.01	<0.002	<0.1
Crystal Springs	1.1	L	0.01	0.20	0.012	<0.01	<0.1
		H	0.05	0.70	<0.01	0.004	<0.1
S. E. 45th	3.5	L	0.01	0.44	0.02	<0.01	1.0
		H	0.05	0.70	<0.01	<0.002	<0.1
S. E. 100th	7.0	L	<0.01	0.70	0.015	<0.01	<0.1
		H	<0.03	0.74	0.02	<0.002	<0.1
S. E. 190th	12.8	L	0.01	1.60	0.024	0.024	1.1
		H	<0.03	0.56	<0.01	<0.01	<0.1
Regner Rd.	16.2	L	<0.01	0.44	0.016	0.016	<0.1
		H	----	----	----	----	<0.1

NOTE:

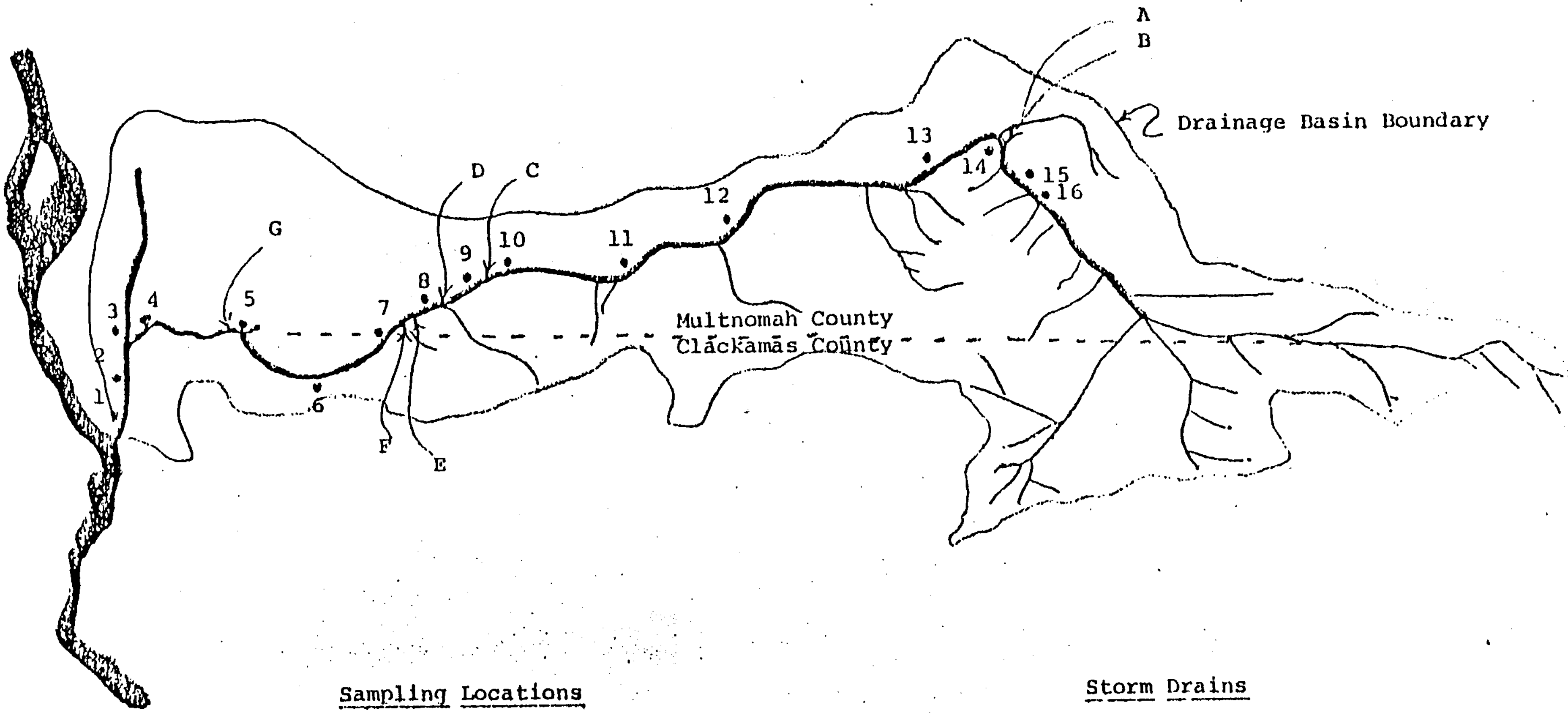
H - High Flow

L - Low Flow

JOHNSON CREEK DRAINAGE BASIN

Sampling Locations

Storm Drains



Sampling Locations

1. Mouth
2. Ochoco Ave.
3. Crystal Springs Creek
4. Johnson Park
5. S. E. 45th
6. Stanley Ave.
7. Luther Road
8. S. E. 92nd
9. S. E. 100th
10. S. E. 110th
11. S. E. 122nd
12. Foster Road
13. S. E. 190th
14. Main Street - Gresham
15. Regner Road
16. Hogan Road

Storm Drains

A. 27 housing development storm drains
B. 2 - 48" pipes - downtown runoff
C. seven foot flood bypass
D. six storm drains
E. 54" drain
F. 72" drain
G. 48" drain