Segment 22-49-02

Publication No. 78-e19

Effects on Receiving Waters of Sewage Wastes Generated by Tonasket, Oroville, Omak, Okanogan and Conconully in the Okanogan Basin

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October 1978

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Project Report DOE PR-3

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INTRODUCTION

Under Public Law 92-500, all municipal sewage treatment plants (STP's) in the United States must eliminate the discharge of pollutants by 1985. In response to this requirement the four STP's in the Okanogan Basin have scheduled upgrades or new construction. The town of Tonasket completed a zero overflow lagoon system in November 1976. Oroville and Omak began construction of secondary activated sludge systems in 1977. Okanogan is scheduled to complete a similar system by June of 1979. All of these facilities were using antiquated trickling filter systems.

Conconully, a fifth community, does not have a municipal sewer system. All homes, resorts, trailer parks, commercial businesses and Conconully State Park use septic tanks. During spring runoff the septic tank drainfields reportedly fail as the water table rises to the surface, contaminating Salmon Creek and Conconully Reservoir. To eliminate this problem, Okanogan County has proposed that a municipal collection system and non-overflow lagoon be constructed.

During 1976 and 1977 water quality and biological surveys were conducted to evaluate the impacts of sewage wastes generated by the five communities in the Okanogan River Basin. Specific objectives were:

1. Determine current STP efficiency and relate these data to the NPDES permit requirements.

2. Establish a baseline of biological and chemical data on the quality of receiving waters which can be used for comparison after the sewage treatment facilities are upgraded.

3. Investigate possible water pollution in Lake Conconully resulting from failing septic tank drainfields in and around Conconully, during periods of high groundwater.

METHODS

Since the Tonasket upgrade was completed before this study was underway, only a limited amount of water quality data on nutrients was collected on the STP that served this community.

For the facility inspections at Oroville, Omak and Okanogan grab samples of the influent and 24-hour composite samples of the effluent were collected. Temperature, pH, specific conductance and total chlorine 1/ were measured in the field. In addition, samples were collected and forwarded to the DOE Laboratory in Tumwater for the following analyses:

Fecal coliform (colonies/100 ml)
Total coliform (colonies/100 ml)
Dissolved oxygen (mg/l)
pH

1/ Free available chlorine plus combined available chlorine as hypochlorous acid, hypochlorite ion, chloramines and other chloro-derivatives.

Temperature (°F)
Dissolved nitrate as nitrogen (mg/l)
Ammonia as nitrogen (mg/l)
Total phosphate as phosphorus (mg/l)
Orthophosphate as phosphorus (mg/l)
Total solids - TS (mg/l)
Total non-volatile solids - TNVS (mg/l)
Total suspended solids - TSS (mg/l)
Total suspended non-volatile solids - TSNVS (mg/l)
Specific conductivity (μmhos/cm)

Flow totalizer values were obtained at the Oroville and Omak STP's to calculate loading and the effluent/stream dilution ratio. Okanogan did not have a flow totalizer, therefore a "Manning Dipper" flowmeter was used. USGS data was used to estimate river flows.

Minimum chlorine contact time was determined by adding dye at the inlet of the contact chamber. Retention and transport time to the river was noted, then the dispersal pattern was observed in the receiving waters.

Depending on the characteristics of the receiving waters, three or four sampling stations were established (Figures 1-3, Pages 10, 11 and 12). The control was located far enough upstream to avoid contamination by the wastewaters, but close enough to be representative of the existing stream conditions. The second station was located in the receiving waters immediately below the STP outfall, or initial mixing zone. The third and fourth stations were located at about 100 yard intervals below the STP, within the total dilution zone.

A grab sample was collected at each receiving water station. Analyses were the same as for the facility inspection with the exception that the BOD, COD and organic nitrogen (KjN) tests were not performed on these samples.

The biological survey consisted of sampling macroinvertebrate populations near each STP outfall. In this effort, 12 stones of approximately equal size were collected at random across a representative riffle above and below the outfall. After each stone was removed from the river, the insects on the surface were washed into a fine-meshed net, then placed in a dissecting tray and enumerated by family.

The Salmon Creek/Conconully complex was sampled using the methods mentioned for the STP's. However, because of the complexity of Salmon Creek as it passes through Conconully, five receiving water stations were established (Figure 4, Page 13). In addition, surface and bottom water samples were collected from Conconully Reservoir at 7 stations (Figure 4, Page 13).

RESULTS

Tonasket

The nutrient data showed that low levels of nitrates, nitrites and orthophosphates were present in the effluent (Table I, Page17).

Oroville

Oroville (population 1,555) was being served by a modified trickling filter sewage treatment facility which discharged into the Similkameen River. The STP consisted of a pumphouse/laboratory, primary/secondary clarifier, digestor, trickling filter and enclosed-baffle chlorine contact chamber. Wastewaters were piped approximately 200 yards to the river. The effluent pipe became clogged a number of years ago and the plant operator broke a hole in the pipe about 50 yards from the chlorine contact chamber (Station E_1, Figure 1, Page 10). At this point there was a small seep pond which was anaerobic and septic. Wastewaters followed a small channel from the pond to the Similkameen River (Station E_3). During periods of higher flow the seep pond becomes a side channel of the river.

At Oroville the Similkameen River is a large, rapidly flowing river. The substrate is cobble (2-3 inches diameter). Average depth was 2-3 feet at the time of the survey. There were two large riffles between the new diffuser and Station B_3. Chinook salmon (Oncorhynchus tshawytscha) and whitefish (Prosopium williamsonii) spawn in this area (Figure 1).

Oroville STP was surveyed during the 3-day period of September 19-22, 1977. Average flow through the STP was 0.307 mgd. During this period the stream effluent flow ratio was 564:1.

The STP was meeting its NPDES requirements (Permit No. WA 002239-0) for pH and total suspended solids but not meeting the requirements for B.O.D. and fecal coliforms (Table II, Page 18). Total residual chlorine (DPD Method) in the effluent averaged 2.1 ppm during the 3-day survey, considerably lower than values reported by orthotolidine kit used by operator (Table III).

Table III. Oroville STP Total Residual Chlorine Data at Station E_1.

Date/Time	Flow (mgd)	Chlorine Reading (mg/l)		Fecal Coliform (colonies/100 ml)
		DPD	Ortho	
10-20/1010	0.326	2.25	0.20	- -
10-20/1100	0.326	3.00	0.15	110,000
10-21/0930	0.554	3.00	0.30	- -
10-21/1030	0.326	1.00	ND	2,000

Fecal coliform counts in the chlorinated effluent were very high at the seep pond considering the amount of total residual chlorine being applied (Table III). This probably occurred because the chlorine contact time of only five minutes was insufficient for disinfection. As the effluent continued from the pond-channel to a large back-eddy in the main river fecal counts cropped to 10 colonies/100 mls and less at station E_3 (Figure 1, Page 10). The total contact time from plant or river was approximately 15 minutes. Dye took approximately two hours to move from this eddy to the main river channel.

Nutrient levels were significantly above upstream values in the Similkameen River at station B_2, the mixing zone. All nutrient concentrations fell to background levels by station B_3 except for ammonia which remained relatively high. No residual chlorine was detected in the receiving waters. All of the remaining parameter concentrations fell to background levels by the time the waters reached stations B_2 and B_3.

Macroinvertebrate species diversity and composition changed significantly between the upstream (B_1) and downstream (B_3) transects on the Similkameen River (Figure 5, Page 14). The Shannon-Weaver species diversity index (d) indicated a substantial change in species distribution[1]. The richness component (e) of diversity which is more sensitive to changes was also substantially different. The family Chironomidae (midges) dominated the species composition below the discharge point. These are facultative benthic organisms and pollution tolerant.

Ten spring chinook salmon (O. tshawytscha) redds and about 14 pairs of spawners were observed between station B_1 and station B_2 (Figure 1). In addition, numerous whitefish (P. williamsoni) eggs were noted in the macroinvertebrate samples at station B_1.

Omak

Omak (population 4,440) was being served by a conventional trickling-filter sewage treatment facility which discharged into the Okanogan River. The plant was comprised of a pumphouse/laboratory, primary clarifier, trickling filter, secondary clarifier, sludge digestor and baffled chlorine contact chamber. An effluent pipe transported wastewaters one-fourth mile to the river. The end of the pipe only extended 5-6 feet out into the river (Figure 1, Page 10). At the time of the survey, the STP's new diffuser had already been put into the river upstream of the old diffuser. It extended approximately 50 feet into the river.

The Okanogan River near the Omak STP is a riffle area measuring approximately 50 yards wide with a two to three feet average depth. The substrate is large cobble (1-2 inch diameter). Spring chinook and whitefish spawn in the general area. There is very little epiphytic growth. Directly downstream of the old diffuser for approximately 8-10 feet the substrate is covered with a dark-green slime.

Omak STP was surveyed during the 72-hour period of October 3-6, 1977. Average flow through the STP was 0.617 mgd. Average river dilution ratio during this period was 896:1.

Omak was meeting its permit requirements (permit No. WA 002094-0) for BOD, fecal coliforms, total suspended solids (TSS) and pH (Table IV, Page 19). Total chlorine in the effluent averaged 2.1 ppm (DPD) at the chlorine contact chamber outlet. The minimum chlorine contact time was estimated at 10 minutes with fecal counts averaging 84 colonies/100 ml at the contact chamber outfall. Wastewater travel time to the Okanogan River was about 20 minutes.

The dye study indicated the effluent moves along the west bank of the river and spanned about one-third of the river after traveling about 200 yards, then disperses.

Nutrient levels increased significantly at station B_2 (Table I, Page 17). Total chlorine levels also were high at stations B_2 and B_3 but not detected at station B_4. All other parameters were normal.

Macroinvertebrate data indicated very little, if any, change in species composition or diversity at station B_4 (Figure 6, Page 15).

Two spring chinook salmon redds were observed below the new diffuser pipe. Also numerous whitefish were spawning in the same area.

Okanogan

Okanogan (population, 2,225) is served by a conventional trickling-filter secondary sewage treatment facility which discharges into the Okanogan River. The plant includes a primary clarifier, pumphouse/laboratory, digestor, trickling-filter, secondary clarifier, and baffled chlorine contact chamber. The effluent pipe extended approximately 50 yards to the river bank and discharge point (Figure 3, Page 12).

The Okanogan River at this point is a long deep run terminating in a riffle. The run is approximately 50 yards wide and 4-5 feet deep. The substrate in the run is a sand/gravel mixture, then turns to cobble (1-2 inch diameter) in the riffle. Very little epiphytic growth was noted in the run but heavy algal growth (Cladophora) was noted at the end of the run on the west bank. Spring chinook and whitefish utilize the area for spawning.

Okanogan STP was surveyed during the 3-day period of October 10-13, 1977. Average flow through the STP was 0.098 mgd. The stream/effluent dilution ratio averaged about 5,300:1 during this time.

The STP was meeting its NPDES requirements (permit No. WA 002236-5) for BOD, fecal coliform, total suspended solids (TSS) and pH, during the survey (Table V, Page 20). Total chlorine in the effluent was high, averaging 5.3 ppm (Table VI, Page 6).

Table VI. Okanogan STP Total Chlorine Data

Date/Time	Total Cl_2 (ppm)	Fecal Coliform (colonies/100 ml)
10-11/0945	5.6	77
10-11/1120	5.4	10
10-11/1200	5.0	410
10-12/1030	4.5	53
10-12/1130	5.2	40
10-12/1245	6.0	60

The dye test indicated a minimum chlorine contact time of only two minutes and approximately five minutes total time to the Okanogan River. Once the effluent reached the river, it mixed quickly (mixing zone) and dispersed uniformly across the river within 15-20 minutes (Figure 3, Page 12).

Nutrient levels were significantly higher than upstream values at stations B_2 and B_3, with no significant change at station B_4 (Table I, Page 17). There was no significant increases in BOD, COD or TSS levels below the outfall. Total chlorine in the mixing zone (station B_3) was 0.2 ppm and non-detectable at station B_4 approximately 100 yards downstream. Temperature, pH, dissolved oxygen, and specific conductivity levels were affected by the wastewater discharge immediately below the outfall at station B_3 (mixing zone), but returned to ambient by station B_4.

One pair of chinook salmon and numerous whitefish were observed spawning just above station B_4. Macroinvertebrate data indicated neither composition or diversity of these populations were substantially altered at station B_4 (Figure 7, Page 16).

Conconully

The community of Conconully (population 140) is located on an alluvial fan between Conconully Lake and Conconully Reservoir. The North Fork of Salmon Creek flows through the town on its way to Conconully Reservoir (Figure 4, Page 13). The diversion canal north of town flows into Conconully Lake. On occasion this water is returned to N.F. Salmon Creek via the overflow canal.

North Fork Salmon Creek is a small fast-flowing montane stream averaging less than six feet wide and six inches deep, with many tumbling runs but few riffles and pools. The substrate is large cobble (3-4 inches diameter) and gravel/sand.

Conconully Reservoir had an approximate surface area of 400 acres and maximum depth of 30 feet at the time of the survey. Less than half of its shoreline was developed. The reservoir had macrophyte populations only off Liar's Cove Resort. It appeared to mesotrophic, although algal blooms have been noted in the past.

The Conconully reservoir data collected in August 1976 revealed little change in water quality between stations (Table VII, Page 21). The data did not indicate a point source within the reservoir at the time of the survey. Data collected at the same time from Salmon Creek indicated little change in water quality between the upstream stations 1 and 2 and station 4. Data from stations 3 and 5 was invalidated due to unusual turbidity caused by heavy machinery working in the streambed just above station 3. The area was not surveyed in 1977 because of the lack of spring runoff and the abnormally low water table.

DISCUSSION AND SUMMARY

All of the STP's surveyed were meeting the majority of their NPDES permit requirements. Oroville and Omak were under construction during the surveys and had minor discrepancies. Okanogan on the other hand was not under construction and met its permit requirements. All of the STP's had high total chlorine levels in their effluents. This should improve after upgrade with flow regulated chlorination and 30 minute minimum contact time required by the PL 92-500 construction grant program. Also, the ammonia level in all the effluents was above toxic limits. The new oxidation-ditches should help to alleviate some of the problem.

Of the STP's surveyed, only the Oroville had any measurable adverse effect on receiving water quality in the total dilution zone. Oroville STP also had the lowest dilution factor (564:1). The benthic community below this outfall was predominantly Diptera of the family Chironomidae which are facultative, pollution tolerant organisms. This is indicative of benthic communities exposed to low level toxicity over a long period of time. The synergistic effect of chlorine with other known toxicants (2-5) in the Oroville sewage coupled with the dilution factor has probably caused this problem.

Below the Omak and Okanogan STP outfalls the total chlorine and ammonia levels were high in the mixing zone. Because of high dilution (869:1 and 5,300:1) those water quality values returned to upstream levels in the total dilution zone with the exception of ammonia at Omak. At the pH and temperature that existed in the area, the amount of un-ionized ammonia was below the 0.02 mg/l limit established by EPA for receiving waters (1).

High dilution ratios, even during low flow conditions, have minimized the impact of the toxic chlorinated STP effluents. Dilution by the river ranged from 564:1 to 5,300:1 (river:effluent) in spite of low flow drought conditions. During an average water-year flows would be about twice as high, making the dilution larger and impacts smaller.

Potential impact from the new diffusers would be the loss of spawning area if total chlorine levels are above the EPA criteria. All of the STP's had toxic levels of ammonia and residual chlorine in their mixing zones. The new diffusers at Oroville and Omak are located directly upstream of spawning salmon and whitefish. Salmonid eggs and fry are

extremely sensitive to any perturbation in environmental conditions. A slight change in water quality often has disasterous effects i.e.: broken backs, abnormal fin development, and sterility. This could result in production losses and lower survival rates. The new diffusers will change the water quality in the mixing zone.

The Conconully survey data indicates no significant point or non-point source in Conconully Reservoir during drought conditions. The question of contamination of the N.F. Salmon Creek remains unanswered. Because the town is located on porous ground between two lakes it could be contaminating the creek. A small survey during a normal spring runoff should answer the question.

CONCLUSIONS

1. Macroinvertebrate populations were affected only below Oroville STP.

2. Upgrading STP's on the Similkameen/Okanogan River will probably have its greatest impact on water quality by reducing the total residual Cl_2 in their effluents.

3. The other improved components of the new secondary treatment systems (NH_3-N, T.S.S., B.O.D. and pH) will have minimal impact on water quality due to high dilution.

4. Relocation of the outfall diffuser pipes into the main river flow should improve mixing and dilution zones.

5. The position of the new outfall diffuser pipe at Oroville and Omak may adversely affect chinook salmon eggs and fry developing in the gravel downstream.

6. No significant degradation of water quality in Conconully Reservoir.

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APPENDIX

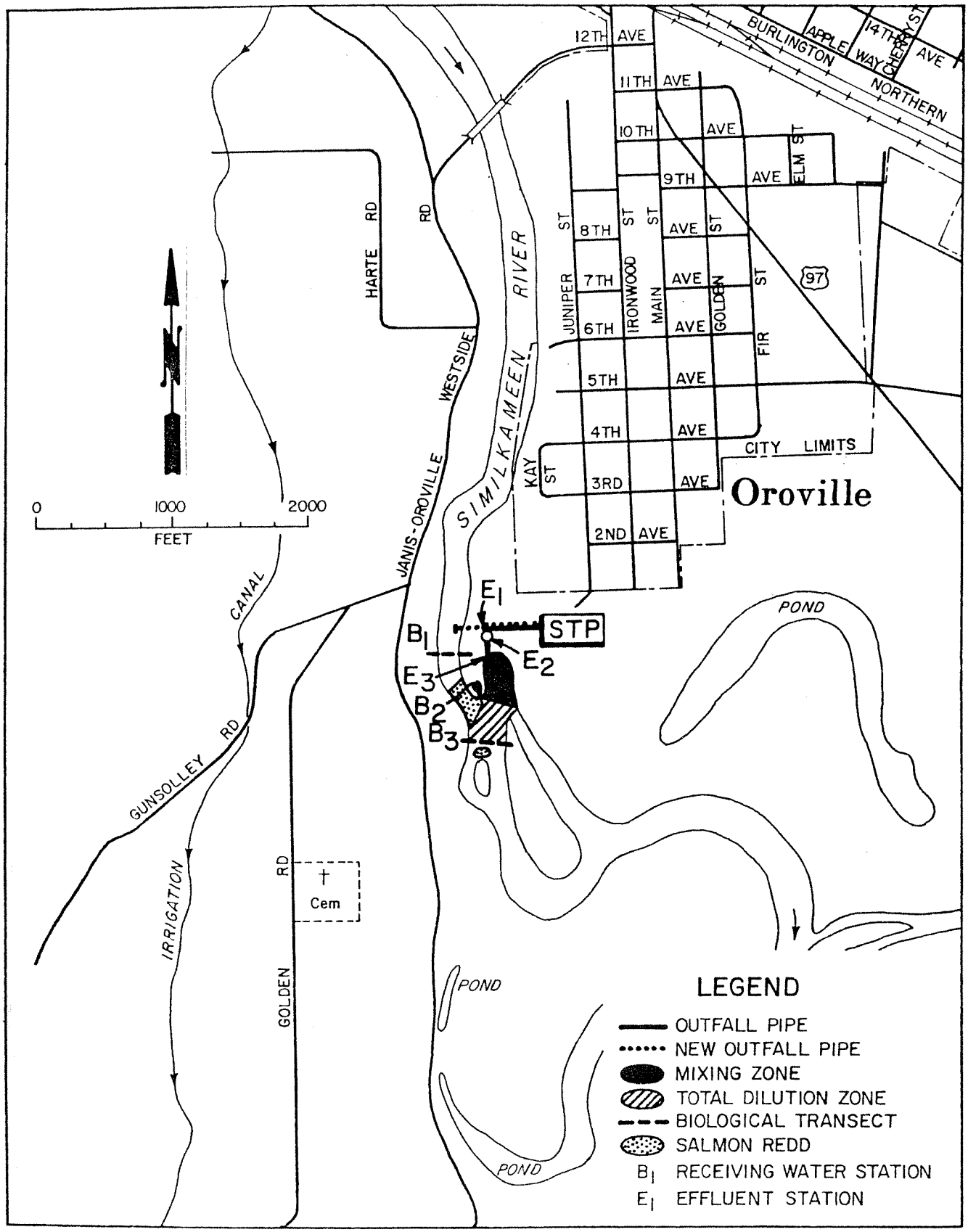

Figure 1. OROVILLE STP SURVEY STUDY AREA: SAMPLING STATION LOCATIONS AND GENERAL LAYOUT (FALL 1977).

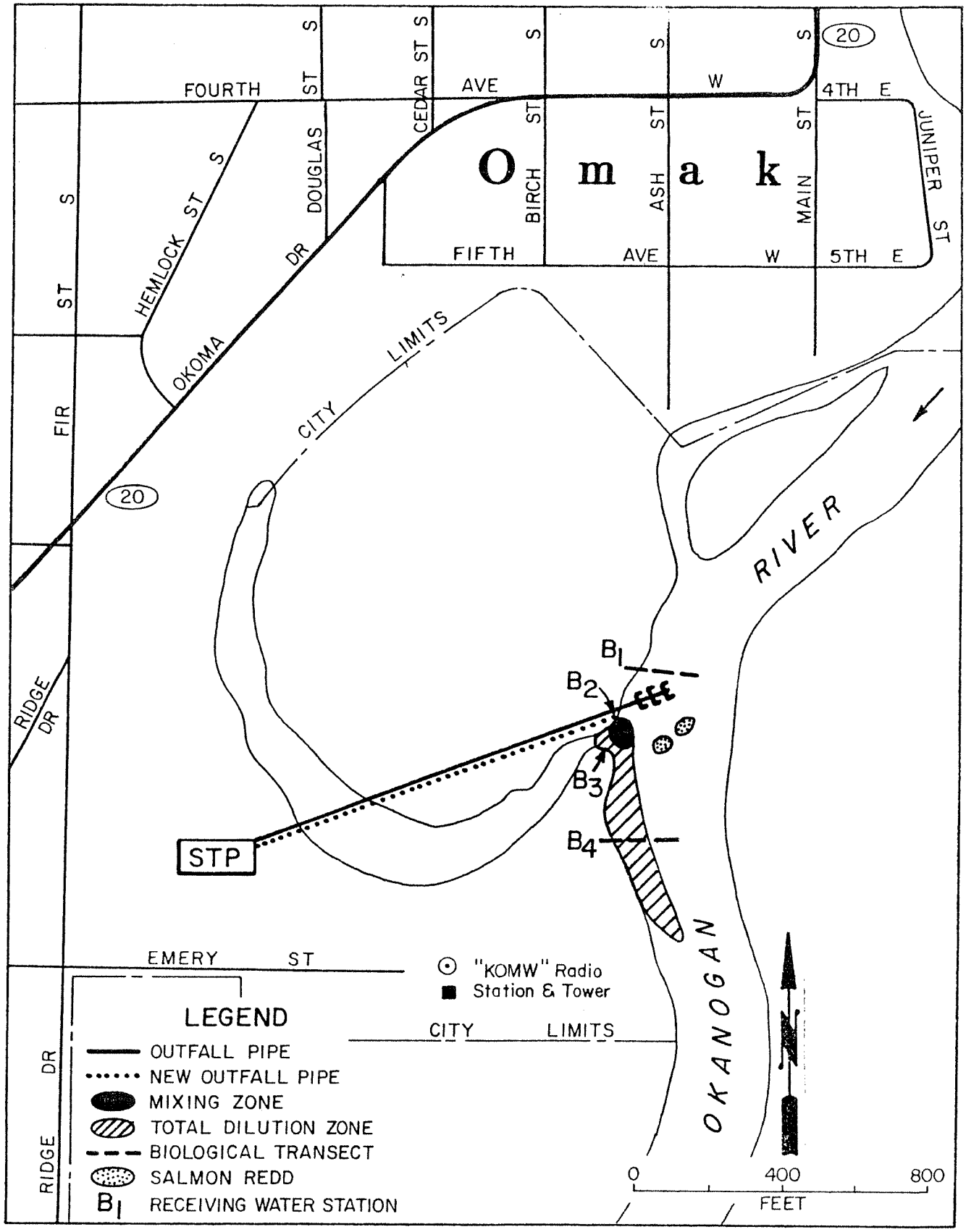

Figure 2. OMAK STP SURVEY STUDY AREA: SAMPLING STATION LOCATIONS AND GENERAL LAYOUT (FALL 1977)

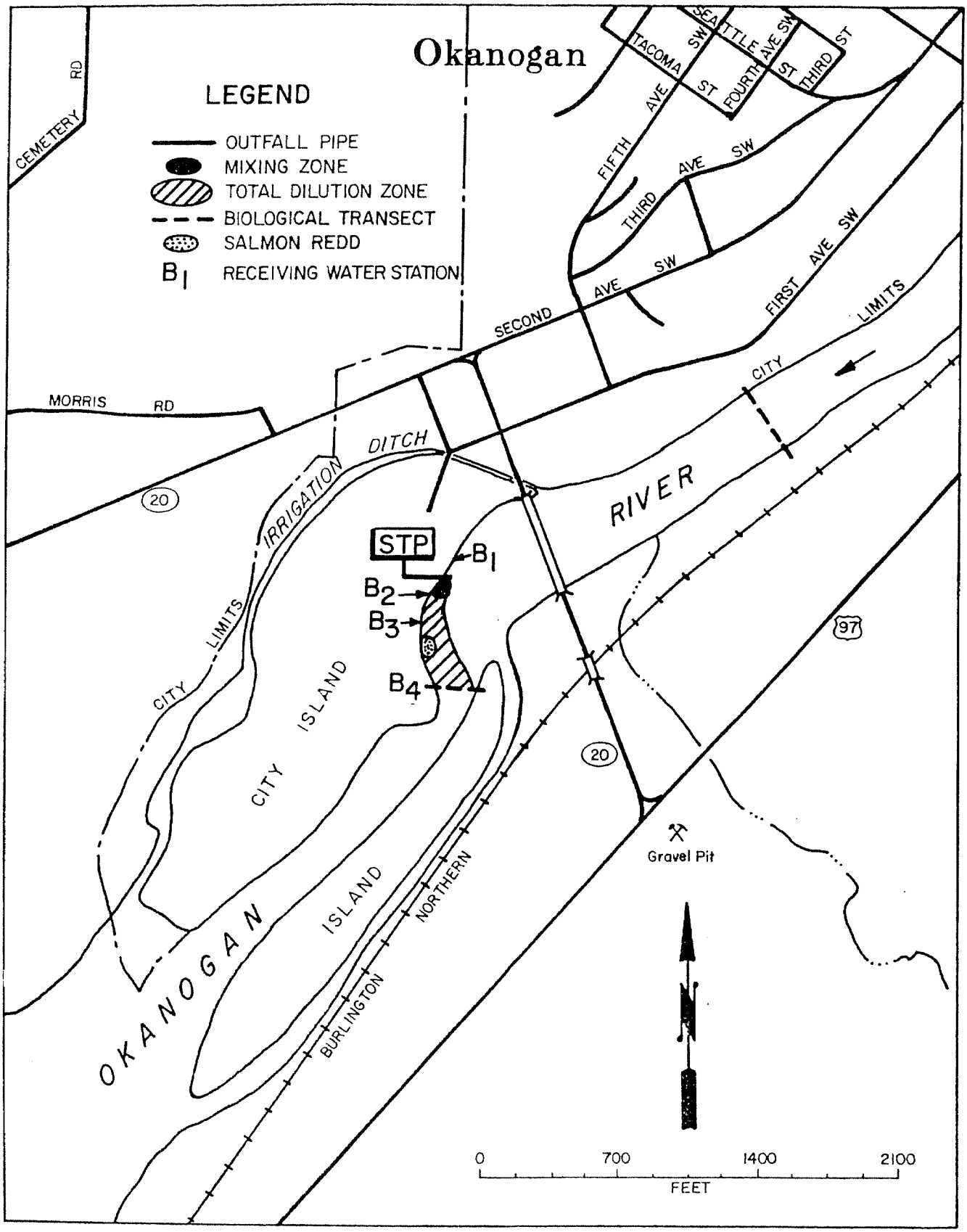

Figure 3. OKANOGAN STP SURVEY STUDY AREA: SAMPLING STATION LOCATIONS AND GENERAL LAYOUT (FALL 1977).

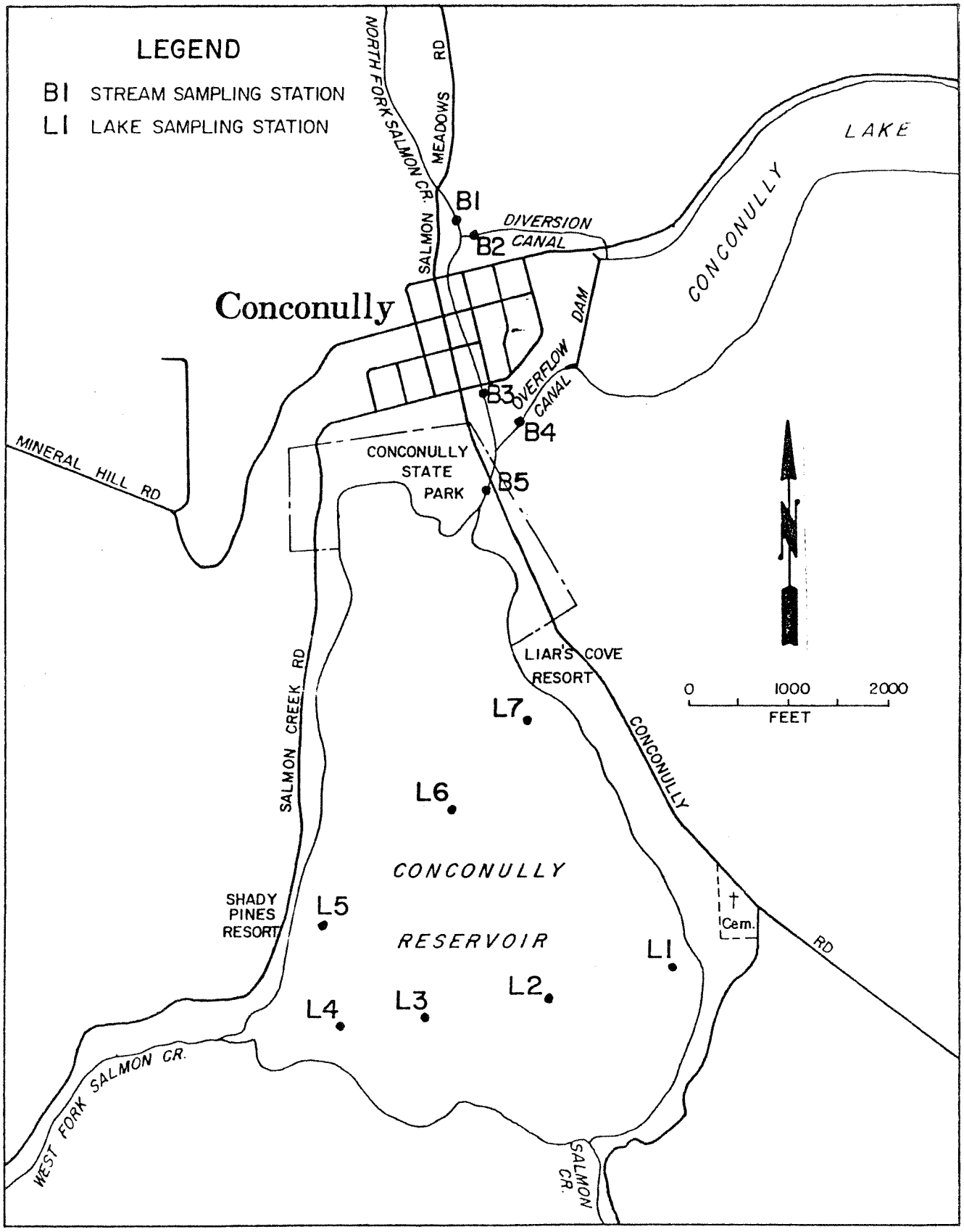

Figure 4. CONCONULLY STUDY AREA: SAMPLING STATION LOCATIONS.

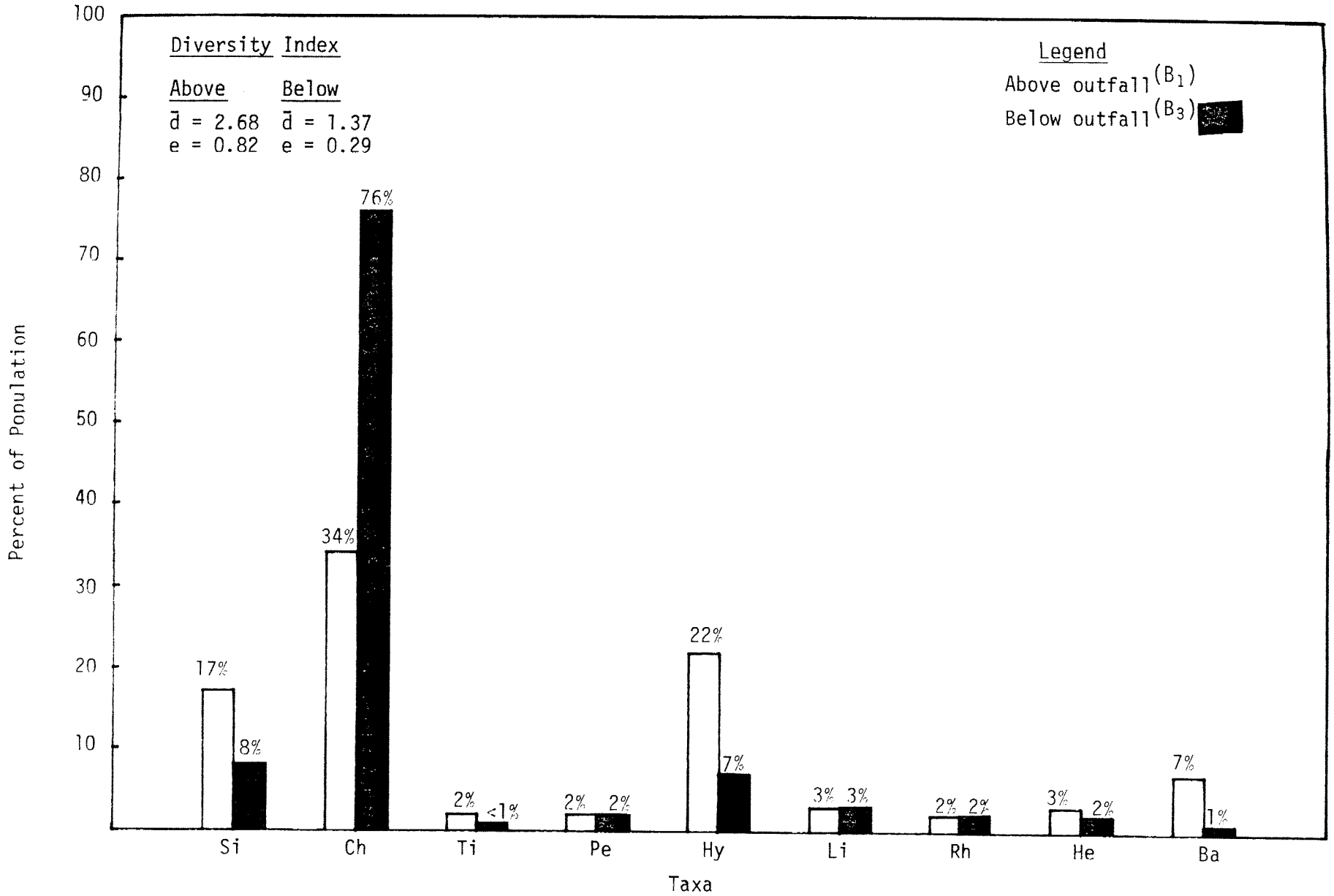

Figure 5. Macroinvertebrate species composition and diversity in the Similkameen River above and below the Oroville STP outfall.

Si - Simuliidae (Blackflies)
Ch - Chironomidae (Midges)
Ti - Tipulidae (Craneflies)
Hy - Hydropsychidae (Caddisflies)
Li - Limnephilidae (Caddisflies)
Pe - Perlidae (Stoneflies)
Rh - Rhyacophilidae (Caddisflies)
He - Heptageniidae (Mayflies)
Ba - Baetidae (Mayflies)

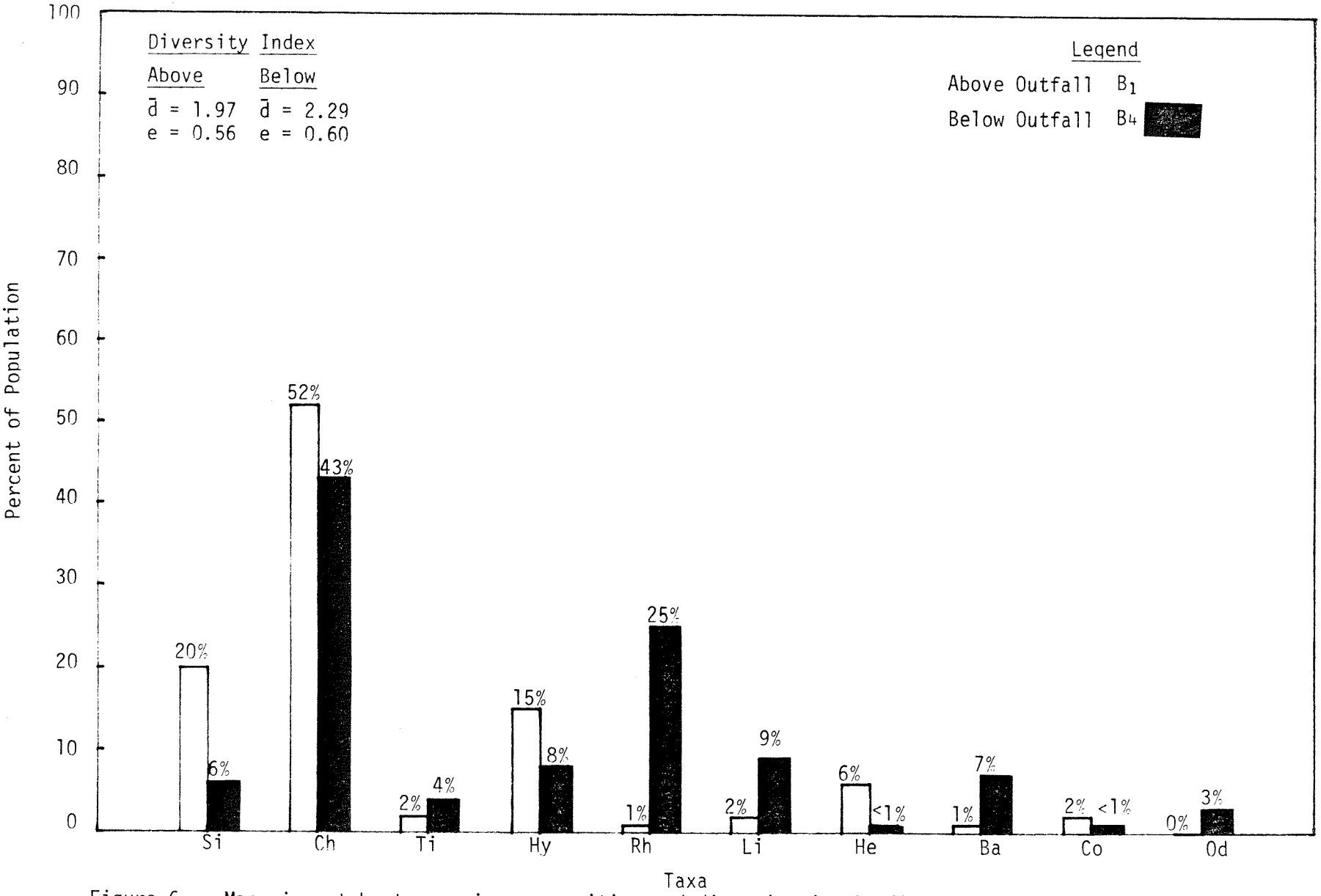

Figure 6. Macroinvertebrate species composition and diversity in the Okanogan River above and below the Omak STP outfall.

Si - Simuliidae (Blackflies)
Ch - Chironomidae (Midges)
Ti - Tipulidae (Craneflies)
Hy - Hydropsychidae (Caddisflies)
Rh-Rhyacophilidae (Caddisflies)
Li - Limnephilidae (Caddisflies)
He - Heptagenidae (Mayflies)
Ba - Bactidae (Mayflies)
Co - Coleoptera (Riffle Beetles)
Od - Odanata (Dragonflies)

Ti - Tipulidae (Craneflies) He - Heptagenidae (Mayflies)
Hy - Hydropsychidae (Caddisflies) Ba - Bactidae (Mayflies)

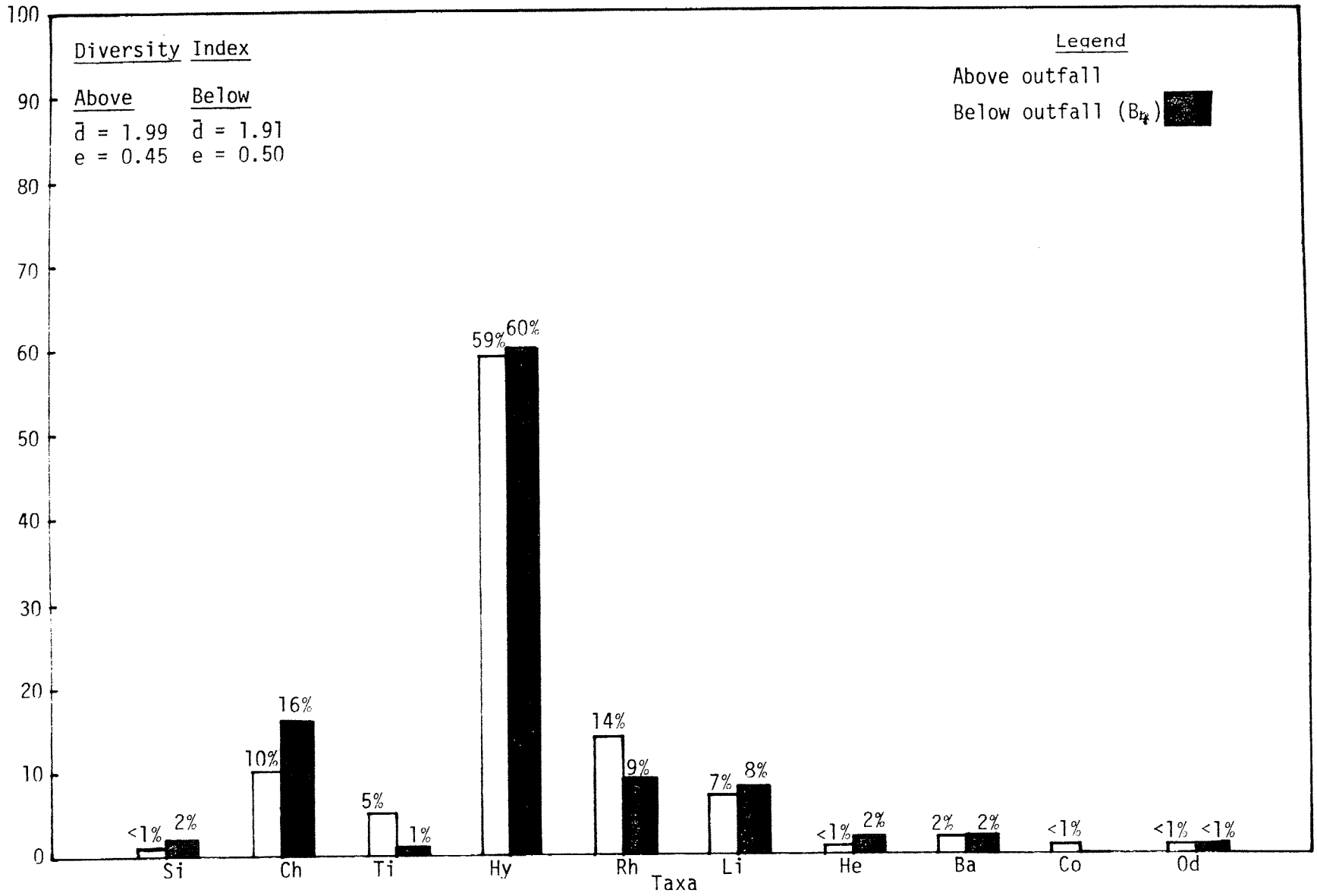

Figure 7. Macroinvertebrate species composition and diversity in the Okanogan River above and below the Okanogan STP outfall.

Si - Simuliidae (Blackflies)
Ch - Chironomidae (Midges)
Ti - Tipulidae (Craneflies)
Hy - Hydropsychidae (Caddisflies)
Li - Limnephilidae (Caddisflies)
He - Heptagenidae (Maylies)
Rh - Rhyacophilidae (Caddisflies)
Ba - Bactidae (Mayflies)
Co - Coleoptera (Riffle Beetles)
Od - Odanata (Dragonflies)

Table I. Receiving Water Data Collected by DOE during Okanogan River Basin Survey, September and October 1977.

STP	Sta.	Description	Sample Type	Temp (°F)	pH	D.O. (mg/l)	D.O. (% Sat.)	Sp. Cond.	Total Cl_2 (mg/l)	NO_3-N (mg/l)	NO_2-N (mg/l)	Total NH_3-N (mg/l)	Un-ionized NH_3 (mg/l)	KjN (mg/l)	T-PO_4-P (mg/l)	O-PO_4-P (mg/l)
Oroville	B_1	Upstream control	Grab	60°	7.5	11.1	110	207	0.0	< 0.02	< 0.02	< 0.02		0.13	< 0.02	< 0.02
	E_3 2/	End of ditch	Grab	63°	7.2	- -	- -	1017	2.05	1.10	0.27	11.4	0.0700	16.0	5.27	3.43
	B_2	200 ft. below outfall	24 hr. composite	60°	7.3	10.9	109	228	0.0	0.04	0.03	0.47	0.0150	0.55	0.20	0.14
	B_3	400 ft. below outfall	Grab	60°	7.3	10.9	109	209	0.0	< 0.02	< 0.02	0.06	0.0002	0.09	< 0.02	< 0.02
Tonasket 1/	B_1	Upstream control	Grab	*	*	*	*	*	*	< 0.02	< 0.02	< 0.01		*	*	0.02
	B_2	50 ft. below outfall	Grab	*	*	*	*	*	*	< 0.02	< 0.02	0.01		*	*	< 0.10
	B_3	10 ft. below outfall	Grab	*	*	*	*	*	*	< 0.02	< 0.02	0.02		*	*	0.02
Omak	B_1	Upstream control	Grab	54°	7.2	11.2	103	312	0.0	< 0.02	< 0.02	< 0.02		0.22	< 0.03	< 0.02
	B_2	50 ft. below outfall	24 hr. composite	62°	7.2	4.7	49	1058	2.06	0.60	0.02	1.77	0.0103	30.0	7.83	6.40
	B_3	100 ft. below outfall	Grab	54°	7.0	11.2	103	330	est. 0.3	0.08	< 0.02	0.54	0.0012	0.78	0.26	0.17
	B_4	200 ft. below outfall	Grab	54°	7.0	11.2	103	- -	0.0	0.02	< 0.02	0.30	0.0007	0.40	0.08	0.09
Okanogan	B_1	Upstream control	Grab	52°	7.0	11.8	105	325	0.0	< 0.02	< 0.02	< 0.02		0.41	< 0.02	< 0.02
	B_2	50 ft. below outfall	24 hr.	63°	7.2	5.1	53	1283	5.3	1.17	< 0.02	14.9	0.0549	28.5	9.00	7.10
	B_3	100 ft. below outfall	Grab	52°	7.0	11.8	105	342	est. 0.2	< 0.12	< 0.02	0.14	0.0003	0.46	0.10	0.06
	B_4	300 ft. below outfall	Grab	52°	7.0	11.8	105	- -	0.0	< 0.02	< 0.02	0.03	0.0001	0.31	0.03	< 0.02

1/ Preliminary data collected during August 1976

2/ E_3 was located at the end of ditch as it entered the Similkameen River (Figure 1)

Table II. Oroville STP Loading and Efficiency Data
September 19-22, 1978 (Average Flow = 0.307 mgd)

Parameter	Influent (mg/l)	Influent (lbs/day)	Effluent (mg/l)	Effluent (lbs/day)	% Reduction	NPDES (weekly avg.)
Temp °F			63°F			
pH (median)	7.1		7.2			6.5 - 8.5
Sp. Cond. (μmhos/cm)	2050		1017			
T. Chlorine			5.25			
COD	297	759	112	287	62%	
BOD	162	413	54	138	67%	99 lbs/day or 85% reduction
Fecal Coli. (median) (colonies/100 ml)			3.1×10^5			400
NO_3-N	<0.02	<0.05	1.10	2.82	inc.	
NO_2-N	<0.02	<0.05	0.27	0.68	inc.	
NH_3-N	15.6	39.8	11.4	29.2	27%	
Kjel-N	21.7	55.3	16.0	41.0	26%	
O-PO_4-P	2.90	7.40	3.43	8.8	inc.	
T. PO_4-P	6.57	16.8	5.27	13.5	20%	
T. Solids	1104	2819	569	1454	48%	
T. Non Vol. Solids	835	2137	454	1159	76%	
T. Suspended Solids	93.5	239	20	51	79%	114 lbs/day or 85% reduction
T. Suspended Non Volatile Solids	11.3	29	<0.33	<0.85	97%	

T = Total
inc. = Increase

Table IV. Omak STP Loading and Efficiency Data;
October 3-6, 1977 (Average Flow = 0.617)

Parameter	Influent (mg/l)	Influent (lbs/day)	Effluent (mg/l)	Effluent (lbs/day)	% Reduction	NPDES (weekly avg.
Temp.	66°F		62°F			6.5 - 8.5
pH (median)	7.2		7.2			
Sp. Cond. (μmhos/cm)	1152		1058			
T. Chlorine			10.6			
COD	313	1611	126	650	60%	
BOD	151	777	37	189	76%	270 lbs/day 85% reduct
Fecal Coli. (median) (colonies/100 ml)			85			400
NO_3-N	< 0.03	< 0.15	0.60	3.09	inc.	
NO_2-N	< 0.02	< 0.10	< 0.02	0.10	inc.	
NH_3-N	20.6	106	1.77	9.11	92%	
Kjel-N	16.2	83.4	16.0	82.3	1%	
O-PO_4-P	5.13	26.4	6.4	32.9	inc.	
T-PO_4-P	8.47	43.6	7.83	40.3	8%	
T. Solids	766	3940	602	3098	21%	
T. Non Vol. Solids	494	2542	451	2321	9%	
T. Suspended Solids	170	875	237	122	86%	311 lbs/day or 85% reduction
T. Suspended Non Volatile Solids	16.7	86.0	2.33	12.0	14%	

T = Total
inc. = Increase

Table V. Okanogan STP Loading and Efficiency Data; October 10-13, 1978 (Average Flow = 0.98 mgd)

Parameter	Influent (mg/l)	Influent (lbs/day)	Effluent (mg/l)	Effluent (lbs/day)	% Reduction	NPDES (weekly avg.)
Temp °F	65°F		63°F			
pH (median)	7.4		7.2			6.5 - 8.5
Sp. Cond. (μmhos/cm)	1380		1283			
T. Chlorine			5.3			
COD	271	221	137	112	49%	
BOD	137	112	30.7	25	77%	188 lbs/day or 85% reduction
Fecal Coli. (median) (colonies/100 ml)			57 est.			400
NO_3-N	0.50	0.41	1.17	0.95	inc.	
NO_2-N	< 0.11	<0.09	< 0.02	< 0.02	78%	
NH_3-N	17.4	14.2	14.9	12.2	14%	
Kjel-N	35.5	29.0	28.5	23.3	20%	
O-PO_4-P	6.30	5.20	7.13	5.83	inc.	
T. PO_4-P	8.97	7.30	8.60	7.03	4%	
T. Solids	837	684	749	612	11%	
T. Non Vol. Solids	593	485	591	483	1%	
T. Suspended. Solids	131	107	28.0	22.9	79%	188 lbs/day or 85% reduction
T. Suspended Non Volatile Solids	11.0	9.00	< 3.00	< 2.50	71%	

T = Total
inc. = Increase
N.A. = Not applicable

Table VII. Conconully Lake Complex Fall 1976 Survey Data

Watercourse	Sta.	Description	Sample Type	T. Coli. (Col/100 ml)	F. Coli. (Col/100 ml)	NO_3-N (mg/l)	NO_2-N (mg/l)	NH_3-N (mg/l)	T.-PO_4 (mg/l)	O-PO_4 (mg/l)
N.F. Salmon	B_1	Upstream of canal diversion	Grab	60	4	0.01	< 0.02	0.01	0.09	**
Creek	B_2	Diversion canal	Grab	110	< 2	< 0.01	< 0.02	0.01	0.01	< 0.01
	B_3*	Below trailer park	Grab	3,800	300	0.03	< 0.02	0.02	0.10	0.08
	B_4	Overflow canal	Grab	15	< 2	< 0.01	< 0.02	0.01	0.02	0.01
	B_5*	500 ft. above mouth	Grab	7,200	800	< 0.01	< 0.02	0.01	0.08	**
Conconully	L1S	100 ft. off shore, south end	Grab	40 est.	< 2	< 0.01	< 0.02	0.06	0.05	0.01
Reservoir	L1M	100 ft. off shore, south end	Grab			< 0.01	< 0.02	0.04	0.03	0.01
	L1B	100 ft. off shore, south end	Grab			< 0.01	< 0.02	0.06	0.03	0.01
Conconully	L2S	Mid lake, south end	Grab	32 est.	< 2	< 0.01	< 0.02	0.07	0.02	0.01
Reservoir	L2M	Mid lake, south end	Grab			< 0.01	< 0.02	0.06	0.03	< 0.01
	L2B	Mid lake, south end	Grab			< 0.01	< 0.02	0.06	0.07	0.01
Conconully	L3S	200 ft. off w. shore, so. end	Grab	50 est.	2 est.	< 0.01	< 0.02	0.03	0.03	< 0.01
Reservoir	L3M	200 ft. off w. shore, so. end	Grab			< 0.01	< 0.02	0.03	0.02	< 0.01
	L3B	200 ft. off w. shore, so. end	Grab			< 0.01	< 0.02	0.06	0.02	< 0.01
Conconully Reservoir	L4S	500 ft. off mouth of W.F. Salmon Cr.	Grab	110	16 est.	< 0.01	< 0.02	0.04	0.03	0.01
Conconully	L5S	100 ft. off Shady Pines Resort	Grab	72 est.	6 est.	< 0.01	< 0.02	0.03	0.03	< 0.01
Reservoir	L5M	100 ft. off Shady Pines Resort	Grab			< 0.01	< 0.02	0.06	0.03	< 0.01
	L5B	100 ft. off Shady Pines Resort	Grab			< 0.01	< 0.02	0.08	0.04	< 0.01
Conconully	L6S	Mid lake, north end	Grab	40 est.	< 2	< 0.01	< 0.02	0.02	0.02	< 0.01
Reservoir	L6M	Mid lake, north end	Grab			< 0.01	< 0.02	0.03	0.03	< 0.01
	L6B	Mid lake, north end	Grab			< 0.01	< 0.02	0.05	0.03	< 0.01
Conconully	L7S	100 ft. off Liar's Cove Resort	Grab	60 est.	< 2	< 0.01	< 0.02	0.02	0.03	< 0.01
Reservoir	L7M	100 ft. off Liar's Cove Resort	Grab			< 0.01	< 0.02	0.02	0.03	< 0.01
	L7B	100 ft. off Liar's Cove Resort	Grab			< 0.01	< 0.02	0.02	0.02	< 0.01

S = Surface
M = Mid
B = 1m off the bottom
* = Invalid data because of heavy machinery in streambed
** = Interference