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SPOKANE INDUSTRIAL PARK CLASS II INSPECTION, MAY 18-20, 1992

by
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ABSTRACT

A Class II Inspection was conducted May 18-20, 1992, at the Spokane Industrial Park Sewage Treatment Plant. The Spokane Industrial Park facility treats wastewater from a variety of industrial tenants with an oxidation ditch facility. Effluent quality during the inspection generally met weekly and monthly NPDES permit limits; or, in the case of metals, met interim limits. Three target organic compounds were detected in the influent or effluent. The pesticide heptachlor was found in the effluent at a concentration of about eight times the EPA criteria to protect against chronic toxicity in receiving waters. The effluent copper concentration exceeded EPA acute toxicity criteria for receiving waters by roughly ten times. Also, lead, cadmium, mercury, and silver effluent concentrations exceeded the EPA chronic toxicity criteria. Rainbow trout, *Daphnia magna*, *Ceriodaphnia dubia* bioassays found no measurable toxicity in the Spokane Industrial Park effluent.

INTRODUCTION

A Class II Inspection was conducted at the Spokane Industrial Park (SIP) Sewage Treatment Plant (STP) on May 18-20, 1992. Guy Hoyle-Dodson and Marc Heffner, environmental engineers for the Washington State Department of Ecology (Ecology) Toxics, Compliance and Ground Water Investigations Section, conducted the inspection. Donald G. Nichols, permit manager for the Washington State Department of Ecology Eastern Regional Office, requested the inspection and provided background information on SIP's previous compliance history. Assisting onsite at the Sewage Treatment Plant was plant superintendent Al Willner. Scott Brown, SIP's park manager, acted as a contact person and provided information on the park's operation. Two of the park's tenants were visited during the inspection. Tom Crawford, chief industrial engineer at Columbia Lighting, Inc. and Shaun Tadino, at Boise Cascade Corporation Packaging Plant, represented their respective companies.

The SIP operates an industrial sewage treatment facility that provides secondary treatment for the park's sanitary and industrial wastewater. The facility is regulated by NPDES permit #WA-000095-7 (issue date: April 20, 1992). A companion Administrative Order was issued with the permit to give interim discharge limits for several parameters until improvements recommended in a forth-coming required engineering report are made. The new NPDES permit and Administrative Order have no percent removal requirements. Effluent is discharged into the Spokane River.

Three SIP tenants discharge pretreated process wastewater regulated by state waste discharge permits (SWDP) to the SIP STP. These industries include Columbia Lighting (SWDP #5222), Ketronics Inc. (SWDP #5284), and Johnson Matthey (SWDP # 5359).

The Class II Inspection was conducted after the issuance of the current permit and prior to an impending engineering study. The inspection helped determine the present plant operating status and will aid in evaluating the engineering report. Specific objectives include:

1. Verify compliance with both NPDES permit limits and with interim limits set forth by the Washington State Department of Ecology in an administrative order.

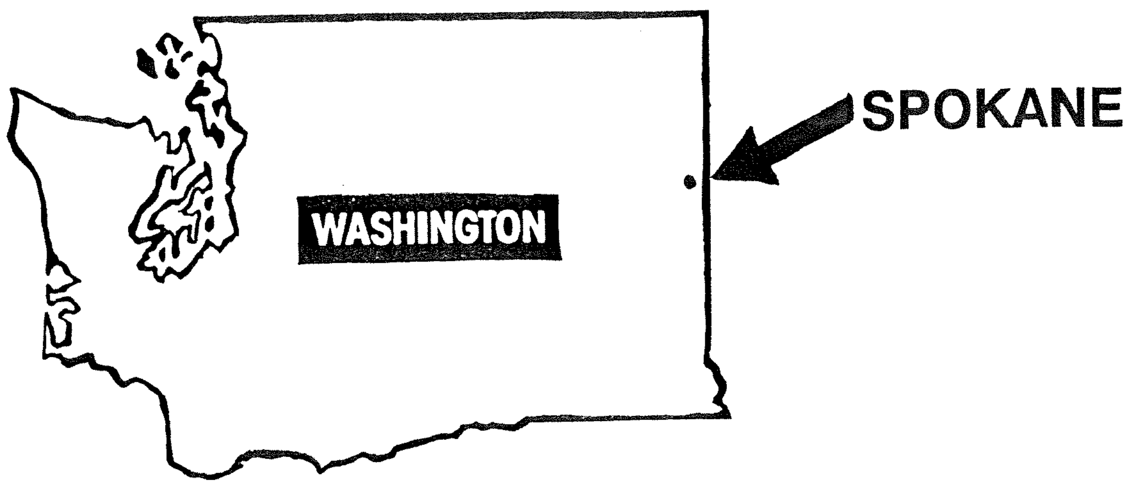
2. characterize wastewater toxicity with chemical scans and bioassays;

3. assess discharge to the plant by selected tenants for parameters of concern;

4. assess plant operation and ability to treat wastewater flows.

SETTING

The Spokane Industrial Park is located within Spokane County, east of the city of Spokane (Figure 1). The site encompasses 490 acres, zoned for light to heavy industry. The park is



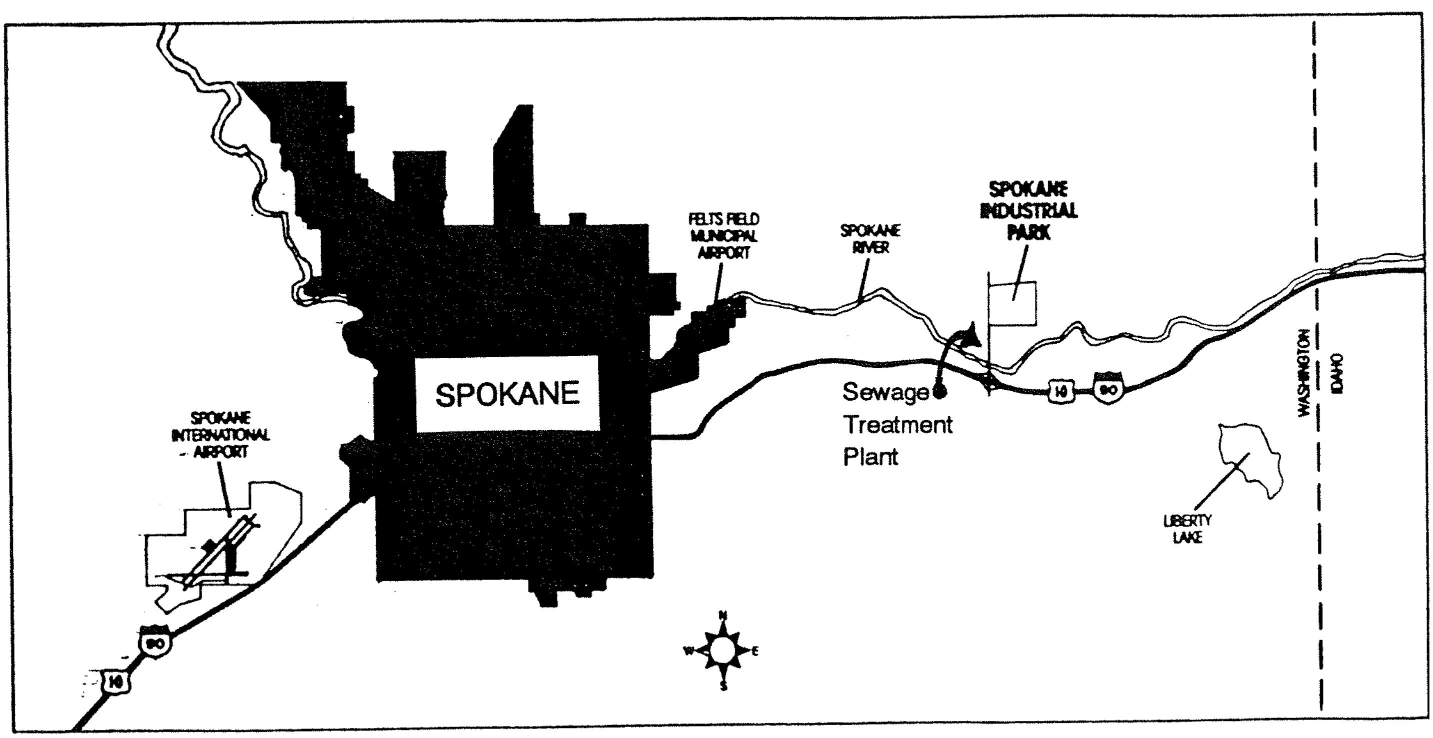


Figure 1
Sewage Treatment Plant
Site Map

owned and operated by Pentzer Development Corporation, a subsidiary of Washington Water Power Company. There are approximately 100 tenants in the park.

The site was originally built as a U.S. Navy supply depot during WWII. The initial sewage treatment facility consisted of a trickling filter system designed to treat only sanitary wastes generated onsite. After conversion to an industrial park in the early 1960s an engineering study in 1969 showed that the STP was hydraulically overloaded and subjected to toxic effects from industrial discharge. In 1970 the current facility was constructed.

Treatment units at the facility during the inspection were: 1) a comminutor, 2) an oval oxidation ditch, 3) a secondary clarifier, and 4) a chlorine contact chamber (Figure 2). Influent flow was measured by a flow meter at a weir downstream of the comminutor. Discharge of treated wastewater to the Spokane River was via a single port diffuser. A small sludge drying bed was available but not in use due to infrequency of sludge wasting.

PROCEDURE

Ecology collected both grab and composite samples at the STP. Composite samples were collected at the influent weir and at the end of the chlorine contact chamber. Ecology Isco composite samplers collected equal volumes of sample every 30 minutes for 24 hours. Grab samples were collected from the headworks, from the oxidation ditch, and from the chlorine contact tank discharge. A grab sample was also taken of the SIP water supply. Sampler locations are summarized in Appendix A.

SIP also collected influent and effluent composite samples. Sampling locations corresponded to those of Ecology samples. Sampling periods and volumes replicated Ecology sampling procedures. Ecology and SIP samples were split for analysis by both Ecology and SIP labs. Parameters, samples collected, and schedules are summarized in Appendix B.

Samples for Ecology analysis were placed on ice and delivered to the Manchester Laboratory. Chain-of-custody procedures were observed throughout. Appendix C summarizes analytical procedures and the laboratories performing the analysis.

QUALITY ASSURANCE/QUALITY CONTROL

Sampling

Sampling quality assurance included priority pollutant cleaning of sampling equipment (Appendix D). Sampling in the field followed all protocols for holding times, preservation, and chain-of-custody set forth in the Manchester Laboratory Users Manual (Ecology, 1991).

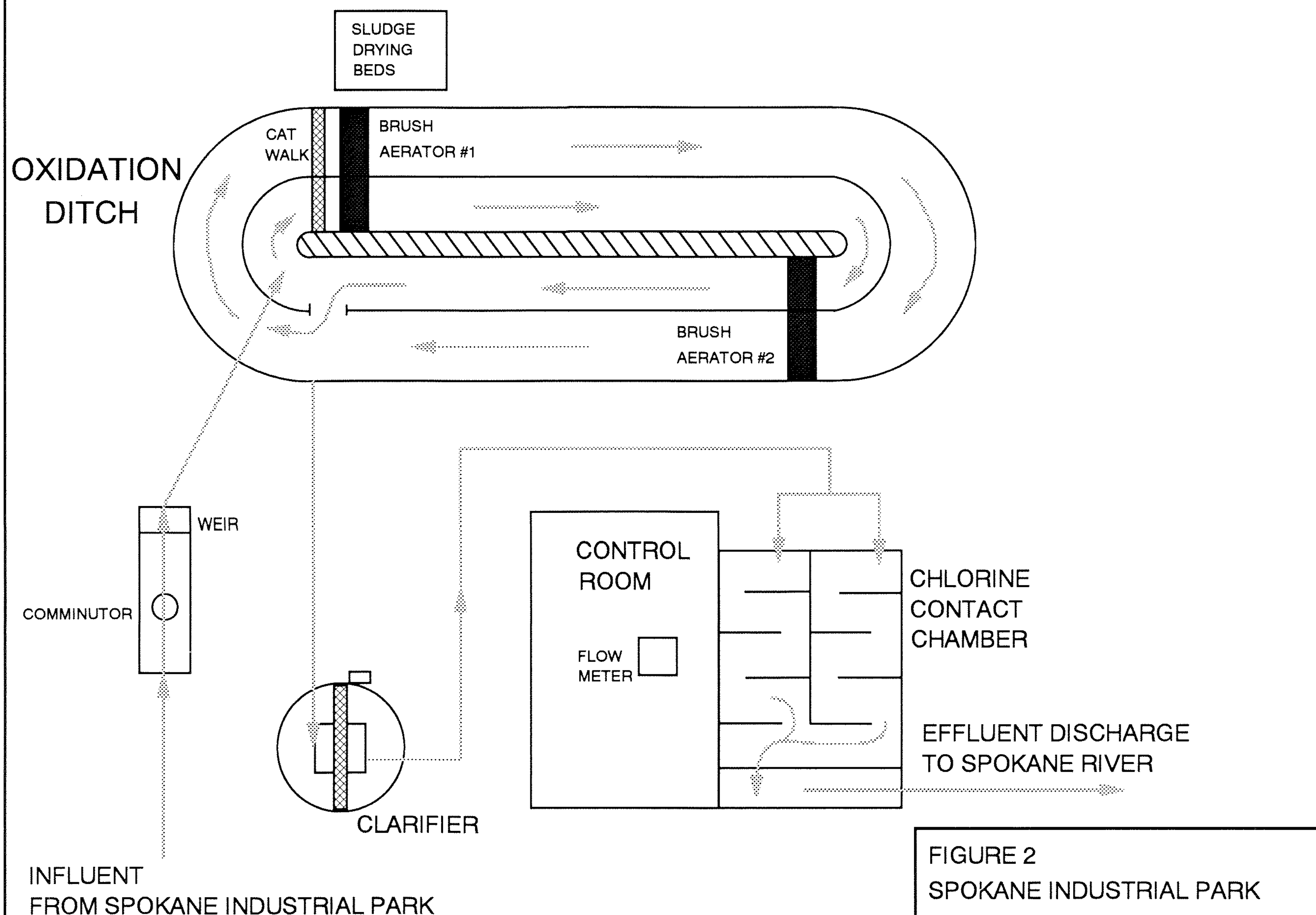


FIGURE 2
SPOKANE INDUSTRIAL PARK
TREATMENT PLANT SCHEMATIC

General Chemistry Analysis

Holding times and procedural blanks were acceptable. Instrument calibrations, precision data, external verification standards, and standard reference material were within appropriate control limits.

Metals Analysis

Holding times and procedural blanks were generally acceptable. Instrument calibration, spike recoveries, duplicate spike recoveries, standard reference materials, and external verification standards were generally within acceptable control limits. Exceptions were:

1. Nickel was detected in the procedural blank. Nickel concentrations above detection limits and less than ten times the amount in the blank are assigned a "B" qualifier to indicate blank contamination.

2. Spike recoveries for mercury and silver were not in an acceptable range. These parameters are assigned an "N" qualifier to indicate poor spike recovery.

VOAs, BNAs, and Pesticide/PCBs

Holding times and method blanks were acceptable. Instrument calibrations were acceptable and met minimum and maximum response criteria. Matrix spike, precision data, and surrogate recoveries were acceptable and within QC control limits.

Bioassays

Negative control results, positive control results using a reference toxicant, and test environment data (*i.e.* dissolved oxygen, pH, etc.) were within acceptable ranges for all organisms tested.

RESULTS AND DISCUSSION

Flow Measurements

Ecology's evaluation of instantaneous flow through the weir corresponded closely with SIP plant flow meter measurement. The plant meter recorded an instantaneous flow of 0.822 MGD compared to a calculated instantaneous flow of 0.848 MGD. The meter flow reading was within 3% of the calculated flow. The average flow recorded by the plant meter for May 19, 1992, was 0.602 MGD. Maximum and minimum flows recorded on that day were 0.83 MGD and 0.41 MGD, respectively.

NPDES Permit Comparison

Inspection results were generally less than weekly and monthly permit limits; or for metals less than interim limits (Table 1). The TSS concentration was slightly greater than the monthly permit limits, but less than the weekly permit limits. The copper, lead, and zinc concentrations exceeded final permit limits, but met interim limits. Reduction of effluent metals concentrations is to be addressed in the forthcoming SIP engineering study.

Also, one of the fecal coliform samples slightly exceed the monthly permit limit. The geometric mean of the two samples collected (79/100 mL) was less than the monthly limit. The effluent chlorine residual was 0.1-0.2 mg/L, slightly less than or equal to the weekly limit, but greater than the monthly limit. Dechlorination will likely be necessary to meet both fecal coliform and chlorine residual monthly average limits.

General Chemistry/Plant Operation

Inspection general chemistry data are summarized in Table 2.

During the inspection the plant influent was very weak in comparison to domestic sewage for several parameters (Table 3). The oxygen demand parameters (BOD_5, TOC, and COD), NH_3-N, and total-P were all approximately one half the strength of weak domestic sewage. Because concentrations of all three of the oxygen demand parameters were low, it appears BOD_5 test inhibition due to toxicants is unlikely; and in fact, the waste has a low BOD_5.

As is expected with a low strength waste, treatment percent removals were fairly low (Table 3). The plant appeared to be actively nitrifying. The influent NH_3-N concentration (7 mg/L) was reduced to <0.2 mg/L in the effluent. A concurrent increase in NO_2+NO_3-N and decrease in alkalinity occurred as expected. Nitrification indicates biological activity is occurring in the oxidation ditch.

Comparison of typical design loading and operational parameters for extended aeration type activated sludge systems with SIP data suggests the plant is organically underloaded (Table 4 and Appendix E: Metcalf and Eddy, 1991). The sludge age is near the high end of the expected range. The MLSS concentration is 21% of the lower end of the usual design range. The operator had not wasted sludge for several months prior to the inspection and the MLSS concentration was still low. The MLVSS(microorganisms) is typically 70-90% of the MLSS (organic substances) (WEF, 1991) but was only 56% at the SIP STP suggesting a low level of biological activity in the system. The organic loading rate was about 20% of the lower end of the usual design range.

Reduced water usage and reduced cooling water usage in the park may increase the wastewater strength. A stronger influent may result in improved treatment efficiency (higher percent removals). A reduced hydraulic load would likely have little effect on effluent quality

Table 1 – NPDES Limits/Inspection Results Comparison – Spokane Industrial Park, 1992

Parameter	NPDES Permit Limits		NPDES Interim Permit Limits *		Inspection Data					
					Ecology Composite	STP Composite	Grab Samples			
				Location:	Ef-E	Ef-S	Ef-1	Ef-2	Ef-3	Ef-4
				Type:	E-comp	S-comp	grab	grab	grab	grab
				Date:	5/19-20	5/19-20	5/19	5/19	5/20	5/20
	Monthly Average	Weekly Average	Monthly Average	Weekly Average / Time:	@	@	0955	1525	0950	1050
				Lab #:	218237	218238	218235	218236	218255	218256
BOD5										
(mg/L)	10.4	20			8	7	–	–	–	–
(lbs/D)	65	125			40	35	–	–	–	–
TSS										
(mg/L)	15.2	30.4			17	16	18	18	–	–
(lbs/D)	95	190			85	80	90	90	–	–
Fecal coliform (#/100 mL)	200	400			–	–	–	–	27	230
pH (S.U.)	6.0 < pH < 9.0				–	–	7.4	7.5	7.6	–
Flow (MGD)**	0.75	--------			0.602	0.602	0.602	0.602	–	–
Ammonia (NH3)										
(mg/L)	8.5	17.0			0.17	0.10	0.09	0.12	–	–
(lbs/D)	53.2	106.3			0.85	0.51	0.43	0.60	–	–
Total Residual Cloride (mg/L)	0.05	0.2	**Sufficient, but not in excess of that needed to attain fecal coliform limits in NPDES permit.**		0.1	–	0.1	0.2	0.2	0.2
Phosphorus										
(mg/L)	3.0				1.76	1.76	1.72	1.81	–	–
(lbs/D)	18.6	--------			8.84	8.84	8.64	9.09	–	–
Copper (µg/L)	20	30	400	500	332	356	–	–	–	–
Lead (µg/L)	3	8	80	180	40.1	41.3	–	–	–	–
Nickel (µg/L)	3000	5000			170 B	187 B	–	–	–	–
Zinc (µg/L)	60	100	150	200	72.4	72.8	–	–	–	–
1,1,1 trichloroethane (µg/L)	100	--------			–	–	10 U	10 U	–	–

E Ecology Sample.
S Spokane STP sample.
@ Composite sampling time: 0800-0800.
* Administrative Order in effect until remedial actions are taken to comply with permit.

comp Composite sample.
grab Grab sample.
Ef Effluent.
B Analyte was found in the analytic method blank indicating the sample may have been contaminated.

U The analyte was not detected above the reported amount.
** The reported value is an average flow.

Table 2 - Ecology General Chemistry Results - Spokane Industrial Park, 1992

Parameter		Inf-1	Inf-2	Inf-E	Inf-S	Ef-1	Ef-2	Ef-3	Ef-4	Ef-E	Ef-S
	Location:	Inf-1	Inf-2	Inf-E	Inf-S	Ef-1	Ef-2	Ef-3	Ef-4	Ef-E	Ef-S
	Type:	grab	grab	E-comp	S-comp	grab	grab	grab	grab	E-comp	S-comp
	Date:	5/19	5/19	5/19-20	5/19-20	5/19	5/19	5/20	5/20	5/19-20	5/19-20
	Time:	0925	1510	@	@	0955	1525	0950	1050	@	@
	Lab Log #:	218231	218232	218233	218234	218235	218236	218255	218256	218237	218238
GENERAL CHEMISTRY											
Conductivity (umhos/cm)		592	681	776	772	575	601			612	634
Alkalinity (mg/L CaCO3)				182	179					128	128
Hardness (mg/L CaCO3)				176	172					170	168
SOLIDS 4											
TS (mg/L)				622	598					442	498
TNVS (mg/L)				384	389					272	316
TSS (mg/L)		80	39	68	100	18	18			17	16
TNVSS (mg/L)				26	30					8	7
OXYGEN DEMAND PARAMETERS											
BOD5 (mg/L)				36	47					8	7
COD (mg/L)		78	73	110	130	41	44			42	42
TOC (water mg/L)		17.8	20	26.8	30.7	8.3	9.5			10.3	11.3
NUTRIENTS											
Total Persulfate N(TPN) (mg/L)				13.8	14.8					9.98	10.3
NH3-N (mg/L)				6.62	7.31	0.086	0.119			0.169	0.102
NO2+NO3-N (mg/L)				1.74	1.63	9.07	8.97			9.1	9.46
Total-P (mg/L)				1.98	2.87	1.72	1.81			1.76	1.76
MISCELLANEOUS											
Oil and Grease (mg/L)		8 J	4 J			1 UJ	1 UJ				
F-Coliform MF (#/100mL)								27	230		
Cyanide total (ug/L)				4	2					2	4
Cyanide (wk & dis ug/L)				2 U	2 U					2 U	2 U
FIELD OBSERVATIONS											
Temperature (C)		16.7	17.5			16.4	17.7	15.4			
Temp-cooled (C)*+				3.1	4.7					3.1	0.8
pH		7.68	7.45	7.76	7.93	7.44	7.51	7.58		7.8	7.8
Conductivity (umhos/cm)		667	587	652	650	591	506			557	565
Total Chlorine Residual (mg/L)						0.1	0.2	0.2	0.2	0.1	0.1

E	Ecology Sample.
S	Spokane STP sample.
@	Composite sampling time: 0800-0800.
comp	Composite sample.
grab	Grab sample.
gr-comp	Grab-composite sample.
J	The analyte was positively identified and the associated result is an estimate.
U	The analyte was not detected above the reported value.
UJ	The analyte was not detected at or above the reported estimate result.
Tr Blk	Transfer blank
Inf	Influent
Ef	Effluent
Intake	SIP water supply
MLSS	Oxidation Ditch Solids
CoLtg	Columbia Lighting discharge
*+	Refrigerated temperature.

Table 2 - Ecology General Chemistry Results - Spokane Industrial Park, 1992

Parameter II	Locatn:	Ef-GC	MLSS-1	MLSS-2	Intake	CoLtg-1	CoLtg-2
	Type:	gr-comp	grab	grab	grab	grab	grab
	Date:	5/19	5/19	5/19	5/19	5/19	5/19
	Time:	1550	1050	1520	1620	1355	1405
	Lab Log #:	218239	218240	218241	218243	218246	218247
GENERAL CHEMISTRY							
Conductivity (umhos/cm)		589			292	365	744
Alkalinity (mg/L CaCO3)		128			137		
Hardness (mg/L CaCO3)		169			174		
SOLIDS 4							
TS (mg/L)							
TNVS (mg/L)							
TSS (mg/L)			330	310		3	159
TNVSS (mg/L)			150	130			
OXYGEN DEMAND PARAMETERS							
BOD5 (mg/L)							
COD (mg/L)						39	750
TOC (water mg/L)						12.3	304
NUTRIENTS							
Total Persulfate N(TPN) (mg/L)							
NH3-N (mg/L)						0.039	2.08
NO2+NO3-N (mg/L)						1.3	0.059
Total-P (mg/L)						8.59	99.4
MISCELLANEOUS							
Oil and Grease (mg/L)							
F-Coliform MF (#/100mL)							
Cyanide total (ug/L)							
Cyanide (wk & dis ug/L)							
FIELD OBSERVATIONS							
Temperature (C)					10.7	24.4	23
Temp-cooled (C)*+							
pH					7.78	8.06	7.39
Conductivity (umhos/cm)					255	312	647
Total Chlorine Residual (mg/L)						0.1	

E	Ecology Sample.
S	Spokane STP sample.
@	Composite sampling time: 0800-0800.
comp	Composite sample.
grab	Grab sample.
gr-comp	Grab-composite sample.
U	The analyte was not detected above the reported value.
Tr Blk	Transfer blank
Inf	Influent
Ef	Effluent
Intake	SIP water supply
MLSS	Oxidation Ditch Solids
CoLtg	Columbia Lighting discharge
*+	Refrigerated temperature.

Table 3 – Comparison to Typical Untreated Domestic Wastewater/Percent Removal – Spokane Industrial Park, 1992

PARAMETER	CONCENTRATION (mg/L)				Percent Removal (%)		CONCENTRATION (mg/L)	
	SIP–INF		SIP–EF				Typical* Domestic Weak	Typical* Domestic Average
SAMPLER:**	Ecology	Spokane	Ecology	Spokane	Ecology	Spokane		
Total Solids (TS)	622	598	442	498	28.9	16.7	350	757
Total Suspended Solids (TSS)	68	100	17	16	75.0	84.0	100	223
Total NonVolatile Suspended Solids (TNVSS)	26	30	8	7	69.2	76.7	20	50
Biological Oxygen Demand (BOD5)	36	47	8	7	77.8	85.1	110	243
Total Organic Carbon (TOC)	26.8	30.7	10.3	11.3	61.6	63.2	80	177
Chemical Oxygen Demand (COD)	110	130	42	42	61.8	67.7	250	583
Total Nitrogen (Total Persulfate)	13.8	14.8	9.98	10.3	27.7	30.4	20	48
Organic Nitrogen	5.44	5.86	0.71	0.74	86.9	87.4	8	19
Ammonia (NH3–N)	6.62	7.31	0.17	0.1	97.4	98.6	12	29
Nitates & Nitrites (NO2&NO3–N)	1.74	1.63	9.1	9.5	-423.0	-482.8	0	0
Total Phosphorus	1.98	2.87	1.8	1.8	9.1	37.3	4	9

SIP Spokane Industrial Park
INF Influent Wastewater
EF Effluent Wastewater

Ecology Ecology sample
Spokane Spokane Spokane Industrial Park sample
* Typical domestic wastewater (Medcalf & Eddy, 1991)
** Ecology laboratory results

Table 4 – Typical Activated Sludge Design Parameters – Spokane Industrial Park, 1992

Parameters	Design Parameters for Activated Sludge Processes ¤	Spokane SIP
Process Modification:	Extended Aeration	Extended Aeration
Flow Regime:	Plug or Complete Mix	Complete Mix
Food-to- Microorganism Ratio (F/M) (lb BOD/[lb MLVSS/day])	0.05 - 0.15	0.18
Sludge Age (Days)	10 - 30	27
Mixed-Liquor Suspended Solids (MLSS) (mg/L)	2000 - 6000	320
Detention Time (hydraulic) (hours)	10 - 20	32
Aerator Loading (lb BOD/1000 cu ft)	10 - 25	2.0

¤ Table from: Metcalf & Eddy, 1991

(concentrations of pollutants), although effluent pollutant loads (pounds discharged) may be less with the lower flow. One potential concern at the facility has been toxics. Reduced flows to the plant may result in higher concentrations of potential toxicants in the influent and effluent unless pollutant loads to the STP are reduced at their sources.

Plant operation consisted primarily of monitoring to satisfy NPDES requirements. The low plant loading has allowed permit compliance with minimal time expenditure by the plant operator. Compliance with the new permit after the required engineering study is completed will likely require more process control and/or an active pretreatment program to meet metals limits. Either of these items will require more time for STP operation and park tenant discharge monitoring/control by the SIP STP owner, Pentzer Development Corporation. During the inspection an "Operation and Maintenance Manual" for the plant could not be located. Locating or compiling an "Operation and Maintenance Manual" is recommended to provide guidance to the plant operator.

Priority Pollutant Scans

Acetone, bis(2-ethylhexyl)phthalate, and heptachlor were the only three target organic compounds detected in the influent or effluent (Table 5). Acetone was the organic found at the highest concentration in both the influent (540 to 2500 μg/L) and effluent (27 to 42 μg/L). There are no EPA water quality criteria for acetone, although the effluent concentration was less than threshold concentrations (8300-14250 mg/L) found to cause immobilization in several aquatic invertebrates and fishes by the Water Quality Board of California (Mckee & Wolf, 1963).

The effluent concentration of heptachlor (0.03 μg/L) exceeded the EPA chronic criteria for receiving waters of 0.0038 μg/L (EPA, 1986). Identifying the source as past use or present use of the material and taking any appropriate action is suggested.

Several metals exceeded chronic or acute EPA water quality criteria in the effluent (Table 5: EPA, 1986). The effluent copper concentration exceeded acute toxicity criteria by roughly ten times. Also, lead, cadmium, mercury, and silver effluent concentrations exceeded the EPA chronic water quality criteria. The SIP water supply sample had low metals concentrations indicating the metals observed in the influent and effluent came from SIP tenant wastewaters (Table 6). A study currently underway by the Ecology Watershed Assessments Section appraising the biological impact of metals in the Spokane River system may help define the significance of metals concentrations in the SIP discharge.

Changes in metals concentrations across the plant ranged from moderate increases to moderate decreases (Table 6). Association of metals with the MLSS and subsequent loss of MLSS in the effluent is likely responsible for this observation. Collecting a sample of the sludge (perhaps settling and spinning down a MLSS sample) for metals analysis is suggested to determine metals concentrations in the oxidation ditch solids.

Table 5 – VOA, Pesticides/PCB, and Metals Detected – Spokane Industrial Park, 1992

Parameter Location:	Tr Blk	Inf-1	Inf-2	Inf-E	Inf-S	Ef-1	Ef-2	Ef-E	Ef-S	Intake	CoLtg-1	CoLtg-2	EPA Water Quality Criteria Summary Acute	EPA Water Quality Criteria Summary Chronic
Type:		grab	grab	E-comp	S-comp	grab	grab	E-comp	S-comp	grab	grab	grab	Acute	Chronic
Date:	5/18	5/19	5/19	5/19-20	5/19-20	5/19	5/19	5/19-20	5/19-20	5/19	5/19	5/19	Fresh	Fresh
Time:	1540	0925	1510	@	@	0955	1525	@	@	1620	1355	1405		
Lab Log#:	218230	218231	218232	218233	218234	218235	218236	218237	218238	218243	218246	218247		
VOA Compounds														
(UNITS:)		(µg/L)	(µg/L)			(µg/L)	(µg/L)				(µg/L)	(µg/L)	(µg/L)	(µg/L)
Acetone		2500 D	540 D			27	42				27	48		
4-Methyl-2-Pentanone (MIBK)		10 U	10 U			10 U	10 U				10 U	7 J		
Toluene		10 U	10 U			10 U	10 U				1 J	10 U	17,500 *	
Ethylbenzene		10 U	10 U			10 U	10 U				7 J	8 J	32,000 *	
Total Xylenes		10 U	10 U			10 U	10 U				42	50		
BNA Compounds														
(UNITS:)				(µg/L)				(µg/L)						
Bis(2-Ethylhexyl)Phthalate				2 J				2 J					940 *(i)	3 *(i)
Pesticides/PCBs Compounds														
(UNITS:)				(µg/L)				(µg/L)						
Heptachlor				0.018 JP				0.03 JP					0.52 (r)	0.0038 (r)
Metals (Total) Hardness = 170														
(UNITS:)	(µg/L)			(µg/L)	(µg/L)			(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)		
Antimony	30 U			30 U	30 U			30 U	30 U	30 U	30 U	35 P	9,000 *	1,600 *
Arsenic	1.5 U			2.8 P	2.9 P			3.1 P	3.6 P	4.2 P	3.7 P	15.4		
Pentavalent													850 *	48 *
Trivalent													360	190
Cadmium	0.1 U			2.5 P	2.12			2.87	2.64	0.12 P	0.1 U	0.6	7.1 +	1.7 +
Copper	3.0 U			564	505			332	356	3 U	3.5 P	48.7	29 +	19 +
Lead	1.0 U			10.5	30.6			40.1	41.3	1 U	1 U	55.4	160 +	6.3 +
Mercury	0.13 PN			0.973 N	0.671 N			0.552 N	0.651 N	0.1 UN	0.24 PN	0.45 PN	2.4	0.012
Nickel	10 U			399	366			170 B	187 B	10 U	10 U	24 PB	2,222 +	247 +
Silver	0.5 UN			1.2 N	0.5 UN			1.9 N	2.2 N	0.5 UN	0.5 UN	0.5 UN	10.1 +	0.12
Zinc	4.0 U			56.5	85.7			72.4	72.8	17 P	8.6 P	63.8	183 +	166 +

B Analyte was found in the analytic method blank, indicating the sample may have been contaminated.
J The analyte was positively identified, but the associated result is an estimate.
N For metals analytes the spike sample recovery is not within control limits.
P Analyte was detected above the instrument detection limits, but below the minimum qualification limits.
U The analyte was not detected above the reported result.
D Analysis of sample used a dilution.

E Ecology Sample.
S Spokane STP sample.
@ Composite sampling time: 0800-0800.
comp Composite sample.
grab Grab sample.
gr-comp Grab-composite sample.

Tr Blk Transfer blank
Inf Influent
Ef Effluent
Intake SIP water supply
MLSS Oxidation Ditch Solids
CoLtg Columbia Lighting disc

* Insufficient data to develop criteria. Value presented is the LOEL – Lowest Observed Effect Level.
** pH dependent criteria (7.8 pH used).
+ Hardness dependent criteria (170 mg/L used).
i Total Phthalate Esters
r Heptachlor

Table 6 – Increase and Removal of BNAs, Pesticides/PCB, and Metals – Spokane Industrial Park, 1992

Parameter	Location:	Inf-E	Inf-S	Ef-E	Ef-S	Percent Removel Across STP		Intake
	Type:	E-comp	S-comp	E-comp	S-comp			grab
	Date:	5/19-20	5/19-20	5/19-20	5/19-20	Ecology	Spokane	5/19
	Time:	@	@	@	@	Sample	Sample	1620
	Lab Log#:	218233	218234	218237	218238	%	%	218243
BNA Compounds								
(UNITS:)		(µg/L)		(µg/L)				
Bis(2-Ethylhexyl)Phthalate		2 J		2 J		0.0	N.A.	
Pesticides/PCBs Compounds								
(UNITS:)		(µg/L)		(µg/L)				
Heptachlor		0.018 JP		0.03 JP		-66.7	N.A.	
Metals (Total)								
(UNITS:)		(µg/L)	(µg/L)	(µg/L)	(µg/L)			(µg/L)
Antimony		30 U	30 U	30 U	30 U	0.0	0.0	30 U
Arsenic		2.8 P	2.9 P	3.1 P	3.6 P	-10.7	-24.1	4.2 P
Cadmium		2.5 P	2.12	2.87	2.64	-14.8	-24.5	0.12 P
Copper		564	505	332	356	41.1	29.5	3 U
Lead		10.5	30.6	40.1	41.3	-281.9	-35.0	1 U
Mercury		0.973 N	0.671 N	0.552 N	0.651 N	43.3	3.0	0.1 UN
Nickel		399	366	170 B	187 B	57.4	48.9	10 U
Silver		1.2 N	0.5 UN	1.9 N	2.2 N	-58.3	-340.0	0.5 UN
Zinc		56.5	85.7	72.4	72.8	-28.1	15.1	17 P

B Analyte was found in the analytic method blank, indicating the sample may have been contaminated.
N For metals analytes the spike sample recovery is not within control limits.
P Analyte was detected above the instrument detection limits, but below the minimum qualification limits.
U The analyte was not detected above the reported result.

Inf Influent
Ef Effluent
Intake SIP water supply
E Ecology sample
S Spokane sample
@ Composite collection time: 08:00-08:00
N.A. Not available

comp Composite sample.
grab Grab sample.

Complete organics and metals scan results are tabulated in (Appendix F). Also, several tentatively identified compounds (TICs - non target compounds detected with the scan) were found at concentrations less than 100 μg/L. TICs are summarized in Appendix G.

Bioassays

The rainbow trout and *Daphnia magna* acute toxicity tests found no toxicity in the SIP effluent (Table 7). The *Ceriodaphnia dubia* survival and reproduction test indicated no acute or chronic toxicity.

The fathead minnow chronic toxicity test data show little correlation between effects and concentration. Laboratory notes were double-checked, but a source of error could not be identified. The data are presented but are inconclusive.

Lack of toxicity in the effluent was somewhat surprising given the high concentration of copper in the effluent (332-356 μg/L). At SIP effluent hardness concentrations, the expected LC_{50} for rainbow trout and *Daphnia magna* would be 10% and 33-50% of the effluent concentration, respectively (EPA, 1980).

It is possible that the copper is adsorbed or bound reducing its biological availability. Another possibility is $CaCO_3$ (alkalinity) reacting with free Cu^{2+} to form $Cu(CO_3)_2^{2+}$, $CuHCO_3^{+}$, and $CuCO_3^{0}$ (EPA, 1987). These three species are soluble, generally not toxic, and are formed at the observed pH and alkalinity concentrations (Miller & Mackay, 1979).

A prior investigation of high copper concentrations in SIP wastewater considered a copper dye used in printing ink (Leber, 1984). A representative of Leber Ink, the dye manufacturer, pointed out the copper is tightly bound within the copper phthalocyanine molecule and not available to cause toxic effects. The company using the ink is no longer listed as a tenant of Spokane Industrial Park. Other firms in the facility might be using this particular printing ink, but during the inspection none were identified.

The source of copper remains unknown. Determining the source(s) could help explain the unusual bioassay results and help SIP meet final NPDES permit limits.

Visits To Industries

Two industries in the SIP were visited during the inspection. They were the Boise Cascade Corporation Packaging Plant and Columbia Lighting, Inc.

Interest in the Boise Cascade facility was due to frequent color change occurring in the SIP STP influent and the past history of dyes in the SIP (see discussion in priority pollutant section). The Boise Cascade facility labels packaging boxes (primarily corrugated cardboard). Ink used for

Table 7 – Effluent Bioassay Results – Spokane Industrial Park, 1992.

NOTE: all tests were run on the effluent (Ef–GC sample) – lab log # 218239.

Ceriodaphnia dubia - 7-day Partial Life Cycle Test
(Ceriodaphnia dubia)

Sample	# Tested *	Percent Survival	Total Reproduction	Mean Number Young/Female
Control	10	90	226	21
6.25% Effluent	10	90	284	23
12.5% Effluent	10	90	225	24
25% Effluent	10	90	241	23
50% Effluent	10	100	226	28
100 % Effluent	10	90	210	23

Acute
LC50 = >100 % effluent
LOEC = 100 % effluent
NOEC = 100 % effluent

Chronic
LOEC = >100 % effluent
NOEC = >100 % effluent

* 10 replicates of 1 organism

Daphnia magna - Acute Toxicity Test (48 hour LC50)
(Daphnia magna)

Sample	# Tested	Percent Survival
Control	10	100
6.25 % Effluent	10	100
12.5 % Effluent	10	100
25 % Effluent	10	100
50 % Effluent	10	100
100 % Effluent	10	100

LC50 > 100 % effluent
NOEC > 100 % effluent
LOEC > 100 % effluent

Fathead Minnow - 7-day Larval Fish Survival and Growth Test
(Pimephales promelas)

Sample	# Tested *	Percent Survival	Average Growth per Fish (mg)
Control	40	81	0.53
6.25 % Effluent	40	18	0.93
12.5 % Effluent	40	50	0.79
25 % Effluent	40	30	1.30
50 % Effluent	40	40	0.99
100 % Effluent	40	75	0.46

Acute
LOEC: N.A.**
LC50: N.A.**

Chronic
NOEC: N.A.**
LOEC: N.A.**

* four replicates of 10 organisms
** Not Available due to negative dose response relationship of organisms.

Rainbow Trout - 96 hour Acute Toxicity Test
(Oncorhynchus mykiss)

Sample	# Tested	Percent Survival
Control	30	100
100% Effluent	30	97

NOEC – no observable effects concentration
LOEC – lowest observable effects concentration
LC50 – lethal concentration for 50% of the organisms
EC50 – effect concentration for 50% of the organisms

labelling was distributed by a roller with micro-pores to minimize ink used and wasted. Clean-up was with water by an automated roller clean-up unit. The amount of water used was approximated at less than ten gallons per clean-up by the Boise Cascade representative. Based on the small amount of water used and the type of ink being used, no samples were collected.

Two grab samples were collected at Columbia Lighting, Inc. One sample (CoLtg-1) was collected from the plant discharge. The second sample (CoLtg-2) was collected from the washer-wastewater neutralization tank. Contents of the tank are occasionally bled into the plant discharge, but this was not being done when samples were collected.

General chemistry parameters for the plant discharge (CoLtg-1 - Table 2) were present in fairly low concentrations, although the total-P concentration was moderately elevated (8.6 mg/L). Metals concentrations approximated the concentrations found in the SIP water supply (Table 5). Acetone (27 μg/L) and total xylenes (42 μg/L) were detected. A system of flow measurement was being investigated for installation. Accurate flows would help determine if the total-P amount is significant.

The neutralization tank (CoLtg-2 - Table 2) sample had higher COD, TSS, and total-P concentrations than the plant discharge. Acetone and total xylenes concentrations were similar to the plant discharge (Table 5). Metals concentrations were all less than either the SIP STP effluent concentration or water quality criteria. The volume of the neutralization tank is fairly small (4800 gallons) with an average daily discharge of 860 gallons per day.

Split Samples

Ecology laboratory results of the Ecology and SIP samples were similar (Table 8). The Ecology influent sample BOD_5 and TSS were slightly weaker than the SIP sample. SIP sampling appeared appropriate.

SIP analyzes pH and total chlorine residual at the small laboratory at the STP. A split sample found good agreement between Ecology and SIP total chlorine residual results and poor agreement for pH results. The SIP pH meter allowed only single point calibration and was difficult to operate. Replacement of the pH meter is recommended.

Since the inspection, the Ecology Laboratory Accreditation program issued the SIP STP provisional accreditation for pH and chlorine residual analysis. SIP agreed to replace their pH meter and to provide additional total chlorine residual test training for the operator to attain accreditation.

The balance of the SIP analyses are sent out to a contract laboratory. Ecology and SIP results for COD, total-P, fecal coliform, copper, and zinc compared well. Nickel, NH_3-N, effluent TSS, and effluent BOD_5 results showed some differences, but were in the same range. The influent TSS and influent BOD_5 results were far enough apart to be of concern. Attention should

Table 8 - Split Sample Results Comparison - Spokane Industrial Park, 1992

Parameter	Location:	Inf-E	Inf-S	Ef-2	Ef-3	Ef-E	Ef-S
	Type:	E-comp	S-comp	grab	grab	E-comp	S-comp
	Date:	5/19-20	5/19-20	5/19	5/20	5/19-20	5/19-20
	Time:	@	@	1525	0950	@	@
	Lab Log #:	218233	218234	218236	218255	218237	218238
	Laboratory*						
TSS (mg/L)	Ecology	68	100			17	16
	Spokane	27.9	74.7			14.4	18.5
BOD5 (mg/L)	Ecology	36	47			8	7
	Spokane	53.8	85.5			13.6	12.3
COD (mg/L)	Ecology	110	130			42	42
	Spokane	89.2	118.7			39.3	39.3
NH3-N (mg/L)	Ecology	6.62	7.31			0.169	0.102
	Spokane	4.55	6.3			0.38	0.03
Total-P (mg/L)	Ecology	1.98	2.87			1.76	1.76
	Spokane	2.11	2.73			1.95	1.91
F-Coliform MF (#/100mL)	Ecology				27		
	Spokane				50		
PP Metals (water)							
Copper (μg/L)	Ecology	564	505			332	356
	Spokane	543	572			383	409
Lead (μg/L)	Ecology	10.5	30.6			40.1	41.3
	Spokane	30	30			56	55
Nickel (μg/L)	Ecology	399	366			170 B	187 B
	Spokane	246	263			125	147
Zinc (μg/L)	Ecology	56.5	85.7			72.4	72.8
	Spokane	40	76			85	81
pH	Ecology			7.51			
	Spokane			6.8			
Total Chlorine Residual (mg/L)	Ecology			0.2			
	Spokane			0.19			

Inf Influent
Ef Effluent
grab Single grab.
comp Composite sample
Ecology Ecology analysis.
Spokane Spokane analysis.
@ Sample period: 08:00-08:00.

B Analyte was also found in the analytic method blank indicating the sample may have been contaminated.
* SIP analyzed pH and total chlorine residual at the STP lab. Other SIP analyses were contracted to Inland Environmental Laboratoies.

be paid to the contract laboratory's accreditation program performance evaluation results for BOD_5, TSS, NH_3-N and nickel to help determine if there is a problem. Additional sample splits for these parameters should be considered as possible.

CONCLUSIONS AND RECOMMENDATIONS

Flow Measurement

The STP in-plant flow meter was accurate in comparison to Ecology instantaneous flow measurements.

NPDES Permit Comparison

Based on inspection results, SIP effluent quality generally met weekly and monthly permit limits. Metals concentrations were less than interim limits, but copper, lead, and zinc concentrations exceeded final permit limits. The TSS concentration and one fecal coliform result were slightly greater than the monthly average permit limits.

- Dechlorination will likely be necessary to meet both fecal coliform and chlorine residual monthly average limits.

General Chemistry/Plant Operation

During the inspection the plant influent was very weak in comparison to domestic sewage for several parameters. All concentrations of oxygen-demanding substances were low. The plant appeared to be actively nitrifying.

- Low influent BOD_5 concentrations due to test inhibition by toxicants appears unlikely; and in fact the waste has a low BOD_5.

Comparison of typical loading and operational parameters with SIP data suggests the plant is organically underloaded. The low plant loading has allowed permit compliance with minimal plant operation.

- Compliance with the new permit metals limits will likely require more operator effort for process control and/or an active pretreatment program.

- Locating or compiling an "Operation and Maintenance Manual" is recommended to provide guidance to the plant operator.

Percent removals for most parameters were fairly low. Reduced water usage and/or reduced cooling water discharges in the SIP may increase the wastewater strength and result in higher percent removals. Reducing wastewater flows is likely to increase removal efficiency, however, effluent concentrations of most pollutants will probably change little. Note that flow reduction could increase influent concentrations of potential toxicants. To prevent adverse impacts from this potential increase, the sources of toxics should be identified and reduced (see below).

Priority Pollutant Scans

Three target organic compounds were detected in the influent or effluent. The effluent concentration of heptachlor, which exceeded chronic criteria by about eight times, was the only organic compound exceeding EPA water quality criteria (EPA, 1986).

- Identifying the heptachlor source as past use or present use and taking appropriate action is recommended.

The effluent copper concentration exceeded EPA acute toxicity criteria by roughly ten times (EPA, 1986). Also, lead, cadmium, mercury, and silver effluent concentrations exceeded the EPA chronic water quality criteria.

- Collecting a sample of the sludge (perhaps settling and spinning down a MLSS sample) for metals analysis is suggested to determine metals concentrations in the oxidation ditch solids.

Bioassays

The rainbow trout and *Daphnia magna* acute toxicity tests found no toxicity in the SIP effluent. The *Ceriodaphnia dubia* survival and reproduction test indicated no acute or chronic toxicity. The fathead minnow test data show little correlation between effects and concentration and are likely of little value. Lack of toxicity in the effluent was somewhat surprising given the high concentration of copper in the effluent.

- Determining the source(s) of copper could help explain the unusual bioassay results and help SIP meet final NPDES permit limits.

- A study currently underway by the Ecology Watershed Assessment Section appraising the biological impact of metals in the Spokane River system may help define the significance of metals concentrations in the SIP discharge.

Visits To Industries

The Boise Cascade discharge appeared capable of causing only minimal impacts at the SIP STP, so no samples were collected.

The significance of analytes detected in samples of the Columbia Lighting, Inc. discharge is unclear without corresponding flow data.

- A flow meter should be installed by Columbia Lighting to measure discharge to the SIP sewer system.

Split Samples

SIP sampling appeared acceptable.

SIP pH results showed poor agreement with Ecology results.

- Replacement of the pH meter is recommended.

SIP contract laboratory results were similar to Ecology results for most parameters.

- Attention should be paid to the contract laboratory's accreditation program performance evaluation results for BOD_5, TSS, NH_3-N and nickel. Additional sample splits for the parameters noted above should be considered as possible.

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APPENDICES

Appendix A - Sampling Locations - Spokane Industrial Park, 1992

Inf-1 & Inf-2:
: Influent grab samples collected at the headworks just past the weir.

Inf-S & Ef-E:
: Spokane Industrial Park STP and Ecology composite influent sample collected at the headworks.

Ef-1 & Ef-2:
: Effluent grab samples collected at the discharge from the chlorine contact chamber.

Ef-3 & Ef-4:
: Effluent fecal coliform grab samples collected at the discharge from the chlorine contact chamber.

Ef-S & Ef-E:
: Spokane Industrial Park STP and Ecology composite effluent sample collected from the end of the channel in the chlorine contact chamber.

EF-GC:
: Effluent bioassay grab-composite samples collected at the discharge from the chlorine contact chamber.

MLSS-1 & MLSS-2:
: Grab samples from the mixed liquor in the aeration ditch.

Intake:
: Grab samples taken from the well supplying water to the Spokane Industrial Park.

CoLgt-1 :
: Grab samples taken from the wastewater discharge channel at Columbia Lighting, Inc.

CoLgt-2
: Grab sample taken from the Columbia Lighting, Inc. "Ecology Tank" (washer - wastewater neutralization tank).

Appendix B – Sampling Schedule – Spokane Industrial Park, 1992

Parameter	Location:	Tr Blk	Inf–1	Inf–2	Inf–E	Inf–S	Ef–1	Ef–2	Ef–3	Ef–4	Ef–E	Ef–S	Ef–GC
	Type:		grab	grab	E–comp	S–comp	grab	grab	grab	grab	E–comp	S–comp	gr–comp
	Date:	5/18	5/19	5/19	5/19–20	5/19–20	5/19	5/19	5/20	5/20	5/19–20	5/19–20	5/19
	Time:	1540	0925	1510	@	@	0955	1525	0950	1050	@	@	1550
	Lab Log #:	218230	218231	218232	218233	218234	218235	218236	218255	218256	218237	218238	218239
GENERAL CHEMISTRY													
Conductivity			E	E	E	E	E	E			E	E	E
Alkalinity					E	E					E	E	E
Hardness					E	E					E	E	E
Chloride													
Sulfate													
SOLIDS 4													
TS					E						E		
TNVS					E						E		
TSS			E	E	ES	ES	E	E			ES	ES	
TNVSS					E						E		
TDS													
OXYGEN DEMAND PARAMETERS													
BOD5					ES	ES					ES	ES	
COD			E	E	ES	ES	E	E			ES	ES	
TOC (water)			E	E	E	E	E	E			E	E	
NUTRIENTS													
Total Persulfate N					E	E					E	E	
NH3–N					E	E	EE	E			ES	ES	
NO2+NO3–N					E	E	E	E			E	E	
Total–P					ES	ES	E	E			ES	ES	
MISCELLANEOUS													
Oil and Grease (water)			E	E			ES	E					
F–Coliform MF									ES	ES			
Cyanide (total)					E	E					E	E	
Cyanide (wk & dis)					E	E					E	E	
ORGANICS													
VOC (water)			E	E			ES	E					
BNAs (water)					E						E		
Pest/PCB (water)					E						E		
METALS													
PP Metals (water)		E			E	E					ES	ES	
Metals 6 + Hg (tot rec)													
Metals 6 + Hg (dis)													
BIOASSAYS													
Salmonid (acute 100%)													E
Daphnia magna (acute)													E
Ceriodaphnia (chronic)													E
Fathead Minnow (chronic)													E
FIELD OBSERVATIONS													
Temperature			E	E			E	E					
Temp–cooled*+					E	E					E	E	
pH			E	E	E	E	ES	ES			E	E	
Conductivity			E	E	E	E	E	E			E	E	
Chlorine							ES	ES	ES	ES			

@	Collection Period: 0800–0800.	Tr Blk	Transfer blank
S–comp	Spokane Industrial Park composite sample	Inf	Influent
E–comp	Ecology composite sample	Ef	Effluent
S	SIP lab analysis	grab	Grab sample
E	Ecology lab analysis		

Appendix B – Sampling Schedule – Spokane Industrial Park, 1992

Parameter II										
	Locatn:	MLSS–1	MLSS–2	Intake	CoLtg–1	CoLtg–2	River–1	River–2	River–3	River–4
	Type:	grab	grab	grab	grab	grab	grab	grab	grab	grab
	Date:	5/19	5/19	5/19	5/19	5/19	5/20	5/20	5/20	5/20
	Time:	1050	1520	1620	1355	1405	1255	1400	1500	1500
	Lab Log #:	218240	218241	218243	218246	218247	218248	218249	218250	218251
GENERAL CHEMISTRY										
Conductivity				E	E	E	E	E	E	E
Alkalinity				E			E	E	E	E
Hardness				E			E	E	E	E
Chloride							E	E	E	E
Sulfate							E	E	E	E
SOLIDS 4										
TS										
TNVS										
TSS		E	E		E	E	E	E	E	E
TNVSS		E	E							
TDS							E	E	E	E
OXYGEN DEMAND PARAMETERS										
BOD5										
COD					E	E				
TOC (water)					E	E	E	E	E	E
NUTRIENTS										
Total Persulfate N										
NH3–N					E	E				
NO2+NO3–N					E	E	E	E	E	E
Total–P					E	E	E	E	E	E
MISCELLANEOUS										
Oil and Grease (water)										
F–Coliform MF										
Cyanide (total)										
Cyanide (wk & dis)										
ORGANICS										
VOC (water)					E	E				
BNAs (water)										
Pest/PCB (water)										
METALS										
PP Metals (water)				E	E	E				
Metals 6 + Hg (tot rec)							E	E	E	E
Metals 6 + Hg (dis)							E	E	E	E
BIOASSAYS										
Salmonid (acute 100%)										
Daphnia magna (acute)										
Ceriodaphnia (chronic)										
Fathead Minnow (chronic)										
FIELD OBSERVATIONS										
Temperature		E	E	E	E	E				
Temp–cooled*+										
pH		E	E	E	E	E				
Conductivity		E	E	E	E	E				
Chlorine					E	E				

#	Composite Collection Period: 0800–0800.	Intake	SIP water supply
S–comp	Spokane Industrial Park composite sample	MLSS	Oxidation Ditch Solids
E–comp	Ecology composite sample	River	Spokane River Ambient Sample
S	SIP lab analysis	CoLtg	Columbia Lighting discharge
E	Ecology lab analysis	grab	Grab sample

APPENDIX C – ECOLOGY ANALYTICAL METHODS – Spokane Industrial Park, 1992

PARAMETER	MANCHESTER_METHODS	LAB USED
<u>GENERAL CHEMISTRY</u>		
Conductivity	EPA, Revised 1983: 120.1	ECOLOGY
Alkalinity	EPA, Revised 1983: 310.1	ECOLOGY
Hardness	EPA, Revised 1983: 130.2	ECOLOGY
Chloride	EPA, Revised 1983: 330.0	ECOLOGY
<u>SOLIDS 4</u>		
TS	EPA, Revised 1983: 160.3	ECOLOGY
TNVS	EPA, Revised 1983: 106.3	ECOLOGY
TSS	EPA, Revised 1983: 160.2	ECOLOGY
TNVSS	EPA, Revised 1983: 106.2	ECOLOGY
<u>OXYGEN DEMAND PARAMETERS</u>		
BOD5	EPA, Revised 1983: 405.1	ECOLOGY
COD	EPA, Revised 1983: 410.1	SOUND ANALYTICAL SERVICES, INC.
TOC (water)	EPA, Revised 1983: 415.1	ECOLOGY
<u>NUTRIENTS</u>		
Total Persulfate N	EPA, Revised 1983: 351.3	ECOLOGY
NH3–N	EPA, Revised 1983: 350.1	ECOLOGY
NO2+NO3–N	EPA, Revised 1983: 353.2	ECOLOGY
Total–P	EPA, Revised 1983: 365.3	ECOLOGY
<u>MISCELLANEOUS</u>		
Oil and Grease (water)	EPA, Revised 1983: 413.1	ECOLOGY
F–Coliform MF	APHA, 1989: 9222D.	ECOLOGY
Cyanide (total)	EPA, Revised 1983: 335.2	ECOLOGY
Cyanide (wk & dis)	APHA, 1989: 4500–CNI.	ECOLOGY
<u>ORGANICS</u>		
VOC (water)	EPA, 1986: 8260	WEYERHAEUSER
BNAs (water)	EPA, 1986: 8270	WEYERHAEUSER
Pest/PCB (water)	EPA, 1986: 8080	WEYERHAEUSER
<u>METALS</u>		
PP Metals (water)	EPA, Revised 1983: 200–299	ECOLOGY
Metals 6 + Hg (tot rec)		ECOLOGY
Metals 6 + Hg (dis)		ECOLOGY
<u>BIOASSAYS</u>		
Salmonid (acute 100%)	Ecology, 1981.	EVS CONSULTANTS
Daphnia magna (acute)	EPA 1985	EVS CONSULTANTS
Ceriodaphnia (chronic)	EPA 1989: 1002.0	EVS CONSULTANTS
Fathead Minnow (chronic)	EPA 1989: 1000.0	EVS CONSULTANTS

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APPENDIX D - Cleaning Procedures Prior to Sampling for Priority Pollutants - Spokane Industrial Park, 1992.

1. Wash with laboratory detergent
2. Rinse several times with tap water
3. Rinse with 10% HNO_3 solution
4. Rinse three (3) times with distilled/deionized water
5. Rinse with high purity methylene chloride
6. Rinse with high purity acetone
7. Allow to dry and seal with aluminum foil

Appendix E - F/M Calculations - Spokane Industrial Park, 1992

I. Calculation of Food-to-Microorganism Ratio (F/M Ratio)

A. Equation:

1. $F/M = S_o/\theta X$
2. Where:
   - a. F/M ≡ Food-to-Microorganism Ratio: day^{-1}
   - b. S_o ≡ Influent BOD_5 or COD: mg/L or lb/day
   - c. θ ≡ Hydraulic detention time ($\theta = V/Q$): day
   - d. V ≡ Aeration tank volume: Mgal
   - e. Q ≡ Influent and effluent flow rate: MGD
   - f. X ≡ Concentration of volatile suspended solids in the aeration ditch (X = TSS - TNVSS): Averages in mg/L or lb/day
   - g. X_e ≡ Concentration of volatile suspended solids in the effluent stream (X_e = TSS-TNVSS): Averages in mg/L or lb/day
   - h. θ_c ≡ Mean Cell-Residence Time in days

Note: The ditch was measured by Ecology using measuring tape to determine volumes.

B. Cross Section of Aeration Ditch:

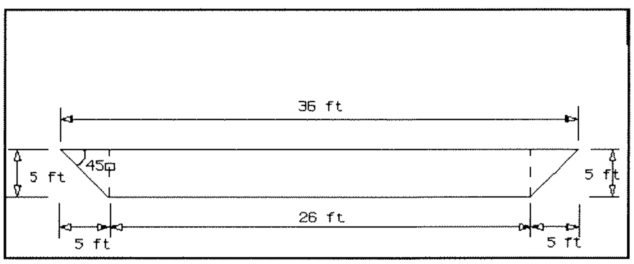

Figure 1

a. $A_c = 5'(26') + 2((5')(5')/2)$

b. $A_c = 155\ ft^2$

C. Volume of Aeration ditch:

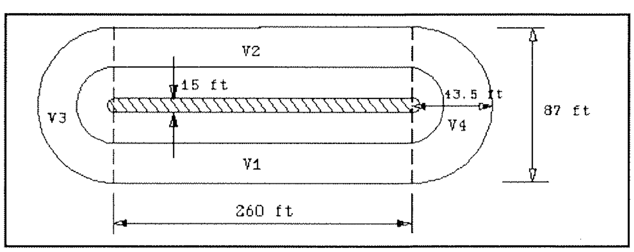

Figure 2

Appendix E - F/M Calculations (cont.) - Spokane Industrial Park, 1992

1. Inner sections:

a. $V_1 = V_2 \cong$ Length*Cross section = (260ft)*(155ft^2) = 40,300ft^2
b. $V_1 + V_2$ = 80,600 ft^3

2. End sections:

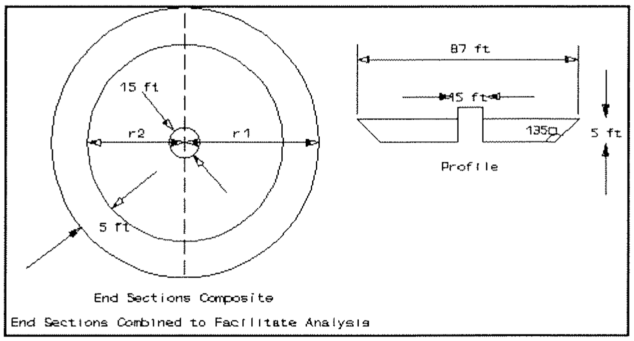

Figure 3

$r_1 = 87'/2 = 43.5'$
$r_2 = (87'/2 - 5') = 38.5'$
Area of Inner Island = $\pi(15/2)^2$ = 176.7 ft^2

a. $V_3 + V_4 \cong [5'*(\pi*(r_2)^2)-176.7ft^2)] + [5'*[\pi*((r_1)^2 - (r_2)^2)/2]]$
b. $V_3 + V_4$ = 25,619.8 ft^3

3. Total $V = V_1 + V_2 + V_3 + V_4$ = 106,219.8 ft^3

4. Total V in gal = 794,577 gal

D. Influent flow rate and hydraulic detention time:
1. Average flow:Q = 0.602 MGD
2. θ = V/Q = 794,577 gal/602,000 gal/day = 1.32 day

E. Concentration of volatile suspended solids:

X = TSS - TNVS = 320 mg/L - 140 mg/L = 180 mg/L

F. Concentration of Influent BOD_5

Average BOD_5 = (36 mg/L + 47 mg/L)/2 = 41.5 mg/L

G. F/M ratio

$F/M = S_o/\theta X$ = 41.5 mg/L /(180 mg/L*1.32day) = 0.18 day^{-1}

Appendix E - F/M Calculations (cont.) - Spokane Industrial Park, 1992

H. Mean Cell-Residence Time (Sludge Age)

1. θ_c = V*X/Q*X_e
2. V*X = 0.795Mgal * [180mg/L * (8.34 lbs/gal/mg/L)] = 1193 lbs
3. Q*X_e = [((17-8)+(16-7))/2]*(mg/L)*(8.34lbs/gal/mg/L)*0.602MGD = 45 lbs/day
4. θ_c = 1193 lbs/45lbs/day = 26.5 days

I. Volumetric Loading

1. Loading = lbs BOD_5/Volume($10^3 ft^3$)*day
2. Loading = [41.5mg/L * (8.34 Lbs/gal/mg/L) * 0.602 MGD] / [106,219 ft^3 /(1000/10^3)] = 1.96 lbBOD_5/($10^3 ft^3$)*day

Appendix F – VOA, BNA, Pesticide/PCB and Metals Scan Results – Spokane Industrial Park – 1992.

Parameter		Inf-1		Inf-2		Ef-1		Ef-2		CoLtg-1		CoLtg-2	
	Location:	Inf-1		Inf-2		Ef-1		Ef-2		CoLtg-1		CoLtg-2	
	Type:	grab		grab		grab		grab		grab		grab	
	Date:	5/19		5/19		5/19		5/19		5/19		5/19	
	Time:	0925		1510		0955		1525		1355		1405	
	Lab Log#:	218231		218232		218235		218236		218246		218247	
VOA Compounds													
(UNITS:)		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Chloromethane		10	U	10	U	10	U	10	U	10	U	10	U
Bromomethane		10	U	10	U	10	U	10	U	10	U	10	U
Vinyl Chloride		10	U	10	U	10	U	10	U	10	U	10	U
Chloroethane		10	U	10	U	10	U	10	U	10	U	10	U
Methylene Chloride		10	U	10	U	10	U	10	U	10	U	10	U
Acetone		2500	D	540	D	27		42		27		48	
Carbon Disulfide		10	U	10	U	10	U	10	U	10	U	10	U
1,1-Dichloroethene		10	U	10	U	10	U	10	U	10	U	10	U
1,1-Dichloroethane		10	U	10	U	10	U	10	U	10	U	10	U
1,2-Dichloroethene (total)		10	U	10	U	10	U	10	U	10	U	10	U
Chloroform		10	U	10	U	10	U	10	U	10	U	10	U
1,2-Dichloroethane		10	U	10	U	10	U	10	U	10	U	10	U
2-Butanone (MEK)		10	U	10	U	10	U	10	U	10	U	10	U
1,1,1-Trichloroethane		10	U	10	U	10	U	10	U	10	U	10	U
Carbon Tetrachloride		10	U	10	U	10	U	10	U	10	U	10	U
Bromodichloromethane		10	U	10	U	10	U	10	U	10	U	10	U
1,2-Dichloropropane		10	U	10	U	10	U	10	U	10	U	10	U
cis-1,3-Dichloropropene		10	U	10	U	10	U	10	U	10	U	10	U
Trichloroethene		10	U	10	U	10	U	10	U	10	U	10	U
Dibromochloromethane		10	U	10	U	10	U	10	U	10	U	10	U
1,1,2-Trichloroethane		10	U	10	U	10	U	10	U	10	U	10	U
Benzene		10	U	10	U	10	U	10	U	10	U	10	U
trans-1,3-Dichloropropene		10	U	10	U	10	U	10	U	10	U	10	U
Bromoform		10	U	10	U	10	U	10	U	10	U	10	U
4-Methyl-2-Pentanone (MIBK)		10	U	10	U	10	U	10	U	10	U	7	J
2-Hexanone		10	U	10	U	10	U	10	U	10	U	10	U
Tetrachloroethene		3	J	10	U	10	U	10	U	10	U	10	U
1,1,2,2-Tetrachloroethane		10	U	10	U	10	U	10	U	10	U	10	U
Toluene		10	U	10	U	10	U	10	U	1	J	10	U
Chlorobenzene		10	U	10	U	10	U	10	U	10	U	10	U
Ethylbenzene		10	U	10	U	10	U	10	U	7	J	8	J
Styrene		10	U	10	U	10	U	10	U	10	U	10	U
Total Xylenes		3	J	5	J	10	U	10	U	42		50	

D Analysis of sample used a dilution.
J The analyte was positively identified. The associated numerical result is an estimate.
U The analyte was not detected above the reported result.

Parameter	Location:	Inf–E	Ef–E
	Type:	E–comp	E–comp
	Date:	5/19–20	5/19–20
	Time:	@	@
	Lab Log#:	218233	218237
BNA Compounds			
(UNITS:)		μg/L	μg/L
Phenol		10 U	10 U
Bis(2–Chloroethyl)Ether		10 U	10 U
2–Chlorophenol		10 U	10 U
1,3–Dichlorobenzene		10 U	10 U
1,4–Dichlorobenzene		10 U	10 U
1,2–Dichlorobenzene		10 U	10 U
2–Methylphenol		10 U	10 U
Bis(2–Chloroisopropyl)Ether		10 U	10 U
4–Methylphenol		10 U	10 U
N–Nitroso–di–n–Propylamine		10 U	10 U
Hexachloroethane		10 U	10 U
Nitrobenzene		10 U	10 U
Isophorone		10 U	10 U
2–Nitrophenol		10 U	10 U
2,4–Dimethylphenol		10 U	10 U
Bis(2–Chloroethoxy)Methane		10 U	10 U
2,4–Dichlorophenol		10 U	10 U
1,2,4–Trichlorobenzene		10 U	10 U
Naphthalene		10 U	10 U
4–Chloroaniline		10 U	10 U
Hexachlorobutadiene		10 U	10 U
4–Chloro–3–Methylphenol		10 U	10 U
2–Methylnaphthalene		10 U	10 U
Hexachlorocyclopentadiene		10 U	10 U
2,4,6–Trichlorophenol		10 U	10 U
2,4,5–Trichlorophenol		25 U	25 U
2–Chloronaphthalene		10 U	10 U
2–Nitroaniline		25 U	25 U
Dimethyl Phthalate		10 U	10 U
Acenaphthylene		10 U	10 U
2,6–Dinitrotoluene		10 U	10 U
3–Nitroaniline		25 U	25 U
Acenaphthene		10 U	10 U
2,4–Dinitrophenol		25 U	25 U
4–Nitrophenol		25 U	25 U
Dibenzofuran		10 U	10 U
2,4–Dinitrotoluene		10 U	10 U
Diethyl Phthalate		10 U	10 U
4–Chlorophenyl Phenylether		10 U	10 U
Fluorene		10 U	10 U
4–Nitroaniline		25 U	25 U
4,6–Dinitro–2–Methylphenol		25 U	25 U
N–Nitrosodiphenylamine		10 U	10 U
4–Bromophenyl Phenylether		10 U	10 U
Hexachlorobenzene		10 U	10 U
Pentachlorophenol		25 U	25 U
Phenanthrene		10 U	10 U

U The analyte was not detected above the reported result.

Appendix F (cont'd) – Spokane Industrial Park – 1992.

Parameter	Location:	Inf–E	Ef–E
	Type:	E–comp	E–comp
	Date:	5/19–20	5/19–20
	Time:	@	@
	Lab Log#:	218233	218237
BNA Compounds			
(UNITS:)		µg/L	µg/L
Anthracene		10 U	10 U
Di–n–Butyl Phthalate		10 U	10 U
Fluoranthene		10 U	10 U
Pyrene		10 U	10 U
Butylbenzyl Phthalate		10 U	10 U
3,3'–Dichlorobenzidine		10 U	10 U
Benzo(a)Anthracene		10 U	10 U
Chrysene		10 U	10 U
Bis(2–Ethylhexyl)Phthalate		2 J	2 J
Di–n–Octyl Phthalate		10 U	10 U
Benzo(b)Fluoranthene		10 U	10 U
Benzo(k)Fluoranthene		10 U	10 U
Benzo(a)Pyrene		10 U	10 U
Indeno(1,2,3–cd)Pyrene		10 U	10 U
Dibenzo(a,h)Anthracene		10 U	10 U
Benzo(g,h,i)Perylene		10 U	10 U
Carbazole		10 U	10 U
Pyridine		10 U	10 U

Parameter	Location:	Inf–E	Ef–E
	Type:	E–comp	E–comp
	Date:	5/19–20	5/19–20
	Time:	@	@
	Lab Log#:	218233	218237
Pesticides/PCBs Compounds			
(UNITS:)		µg/L	µg/L
alpha–BHC		0.05 U	0.05 U
beta–BHC		0.05 U	0.05 U
delta–BHC		0.05 U	0.05 U
gamma–BHC (Lindane)		0.05 U	0.05 U
Heptachlor		0.018 JP	0.03 JP
Aldrin		0.05 U	0.05 U
Heptachlor Epoxide		0.05 U	0.05 U
Endosulfan I		0.05 U	0.05 U
Dieldrin		0.1 U	0.1 U
4,4'–DDE		0.1 U	0.1 U
Endrin		0.1 U	0.1 U
Endosulfan II		0.1 U	0.1 U
4,4'–DDD		0.1 U	0.1 U
Endosulfan Sulfate		0.1 U	0.1 U
4,4'–DDT		0.1 U	0.1 U
Methoxychlor		0.5 U	0.5 U
Endrin Ketone		0.1 U	0.1 U
alpha–Chlordane		0.1 U	0.1 U
gamma–Chlordane		0.1 U	0.1 U
Toxaphene		5 U	5 U

J The analyte was positively identified. The associated numerical result is an estimate.
P Analyte was detected above the instrument detection limits, but below the minimum qualification limits.
U The analyte was not detected above the reported result.

Location:	Inf–E	Ef–E
Type:	E–comp	E–comp
Date:	5/19–20	5/19–20
Time:	@	@
Lab Log#:	218233	218237
Pesticides/PCBs Compounds		
(UNITS:)	µg/L	µg/L
Aroclor–1016	1 U	1 U
Aroclor–1221	2 U	2 U
Aroclor–1232	1 U	1 U
Aroclor–1242	1 U	1 U
Aroclor–1248	1 U	1 U
Aroclor–1254	1 U	1 U
Aroclor–1260	1 U	1 U
Endrin Aldehyde	0.1 U	0.1 U

Location:	Tr Blk	Inf–E	Inf–S	Ef–E	Ef–S	Intake	CoLtg–1	CoLtg–2
Type:		E–comp	S–comp	E–comp	S–comp	grab	grab	grab
Date:	5/18	5/19–20	5/19–20	5/19–20	5/19–20	5/19	5/19	5/19
Time:	1540	@	@	@	@	1620	1355	1405
Lab Log#:	218230	218233	218234	218237	218238	218243	218246	218247
Metals (Total) Hardness = 170								
(UNITS:)	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Antimony	30 U	30 U	30 U	30 U	30 U	30 U	30 U	35 P
Arsenic	1.5 U	2.8 P	2.9 P	3.1 P	3.6 P	4.2 P	3.7 P	15.4
Pentavalent								
Trivalent								
Beryllium	1.0 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	0.1 U	2.5 P	2.12	2.87	2.64	0.12 P	0.1 U	0.6
Chromium	5.0 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Hexavalent								
Trivalent								
Copper	3.0 U	564	505	332	356	3 U	3.5 P	48.7
Lead	1.0 U	10.5	30.6	40.1	41.3	1 U	1 U	55.4
Mercury	0.13 PN	0.973 N	0.671 N	0.552 N	0.651 N	0.1 UN	0.24 PN	0.45 PN
Nickel	10 U	399	366	170 B	187 B	10 U	10 U	24 PB
Selenium	2.0 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Silver	0.5 UN	1.2 N	0.5 UN	1.9 N	2.2 N	0.5 UN	0.5 UN	0.5 UN
Thallium	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Zinc	4.0 U	56.5	85.7	72.4	72.8	17 P	8.6 P	63.8

B Analyte was found in the analytic method blank, indicating the sample may have been contaminated.
J The analyte was positively identified, but the associated result is an estimate.
N For metals analytes the spike sample recovery is not within control limits.
P Analyte was detected above the instrument detection limits, but below the minimum qualification limits.
U The analyte was not detected above the reported result.

E Ecology Sample.
S Spokane STP sample.
@ Composite sampling time: 0800–0800.
comp Composite sample.
grab Grab sample.
gr–comp Grab–composite sample.

Tr Blk Transfer blank
Inf Influent
Ef Effluent
Intake SIP water supply
MLSS Oxidation Ditch Solids
CoLtg Columbia Lighting discharge

Sample Location:	Inf-E
Type:	comp
Date:	5/19-20/92
Time:	24 hours
Sample ID:	218233

Compound Name	Estimated Concentration (μg/L)	Qualifier
1.UNKNOWN	40	J
2.METHANONE, DIPHENYL-	84	NJ
3.ETHANOL, 2-[2-(2-PHENOXYATHO)]-	47	NJ
4.UNKNOWN	39	J
5.UNKNOWN	24	J
6.UNKNOWN	39	J
7.UNKNOWN	16	J
8.UNKNOWN	47	J
9.UNKNOWN	26	J
10.UNKNOWN	21	J
11.UNKNOWN	21	J
12.UNKNOWN	21	J
13.UNKNOWN	49	J
14.UNKNOWN	36	J
15.UNKNOWN	12	J
16.UNKNOWN	32	J
17.PHOSPHINE SULFIDE, TRIPHENYL-	24	NJ
18.UNKNOWN	22	J
19.CHLOESTAN-3-OL, (3.BETA.,5.A)-	34	NJ
20.CHOLEST-5-EN-3-OL (3.Beta.)-	18	NJ

J The associated numerical result is an estimated quantity.

NJ There is evidence that the analyte is present. The associated numerical result is an estimate.

Ef	Efluent sample	grab	Grab sample
Inf	Influent sample	comp	Composite sample
E	Ecology sample	CoLtg	Columbia Lighting, Inc. sample

Sample Location:	EF-1
Type:	grab
Date:	5/19/92
Time:	0955
Sample ID:	218235

Compound Name	Estimated Concentration ($\mu g/L$)	Qualifier
1.HEXAMETHYLCYCLOTRISILOXANE	21	JN
2.Cyclotetrasiloxane, octameth-	27	JN

Sample Location:	EF-2
Type:	grab
Date:	5/19/92
Time:	1525
Sample ID:	218236

Compound Name	Estimated Concentration ($\mu g/L$)	Qualifier
1.Cyclotetrasiloxane, octameth-	97	NJ

Sample Location:	EF-E
Type:	comp
Date:	5/19-20/92
Time:	24 hours
Sample ID:	218237

Compound Name	Estimated Concentration ($\mu g/L$)	Qualifier
1.UNKNOWN	15	J
2.UNKNOWN	33	J
3.ETHANOL, 2-[2-(2-PHENOXYETHO)]-	9	NJ
4.UNKNOWN	8	J
5.UNKNOWN	20	J
6.UNKNOWN	15	J
7.UNKNOWN	14	J
8.UNKNOWN	15	J
9.UNKNOWN	43	J
10.UNKNOWN	7	J
11.UNKNOWN	8	J
12.UNKNOWN	18	J
13.UNKNOWN	7	J
14.UNKNOWN	12	J
15.UNKNOWN	19	J
16.UNKNOWN	38	J
17.PHOSOHINE OXIDE, TRIPHENYL-	15	NJ
18.UNKNOWN	15	J
19.PHOSPHINE SULFIDE< TRIPHENYL-	25	NJ
20.UNKNOWN	28	J

Sample Location:	CoLtg-1
Type:	grab
Date:	5/19/92
Time:	1355
Sample ID:	218246

Compound Name	Estimated Concentration ($\mu g/L$)	Qualifier
1.Cyclotetrasiloxane	49	NJ

Sample Location:	CoLtg-2
Type:	grab
Date:	5/19/92
Time:	1405
Sample ID:	218247

Compound Name	Estimated Concentration ($\mu g/L$)	Qualifier
1 1-propanol, 2-methyl-	12	NJ
2. HEXAMETHYLCYCLOTRISILOXANE	9	NJ
3. Cyclotetrasiloxane	22	NJ