A Department of Ecology Report

Spokane River Basin Class II Inspection at the Liberty Lake Wastewater Treatment Plant

Abstract

Announced Class II inspections were conducted at three industrial wastewater treatment plants (WWTPs) and two municipal WWTPs in the Spokane River Basin during March 22-24, 1993. A separate inspection report was written for each discharger in the basin. This report is based on the inspection conducted at the Liberty Lake Sewer District WWTP. The plant was operating well at the time of inspection and met permit requirements for five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, and pH. However, the effluent concentration exceeded the daily maximum limit for total residual chlorine on March 22. Removal efficiencies for BOD_5 and TSS were much higher than the 85% requirement. Effluent lead concentrations exceeded the chronic water quality criterion. Copper and zinc concentrations exceeded both acute and chronic water quality criteria. A concurrent metals study is also progressing in the Spokane River Basin, and it should provide greater insight concerning effluent metals toxicity in the receiving water. Other minor recommendations are included in this report.

Introduction

Announced Basin Class II inspections were conducted at three industrial wastewater treatment plants (WWTPs) and two municipal WWTPs in the Spokane River Basin on March 22-24, 1993. Entities operating the plants were as follows: Inland Empire Paper Company, Kaiser Aluminum, Spokane Industrial Park, City of Spokane, and Liberty Lake Sewer District. These Basin Class II inspections are done in support of an emerging concept within the Department of Ecology to conduct activities on a coordinated geographic basis. This concept is referred to as the Basin (Watershed) Approach to environmental management. Figure 1 is a map showing the locations of the five WWTPs.

Conducting the inspections were Rebecca Inman and Tapas Das of the Environmental Investigations and Laboratory Services Program's Watershed Assessments Section. Patrick Hallinan and Kenneth Merrill of Ecology's Eastern Regional Office were present to observe the inspection. The data obtained from these inspections will contribute to the ongoing Spokane River total maximum daily load (TMDL) study for metals (Pelletier, in prep.).

A separate Class II inspection report was written for each discharger. This report is based on the inspection conducted at the Liberty Lake WWTP. Dan Grogg, chief operator, provided assistance during the inspection.

Objectives

1) verify compliance with NPDES permit limits;
2) provide effluent data (including metals) to support the Spokane River TMDL assessment; and
3) evaluate the permittee's sampling and testing procedures by conducting sample splits.

by Tapas Das
Waterbody No. WA-57-1010
Ecology Report #94-55
April 1994

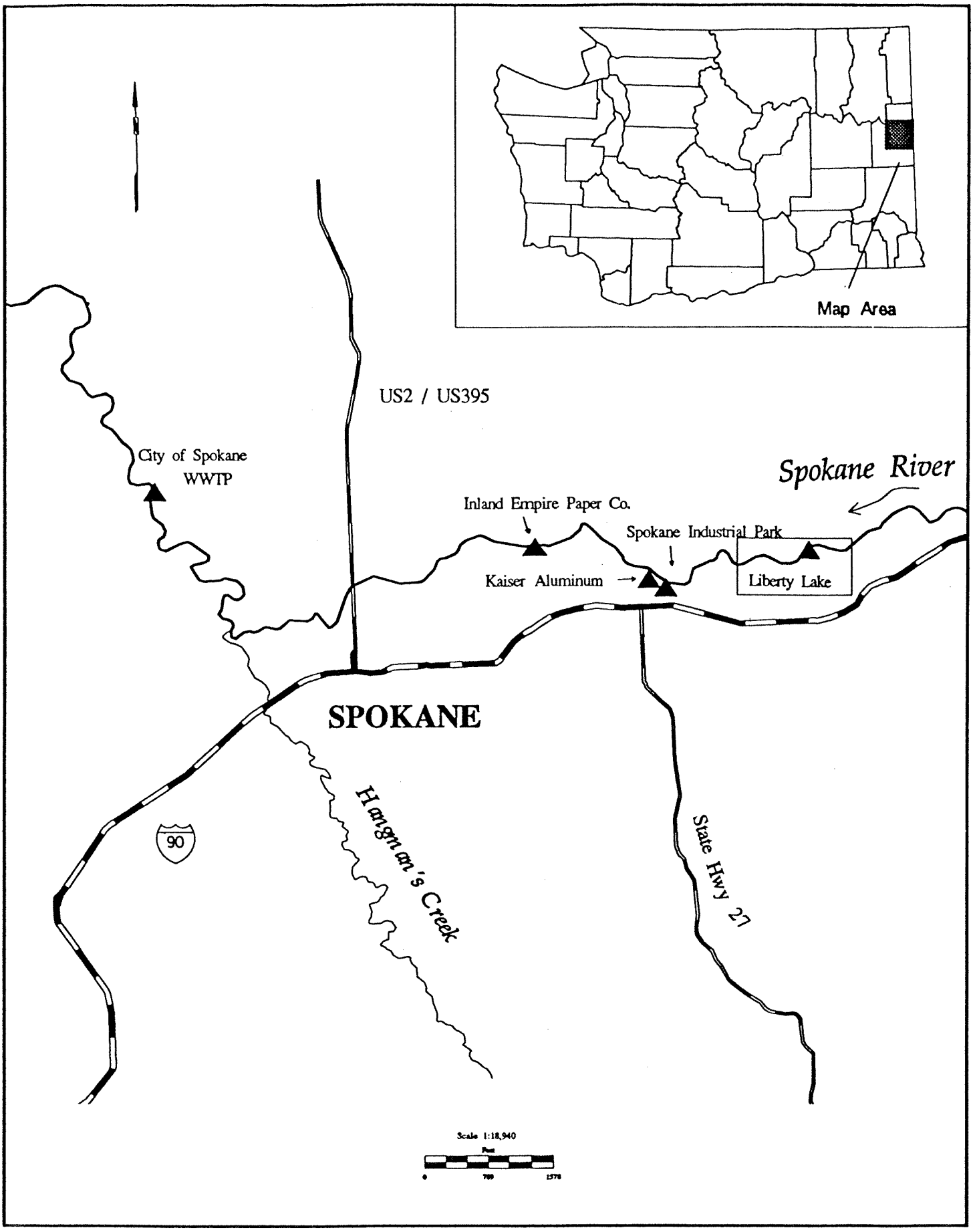

Figure 1. Locations of Five WWTPs - Spokane River Basin Class II Inspection, 3/93

The primary source of wastewater to the Liberty Lake WWTP is households. The Liberty Lake Sewer District is authorized to discharge treated wastewater to the Spokane River under NPDES Permit No. WA-004514-4. The permit expired on September 19, 1993, but has been administratively extended.

Figure 2 is a schematic diagram of the plant at the time of inspection. Primary treatment consists of screening and grit removal. Flow equalization is provided in a basin designed to store peak flows. The wastewater is pumped from this basin to the remainder of their treatment plant at a constant flow rate. Flow from the equalization basin is monitored by an enclosed device (Sparkling Series 501-C model), and this rate is reported daily as the discharge to the river. Ultrasonic flow measuring devices (Manning® UTX 2100 A) are installed at the influent and effluent; however, flows from these two meters are used only for the plant's day-to-day operations.

The WWTP's secondary treatment consists of an aeration basin and clarifier. Effluent from the secondary clarifier is chlorinated by a gas mixing system in a chlorine contact tank. Following chlorination, dechlorination with sulfur dioxide is provided before discharge. Waste activated sludge is treated in an aerobic digester. Digested sludge is dried in drying beds and stockpiled on the plant site for future land disposal (Grogg, 1993).

Procedures

Sampling locations are shown in Figure 2. A summary of the analytical methods and laboratories conducting the analyses is given in Table 1. Standard operating procedures (SOPs) which are routinely employed when conducting Basin Class II inspections and when preserving and analyzing the samples are provided in the Ecology document Quality Assurance Project Plan for Basin Class II Inspections (Glenn, in prep.). The following procedures were exceptions to those SOP's (asterisks denote QAPP changes made at the request of the client):

1) Composite samples of influent wastewater were obtained from the permittee's sampler;
*2) several standard influent and effluent parameters were not analyzed for;
*3) eight selected priority pollutant metals were analyzed by the total recoverable method;
4) no equipment blank was run even though composited samples of priority pollutant metals were collected;
*5) duplicates were not collected for all effluent parameters;
6) ortho-phosphate samples were filtered in the field rather than at the Manchester Lab;
7) an instantaneous flow verification could not be done because the flow measuring devices weren't accessible; and
8) although the permittee's lab has not been accredited, no performance evaluation (PE) standards were left.

Results and Discussion

General chemistry results are summarized in Table 2. BOD_5 and TSS data indicate that the plant was receiving a weak influent, but delivering a well-treated effluent (Metcalf & Eddy, 1991). Ammonia concentrations in the effluent were very low (0.04 mg/L), suggesting that nitrification was complete. Nitrite and nitrate nitrogen (NO_2+NO_3-N) concentrations in effluent were high (17.8 mg/L), suggesting that little denitrification was achieved. One grab sample of effluent had a relatively high residual chlorine level following dechlorination (0.8 mg/L). The WWTP's influent and effluent total phosphorus concentrations indicated that there was some phosphorus removal by the plant.

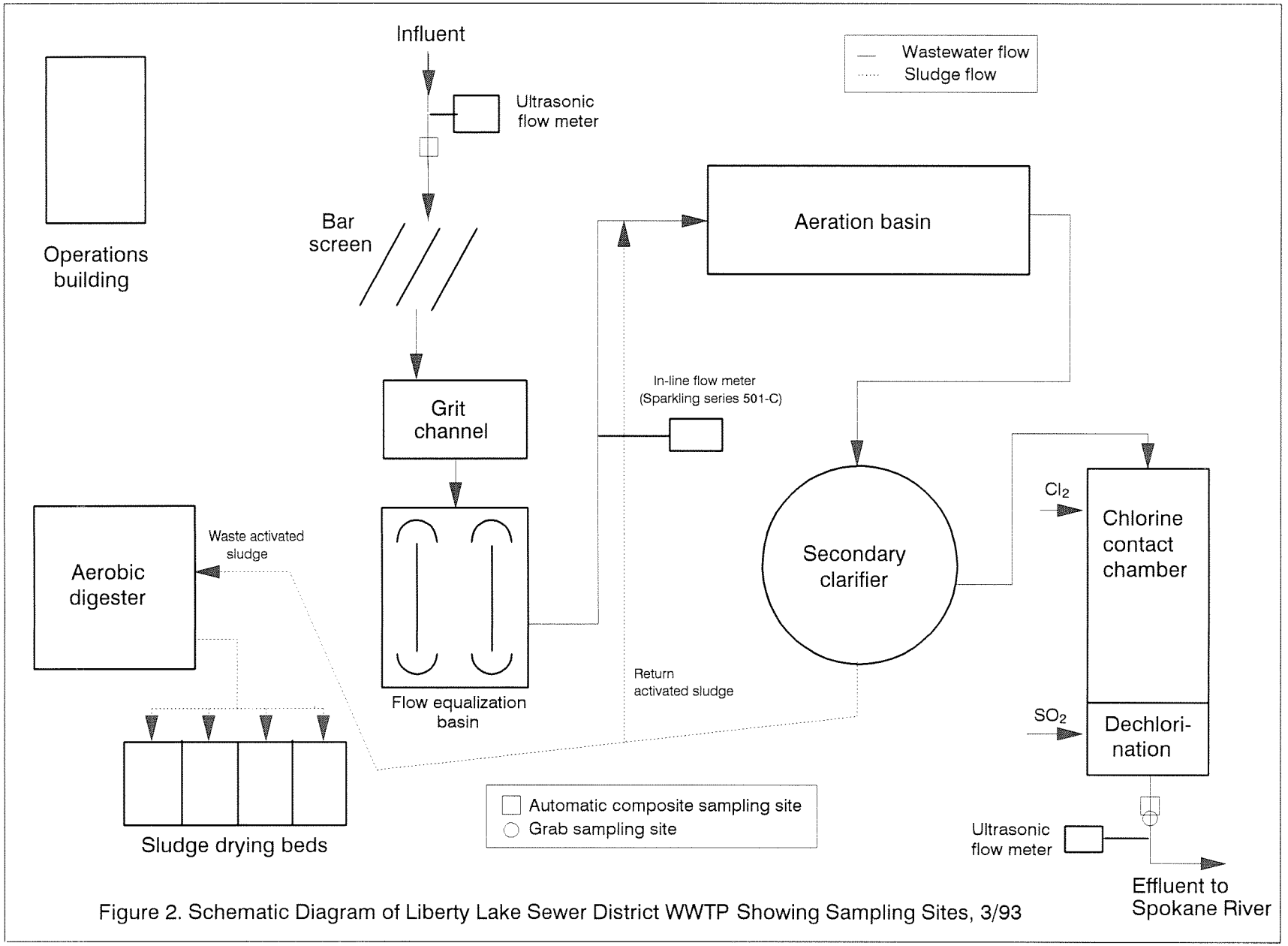

Figure 2. Schematic Diagram of Liberty Lake Sewer District WWTP Showing Sampling Sites, 3/93

Table 1. Analytical Methods and Laboratories, Liberty Lake WWTP - Spokane River Basin Class II Inspections, 3/93

Parameter	Method	Lab used
Turbidity	EPA, 1983: 180.1	Ecology; Manchester, WA
Conductivity	EPA, 1983: 120.1	Ecology; Manchester, WA
Alkalinity	EPA, 1983: 310.1	Ecology; Manchester, WA
Hardness	EPA, 1983: 130.2	Ecology; Manchester, WA
SOLIDS4		
TS	EPA, 1983: 160.3	Ecology; Manchester, WA
TNVS	EPA, 1983: 106.4	Ecology; Manchester, WA
TSS	EPA, 1983: 160.2	Ecology; Manchester, WA
TNVSS	EPA, 1983: 106.4	Ecology; Manchester, WA
BOD5	EPA, 1983: 405.1	Ecology; Manchester, WA
TOC	EPA, 1983: 415.2	Ecology; Manchester, WA
NUTRIENTS		
NH3-N	EPA, 1983: 350.1	Ecology; Manchester, WA
NO2+NO3-N	EPA, 1983: 353.2	Ecology; Manchester, WA
T-phosphorus	EPA, 1983: 365.1	Ecology; Manchester, WA
O-phosphate	EPA, 1983: 365.3	Ecology; Manchester, WA
Total Kjeldahl nitrogen	EPA, 1983: 351.4	Analytical Resources Inc.; Seattle, WA
Fecal coliform (MF)	APHA, 1989:9222D	Ecology; Manchester, WA
Oil and grease	EPA, 1983: 413.1	Ecology; Manchester, WA
METALS		
Cr;Cu;Ni;Zn	EPA, 1983: 200.7	Ecology; Manchester, WA
Hg	EPA, 1983: 245.5	Ecology; Manchester, WA
Ag	EPA, 1983: EP1-272.2	Ecology; Manchester, WA
Cd	EPA, 1983: EP1-213.2	Ecology; Manchester, WA
Pb	EPA, 1983: EP1-239.2	Ecology; Manchester, WA

A comparison of effluent results to NPDES permit limits is presented in Table 3. The plant's totalizer readings for a 24-hour time period (March 22-23) indicated a flow of 0.28 MGD; this flow was used to calculate effluent mass loadings for comparison to permit limits. Calculated effluent quality met permit requirements for BOD_5, TSS, pH, and fecal coliform at the time of inspection. Removal efficiencies for BOD_5 and TSS were well above the 85% requirement. Influent loadings and flow to the plant were well below 85% of design criteria/capacity. On March 22, effluent exceeded the daily maximum permit limit for total residual chlorine by two-fold. This is an enforceable violation.

A listing of eight priority pollutant metals results is presented in Table 4. The water quality criteria for metals were calculated using a receiving water hardness of 24.7 mg/L as $CaCO_3$ (Pelletier, in prep.). Cadmium, copper, lead, and zinc were detected in effluent. Lead concentrations were higher than the chronic water quality criterion, while copper and zinc exceeded both acute and chronic criteria (EPA, 1986). The copper concentration (40.9 μg/L) in effluent was high enough to cause some concern about potential toxicity in the receiving water. The toxicity of metals in the Spokane River is currently being evaluated by Pelletier (in prep.).

Table 5 compares results of analyses performed by Liberty Lake and Ecology on splits of the same samples. Effluent BOD_5, TSS, and total phosphate results showed acceptable agreement. However, the permittee's influent BOD_5 result (239 mg/L) was considerably higher than Ecology's lab result (166 mg/L). Incomplete mixing of the sample before pouring into individual bottles might have caused this difference. Also, this difference may be due to the type of "seed" (activated sludge) used by each lab. The discharger's overall lab performance revealed by the sample splits was acceptable. The temperature of the permittee's effluent composite sample was above the recommended 4°C (APHA, 1989).

Conclusions and Recommendations

1) The plant was operating well during the inspection and met applicable effluent limitations except for total residual chlorine, which exceeded the daily maximum concentration on March 22, 1993. It is recommended that the Liberty Lake WWTP's chlorination/dechlorination systems be checked and corrected as necessary.

2) Cadmium, copper, lead, and zinc were detected in the effluent. Among them, lead concentrations exceeded the chronic water quality criterion, while copper and zinc exceeded both acute and chronic water quality criteria. It is recommended that Pelletier's Spokane River metals study be consulted for further discussion of potential metals toxicity.

3) The permittee's overall laboratory performance revealed by the sample splits was acceptable except the influent BOD_5 result. It is recommended that the permittee's lab method for high level BOD_5 be reviewed. The permittee has not yet received accreditation for their lab. Therefore, it is recommended that performance evaluation (PE) standards be used during the next Class II inspection.

4) The discharger's effluent composite sample temperature was higher than the recommended 4°C. The plant's effluent sample cooler should be inspected and adjusted as necessary to provide better sample cooling. Until this correction is made, the permittee's effluent results should be used with some caution.

Table 2. General Chemistry Results, Liberty Lake WWTP - Spokane River Basin Class II Inspections, 3/93

	Station:	Inf-LL	Eff-E	Eff-LL	Eff-1	Eff-T	Eff-2	Blank
	Type:	comp	comp	comp	grab	grab	grab	rinsate
	Date:	3/22-23	3/22-23	3/22-23	3/22	3/22	3/24	3/23
	Time:	1720-1720	1700-1700	1700-1700	1620	1620	1145	1830
Parameter	Lab ID#1382:	-59	-60	-61	-57	-58	-62	-63
Turbidity (NTU)			4.8				5.7	
Conductivity (µmhos/cm)			474				477	
Alkalinity (mg/L)			53.4				51.1	
Hardness (mg/L CaCO3)			101	104+			107	
TS (mg/L)			372	414+				
TNVS (mg/L)			239	228+				
TSS (mg/L)		140	12	11+	12	11	13	
TNVSS (mg/L)			4	4+				
BOD5 (mg/L)		166	5	5+				
TOC (mg/L)				8.8+				
NH3-N (mg/L)			0.04	0.04+	0.04	0.04	0.04	
NO2+NO3-N (mg/L)			17.8	17.8+				
Total phosphate (mg/L)		5.82	3.29	3.30+			3.60	
Ortho- Phosphate (mg/L)			2.92	2.72+				0.03
TKN (mg/L)			1.0	0.88+				
Oil & Grease (mg/L)					1 J	3	3	
F-Coliform MF (#/100 mL)					6	<3	9	
FIELD OBSERVATIONS								
Flow (MGD)			0.28*					
Temperature (°C)		3.9++	5.0++	10.6++	10.5	10.4	11.5	
pH (S.U.)					6.7	6.8	6.7	
Conductivity (µmhos/cm)		550	430	480	460	470	475	
Chlorine								
Free (mg/L)					0.1**		0.06**	
Total (mg/L)					0.8**		0.10**	

Eff - Effluent, Inf - Influent, E - Ecology sample, LL - Liberty Lake WWTP sample, T - Ecology replicate sample

J - Indicates an estimated value when result is less than specified detection limit.

* Flow was obtained from plant's totalizer for a 24-hour time period (3/22-23).

\+ Because the sample field temperature remained higher than (4-5)°C, these results should be used with some caution.

++ Iced composite sample.

** Chlorine samples collected postdechlorination.

Table 3. Comparison of Results to NPDES Permit Limits, Liberty Lake WWTP - Spokane River Basin Class II Inspections, 3/93

	NPDES Permit Limits		Inspection Data		Loading and Performance			
Parameter	Monthly Average	Weekly Average	Ecology/WWTP Composite	Grab Samples	Design Criteria	Derived Results	Plant Loading (% of DC)	Planning to begin (% of DC)
Influent BOD5								
(mg/L)			166*	---				
(lbs/day)					2,000	388	19	85
Effluent BOD5**								
(mg/L)	30	45	5	---				
(lbs/day)	250	357				12		
(% removal)	85					97		
Influent TSS								
(mg/L)			140*	---				
(lbs/day)					2,500	327	13	85
Effluent TSS**								
(mg/L)	30	45	12	---				
(lbs/day)	250	357				28		
(% removal)	85					91		
Fecal Coliform++	200	400		7				
(#/100 mL)			---	(<3;6;9)				
	Daily Maximum							
Total Residual Chlorine*** (mg/L)	0.4			0.8;0.1				
pH*** (S.U.)	Within the range of 5.5 to 9.0			6.7;6.7				
Flow (MGD)	1.0					0.28+	28	85

+ Flow obtained from WWTP's totalizer for a 24-hour time period.
++ The average for fecal coliform bacteria is based on the geometric mean of the samples taken.
* Data obtained by analyzing sample from the WWTP's compositor.
** The monthly and weekly averages for BOD5 and TSS are based on the arithmetic mean of the samples taken.
*** Limit effective until effluent discharge equals or exceeds 0.50 MGD. When that flow is reached, this limitation will be adjusted downward to maintain the instream concentration for chlorine and upward for pH.

Table 4. Results of Metals Analyses, Liberty Lake WWTP - Spokane River Basin Class II Inspections, 3/93

Station:	Inf-LL	Eff-E	Water Quality Criteria (µg/L)	
Type:	comp	comp	Freshwater	
Date:	3/22-23	3/22-23		
Time:	1720-1720	1700-1700		
Lab ID#:	138259	138260	Acute	Chronic
Metals tot rec (µg/L)				
Cadmium	0.25 J	0.14 J	0.8*	0.4*
Chromium	<5	<5	16	11
Copper	105	40.9	5*	4*
Lead	10.8	1.5 P	14*	0.5*
Mercury	<0.05 J	<0.05 J	2.4	0.012
Nickel	<10	<10	434*	48*
Silver	<3	<3	0.4*	0.12
Zinc	165 J	56.4 J	36*	32*

Eff - Effluent, Inf - Influent, E - Ecology sample, LL - Liberty Lake WWTP sample

J - Indicates an estimated value when result is less than specified detection limit.

P - The analyte was detected above the instrument detection limit but below the established minimum quantitation limit.

* Receiving water hardness dependent criteria (based on 24.7 mg/L as CaCO3) (EPA, 1986).

Shaded area denotes metal detected.

Table 5. Comparison of Laboratory Results of Sample Splits, Liberty Lake WWTP - Spokane River Basin Class II Inspections, 3/93

Station:	Inf-LL		Eff-E		Eff-LL	
Lab ID#:	138259		138260		138261	
Date:	3/22-23		3/22-23		3/22-23	
Sampler:	LL		Ecology		LL	
Laboratory:	Ecology	WWTP	Ecology	WWTP	Ecology	WWTP
BOD5 (mg/L)	166	239	5	7	5	8
TSS (mg/L)	140	132	12	8	4	---
T-Phos (mg/L)	5.82	5.9	3.29	3.70	3.30	---

Inf - Influent, Eff - Effluent, E - Ecology sample, LL - Liberty Lake WWTP sample

References

APHA-AWWA-WPCF, 1989. Standard Methods for the Examination of Water and Wastewater. 17th edition. American Public Health Association, Washington DC.

EPA, 1983. Methods for Chemical Analyses of Water and Waste. EPA-600/4-79-020 (Rev. March 1983), Washington DC.

------, 1986. Quality Criteria for Water. EPA 440/5-86-001.

Glenn, N., in prep. Quality Assurance Project Plan for Basin Class II Inspections. Washington State Department of Ecology, Environmental Investigations and Laboratory Services Program, Olympia WA.

Grogg, D., 1993. Personal Communication, Plant Operator, Liberty Lake WWTP, Liberty Lake WA., November 29.

Metcalf & Eddy, Inc., 1991. Wastewater Engineering: Collection, Treatment, & Disposal. 3rd edition, McGraw-Hill, Inc., New York.

Pelletier, G., in prep. Spokane River Metals Project. Washington State Department of Ecology, Environmental Investigations and Laboratory Services Program, Olympia WA.

Contacts

Tapas Das — Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
(206) 407-6684

Will Kendra — Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
(206) 407-6698

If you have special accommodation needs, please contact Barbara Tovrea at (206) 407-6696 (voice). Ecology's telecommunications device for the deaf (TDD) number at Ecology Headquarters is (206) 407-6006.

For additional copies of this publication, please contact Ecology's Publications Distribution Office at (206) 407-7472, and refer to publication number 94-55.