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PORT TOWNSEND PAPER COMPANY
CLASS II INSPECTION

by
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ABSTRACT

A Class II inspection was conducted at the Port Townsend Paper Company's wastewater treatment system on December 1 and 2, 1987. The inspection was timed to correspond with an investigation of pen-reared salmon mortalities in Port Townsend Bay. No effluent contaminants were detected that would be expected to contribute to the observed salmon mortalities. The treatment system was operating well during the inspection. No NPDES permit violations were noted; effluent BOD and TSS values were almost an order of magnitude less than permitted limits. Chronic toxicity, but not acute, was seen in the effluent, but is not expected to exert toxic effects outside the diffuser mixing area. Slight acute effects were found in outfall near-field sediments. These low-level toxicities may be related to several metals and organics in the effluent and sediments. Several recommendations were made.

INTRODUCTION

A Class II inspection was held at the Port Townsend Paper Company's (PTPC) wastewater treatment plant on December 1 and 2, 1987. The inspection was requested by Fred Fenske of Ecology's Industrial Section. Don Reif of the Compliance Monitoring Section and Don Kjosness of the Industrial Section conducted the inspection. Assistance was provided by Thor Sorenson and Ev Muehlethaler of PTPC, and Marc Horton of Ecology. The inspection was timed to correspond with an investigation of pen-reared salmon mortalities in Port Townsend Bay. The problem under investigation was fish liver lesions thought to be caused by exposure to a water-borne toxic chemical. Results of the salmon mortality study are available in another report (Johnson, 1988).

Objectives of the survey included:

1. Collect samples and measure flows to determine plant loadings and treatment efficiencies.

2. Determine NPDES permit compliance.

3. Perform a laboratory evaluation and split samples to determine accuracy and adherence to analytical protocol.

4. Examine effluent toxicity by conducting a series of effluent and sediment bioassays.

LOCATION AND DESCRIPTION

The PTPC mill is located in southern Port Townsend on the west side of Port Townsend Bay (Figure 1). The Kraft mill, formerly Crown Zellerbach, produces

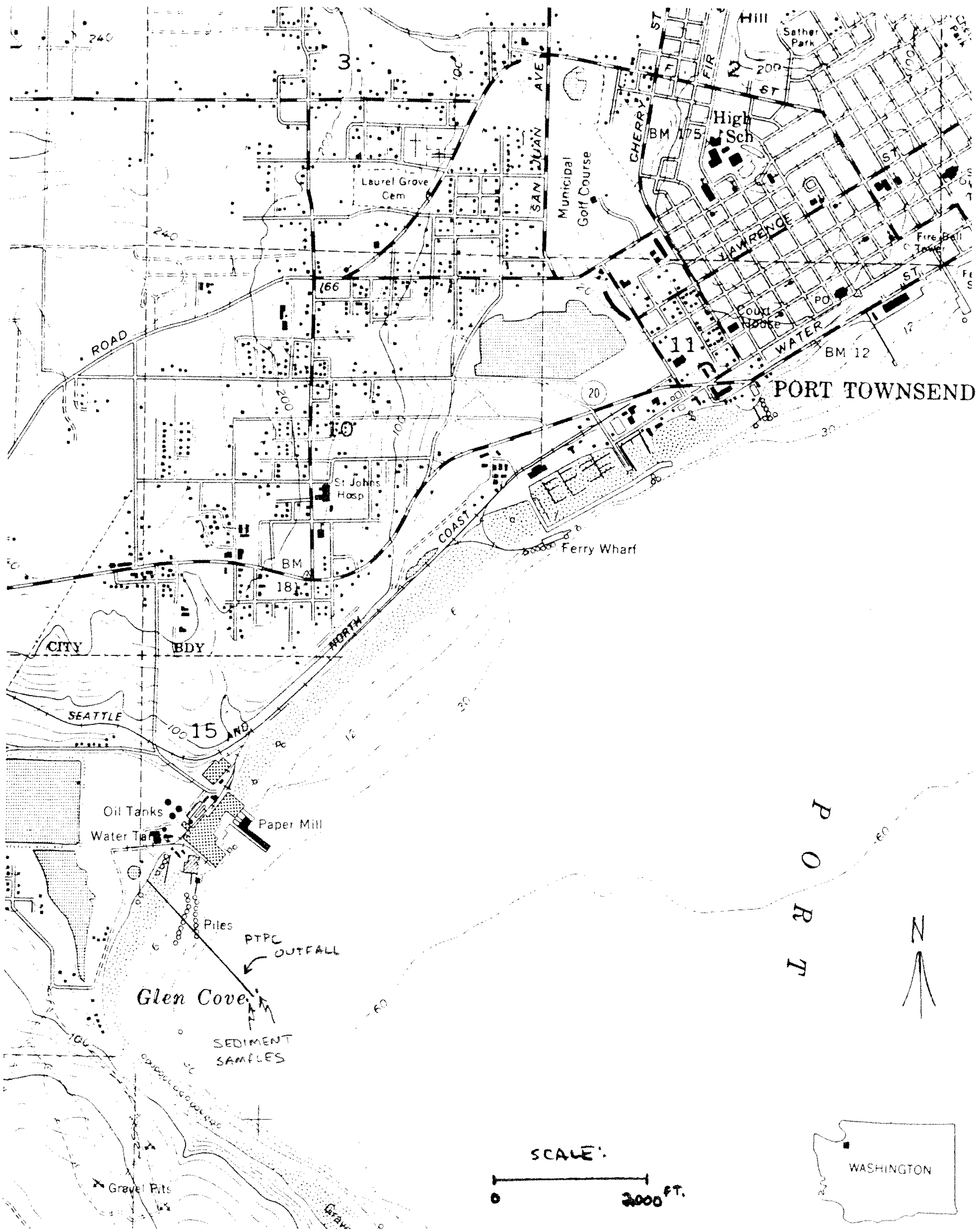

FIGURE 1. PTPC site with outfall and sediment sample locations.

approximately 550 tons per day of unbleached market pulp, a portion of which is converted to brown paper on-site.

Port Townsend Paper Company's wastewater treatment facilities include primary clarification followed by an aerated lagoon (aerated stabilization basin or ASB) with an average flow of about 12 to 14 MGD. The 40-acre ASB has a six- to 12-day detention time. Sanitary wastes from the mill are treated in a small activated sludge plant (~17,000 gal/day) which after chlorination, joins the ASB outfall line. Discharge is to Glen Cove, about 2000 feet from shore at about a 48-foot depth (Figure 2). Sludge from the primary clarifier is burned in the hog fuel boiler.

METHODS

Sampling consisted of both grabs and composites. Composite samplers were set up at the ASB influent and effluent. Approximately 220 mL were collected every 30 minutes for 24 hours. General chemistry parameters were run on both samples. Priority pollutants and other organics of interest to the salmon study were analyzed from the effluent sample. In addition, grab samples were collected from the ASB influent and effluent and the sanitary plant effluent. ASB effluent bioassays (three grab composites over 24 hours) were conducted with juvenile rainbow trout (Ecology, 1980), Pacific oyster, and Microtox (Microtox System Operating Manual by Beckman). The full sampling schedule is listed in Table 1.

Sediment samples were collected from both sides of the effluent diffuser, about 50 feet laterally off the diffuser's end. Sample No. 1 was collected south of the diffuser, and Sample No. 2 was from the north side. A sediment control sample was collected near Point Wilson, approximately three miles north of the PTPC outfall. A 0.2 m2 van Veen sampler was used for sample collection, following Puget Sound Protocols (Tetra Tech, 1986).

Most analyses were completed at Ecology's Manchester Laboratory. Priority pollutant organics were contracted to A.R.I. in Seattle. E.V.S. Consultants of Vancouver, B.C., ran the oyster bioassay (Swartz, 1985) and sediment amphipod bioassays (ASTM, 1980). Sediment grain size was analyzed at Parametrix Inc., in Seattle following Holme and McIntyre (1971). Effluent metals were run by Battelle Marine Research Laboratory in Sequim. Additional methods are listed in Appendix II.

RESULTS

General Conditions

Ecology's general chemistry results are listed in Table 2. The long detention time within the ASB (6-12 days) is evidenced by the consistent effluent quality. Saltwater discharge from the barometric condensers to the ASB's can be seen in high effluent conductivity and total solids. This discharge seems to be intermittent, as it was

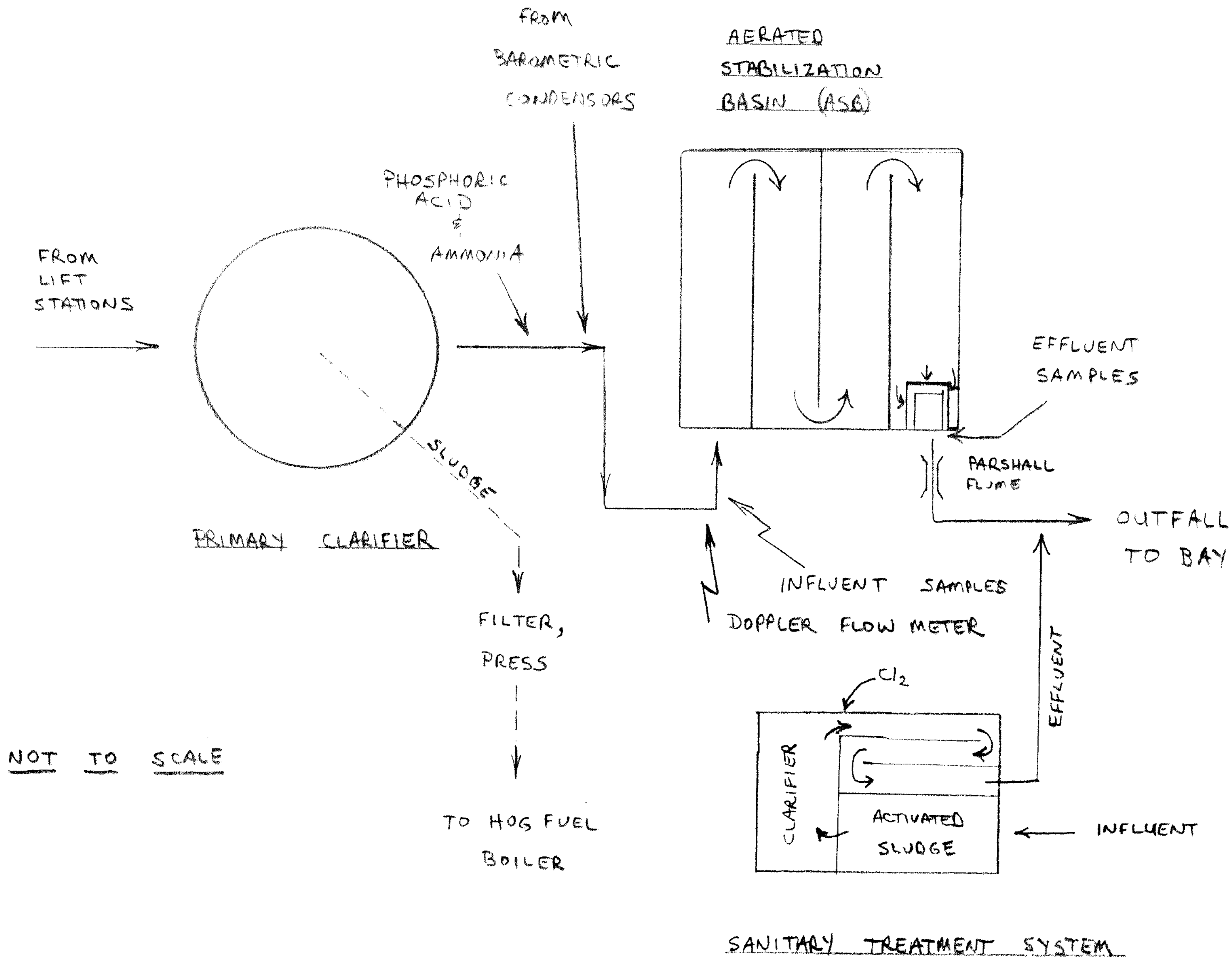

FIGURE 2. Process and sanitary treatment systems schematic: PTPC Class II Inspection; Dec. 1-2, 1987.

Table 1. Sampling schedule: PTPC Class II inspection- December 1-2, 1987.

				Field				Laboratory					Nutrients			Solids																	Bioassays				
Station	Date	Time		T	pH	Cond	Cl2 Res	pH	Turb	Cond	Alk	Tot. Hard	NH3	NO3+2	Tot-P	TS	TNVS	TSS	TNVSS	COD	BOD5	Fec. Col.	BNA	VOA	Pest/ PCB	PP Met	Phen	Cn	Resin Acids	% Sol	TOC	Gr. size	Trout	Oyster	Mictx	Rhep. abron.	Ames Test
ASB Inf.	12/1	am		X	X	X		X	X	X	X		X	X	X			X	X	X																	
	12/1	pm		X	X	X		X	X	X	X		X	X	X			X	X	X																	
	12/2	am		X	X	X		X	X	X	X		X	X	X			X	X	X																	
		Comp:	Eco	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X																
ASB Eff.	12/1	am		X	X	X		X	X	X	X		X	X	X			X	X	X		X															
	12/1	pm		X	X	X		X	X	X	X		X	X	X			X	X	X		X															
	12/2	am		X	X	X		X	X	X	X		X	X	X			X	X	X		X															
		Comp:	Eco	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X				X	X	X		X
			PTPC	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X																
San.Eff.	12/1	pm		X	X	X		X	X	X	X		X	X	X			X	X		X	X															
	12/2	am					X																														
Sed.#1	11/30	pm																					X	X	X	X			X	X	X	X				X	
Sed.#2	11/30	pm																					X	X	X	X			X	X	X	X				X	
Control	11/30	pm																					X	X	X	X			X	X	X	X				X	

Table 2. Ecology analytical results- PTPC Class II inspection: December 1-2, 1987.

Station	Date	Time	Field Analyses: Temp. (C)	Field: pH (S.U.)	Field: Cond. (umhos/cm)	Field: Chlor. Res. (mg/L) Free	Field: Chlor. Res. (mg/L) Total	Laboratory Analyses: pH (S.U.)	Lab: Turb. (NTU)	Lab: Cond. (umhos/cm)	Lab: Alkal. (mg/L as CaCO3)	Lab: Total Hardness (mg/L as CaCO3)	Nutrients- mg/L NH3-N	Nutrients- mg/L NO3+N	Nutrients- mg/L Tot-P	Solids- mg/L TS	Solids- mg/L TNVS	Solids- mg/L TSS	Solids- mg/L TNVSS	COD (mg/L)	BOD (mg/L)	Coliform (#/100mL)
Grabs:																						
ASB Inf.	12/1	11:45	28.6	9.33	>1000			10.5	3	1270	220		8.8	.06	.49			83	13	550		
		3:30	32.6	9.76	>1000			10.6	5	1330	350		7.8	.06	.53			210	100	480		
	12/2	8:45	25.0	9.98	>1000			10.6	7	8390	230		9.3	.13	.23			140	32	470		
ASB Eff.	12/1	11:30	18.9	7.92	>1000			7.9	3	8230	280		2.1	0.17	.9			18	<1	160		<1
		2:45	19.3	7.83	>1000			7.9	3	8320	290		2.3	.15	.85			16	8	160		<1
	12/2	8:30	19.2	7.46	>1000			7.9	3	8310	260		2.0	.16	.83			12	6	160		<1
San. Eff.	12/1	3:45	12.2	7.2	-	5.0	6.0	7.0	11	316	64		6.8	.72	1.7			26	<1		9.9	<1
Composites:																						
Eco. Inf.	12/1 & 2	0900-0830	7.8	10.08	>1000			10.3	6	1840	180		9.0	0.6	.77	1500	1200	350	170	560	180	
Eco. Eff.	12/1 & 2	0920-0850	5.3	7.6	>1000			8.1	2	8320	270	797	2.2	.18	.86	5000	4200	14	10	170	10	
PTPC Eff.	"	"	-	-	-			8.0	4	8270	260		.97	1.6	.85	4900	4300	20	10	170	18	

observed in only one of three influent grab samples and all effluent samples. Fecal coliform counts were very low in the three ASB effluent samples and the sanitary plant effluent sample.

Flow

A flow of 12 MGD was recorded by the PTPC flow meter. No instantaneous checks were made due to no suitable access points. PTPC also recorded a flow of 0.023 MGD for the sanitary plant. In the future, a portable Doppler flow meter could be used to verify ASB flows.

Laboratory Review

A laboratory review was conducted by Don Kjosness during the inspection. All analytical methods were judged as acceptable (Kjosness, 1988). A comparison of split samples is shown in Table 3. All analyses compared well.

NPDES Permit Compliance

A summary of Ecology results are compared to permitted limits in Table 4. No violations were noted; BOD and TSS for the ASB were nearly an order of magnitude below limits. The sanitary plant was operating satisfactorily. However, chlorine residuals in the sanitary effluent were considerably higher than needed. A lesser residual (0.2-0.3 mg/L) could be maintained while still keeping coliform levels within acceptable limits.

Effluent Chemical Analyses

A number of chemical analyses were performed on Ecology's effluent composite sample. Volatile and semi-volatile compounds are listed in Appendix I, resin acids in Table 5, and metals in Table 6.

No organic compounds were detected, with the exception of a slight amount of methylene chloride, a glass-cleaning solvent and common laboratory contaminant. No resin acids, guaiacols, or catechols were detected in the effluent; laboratory procedural problems are believed responsible for this failure (Johnson, 1988). After procedural revisions, these organic analyses were again run on a PTPC effluent sample collected April 5, 1988, by Don Kjosness. These results are listed in Table 5. A total of only 4 ug/L of resin acids, 174 ug/L of fatty acids, and no guaiacols or catechols were detected. This is considerably below the 50-2500 ug/L of resin acids typically found in Kraft mill effluents (Johnson, 1988). A study currently being conducted by the Industrial Section may determine if these levels are reasonable or if laboratory detection is still inaccurate.

Copper, silver, mercury, and cyanide were detected at low levels. Of these, copper, mercury, and cyanide exceeded EPA's water quality criteria (EPA, 1986). These

Table 5. Effluent Resin Acid/Fatty Acid/Guaiacol/Catechol compounds: PTPC sampling inspection; April 5, 1988.

Compound:	Concentration (ug/L)
Guaiacol	0.9 U
4-chlorocatechol	0.9 U
4,5-dichlorocatechol	0.9 U
4,5-dichloroguaiacol	0.9 U
3,4,5-trichlorocatechol	0.9 U
4,5,6-trichloroguaiacol	0.9 U
Tetrachlorocatechol	0.9 U
Tetrachloroguaiacol	0.9 U
Linoleic Acid	**5**
Oleic Acid	**9**
Linolenic Acid	0.9 U
Sandaracopimaric Acid	0.9 U
Isopimaric Acid	0.9 U
Palustric Acid	0.9 U
Levopimaric Acid	**4**
Dehydroabietic Acid	0.9 U
Abietic Acid	0.9 U
Neoabietic Acid	0.9 U
Dichlorodehydroabietic Acid	0.9 U
Tentatively Identified Compounds:	
Dimethyl Trisulfide	**3.6 J**
10-Octadecanoic Acid, methyl ester	**160 J**

Qualifiers:

U = Compound was analyzed for but not detected at the given detection limit.

J = Estimated value when result is less than the specified detection limit.

Table 6. Effluent metals results and comparison to water quality criteria: PTPC Class II inspection; December 1-2, 1987.

		Criteria*			
	Effluent	Freshwater		Saltwater	
Metal	(ug/L)	Acute	Chronic	Acute	Chronic
Antimony	<2.4	9000	1600	-	-
Beryllium	<0.009	130	5.3	-	-
Cadmium	<0.2	41	5.79	43	9.3
Chromium+3	<5	9505	1133	10300	-
Copper	**6.3**	125	70	**2.9**	**2.9**
Lead	<5	1147	45	140	5.6
Mercury	**0.05**	2.4	**0.012**	2.1	**0.025**
Nickel	<4.9	8932	463	75	8.3
Selenium	<0.77	260	35	410	54
Silver	0.02	144	0.12	2.3	-
Thallium	<0.55	1400	40	2130	-
Zinc	<0.04	1799	47	95	86
Cyanide	**8**	22	**5.2**	**1**	**1**
Hardness	797				

* From EPA, 1986.

criteria are ambient water standards, meant to protect the receiving water environment. Because of the fairly low levels observed, relative to the available dilution, no degradation of water quality is expected due to metals.

Effluent Bioassays

Results of the effluent bioassays are listed in Table 7. Very little toxicity was shown in the trout and Microtox tests. The trout test, conducted at a 65 percent concentration of effluent, had 100 percent survival. Decreased luminescence of *Photobacterium phosphoreum* in the Microtox test was low; the estimated EC50 was greater than 100 percent effluent. However, the EC50 for the oyster larval test (the concentration at which half of the larvae had developmental abnormalities after a 48-hour exposure to PTPC effluent) was only 3.0 percent effluent. The oyster larvae test was therefore the most sensitive bioassay to PTPC effluent, and indicated significant chronic toxicity. The oyster larvae bioassay is typically toxic to pulp mill effluent (M. Stinson, personal communication).

An Ames test on PTPC effluent for mutagenic activity was negative.

Sediment Analyses

The complete listing of priority pollutant scan results for the sediment samples are included in Appendix I. Compounds detected are compared against criteria in Table 8. Although a number of compounds were detected, concentrations were fairly low, and none exceeded the apparent effects threshold concentrations (Betts, 1988). Most of the compounds found in the outfall samples were polynuclear aromatic hydrocarbons (PAH). These PAHs were higher than in the Point Wilson sample. Two compounds (phenols) were also found in the Point Wilson sample at fairly low concentrations. The source of these compounds is unknown.

Several resin acids were also detected in the sediments (Table 9). In all cases, concentrations were higher in the outfall samples than the control. Criteria or standards for concentrations of resin acids are not available.

In the metals analyses, no metals exceeded Ecology's draft sediment quality standards (Table 10).

Sediment bioassay results are summarized in Table 7. The amphipod test found small but significant mortality in both outfall samples when statistically compared to the laboratory control sample (Dunnett's t-test, $P=0.05$). Sublethal effects (avoidance and reburial) were not indicated.

Table 7. Summary of bioassay results: PTPC Class II inspection; December 1-2, 1987.

Bioassay:	Results:		
EFfluent			
Rainbow Trout	- 0% mortality at 65% effluent		
Microtox	- EC50: > 100% effluent		
Oyster Larvae	- EC50: 3.0% effluent (larval abnormalities)		
Sediment	Mean Values +/- standard deviations		
	Survival[1]	Avoidance[2]	% Reburial[3]
Outfall:			
South side	16.4 +/- 2.6	1.1 +/- 1.6	98.8
North side	16.8 +/- 1.8	0.4 +/- 0.6	98.8
Field Control*	18.6 +/- 0.5	0.4 +/- 0.7	100
Lab Control**	19.8 +/- 0.4	1.1 +/- 1.0	98.0

[1]Mean based on twenty amphipods per replicate: five replicates per sample.

[2]Number of amphipods on jar surface per day, out of twenty.

[3]Number of amphipods able to rebury in clean sediment at end of test period.

* - Sample from Point Wilson.
** - Sample from West Beach, Whidbey Island; collected by laboratory.

Table 8. Comparison of sediment semi-volatile organics against sediment quality standards: PTPC Class II inspection; December 1-2, 1987 (ug/kg dw).

	Criteria*	Outfall South	Outfall North	Field Control
Phenol	420	<50	<27	320
4-Methylphenol	670	<35	<20	48 M
Phenanthrene	1500	120	175	15 M
Anthracene	960	48 M	57	<14
Fluoranthene	2500	230	420	22 est.
Pyrene	2600	290	380	25 est.
Benzo(a)Anthracene	1300	210	180	<40
bis(2-Ethylhexyl)Phthalate	1300	42 M	68 est.	51 est.
Chrysene	1400	300	280	<10
Benzofluoranthenes	3200	300	300	17 est.
Benzo(a)Pyrene	1600	130	130	<6.7

< - indicates compound was analyzed for but not detected at the given detection limit.

est. - indicates an estimated value when result is less than specified detection limit.

M - indicates an estimated value of analyte found and confirmed by analyst, but with low spectral match parameters.

* - "new lowest apparent effects threshold" (LAET) concentration: from Ecology's draft sediment standards (Betts 1988).

Table 9. Resin acid analysis of PTPC sediment samples collected November 30, 1987: PTPC Class II inspection.

	Outfall		
	South	North	Control
% total organic carbon	4.9	5.2	1.1
% fines(a)	48.9	73.6	15.0
% dry weight	36.0	35.9	73.1
Resin Acids:			
abietic acid	4400	2400	33 est.
dehydroabietic acid	3300	3200	70 est.
isopimaric acid	1700	1700	<200
sandaracopimaric acid	400	970	<200
Sum of resin acids:	9800	8300	~100

(a) - silt + clay (<62 um)

Table 10. Sediment metals vs. criteria comparison (mg/kg dw): PTPC Class II Inspection; December 1-2, 1987.

		Outfall		
Metal	Criteria*	South	North	Field Control
Antimony	150	<0.1	<0.1	<0.1
Arsenic	57	5.9	5.6	2.9
Cadmium	5.1	0.47	0.13	<0.02
Chromium	260	30.3	31.8	31.4
Copper	390	41.5	45.5	10.8
Lead	450	13.8	13.5	0.5
Mercury	0.41	0.05	0.04	0.02
Nickel	140	32.8	31.1	40.8
Silver	5.9	0.21	0.17	<0.02
Zinc	410	76.8	87.4	36.6

* - lowest apparent effects threshold (AET)- from Betts (1988).

CONCLUSIONS AND RECOMMENDATIONS

The wastewater treatment system at PTPC was operating well during the inspection. No violations of NPDES permit parameters were noted; outfall BOD and TSS loads were almost an order of magnitude below permitted limits.

Sanitary plant effluent had an unnecessarily high chlorine residual. A total chlorine residual of 0.2-0.3 mg/L is recommended to provide sufficient disinfection while not exceeding fecal coliform limits. Higher chlorine residuals are an unnecessary cost and can be a source of toxic chlorinated organic compounds.

Split sample comparison between labs was good. Review of laboratory procedures was deemed "acceptable." Future inspections may want to include a portable Doppler-type flow meter to verify flow rates.

No acute effluent toxicity was observed, but sublethal effects were very pronounced in the oyster larvae test. Slight toxicity was found in the sediment samples. None of the toxicity was considered serious and is not believed to be linked to pen-reared salmon deaths. Future bioassay testing may want to include Microtox for sediments and other effluent tests (e.g., echinoderm and Ceriodaphnia).

No organic compounds or metals were observed at high levels. Effluent resin acids (from a subsequent sampling) were found at unusually low levels.

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APPENDICES

Appendix I. Priority pollutant scan results, Port Townsend Paper Company Class II inspection, December 1-2, 1987.

Sample:	Effluent (ug/L)	Sediment Samples (ug/kg dry weight) South	North	Control
Chloromethane	1.9 U	8.7 U	7.9 U	3.0 U
Bromomethane	1.6 U	7.1 U	6.4 U	2.5 U
Vinyl Chloride	1.0 U	4.6 U	4.1 U	1.6 U
Chloroethane	1.7 U	7.6 U	6.8 U	2.6 U
Methylene Chloride	**1.0 JB**	**25 B**	**45 B**	**11 B**
Acetone	3.5 U	16 U	**22**	**13**
Carbon Disulfide	0.6 U	2.8 U	2.5 U	1.0 U
1,1-Dichloroethene	0.4 U	1.6 U	1.5 U	0.6 U
1,1-Dichloroethane	0.3 U	1.4 U	1.2 U	0.5 U
Trans-1,2-Dichloroethene	0.4 U	1.8 U	1.7 U	0.6 U
Chloroform	0.6 U	2.5 U	2.3 U	0.9 U
1,2-Dichloroethane	0.3 U	11 U	1.0 U	0.4 U
2-Butanone	3.1 U	14 U	13 U	4.9 U
1,1,1-Trichloroethane	0.3 U	1.4 U	1.2 U	0.5 U
Carbon Tetrachloride	0.5 U	2.1 U	1.9 U	0.7 U
Vinyl Acetate	1.6 U	7.1 U	6.4 U	2.5 U
Bromodichloromethane	0.2 U	0.7 U	0.6 U	0.2 U
1,2-Dichloropropane	0.4 U	1.6 U	1.5 U	0.6 U
Trans-1,3-Dichloropropene	0.9 U	4.1 U	3.7 U	1.4 U
Trichloroethene	0.3 U	1.4 U	1.2 U	0.5 U
Dibromochloromethane	0.4 U	1.6 U	1.5 U	0.6 U
1,1,2-Trichloroethane	0.4 U	1.6 U	1.5 U	0.6 U
Benzene	0.5 U	2.3 U	2.1 U	0.8 U
cis-1,3-Dichloropropene	1.0 U	4.4 U	3.9 U	1.5 U
2-Chloroethylvinylether	1.4 U	6.2 U	5.6 U	2.1 U
Bromoform	1.3 U	5.7 U	5.2 U	2.0 U
4-Methyl-2-Pentanone	1.8 U	8.0 U	7.3 U	2.8 U
2-Hexanone	1.6 U	7.3 U	6.6 U	2.5 U
Tetrachloroethene	0.3 U	11 U	1.0 U	0.4 U
1,1,2,2-Tetrachloroethane	1.4 U	6.2 U	5.6 U	2.1 U
Toluene	0.4 U	1.8 U	1.7 U	0.6 U
Chlorobenzene	0.5 U	2.1 U	1.9 U	0.7 U
Ethylbenzene	0.4 U	1.8 U	1.7 U	0.6 U
Styrene	0.6 U	2.5 U	2.3 U	0.9 U
Total Xylenes	0.9 U	4.1 U	3.7 U	1.4 U
Phenol	0.2 U	50 U	27 U	**320**
bis(2-Chloroethyl)Ether	0.2 U	51 U	30 U	14 U
2-Chlorophenol	0.2 U	57 U	33 U	15 U
1,3-Dichlorobenzene	0.1 U	20 U	12 U	5.4 U
1,4-Dichlorobenzene	0.2 U	53 U	31 U	14 U
Benzyl Alcohol	0.3 U	61 U	36 U	16 U
1,2-Dichlorobenzene	0.1 U	14 U	8.1 U	3.7 U
2-Methylphenol	0.3 U	69 U	40 U	19 U
bis(2-chloroisopropyl)ether	0.6 U	150 U	88 U	41 U
4-Methylphenol	0.1 U	35 U	20 U	**48 M**
N-Nitroso-Di-n-Propylamine	0.4 U	92 U	53 U	25 U
Hexachloroethane	0.4 U	92 U	53 U	25 U

Appendix I. - (continued)

Sample:	Effluent (ug/L)	Sediment Samples (ug/kg dry weight) South	North	Control
Nitrobenzene	0.3 U	63 U	36 U	17 U
Isophorone	0.6 U	140 U	81 U	37 U
2-Nitrophenol	0.8 U	180 U	110 U	50 U
2,4-Dimethylphenol	0.7 U	160 U	96 U	44 U
Benzoic Acid	0.8 U	200 U	110 U	52 U
bis(2-Chloroethoxy)Methane	0.6 U	140 U	81 U	37 U
2,4-Dichlorophenol	0.8 U	200 U	110 U	52 U
1,2,4-Trichlorobenzene	0.5 U	110 U	63 U	29 U
Naphthalene	0.8 U	190 U	110 U	50 U
4-Chloroaniline	0.4 U	100 U	59 U	27 U
Hexachlorobutadiene	0.4 U	110 U	61 U	28 U
4-Chloro-3-Methylphenol	0.5 U	110 U	63 U	29 U
2-Methylnaphthalene	0.4 U	100 U	59 U	27 U
Hexachlorocyclopentadiene	0.4 U	99 U	58 U	27 U
2,4,6-Trichlorophenol	0.2 U	35 U	21 U	10 U
2,4,5-Trichlorophenol	0.2 U	43 U	25 U	11 U
2-Chloronaphthalene	0.0 U	8.5 U	4.9 U	2.3 U
2-Nitroaniline	0.8 U	190 U	110 U	50 U
Dimethyl Phthalate	0.2 U	57 U	33 U	15 U
Acenaphthylene	0.1 U	12 U	6.8 U	3.1 U
3-Nitroaniline	0.5 U	110 U	63 U	29 U
Acenaphthene	0.3 U	66 U	39 U	18 U
2,4-Dinitrophenol	1.6 U	370 U	220 U	99 U
4-Nitrophenol	0.5 U	120 U	69 U	32 U
Dibenzofuran	0.4 U	97 U	57 U	26 U
2,4-Dinitrotoluene	0.2 U	57 U	33 U	15 U
2,6-Dinitrotoluene	0.7 U	160 U	92 U	42 U
Diethylphthalate	0.2 U	46 U	27 U	12 U
4-Chlorophenyl-phenylether	0.4 U	83 U	49 U	22 U
Fluorene	0.3 U	68 U	40 U	18 U
4-Nitroaniline	0.9 U	220 U	130 U	58 U
4,6-Dinitro-2-Methylphenol	0.6 U	390 U	230 U	100 U
N-Nitrosodiphenylamine	0.8 U	190 U	110 U	50 U
4-Bromophenyl-phenylether	0.3 U	76 U	44 U	20 U
Hexachlorobenzene	0.4 U	100 U	59 U	27 U
Pentachlorophenol	0.3 U	74 U	43 U	20 U
Phenanthrene	0.4 U	**120**	**175**	**15 M**
Anthracene	0.2 U	**48 M**	**57**	14 U
Di-n-Butylphthalate	0.4 U	89 U	52 U	24 U
Fluoranthene	0.9 U	**230**	**420**	**22 J**
Pyrene	0.8 U	**290**	**380**	**25 J**
Butylbenzylphthalate	1.0 U	240 U	140 U	63 U
3,3'-Dichlorobenzidine	0.4 U	95 U	55 U	25 U
Benzo(a)Anthracene	0.6 U	**210**	**180**	40 U
bis(2-Ethylhexyl)Phthalate	0.7 J	**42 M**	**68 J**	**51 J**
Chrysene	0.2 U	**300**	**280**	10 U
Di-n-Octyl Phthalate	0.8 U	190 U	110 U	51 U

Appendix I. - (continued)

Sample:	Effluent (ug/L)	Sediment Samples (ug/kg dry weight)		
		South	North	Control
Benzo(b)Fluoranthene	0.2 U	**300**	**300**	17 J
Benzo(k)Fluoranthene	1.0 U	**300**	**300**	**17 J**
Benzo(a)Pyrene	0.1 U	**130**	**130**	6.7 U
Indeno(1,2,3-cd)Pyrene	0.4 U	100 U	59 U	27 U
Dibenz(a,h)Anthracene	0.5 U	120 U	69 U	32 U
Benzo(ghi)Perylene	0.5 U	110 U	63 U	29 U
Guaiacol	-	120 U	69 U	31 U

Qualifiers:

U = Compound was analyzed for but not detected at the given detection limit.

J = Estimated value when result is less than the specified detection limit.

B = Analyte was found in blank as well as a sample, and indicates possible/probable blank contamination.

M = Estimated value of analyte found and confirmed by analyst, but with low spectral match parameters.

Appendix II. Laboratory analytical methods. PTPC Class II inspection; December 1-2, 1987.

Analysis	Method	Method Number	Reference	Laboratory
BNA	GC/MS	625	EPA(1984a&b)	ARI, Seattle
VOA	GC/MS	624	EPA(1984a&b)	ARI, Seattle
Pest/PCB	GC/ECD	608	EPA(1984a&b)	ARI, Seattle
Resin Acids	GC/MS	-	NCASI (1986)	Ecology
Metals	AA	-	EPA CLP SOW #785	Ecology