93-e33

CLASS II INSPECTION OF THE BOISE CASCADE PULP & PAPER MILL, WALLULA, WASHINGTON - APRIL 1992

by
Art Johnson and
Marc Heffner

Washington State Department of Ecology
Environmental Investigations and Laboratory Services Program
Toxics, Compliance and Groundwater Investigations Section
Olympia, Washington 98504-7710

Water Body No: WA-CR-1020
Segment No: 26-00-02

February 1993

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS iii

ABSTRACT iv

INTRODUCTION 1

OBJECTIVES 1

METHODS 1
- Sample Collection 1
  - In Plant Sampling 1
  - River Sampling 3
  - Sample Handling 3
- Laboratory Analysis 3
  - Chemistry 3
  - Biology 6
  - Analytical Methods 6

DATA QUALITY 6
- Quality Assurance Review 6
- Field Blanks 7
- Duplicate Sampling 7

RESULTS AND DISCUSSION 7
- Mill Operating Conditions 7
- Permit Compliance 8
  - BOD/TSS/pH 8
  - Salmonid Bioassay 9
  - TCDD/AOX 9
- Effluent Toxicity 10
  - Water Quality Criteria 10
  - Chromium 12
  - Other Toxics 12
  - Effluent Bioassays 12
  - Microbiology 13
- Treatment Efficiency 14
- AOX/TOX/DOX 15
- Bleach Plant 15
- Duplicate Sampling 15
- Sludges 17

TABLE OF CONTENTS (Continued)

Page

River Sediments 17
General Characteristics 17
Chemicals Detected 18
Bioassays 20
Other Sediment Data 21

SUMMARY OF MAJOR FINDINGS 23

RECOMMENDATIONS 25

REFERENCES 26

ACKNOWLEDGEMENTS

The authors appreciate the assistance of Dave Serdar in collecting sediment and sludge samples for this inspection. Word processing and report formatting was done by Kelly Carruth.

ABSTRACT

The Department of Ecology conducted an inspection of the Boise Cascade bleached kraft pulp & paper mill at Wallula, Washington, during April 1992. The mill's discharge to the Columbia River was in compliance with NPDES permit limits for five-day biochemical oxygen demand (BOD5), total suspended solids (TSS), pH, and the salmonid bioassay. A 2,3,7,8-TCDD (dioxin) concentration of 2.9 pg/L was measured in the final effluent; this is within the 10 pg/L limit that becomes effective in 1994.

Chemical analyses and bioassays indicated the final effluent had a low potential to cause toxicity in the receiving water, although trace levels of bioaccumulative dioxins, furans, and phenolics were detected. Concentrations of fecal coliform bacteria (30% *Klebsiella*) in the effluent suggested possible violations of state Class A water quality standards downstream of the mill. A limited survey of the Columbia River sediments showed substantial toxicity in 10-day bioassays with the amphipod *Hyallela azteca*. The reason for toxicity was not evident from chemical analysis of the sediments, but the mill did not appear to be the source of the problem.

Recommendations include: 1) initiating effluent monitoring for fecal coliform/*Klebsiella* bacteria, 2) re-evaluating the need for analyzing certain toxics in the effluent, 3) assessing the accuracy of future total phenols data submitted by the mill, 4) managing ASB sludge to prevent dioxin/furan release to the environment, and 5) doing additional bioassays of river sediments.

INTRODUCTION

The Department of Ecology conducted a Class II Inspection of the Boise Cascade Corp. bleached kraft pulp & paper mill at Wallula, Washington, during April 1992. The mill is located on the east shore of the Columbia River (Lake Wallula) about 15 miles southeast of Pasco. It discharges an average of 30 million gallons per day (MGD) of secondary treated effluent and non-contact cooling water to the Columbia via a mid-channel diffuser at river mile 316. Discharge is allowed under conditions of NPDES permit No. WA 000369-7 which was issued for five years beginning May 10, 1991.

The inspection was conducted by Marc Heffner and Art Johnson of the Environmental Investigations and Laboratory Services Program, assisted by Wayne Wooster of the Industrial Section. Dennis Ross, Environmental Control Director for the mill, arranged access to sampling points and provided information on the operating status of the mill. Cheryl Benar acted as Boise Cascade's observer during the inspection.

The Class II was scheduled to coincide with normal operation of the mill and was announced prior to being conducted.

OBJECTIVES

The primary objectives of the inspection were to:

- Verify compliance with NPDES permit limits
- Assess potential for the effluent to cause aquatic toxicity
- Evaluate efficiency of wastewater treatment
- Obtain data on dioxins and other toxics in bleach plant effluents and in sludges
- Survey Columbia River sediment quality above and below the mill

METHODS

Sample Collection

Sampling of mill effluents began at 0600 hours April 7 and was completed at 1315 hours the following day. Plant sludges and Columbia River sediments were collected April 13-14.

In Plant Sampling

Samples were collected at 13 points along Boise Cascade's waste stream (Figure 1). Areas sampled included the primary clarifier, bleach plant, aerated stabilization basin (ASB), cooling

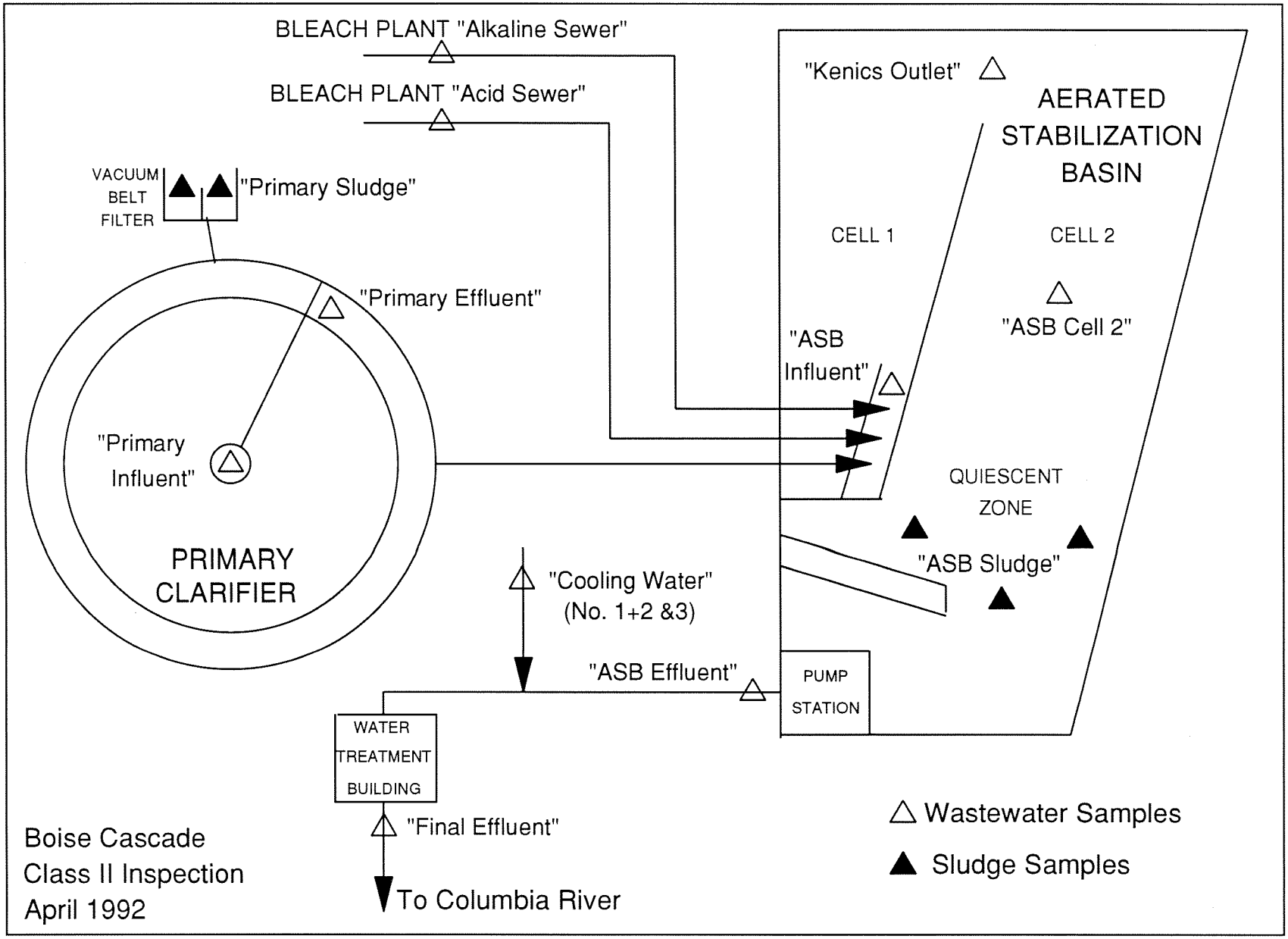

Figure 1. Schematic of Treatment System and Sampling Points (mod. from ENSR Engineering)

water lines, and final effluent. Samples were also taken from Boise Cascade's compositors on the ASB and final effluents. Appendix A contains a description of each sampling point.

Sampling methods (24-hour automatic composites, individual grabs, or grab composites) and timing are recorded as headers of tables in Appendix B. Automatic composites were obtained using ISCO samplers fitted with teflon sampling lines and glass carboys. These were set to collect equal volumes every 30 minutes. Grabs were taken with stainless steel dippers or directly into sample containers. Sludge samples were composites of multiple grabs taken with stainless steel spoons (primary clarifier) or three grabs with a stainless steel Ponar grab sampler (ASB).

River Sampling

Figure 2 shows the general locations where river sediments were collected. Four sites were sampled: one mile above the mill, off the upstream end of Badger Island; at the mill's old outfall (discontinued in 1989); five miles below the mill, near Port Kelley; and 18 miles below the mill, near Hat Rock. Sediment was not collected at the present outfall because it is not in a depositional area. Positions of the sampling stations are given in Appendix C.

Each sediment sample consisted of a composite of the top 2-cm surface layer from three separate grabs taken with a Ponar. The composites were homogenized using stainless steel spoons and beakers before being split into subsamples for analysis.

Sample Handling

Sampling equipment was cleaned with solvents and dilute nitric acid following standard Class II practice. Sample containers, preservation, and holding times are described in Huntamer and Hyre (1991). All samples were kept on ice after collection and for transport to the Ecology Manchester Environmental Laboratory. Chain-of-custody was maintained from sample collection through analysis.

Laboratory Analysis

Table 1 gives an overview of the analytical scheme for the inspection.

Chemistry

The general approach for chemical analysis was as follows: basic water quality data, including the NPDES permit parameters total suspended solids (TSS) and pH, were obtained for each sampling point along the waste stream. Five-day biochemical oxygen demand (BOD5), also a permit parameter, was determined in samples from the primary clarifier, ASB, and final effluent.

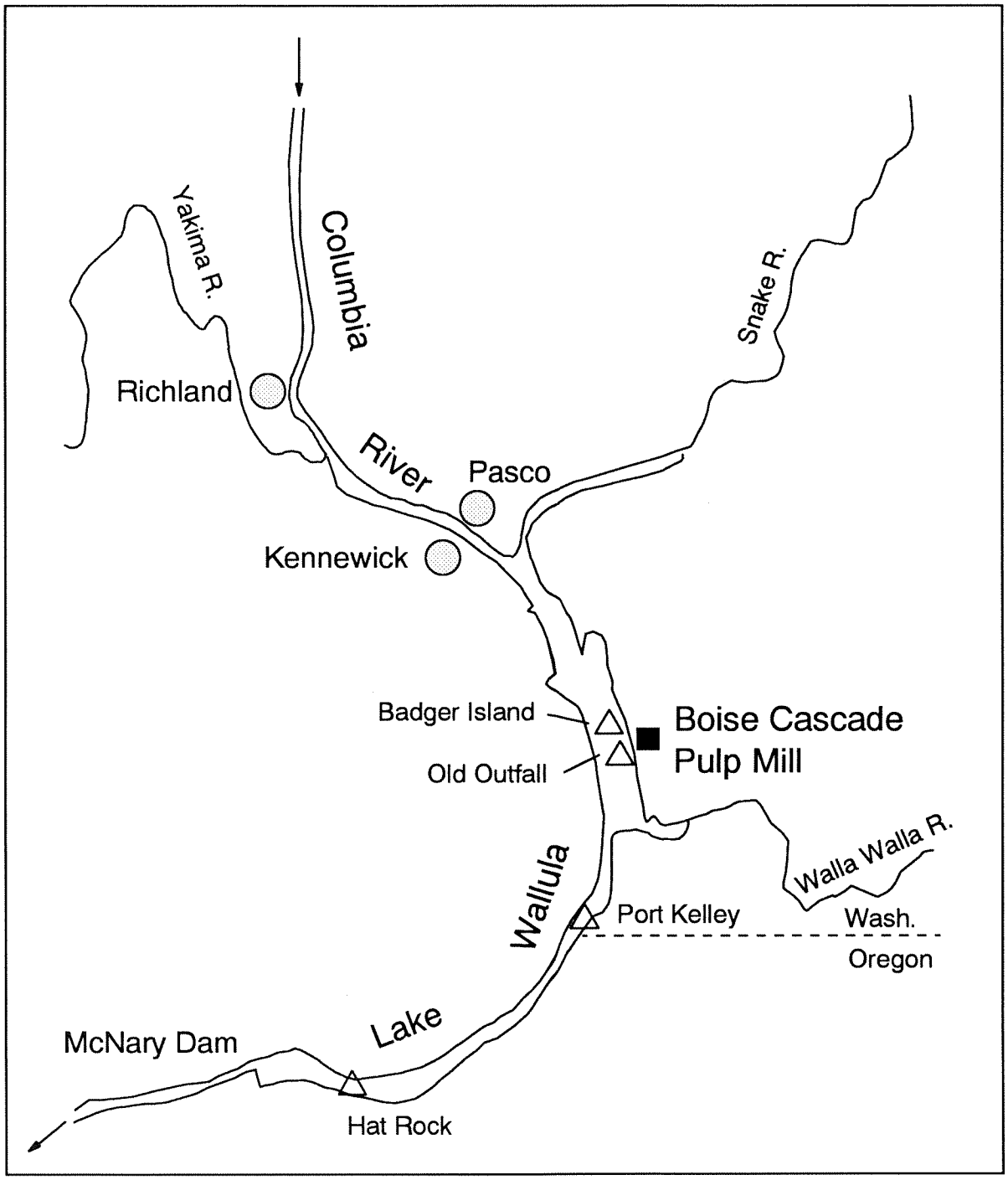

Figure 2. General Location of Ecology Sediment Samples (△)
Boise Cascade Class II Inspection, April 1992

TABLE 1. DATA OBTAINED DURING BOISE CASCADE CLASS II INSPECTION, APRIL 1992

ANALYSIS	PRIMARY CLARIFIER	BLEACH PLANT	ASB	COOLING WATER	FINAL EFFLUENT	SLUDGE	RIVER SEDIMENT
NPDES PERMIT:							
pH	X	X	X	X	X		
TSS	X	X	X	X	X		
BOD5	X		X		X		
2,3,7,8-TCDD		X	X		X	X	X
AOX		X	X		X		
Salmonid Bioassay					X		
TOXICS:							
Cyanide	X		X		X		
Priority Pollutant Metals	X		X		X	X	X
Hexavalent Chromium			X		X		
Volatiles		X	X		X	X	X
Polychlorinated Dioxins,Furans		X	X		X	X	X
Resin & Fatty Acids,Phenolics			X		X	X	X
OC Pesticides,PCBs					X	X	X
Semi-volatiles					X		
GENERAL PHYSICAL/CHEMICAL:							
Temperature,Conductivity	X	X	X	X	X		
COD and/or TOC	X	X	X	X	X	X	X
Hardness	X		X	X	X		
Alkalinity	X		X		X		
TS,TNVS,TNVSS	X		X		X		
Oil & Grease			X	X	X		
Nutrients			X		X		
Color			X		X		
Chlorate		X	X		X		
Total Phenols		X	X		X		
TOX/DOX or EOX		X	X		X	X	X
Grain Size						X	X
% Solids, % Volatile Solids						X	X
BIOASSAYS:							
Daphnia Bioassay					X		
Ceriodaphnia Bioassay					X		
Fathead Minnow Bioassay					X		
Hyalella Bioassay							X
Microtox Bioassay							X
MICROBIOLOGY:							
Fecal Coliforms, % Klebsiella					X		

Analyses for dioxin (2,3,7,8-TCDD) and absorbable organic halogen (AOX) - two additional parameters addressed in the NPDES permit - as well as other toxic chemicals of potential interest (e.g., chloroform and chromium) focused on the bleach plant, ASB, and final effluent. At the request of the Industrial Section, organic halogen was also analyzed by a separate method as total (TOX) and dissolved (DOX).

Changes were made to the 2,3,7,8-TCDD and AOX limits in Boise Cascade's NPDES permit after the inspection was conducted. Compliance with the daily maximum and annual average limits for 2,3,7,8-TCDD is now demonstrated if a 24-hour composite of the final effluent has 10 pg/L or less, or is not detected at a detection limit of 10 pg/L or less (Burkhalter, 1992). The 2,3,7,8-TCDD limit goes into effect in 1994, as specified in the original permit. As the result of an appeal by Boise Cascade to the Pollution Control Hearings Board, AOX limits, which were to have gone into effect in 1995, no longer apply.

The analyses done on sludge and river sediments during the inspection covered the same toxics analyzed in mill wastewaters, except semivolatiles. Extractable organic halogen (EOX) was analyzed on solids samples.

Biology

Bioassays were conducted on the final effluent and on river sediments. Effluent bioassays included the 96-hour rainbow trout (*Oncorhynchus mykiss*) acute toxicity test required quarterly in the permit. Other effluent bioassays involved acute and/or chronic tests using fathead minnows (*Pimephales promelas*, 96-hours and 7-day) and the water fleas *Daphnia magna* (48-hour) and *Ceriodaphnia dubia* (7-day). Concentrations of fecal coliform bacteria and percent *Klebsiella* bacteria were also determined in the final effluent.

The potential toxicity of river sediments was evaluated with the 10-day amphipod (*Hyallela azteca*) bioassay and Microtox, a 15-minute screening test using a luminescent bacterium (*Photobacterium phosphoreum*). Bioassays were not done on sludge.

Analytical Methods

Samples were analyzed at the Manchester Laboratory or by contract laboratories. Methods of chemical analysis are referenced in Appendix D.

DATA QUALITY

Quality Assurance Review

Written quality assurance reviews were prepared by the Manchester Laboratory for all laboratory data contained in this report. For the chemical data this included assessment of sample holding times, instrument calibration, method blanks, spike and surrogate recoveries, and precision data.

All chemical data are considered acceptable for use with the qualifiers shown. Reviews of the bioassays showed water quality measurements, response of controls, results for reference toxicants, and other QA/QC were appropriate for the health of the test organisms and within requirements of the test methods. Quality assurance practice at the Manchester Laboratory is described in Huntamer and Hyre (1991) and Kirchmer (1988).

Field Blanks

A field blank (transfer blank) was prepared for chemicals to be analyzed at or below the parts per billion level. This was done at the ASB by pumping deionized, organic-free water through an ISCO sampler, or, in the case of volatiles and cyanide, pouring directly into sample containers. Results (Appendix B) showed that, except for a trace amount of acetone (11 μg/L), there was no evidence of contamination due to sample collection or handling.

The field blank was not analyzed for semivolatiles or pesticides/PCBs. ISCO blanks prepared in the same fashion for previous Ecology Class II inspections have not had significant contamination by these compounds (e.g, Heffner, 1992; Andreasson, 1991).

Duplicate Sampling

Cheryl Benar collected duplicates of selected Ecology samples for analysis by Boise Cascade. Duplicate samples at the primary clarifier, ASB, and final effluent were taken from Ecology's ISCO composites. Duplicates from the bleach plant sewers were collected side by side with Ecology grabs. The results are summarized later in the report. The complete Boise Cascade data are in Appendix E (Dennis Ross transmitted BOD5 and TSS data by phone).

RESULTS* AND DISCUSSION

Mill Operating Conditions

Process information for the period of the inspection was supplied by Dennis Ross as summarized in Table 2. Substitution of chlorine dioxide for chlorine was reported to be 70% on April 6, 7, and 8. A weekly average substitution level of 70% was also reported to have been achieved during the previous four weeks.

The mill was operating normally except for a shutdown of the bleach plant from 0500-1200 hours on April 7. This was caused by failure of a washer seal. The start time of Ecology's ASB influent composite was therefore delayed to 2400 hours. ASB influent grabs and all

*The complete chemical data obtained from the inspection are tabulated in Appendix B. Bioassays of the final effluent were conducted on grab composite sample number 158253.

TABLE 2. BOISE CASCADE PROCESS DATA (provided by Dennis Ross)			
DATE (1992):	APRIL 6	APRIL 7	APRIL 8
PRODUCTION:			
Bleach Plant	872	*612	948
Paper Mill No. 1	500	*133	494
Paper Mill No. 2	330	322	321
Paper Mill No. 3	539	537	626
EFFLUENT FLOW (MGD):			
Primary Effluent	10.72	11.80	11.97
Acid Sewer	2.51	1.76	2.73
Alkaline Sewer	1.56	1.09	1.70
ASB Effluent	16.91	17.79	17.77
Final Effluent	28.01	28.84	28.66
CHLORINE DIOXIDE SUBSTITUTION:	70%	70%	70%

*Bleach Plant down for repairs

samples from the bleach plant sewers were collected on April 8. Because of the six-to-seven day detention time of the ASB, no other adjustments were required to the sampling schedule at the ASB effluent or final effluent.

Permit Compliance

Discharge limits for the final effluent are compared in Table 3 to results of Ecology's inspection. Also shown are Boise Cascade data for April 7 as contained in their monthly discharge monitoring report (DMR). Loadings were calculated using the flow reported by the mill.

Effluent flow could not be independently verified during the inspection. The NPDES permit contains requirements intended to ensure the flow measurements are accurate. Yake (1992) has raised concerns about Ecology's inability to verify flow at permitted facilities.

BOD/TSS/pH

Results showed Boise Cascade's final effluent was within discharge limits for BOD5, TSS and pH. BOD5 and TSS results from Ecology's composite sample were in reasonable-to-good agreement with samples analyzed from Boise Cascade's composite and with data reported in the DMR. The Ecology pH data are the range of measurements on grabs and the Ecology composite (Appendix B.1).

TABLE 3. NPDES PERMIT COMPLIANCE - BOISE CASCADE, APRIL 1992					
	EFFLUENT LIMITS		INSPECTION RESULTS		BOISE CASCADE MONITORING REPORT
PARAMETER	Monthly Average	Daily Maximum	Ecology Composite	Boise Cascade Composite	April 7 Data
BOD5 (lbs/day)	12,000	22,900	7,900	6,200	6,000
TSS (lbs/day)	26,100*	50,800*	16,800	16,300	16,300
pH	5.1 to 9.0		7.44 to 7.79 (grabs & composites)	NA	7.35 to 7.46
Salmonid Bioassay	80% survival in 65% effluent		100% survival in 65% & 100%	NA	NA
2378-TCDD (pg/L)	10** (annual average)	10**	2.9 E	NA	NA
Flow (MGD)	-	-	NA	NA	28.84
AOX (lbs/day)	2,870 (annual average	3,690 (monthly maximum)	2,920	NA	NA

NOTE: AOX limit no longer applies
*ASB effluent
**TCDD limit to be achieved by 1994
NA = not analyzed
E = based on estimated maximum possible concentration

Salmonid Bioassay

Rainbow trout bioassays were conducted using both the 65% effluent concentration specified in the permit and undiluted effluent. The test chambers were not aerated. No fish died in either test.

TCDD/AOX

The mill's discharge of 2,3,7,8-TCDD was within the daily and annual limit of 10 pg/L set for 1994. The AOX discharge measured during the inspection was within the monthly maximum but slightly in excess of the annual average that was to have been achieved in 1995. As previously noted, the AOX limit no longer applies.

The concentration of 2,3,7,8-TCDD in the final effluent was 2.9 pg/L (Appendix B.4). This result was qualified by the analyzing laboratory as an "estimated maximum possible concentration," a flag indicating all qualitative identification criteria were not met during GC/MS analysis. Therefore, although the detection of 2,3,7,8-TCDD is not in doubt, the load calculation may be an overestimate.

Effluent Toxicity

Water Quality Criteria

EPA has developed water quality criteria for fifteen of the chemicals detected in the final effluent (EPA, 1986 and updates). Table 4 compares their concentrations to criteria for protecting freshwater life. For the organic compounds, EPA gives the lowest levels at which adverse effects have been reported (LOELs), rather than concentrations considered protective of aquatic life. The EPA criteria have been adopted as state water quality standards.

The toxicity of zinc, copper, and lead increase as water hardness decreases. A hardness value of 50 mg/L (as $CaCO_3$) was used to calculate criteria shown for these metals in Table 4. Fifty mg/L is at the lower end of the hardness range for the Columbia River at Richland (Miles, *et al.*, 1991). If effluent concentrations are compared to criteria under hardness conditions of the final effluent (214-228 mg/L; Appendix B.1), no criteria violations occur for metals.

Among the metals detected in the final effluent, copper and mercury substantially exceeded acute and/or chronic water quality criteria, while zinc was essentially at the criteria level. Lead may have slightly exceeded the chronic water quality criterion, but its quantitation was uncertain. A trace of cyanide, well below criteria, was also present.

Yee's (1992) review of dilution ratio studies by Boise Cascade concluded the acute and chronic ratios for the final effluent are 43:1 and 306:1, respectively. Under these conditions, concentrations of all metals would be in compliance with acute and chronic water quality criteria. Adequate dilution assumes a low background for copper and mercury in the receiving water. At present, there are no reliable data to verify that assumption.

None of the organic compounds detected in the final effluent exceeded levels given by EPA as adversely affecting aquatic life. In most instances, concentrations were one or more orders of magnitude below LOELs.

Chlorinated phenols have the potential to impair the flavor of fish at concentrations lower than those toxic to aquatic organisms. The concentration of one of the phenols detected in the final effluent, 2,4-dichlorophenol, was higher by a factor of ten than the Canadian water quality guideline of 0.2 μg/L to prevent fish tainting (CCREM, 1987). The Department of Wildlife has received complaints about off-flavors of fish caught below the Boise Cascade pulp mill in the past, but is not aware of any reports indicating this is a current problem (Schuck, personal communication, 1993).

TABLE 4. FINAL EFFLUENT COMPARED TO EPA WATER QUALITY CRITERIA (ug/L) - BOISE CASCADE, APRIL 1992

CHEMICAL	EFFLUENT CONCENTRATION	AQUATIC LIFE Acute Criteria	AQUATIC LIFE Chronic Criteria	REMARKS
INORGANICS:				
Zinc	72.2	65	59	@ 50 mg/L hardness
Copper	22	9.2	6.5	@ 50 mg/L hardness
Chromium	9.8 P	980/16	120/11	criteria are for chromium III/VI
Lead	3.7 P	34	1.3	@ 50 mg/L hardness
Cyanide	2	22	5.2	criteria are for free cyanide
Arsenic	1.8 P	360/850	190/48	criteria are for arsenic III/V
Mercury	0.72 P	2.4	0.012	
VOLATILES:				
Chloroform	14	28,900	1,240	lowest observed effect level
Toluene	9	17,500		lowest observed effect level
PHENOLICS:				
2,4-Dimethylphenol	0.1 J	2,120		lowest observed effect level
2,4-Dichlorophenol	2	2,020	365	lowest observed effect level
2,3,6-Trichlorophenol	4		970	LOEL for 2,4,6-trichlorophenol
DIOXINS:				
2,3,7,8-TCDD	0.0000029 E	0.01	0.00001	lowest observed effect level
PHTHALATES:				
Diethylphthalate	2	940	3	LOEL for total phthalates
Dimethylphthalate	2	940	3	LOEL for total phthalates

NOTE: metals are total recoverable

P = detected below quantitation limit

J = estimated concentration

E = estimated maximum possible concentration

Chromium

The NPDES permit identifies hexavalent chromium as a pollutant of concern in the final effluent. During the Class II Inspection, hexavalent chromium was analyzed at the ASB and in the final effluent (Appendix B.9). Although none was detected, the samples exceeded the 24-hour holding time to analysis by approximately two days.

Chromium was also analyzed as total recoverable at all sampling points along the waste stream; only low concentrations of 5.6-12 μg/L were found. The chromium concentration in the final effluent was 9.8 μg/L (Appendix B.9).

Other Toxics

2,3,7,8-TCDF, numerous resin & fatty acids, and additional phenolics were detected in the final effluent (Appendix B). These compounds have no associated EPA water quality criteria.

2,3,7,8-TCDF was analyzed at 29.0 pg/L. It was also detected in the method blank at 3.6 pg/L. The lowest concentrations which have been shown to cause adverse effects in laboratory experiments on fish are in the low ng/L range, two-to-three orders of magnitude higher than in the effluent (Mehrle *et al.*, 1988).

Effluent concentrations of individual resin acids, fatty acids, and phenolics were 1-180 μg/L, 2-13 μg/L, and 0.1-7 μg/L, respectively. McLeay & Associates (1986) have reviewed available data on aquatic toxicity of these compounds. LC50s were reported as follows: 2,000-8,200 μg/L for fatty acids; 400-1,740 μg/L for resin acids; and 200-2,800 μg/L for chlorinated phenolics. Sublethal effects are generally considered unlikely at concentrations 0.1 to 0.01 times the LC50 (NAS, 1973).

Effluent Bioassays

Overall, bioassays of the final effluent indicated the potential for Boise Cascade's discharge to cause toxicity in the receiving water was low (Table 5). Test for acute toxicity using rainbow trout, fathead minnows, and *Daphnia* resulted in no mortality. The chronic toxicity tests showed longer exposure to effluent was toxic to fathead minnows, but not *Ceriodaphnia*. The LC50 for 7-day exposure of fathead minnows was 35% effluent; the LOEC was > 25%.

Ceriodaphnia survival was 100% at all effluent concentrations tested. Intermediate concentrations of effluent appeared to stimulate *Ceriodaphnia* reproduction, while a decrease in reproduction occurred at 100% effluent. Because of poor survival in the control, it is not known if decreased reproduction was due to inhibition or less stimulation than at lower concentrations. Although the data suggest the effluent is relatively non-toxic to *Ceriodaphnia*, a NOEC could not be calculated because of the control mortality. Detailed results from the effluent bioassays are reported in EVS (1992).

TABLE 5. RESULTS OF FINAL EFFLUENT BIOASSAYS - BOISE CASCADE, APRIL 1992				
ACUTE TOXICITY TESTS				
Species:	Rainbow trout	Rainbow trout	Fathead minnow	Daphnia
Exposure:	65% effluent	100% effluent	0-100% effluent	0-100% effluent
Duration:	96 hours	96 hours	96 hours	48 hours
Endpoint:	survival	survival	survival	survival
LC50:	>100%	>100%	>100%	>100%
CHRONIC TOXICITY TESTS				
Species:	Fathead minnow	Fathead minnow	Ceriodaphnia	Ceriodaphnia
Exposure:	0-100% effluent	0-100% effluent	0-100% effluent	0-100% effluent
Duration:	7 day	7 day	7 day	7 day
Endpoint:	survival	growth	survival	reproduction
LC50:	35%	-	>100%	-
NOEC:	25%	25%	>100%	appeared relatively
LOEC:	50%	>25%	>100%	non-toxic; see text

LC50 = effluent concentration causing 50% mortality
NOEC = no observed effect concentration
LOEC = lowest observed effect concentration

It should be emphasized that neither the bioassays nor preceding discussion of toxicity data address concerns due to persistent organic compounds with significant bioaccumulation potential. Effluent constituents in this category include chlorinated dioxins, furans, and phenolics.

Microbiology

Examination of two separate grabs from the final effluent indicated the mill was discharging large amounts of fecal coliform bacteria (Appendix B.1). Bacteria counts by the MF (membrane filter) method were 91,000 and 98,000 colonies/100mL, of which approximately 30% were identified as *Klebsiella*. Lower counts of 11,000 and 13,000 colonies/100mL were obtained by the MPN (most probable number) method. The MF data are considered the more reliable when counts are this high (Jensen, personal communication).

These results suggest possible violations of state Class A water quality standards downstream of the mill. Based on the MF data, fecal coliform concentrations at the boundary of the mixing zone (306:1) would be on the order of 300 colonies/100mL. The Class A criterion is a geometric mean of 100 colonies/100mL.

Treatment Efficiency

Estimates of treatment efficiency for NPDES parameters and other selected constituents are summarized in Table 6. Based on Ecology composite samples, TSS removal was 72% in the primary clarifier and 60% in the ASB. BOD5 concentrations were reduced 90% through the ASB.

Little or no removal was evident in the ASB for AOX, 2,3,7,8-TCDD or 2,3,7,8-TCDF. The latter two compounds could not be quantified accurately in the ASB influent. Comparison of 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in the bleach plant sewers and in the ASB effluent suggest the ASB sludge may be acting as a source of these compounds to the final effluent (see Bleach Plant).

TABLE 6. TREATMENT/REMOVAL EFFICIENCY - BOISE CASCADE, APRIL 1992

	PRIMARY CLARIFIER			AERATED STABILIZATION BASIN		
CONSTITUENT	Influent	Effluent	% Removed	Influent	Effluent	% Removed
NPDES PERMIT:						
TSS (mg/L)	357	100	72%	267	108	60%
BOD5 (mg/L)	366	344	6%	443	44	90%
AOX (mg/L)	NA	NA	-	23.3	19.6	16%
2,3,7,8-TCDD (pg/L)	NA	NA	-	4.3U	5.4	0%
SELECTED TOXICS:						
2,3,7,8-TCDF (pg/L)	NA	NA	-	15.3B	48.3B	0%
Sum of Resin & Fatty Acids *(ug/L)	NA	NA	-	2,580	960	63%
Chloroform (ug/L)	NA	NA	-	350	20	94%
Total Phenols (ug/L)	NA	NA	-	919	22.1	98%
Sum of Phenolics (ug/L)	NA	NA	-	2,530	49	98%
Chlorate (mg/L)	NA	NA	-	95	0.5U	100%

NA = not analyzed
U = not detected at or above reported value
B = analyte found in method blank at 3.6 pg/L
*less palustric acid

The ASB was effectively removing other potentially toxic chemicals from the waste stream, such as chloroform, resin & fatty acids, phenolic compounds, and chlorate. Removal efficiencies ranged from 63% for resin & fatty acids to 94-100% for the remaining compounds.

AOX/TOX/DOX

Three measures of organic halogens, each analyzed in duplicate, were obtained on composite samples collected from the bleach plant sewers, ASB influent, ASB effluent, and final effluent (Appendix B.2). Similar results were obtained for AOX (SCAN-W 9:89 Method) and DOX (Standard Methods No. 5320). The DOX analysis consistently gave slightly higher results than AOX.

The TOX results are unreliable. During this analysis there was greater than 10% breakthrough to the second of two activated carbon columns used to separate organic material from inorganic halides. The analysts thought this problem may have been due to shorter pyrolysis time for TOX compared to DOX (5 vs. 10 minutes), which otherwise were analyzed by the same method (Lacroix and Magoon, 1992). Re-analysis could not be done within the holding time.

Bleach Plant

Bleach plant sewers were analyzed for 2,3,7,8-substituted dioxins and furans, and for volatiles (Appendix B.4 and B.5). The primary finding of interest was 12.7 pg/L of 2,3,7,8-TCDD in the alkaline sewer; none was detected in the acid sewer. 2,3,7,8-TCDF was detected in both sewers. Concentrations were 24.3 pg/L in the alkaline sewer and 3.8 pg/L in the acid sewer, the latter concentration being essentially equivalent to the method blank (3.6 pg/L).

A mass balance for the ASB was calculated based on 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in the alkaline sewer and ASB effluent; flow data provided by the mill were used (Table 2). Results showed a net increase load in the ASB effluent of approximately 0.3 mg/day for 2,3,7,8-TCDD and 3 mg/day for 2,3,7,8-TCDF.

Volatiles analysis of the bleach plant sewers identified the same three compounds in both waste streams. These chemicals were acetone (400-1,500 μg/L), chloroform (290-570 μg/L), and 2-butanone (44-120 μg/L). The alkaline sewer again had higher concentrations than the acid sewer.

Duplicate Sampling

Data from Boise Cascade's duplicate samples are compared to Ecology results in Table 7. The TSS and BOD5 duplicates were analyzed at the mill. The remaining analyses were by a contract laboratory, Columbia Analytical Services, Inc. in Kelso.

In most instances, results obtained separately by Boise Cascade and Ecology agreed within approximately 30% of each other. Disparate values seen in some of the analyses may partly

TABLE 7. ECOLOGY/BOISE CASCADE DUPLICATE SAMPLES - BOISE CASCADE, APRIL 1992

ANALYSIS	PRIMARY INFLUENT	ALKALINE SEWER	ACID SEWER	ASB INFLUENT	ASB EFFLUENT	FINAL EFFLUENT	MEAN RPD
NPDES PERMIT:							
TSS (mg/L)	NA	NA	NA	NA	NA	70/68	3%
BOD5 (mg/L)	NA	NA	NA	NA	NA	33/23.8	33%
GENERAL CHEMISTRY:							
TOC (mg/L)	276/240	1930/1200	659/640	408/350	NA	174/72	32%
Total Phenols (ug/L)	NA	NA	NA	NA	22.1/150	14.1/60	140%
NH3-N (mg/L)	NA	NA	NA	18.4/10.8	NA	4.4/4.62	28%
NO2+NO3-N (mg/L)	NA	NA	NA	0.51/0.5	NA	NA	0%
Total P (mg/L)	NA	NA	NA	3.3/4.4	NA	2.6/3.1	23%
METALS (ug/L):							
Zinc	137/121	NA	NA	115/86	100/88	NA	18%
Chromium	12/13	NA	NA	12/16	15/19	NA	20%
Copper	41.6/31	NA	NA	25/13	18/12	NA	44%
Lead	7.9/4	NA	NA	8.0/3	4.6/2	NA	78%
VOLATILES (ug/L):							
Chloroform	NA	480/300	295/200	350/240	20/50U	14/50U	41%
PHENOLICS (ug/L):							
4,5,6-Trichloroguaiacol	NA	NA	NA	NA	7/8	4/5U	13%
3,4,5-Trichloroguaiacol	NA	NA	NA	NA	11/9	7/5U	20%
3,4,5-Trichlorocatechol	NA	NA	NA	NA	4/7	3/5U	54%
RESIN ACIDS (ug/L):							
Palustric Acid	NA	NA	NA	NA	44/32	13/19	35%
Dehydroabietic Acid	NA	NA	NA	NA	140/170	52/110	45%
Abietic Acid	NA	NA	NA	NA	500/780	180/510	70%
Isopimaric Acid	NA	NA	NA	NA	100/200	42/130	84%
Sandaracopimaric Acid	NA	NA	NA	NA	12/30	4/19	110%

RPD = relative percent difference; co-detected values only
NA = not analyzed by one or both parties
U = not detected at or above reported value

arise from being on separate grabs (chloroform) or by virtue of the low concentrations being measured (e.g., copper, lead, phenolic compounds, and certain resin acids). Substantially different results were obtained in the total phenols analysis. The reason for this discrepancy could not be determined. The Manchester Laboratory re-checked all their raw data and could find no errors in Manchester's analysis (Thompson, personal communication).

Sludges

Results of chemical analysis on primary and ASB sludge samples are in Appendix B. Elevated concentrations of 2,3,7,8-TCDD and 2,3,7,8-TCDF, 520 ng/Kg and 1,590 ng/Kg, respectively, were detected in the ASB sludge. Primary sludge had only trace amounts of these compounds. A range of metals, volatiles, resin & fatty acids, and phenolic compounds were also detected in sludges from both sources. No PCBs or organochlorine pesticides were detected in sludge.

River Sediments

General Characteristics

A rocky bottom was encountered during efforts to collect sediments in the mid-channel of upper Lake Wallula. As a result, the samples off Badger Island and near Port Kelley (Figure 2) were confined to the left bank (facing downriver). Finer deposits were found further downstream at the Hat Rock site, allowing grabs to be composited from quarter points across the channel.

As shown in Table 8, the Badger Island and Port Kelley samples were primarily sand. Sediment samples at the old outfall and off Hat Rock were mostly silt. The latter two sites also had a slightly greater percentage of volatile solids and total organic carbon. None of the grabs examined had unusual color, texture, or odor.

TABLE 8. GENERAL CHARACTERISTICS OF LAKE WALLULA SEDIMENTS, APRIL 1992

LOCATION:	BADGER ISLAND	OLD OUTFALL	PORT KELLEY	HAT ROCK
Gravel (%)	0	0	0	0
Sand (%)	89	20	92	33
Silt (%)	9	77	8	65
Clay (%)	2	5	2	11
Solids (%)	67	57	77	43
Volatile Solids (%)	1.2	1.9	0.7	2
Total Organic Carbon (%)	0.4	0.8	0.1	1.3
EOX (mg/Kg, dry)	10 U	10 U	10 U	10 U

U = not detected at or above reported value

At the detection limit achieved for EOX (10 mg/Kg), no influence of the mill's discharge could be detected in the sediments. EOX analysis of the ASB sludge sample had shown 1,200 mg/Kg (Appendix B.3).

Chemicals Detected

Results for chemicals analyzed in these samples are summarized in Table 9. Chemicals detected in river sediments included 2,3,7,8-substituted dioxins and furans, resin & fatty acids, and metals. Concentrations of 2,3,7,8-TCDD and 2,3,7,8-TCDF ranged from 0.3-1.2 ng/Kg and 1.2-18.4 ng/Kg, respectively. No phenolics, volatiles, organochlorine pesticides, or PCBs were detected at any of the sampling sites.

Most chemicals detected at the old outfall and further downstream were also detected off Badger Island above the mill. Concentrations near the old outfall were generally elevated by factors of 2-to-4 over the upstream sample with respect to dioxins, furans, and resin & fatty acids. Metal concentrations at the old outfall were not substantially different from those upstream.

With few exceptions, the highest concentrations of organics and metals were found in the sediments near Hat Rock. Some of the higher chlorinated dioxins and furans, as well as silver, thallium, and selenium were only detectable at this site.

There are no EPA or Washington State sediment criteria by which to judge the significance of these results. The levels of 2,3,7,8-TCDD and 2,3,7,8-TCDF are greater than in other reaches of the Columbia influenced by Washington pulp mills. Tetra Tech (1992) analyzed 20 sediment samples between Bonneville Dam and the Columbia River mouth. They reported median (maximum) concentrations of 0.18 (0.35) ng/Kg for 2,3,7,8-TCDD and 1.4 (3.2) ng/Kg for 2,3,7,8-TCDF. Ecology has done sediment sampling in conjunction with Class II Inspections at the Longview Fibre and Weyerhaeuser Longview Mills. Samples collected near the Weyerhaeuser outfall had no 2,3,7,8-TCDD detected and a maximum 2,3,7,8-TCDF concentration of 0.36 ng/Kg (Andreasson, 1991). A high 2,3,7,8-TCDD concentration of 8.8 ng/Kg was found in one of two samples at the Longview Fibre outfall, while 2,3,7,8-TCDF was not detected (Das, 1991).

The resin & fatty acid concentrations measured in the Wallula sediments are similar to or lower than those reported in sediments near other Washington pulp mills (Tetra Tech, 1988; Johnson and Coots, 1989). The chlorinated forms of these compounds, however, were not detected in Lake Wallula, in contrast to some of the other mills.

Except for Hat Rock, the metals concentrations in Lake Wallula appear similar to those in sediments from uncontaminated Washington lakes and rivers (e.g., Johnson and Norton, 1990; Johnson *et al.*, 1990). Based on Canadian guidelines for freshwater sediments (Persaud *et al.*, 1991), the cadmium and, to a lesser extent, zinc concentrations at Hat Rock may be sufficiently high to adversely effect some benthic organisms. In these guidelines, the concentrations

TABLE 9. CHEMICALS DETECTED IN LAKE WALLULA SEDIMENTS, APRIL 1992

LOCATION:	BADGER ISLAND		OLD OUTFALL		PORT KELLEY		HAT ROCK	
DIOXINS/FURANS (ng/Kg, dry):								
2,3,7,8-TCDD	0.3	E	1.0		0.9	U	1.2	
1,2,3,7,8-PeCDD	0.5	U	0.7	U	1.3	U	0.4	E
1,2,3,4,7,8-HxCDD	0.8	U	0.8	U	1.7	U	0.5	E
1,2,3,6,7,8-HxCDD	0.5	U	0.4	E	1.1	U	1.1	
1,2,3,7,8,9-HxCDD	0.6	U	0.9		1.4	U	1.6	
2,3,7,8-TCDF	4.4		16.3		1.2		18.4	
1,2,3,7,8-PeCDF	0.3	U	0.2	E	0.8	U	0.4	
2,3,4,7,8-PeCDF	0.3	U	0.4		0.8	U	0.5	
1,2,3,4,7,8-HxCDF	0.4	U	0.4	U	0.9	U	0.5	
1,2,3,4,6,7,8-HpCDF	0.8		2.1		0.8	U	3.0	
OCDF	1.8	U	12.7		3.5	U	9.8	
RESIN/FATTY ACIDS (ug/Kg, dry):								
Abietic Acid	170	J	660		170	J	2600	J
Dehydroabietic Acid	270	U	330		250	U	1100	
Pimaric Acid	24	J	88	J	24	J	340	J
Isopimaric Acid	76	J	210	J	54	J	680	
Sandaracopimaric Acid	270	U	300	U	250	U	46	J
Palmitoleic Acid	270	U	1800		290		3300	
METALS (mg/Kg, dry):								
Zinc	84.4	J	61.5	J	45.0	J	284	J
Copper	9.7		14.8		7.4		30.1	
Chromium	11.1	J	13.6	J	9.4	J	23.8	J
Nickel	11.2		12.7		9.1		20.8	
Lead	11.1		9.9		5.6		39.0	
Arsenic	3.3		2.7		1.7		4.9	
Cadmium	0.79	P	0.87	P	0.44	P	3.2	
Beryllium	0.26	P	0.41	P	0.17	P	0.56	P
Silver	0.30	U	0.30	U	0.30	U	0.58	
Thallium	0.2	UN	0.2	UN	0.2	UN	0.27	PN
Selenium	0.20	U	0.20	U	0.20	U	0.32	P
Mercury	0.022	P	0.017	P	0.005	U	0.056	
PHENOLICS:	ND		ND		ND		ND	
VOLATILES:	ND		ND		ND		ND	
OC PESTICIDES/PCBs:	ND		ND		ND		ND	

E = estimated maximum possible concentration
J = estimated concentration
U = not detected at or above reported value
N = spike recovery outside control limits
P = detected below quantitation limit
ND = none detected

considered to be tolerated by most organisms are 0.6 mg/Kg for cadmium and 120 mg/Kg for zinc. Severe adverse effects are predicted to occur at a cadmium concentration of 10 mg/Kg and a zinc concentration of 820 mg/Kg. Hat Rock concentrations were 3.2 and 284 mg/Kg for cadmium and zinc, respectively.

Bioassays

Sediment bioassays showed all of the Lake Wallula sediment samples, including the one collected above the mill, were toxic to *Hyallela* (Table 10). There was little difference in *Hyallela* mortality between sampling sites, ranging from 60% at Port Kelley to 71% at Hat Rock. Mortality in the laboratory control was 14%. The testing protocol allows up to 20% control mortality for the results to be valid.

Little or no sediment toxicity was indicated by the Microtox test. This may indicate Microtox is insensitive to whatever factor(s) affected *Hyallela*. Alternately, because the Microtox test used an aqueous extract rather than bulk sediment as for *Hyallela*, the level of exposure may have been lower. Details of both sediment bioassays are reported in Parametrix (1992).

To put the *Hyallela* results in perspective, a review was done of past Class II inspections and other Ecology studies where this bioassay was used (Yake *et al.*, 1986; Johnson and Norton, 1988 and 1989; Bennett and Cubbage, 1992). Included therein are bioassays done on sediment samples from other parts of the Columbia River influenced by pulp mills and diverse types of industry. It is clear from the data in these reports that *Hyallela* mortality in the range observed for Lake Wallula sediments is unusually high and would be expected to occur only at sites with substantial contamination.

TABLE 10. RESULTS OF LAKE WALLULA SEDIMENT BIOASSAYS, APRIL 1992

LOCATION:	BADGER ISLAND	OLD OUTFALL	PORT KELLEY	HAT ROCK
10-day Amphipod Bioassay (percent mortality)	62%	62%	60%	71%
15-minute Microtox Test (percent light change)	2.5%	5.7%	-0.4%	17%

None of the chemicals detected in the Lake Wallula samples were at sufficient or consistently high levels to explain the toxicity. Physical factors (e.g., grain size) would also not be expected to have had an adverse effect. Although Boise Cascade cannot be ruled out as a possible contributor to this apparent problem, the occurrence of comparable mortality above and below the mill points to upstream sources.

Other Sediment Data

The Boise Cascade mill has been the focus of other recent sediment sampling efforts by EPA/Oregon Department of Environmental Quality (data provided by Raleigh Farlow, EPA, Seattle) and the U.S. Army Corps of Engineers (1991). Boise Cascade has also analyzed sediment samples in conjunction with construction of the present outfall (data provided by Dennis Ross). The analyses conducted by these groups and during the present Ecology inspection are compared in Table 11. Figure 3 shows locations where sediment samples have been collected near the mill (EPA/ODEQ stations are approximate).

TABLE 11. ANALYSES CONDUCTED ON LAKE WALLULA SEDIMENT SAMPLES

ANALYSIS	EPA/ODEQ (n = 3)	CORPS OF ENGINEERS (n = 2)	BOISE CASCADE (n = 4)	ECOLOGY (n = 4)
Metals		X	X	X
Semivolatiles*	(X)	X	X	
Volatiles			X	X
OC Pesticides	(X)	X	X	X
PCBs	(X)	X	X	X
Dioxins and Furans	X	X		X
Resin & Fatty Acids				X
Chlorinated Phenolics				X
Bioassays				X

*EPA/ODEQ and CORPS analyzed polyaromatic hydrocarbons (PAH) only
(X) data not available

Low concentrations of metals and sparse detection of semivolatiles, volatiles, organochlorine pesticides, and PCBs were reported in samples analyzed by the Corps of Engineers and Boise Cascade. The Corps employed lower detection limits than Ecology or Boise Cascade and was able to quantify trace amounts of PCBs (6.5-11 μg/Kg; Aroclor 1260), and the DDT breakdown products DDE and DDD (0.4-2 μg/Kg).

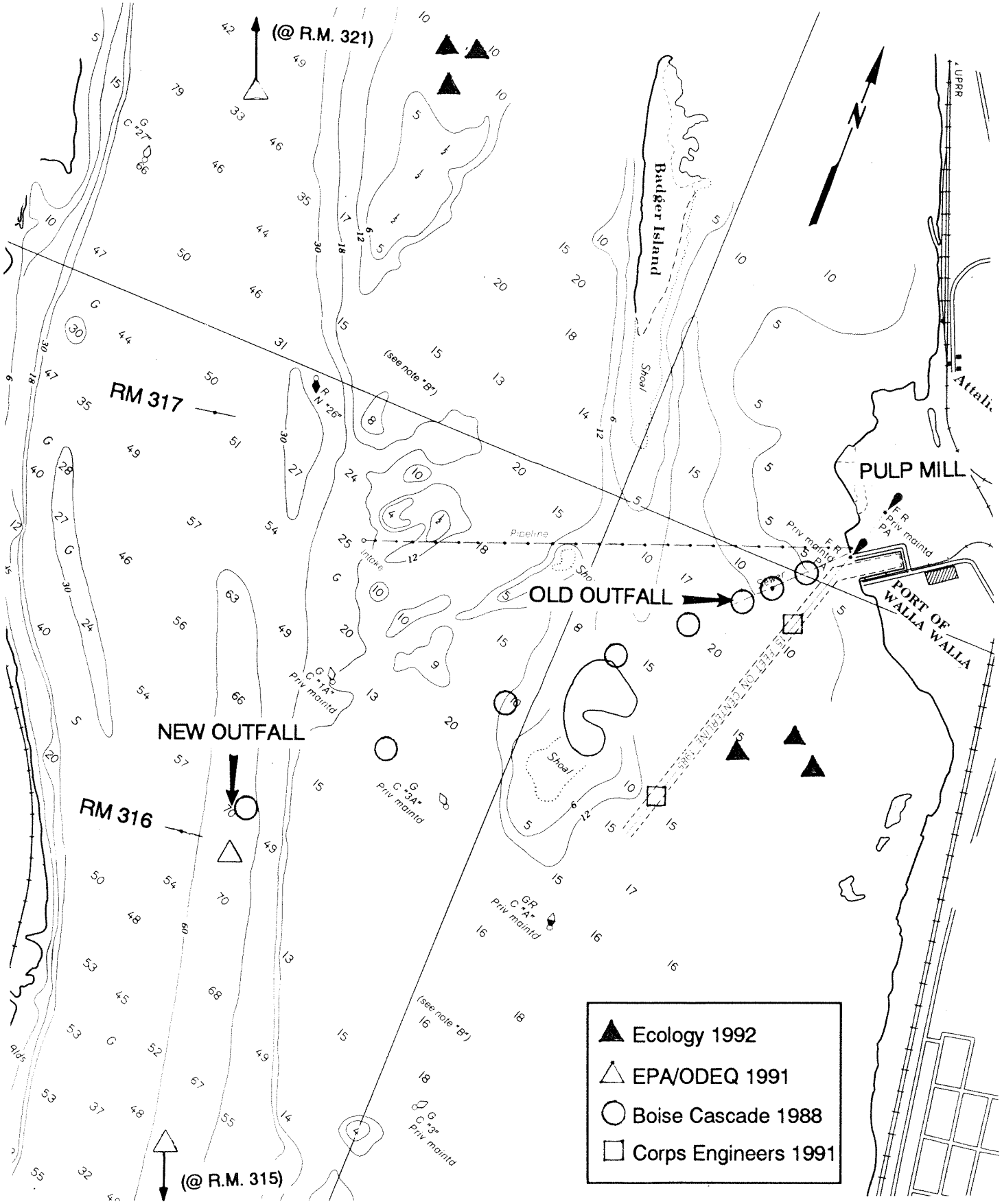

Figure 3. Location of Recent Sediment Samples Near Boise Cascade

Figure 4 summarizes the data presently available on 2,3,7,8-TCDD and 2,3,7,8-TCDF in Lake Wallula sediments. The complete EPA/ODEQ and Corps of Engineers dioxin and furan data are in Appendix F. The U.S. Fish & Wildlife Service has also collected limited sediment samples in Lake Wallula for analysis of dioxins, furans, and other contaminants, but these data are not yet available (Schuler, personal communication).

SUMMARY OF MAJOR FINDINGS

1. The final effluent was within NPDES permit limits for BOD5, TSS, and pH.

2. Rainbow trout bioassays of the final effluent had 100% survival in both 65% and 100% effluent.

3. Other effluent bioassays showed no acute toxicity to fathead minnows or *Daphnia* and no chronic toxicity to *Ceriodaphnia*. Some chronic toxicity occurred to fathead minnows (7-day LC50 = 35%).

4. The 2,3,7,8-TCDD concentration in the final effluent, 2.9 pg/L, was within the 10 pg/L limit set for 1994.

5. EPA water quality criteria for toxics were either not exceeded in the final effluent or, in the case of copper and mercury, would not be expected to be exceeded outside the dilution zone boundary.

6. Chromium concentrations were not elevated in the waste stream.

7. High counts of fecal coliform bacteria were found in the final effluent; 30% were *Klebsiella*. The levels may be sufficient to cause violations of state Class A water quality standards downstream of the mill.

8. 2,3,7,8-TCDD and 2,3,7,8-TCDF concentrations in ASB sludge were 520 and 1,590 ng/Kg, respectively. The sludge appeared to be a source of these compounds to the final effluent.

9. Significant mortality (60-71%) was experienced by amphipods (*Hyallela*) during bioassays of river sediment samples. Similar mortality occurred both above and below the mill. Chemical analysis of the samples did not furnish clues to the reason for toxicity.

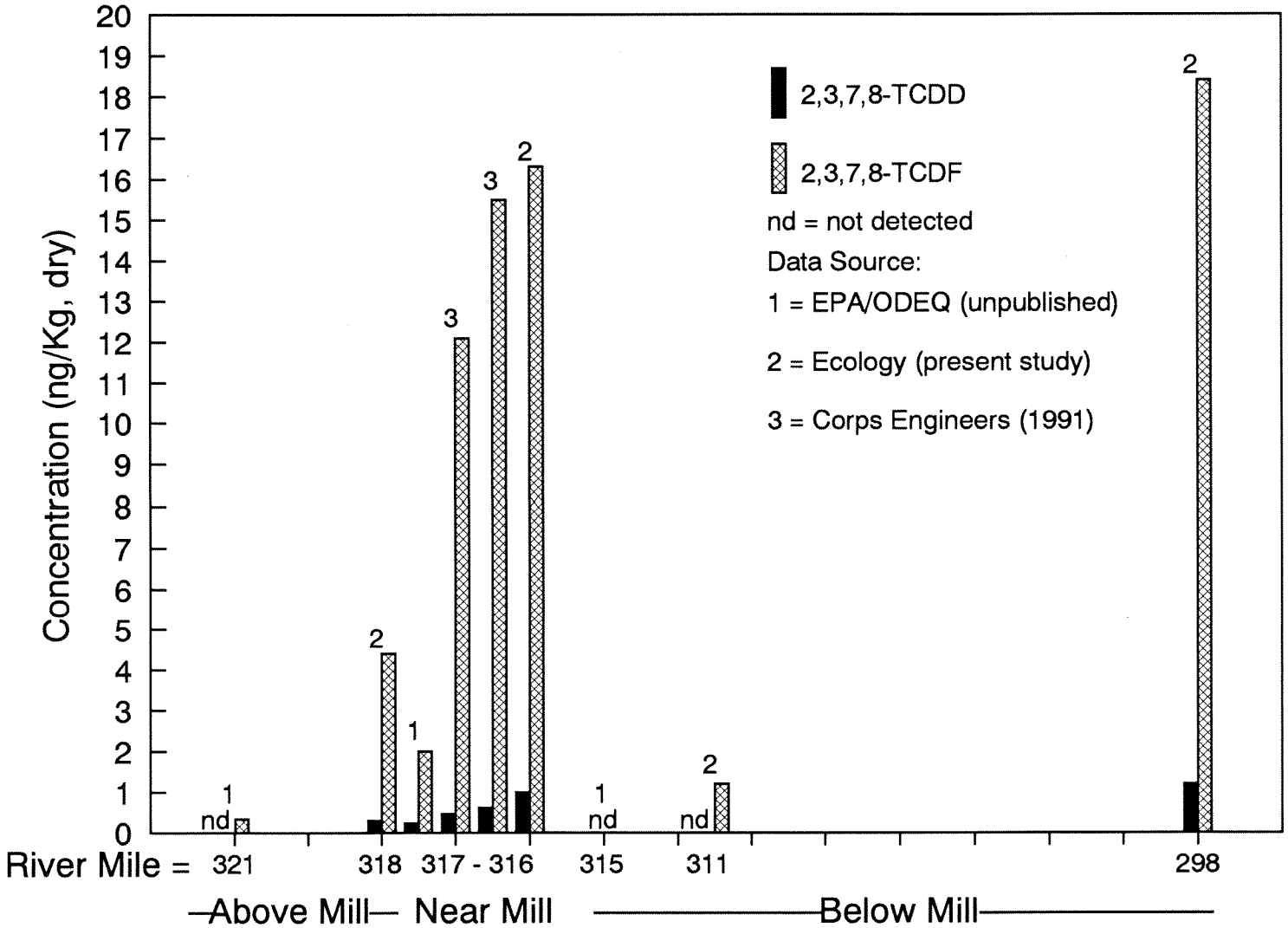

Figure 4. TCDD/TCDF Concentrations in Lake Wallula Sediments

RECOMMENDATIONS

1. Boise Cascade should begin monitoring fecal coliform and *Klebsiella* concentrations in the final effluent.

2. Based on results from this inspection, the following chemicals do not appear to be a concern in the final effluent: semivolatiles, organochlorine pesticides, PCBs, antimony, arsenic, beryllium, selenium, silver, and thallium. The requirement to continue monitoring for these compounds should be re-evaluated in the next permit cycle.

3. Supporting QA information should be provided to establish the accuracy of total phenols data submitted by Boise Cascade. Phenols data obtained by Boise Cascade during the inspection may have overestimated actual concentrations.

4. Boise Cascade should manage ASB sludge in such a way as to prevent release of dioxins and furans to the environment.

5. Additional bioassays should be done on Lake Wallula sediments. The test should include one or more organisms in addition to *Hyallela* and Microtox. Sampling sites should include one above the Richland/Hanford reach and one each at the mouths of the Yakima and Snake Rivers. It would be cost effective to collect and preserve additional sediment chemistry and benthic macroinvertebrates samples to analyze pending bioassay results.

REFERENCES

Andreasson, J., 1991. Class II Inspection of Weyerhaeuser Longview Pulp and Paper Mill, April 16-18, 1990. Washington State Department of Ecology, Olympia, WA.

APHA, AWWA, and WPCF, 1985. Standard Methods for the Examination of Water and Wastewater, 16th edition. American Public Health Association, Washington, D.C.

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

ASTM, 1991. Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates. American Society of Testing Materials.

Bennett, J. and J. Cubbage, 1992. Evaluation of Bioassay Organisms for Freshwater Sediment Toxicity Testing. Washington State Department of Ecology, Olympia, WA.

Burkhalter, R., 1992. Letter to J. Williams, July 16, 1992, at the Boise Cascade Corp. Washington State Department of Ecology, Olympia, WA.

CCREM, 1987. Canadian Water Quality Guidelines. Canadian Council of Resource and Environment Ministers, Ottawa, Ontario.

Das, T., 1991. Longview Fibre Company Class II Inspection. Washington State Department of Ecology, Olympia, WA.

Ecology, 1991. Biological Testing Methods, Part A, Static Acute Fish Toxicity Test, DOE 80-12. Washington State Department of Ecology, Olympia, WA.

EPA, 1979. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020. U.S. Environmental Protection Agency, (revised March 1982).

EPA, 1984. 40 CFR Part 136. U.S. Environmental Protection Agency, October 26, 1984.

EPA, 1986. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846. U.S. Environmental Protection Agency.

EPA, 1989. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA/600/4-89/001. U.S. Environmental Protection Agency.

EPA, 1991. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA/600/4-90/027. U.S. Environmental Protection Agency.

EVS, 1992. Laboratory Report, Effluent Toxicity Testing Program, Project No. 9/192-11. Prep. for: Washington State Department of Ecology by EVS Consultants, Seattle, WA.

Heffner, M., 1992. Simpson Tacoma Kraft Company, February 1991 Class II Inspection Report. Washington State Department of Ecology, Olympia, WA.

Huntamer, D. and J. Hyre, 1991. Manchester Environmental Laboratory, Laboratory Users Manual. Washington State Department of Ecology, Manchester, WA.

Jensen, N., 1992. Personal communication. Washington State Department of Ecology, Manchester Environmental Laboratory, Manchester, WA.

Johnson, A. and R. Coots, 1989. Survey of Chemical Contaminants in the Bottom Sediments of Grays Harbor Estuary. Washington State Department of Ecology, Olympia, WA.

Johnson, A. and D. Norton, 1988. Screening Survey for Chemical Contaminants and Toxicity in Sediments at Five Lower Columbia River Ports, September, 22-23, 1987. Washington State Department of Ecology, Olympia, WA.

Johnson, A. and D. Norton, 1989. Screening Survey for Chemical Contaminants and Toxicity in Drainage Basins at Paine Field, August 10-12, 1987. Washington State Department of Ecology, Olympia, WA.

Johnson, A. and D. Norton, 1990. 1989 Lakes and Reservoir Water Quality Assessment Program: Survey of Chemical Contaminants in Ten Washington Lakes. Washington State Department of Ecology, Olympia, WA.

Johnson, A., D. Norton, B. Yake, and S. Twiss, 1990. Transboundary Metal Pollution of the Columbia River (Franklin D. Roosevelt Lake). Bull. Environ. Contam. Toxicol. 45:703-710.

Kirchmer, C., 1988. Quality Assurance Manual, Manchester Laboratory. Washington State Department of Ecology, Manchester, WA.

Lacroix, D. and S. Magoon, 1992. Data Results, DOX/TOX/AOX Analyses. Memorandum, Washington State Department of Ecology, Manchester Laboratory, Manchester, WA.

McLeay & Associates, 1986. Aquatic Toxicity of Pulp & Paper Mill Effluent: a Review. Prep. for: Environment Canada, Fisheries and Oceans Canada, Canadian Pulp and Paper Assoc., and Ontario Ministry of the Environment, Ottawa, Ontario.

Mehrle, P.M., D.R. Buckler, E.E. Little, L.M. Smith, J.D. Petty, P.H. Peterman, and D.L. Stalling, 1988. Toxicity and Bioconcentration of 2,3,7,8-Tetrachlorodibenzodioxin and 2,3,7,8-Tetrachlorodibenzofuran in Rainbow Trout. Environ. Toxicol. Chem. 7:47-62.

Miles, M.B., W.D. Wiggins, G.P Rupert, R.R. Smith, L.L. Reed, and L.E. Hubbard, 1991. Water Resources Data, Washington, Water Year 1991. U.S. Geological Survey Water Data Report WA-91-1

NCASI, 1986a. Procedures for Analysis for Resin and Fatty Acids in Pulp Mill Effluents, Tech. Bull. 501. National Council of Paper Industry for Air and Stream Improvement Inc., New York.

NCASI, 1986b. Methods for the Analysis for Chlorinated Phenolics in Pulp Industry Wastewater, Tech. Bull. 498. National Council of Paper Industry for Air and Stream Improvement Inc., New York.

NAS, 1973. Water Quality Criteria, 1972. National Academy of Sciences, EPA-R3-73-033.

Parametrix, 1992. Freshwater Sediment Bioassays Using the Amphipod *Hyallela azteca* and Aqueous Extract Microtox Procedures, Project No. 55-1583-43. Prep. for: Washington State Department of Ecology by Parametrix, Inc., Bellevue, WA.

Persaud, D., R. Jaagumagi, and A. Hayton, 1991. The Provincial Sediment Quality Guidelines. Water Resources Branch, Ontario Ministry of the Environment.

SCAN, 1989. Organically Bound Chlorine by the AOX Method. Scandinavian Pulp, Paper, and Board, Testing Committee, SCAN-W 9:89

Schuck, M., 1993. Personal communication. Washington State Department of Wildlife, Dayton, WA.

Schuler, C., 1992. Personal communication. U.S. Fish & Wildlife Service, Portland, OR.

Tetra Tech, 1986. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound. Prep. for: EPA Puget Sound Estuary Program.

Tetra Tech, 1988. Everett Harbor Action Program: Analysis of Toxic Problem Areas. Prep. for: EPA Region 10-Office of Puget Sound, Seattle, WA.

Tetra Tech, 1992. Reconnaissance Survey of the Lower Columbia River. Prep. for: Lower Columbia River Bi-State Water Quality Program.

Thompson, D., 1992. Personal communication. Washington State Department of Ecology, Manchester Environmental Laboratory, Manchester, WA.

U.S. Army Corps of Engineers, 1991. Non-Federal Navigation Dredging and Beneficial Use of Dredge Material in the Columbia and Snake Rivers. Environmental Assessment, Section 404(B)1, Biological Assessment, Walla Walla District.

Yake, B., 1992. Accuracy/Inaccuracy in Flow Measuring at NPDES-Permitted Facilities. Memorandum, Washington State Department of Ecology, Olympia.

Yake, B., D. Norton, and M. Stinson, 1986. Application of the Triad Approach to Freshwater Sediment Assessment: An Initial Investigation of Sediment Quality near Gas Works Park, Lake Union. Washington State Department of Ecology, Olympia.

Yee, C.K., 1992. Dilution Ratio Study - Boise Cascade Wallula Mill. Memorandum, Washington State Department of Ecology, Olympia, WA.

APPENDICES

APPENDIX A. ECOLOGY SAMPLING LOCATIONS - BOISE CASCADE, APRIL 1992	
SAMPLE NAME	LOCATION DESCRIPTION
Primary Influent	From bridge over clarifier, at center
Primary Effluent	From bridge over clarifier, between radial overflow weir and edge of tank
Alkaline Sewer	In bleach plant from tap in alkaline line near the pumps
Acid Sewer	In bleach plant from tap near the heat exchanger
ASB Influent	From bridge over mixing channel near inlet to the Kinnex
Kenics Outlet	From pontoon boat at entrance from ASB Cell 1 to Cell 2
ASB Cell 2	From pontoon boat near Cell 2 outlet
ASB Effluent	From tap near clean-out structure
Cooling No. 1 + 2	From taps between primary and substation
Cooling No. 3	From tap between primary and substation
Final Effluent	From tap next to Boise Cascade sampler
Primary Clarifier Sludge	From deposits on floor of vacuum belt filter, left and right bays
ASB Sludge	From pontoon boat in quiescent zone

APPENDIX B

CLASS II INSPECTION DATA

B.1 GENERAL CHEMISTRY

B.2 AOX/TOX/DOX

B.3 EOX

B.4 DIOXINS AND FURANS

B.5 VOLATILES (WATER)

B.6 VOLATILES (SOLIDS)

B.7 RESIN & FATTY ACIDS

B.9 PHENOLICS

B.10 SEMI-VOLATILES

B.11 PESTICIDES/PCBS

APPENDIX B.1 GENERAL CHEMISTRY RESULTS - BOISE CASCADE, APRIL 1992

Location:	Transfer	Primary	Primary	Primary	Primary	Primary
Source:	Blank	Influent	Influent	Influent	Effluent	Effluent
Method:	grab	grab	grab	ISCOcomp	grab	grab
Date:	April 6	April 7	April 7	April 7-8	April 7	April 7
Time:	1400	1020	1445	0600-0600	1030	1450
Sample Number:	158230	158231	158232	158233	158234	158235
Field Measurements:						
Temperature (C)		29.4	27.7	3.8	29.1	29.5
pH		10.62	12.33	11.73	10.55	9.74
Conductivity (umhos/cm)		750	2290	1130	890	960
Laboratory Analyses:						
Conductivity (umhos/cm)		851	2620	1510	1120	1160
Total Alkalinity (mg/L)				510		
Hardness (mg/L)				210J		
Color (C.U.)						
TS (mg/L)				1640		
TNVS (mg/L)				852		
TSS (mg/L)		391	305	357	104	65
TNVSS (mg/L)				142		
BOD5 (mg/L)				366		
COD (mg/L)		1100	1100	1200	780	800
TOC (mg/L)		245	227	276	222	229
NH3-N (mg/L)						
NO2+NO3-N (mg/L)						
Total-P (mg/L)						
Oil and Grease (mg/L)						
F-Coliform MF (#/100mL)						
F-Coliform MPN (#/100mL)						
Klebsiella (%)						
CN, wk. & diss. (ug/L)	2U				2	2
Total Phenols (ug/L)	2U					
Chlorate (mg/L)						

U = not detected at or above reported value

J = estimated value

APPENDIX B.1 (continued)

Location:	Primary	ASB	ASB	ASB	Kenics	ASB
Source:	Effluent	Influent	Influent	Influent	Outlet	Cell 2
Method:	ISCOcomp	grab	grab	ISCOcomp	grab	grab
Date:	April 7-8	April 8	April 8	April 8	April 14	April 14
Time:	0600-0600	0910	1145	000-1200	1300	1300
Sample Number:	158236	158237	158238	158239	158240	158241
Field Measurements:						
Temperature (C)	2.5		32.8	8.6		
pH	10.84		7.11	7.31		
Conductivity (umhos/cm)	1030		1930	2230		
Laboratory Analyses:						
Conductivity (umhos/cm)	1290	2990	2450	2820		
Total Alkalinity (mg/L)	341			439		
Hardness (mg/L)	104J			526J		
Color (C.U.)				2000		
TS (mg/L)	1330			2750		
TNVS (mg/L)	803			1930		
TSS (mg/L)	100	417	248	267	152	365
TNVSS (mg/L)	43			207	78	120
BOD5 (mg/L)	344			443		
COD (mg/L)	890	1300	1200	1200		
TOC (mg/L)	247	368	391	408		
NH3-N (mg/L)				18.4		
NO2+NO3-N (mg/L)				0.51		
Total-P (mg/L)				3.3		
Oil and Grease (mg/L)						
F-Coliform MF (#/100mL)						
F-Coliform MPN (#/100mL)						
Klebsiella (%)						
CN, wk. & diss. (ug/L)		6	6			
Total Phenols (ug/L)				919		
Chlorate (mg/L)		110	87	95		

U = not detected at or above reported value

J = estimated value

APPENDIX B.1 (continued)

Location:	ASB	ASB	ASB	ASB	Cooling	Cooling
Source:	Effluent	Effluent	Effluent	Effluent	No. 1+2	No. 1+2
Method:	grab	grab	ISCOcomp	BOISEcomp	grab	grab
Date:	April 7	April 7	April 7-8	April 7-8	April 7	April 7
Time:	1000	1425	0600-0600	-	1040	1500
Sample Number:	158242	158243	158246	158247	158248	158249
Field Measurements:						
Temperature (C)	25.7	26.0	2.8	7.3	30.3	31.6
pH	7.48	7.46	7.92	7.77	8.06	8.18
Conductivity (umhos/cm)	1950	2060	1920	2000	240	220
Laboratory Analyses:						
Conductivity (umhos/cm)	2550	2540	2520	2540	290	285
Total Alkalinity (mg/L)			266			
Hardness (mg/L)			285	294	95	96
Color (C.U.)			500			
TS (mg/L)			2150			
TNVS (mg/L)			1450			
TSS (mg/L)	104	109	108	96	11	11
TNVSS (mg/L)			17			
BOD5 (mg/L)			44	37		
COD (mg/L)	780	780	770	770	4	3U
TOC (mg/L)	235	252	261	266	2.3	2.2
NH3-N (mg/L)			6.9			
NO2+NO3-N (mg/L)			0.05			
Total-P (mg/L)			4.2			
Oil and Grease (mg/L)	2J	2J			0.3J	1J
F-Coliform MF (#/100mL)						
F-Coliform MPN (#/100mL)						
Klebsiella (%)						
CN, wk. & diss. (ug/L)	2	2				
Total Phenols (ug/L)			22.1			
Chlorate (mg/L)	0.5U	0.5U	0.5U			

U = not detected at or above reported value

J = estimated value

APPENDIX B.1 (continued)

Location:	Cooling	Final	Final	Final	Final	Final
Source:	No. 3	Effluent	Effluent	Effluent	Effluent	Effluent
Method:	grab	grab	grab	ISCOcomp	grabcomp	BOISEcomp
Date:	April 7	April 7	April 7	April 7-8	April 7	April 7-8
Time:	1500	0915	1345	0600-0600	0900;1345	-
Sample Number:	158262	158250	158251	158252	158253	158254
Field Measurements:						
Temperature (C)	32.3	27.7	26.2	3.2	27.7;26.2	6.6
pH	8.57	7.63	7.44	7.79	7.63;7.44	7.88
Conductivity (umhos/cm)	170	1230	1410	1340	1230;1410	1360
Laboratory Analyses:						
Conductivity (umhos/cm)	187	1600	1760	1720	1670	1730
Total Alkalinity (mg/L)				201	197	
Hardness (mg/L)	75			214	218	228J
Color (C.U.)				750		
TS (mg/L)				1400		
TNVS (mg/L)				977		
TSS (mg/L)	9	54	63	70	48	68
TNVSS (mg/L)				33		
BOD5 (mg/L)				33		26
COD (mg/L)	3U	450	500	500		490
TOC (mg/L)	2.0	159	167	174		162
NH3-N (mg/L)				4.4		
NO2+NO3-N (mg/L)				0.14		
Total-P (mg/L)				2.6		
Oil and Grease (mg/L)	0.8J	2J	2J			
F-Coliform MF (#/100mL)		98000J	91000J			
F-Coliform MPN (#/100mL)		11000	13000			
Klebsiella (%)		29J	28J			
CN, wk. & diss. (ug/L)		2	2			
Total Phenols (ug/L)				14.1		
Chlorate (mg/L)		0.5U	0.5U	0.5U		

U = not detected at or above reported value

J = estimated value

APPENDIX B.1 (continued)

Location:	Alkaline	Alkaline	Alkaline	Acid	Acid	Acid
Source:	Sewer	Sewer	Sewer	Sewer	Sewer	Sewer
Method:	grab	grab	grabcomp	grab	grab	grabcomp
Date:	April 8	April 8	April 8	April 8	April 8	April 8
Time:	0835	1315	0835;1315	0845	1300	0845;1300
Sample Number:	158255	158256	158257	158258	158259	158260
Field Measurements:						
Temperature (C)	48.7	57.8		43.0	44.9	
pH	11.73	10.55		1.34	1.25	
Conductivity (umhos/cm)	8600	9510		9750	10520	
Laboratory Analyses:						
Conductivity (umhos/cm)	9910	9340	8970	11800	13100	12400
Total Alkalinity (mg/L)						
Hardness (mg/L)						
Color (C.U.)						
TS (mg/L)						
TNVS (mg/L)						
TSS (mg/L)	29	34	28	43	39	39
TNVSS (mg/L)						
BOD5 (mg/L)						
COD (mg/L)			4600			1600
TOC (mg/L)			1930			659
NH3-N (mg/L)						
NO2+NO3-N (mg/L)						
Total-P (mg/L)						
Oil and Grease (mg/L)						
F-Coliform MF (#/100mL)						
F-Coliform MPN (#/100mL)						
Klebsiella (%)						
CN, wk. & diss. (ug/L)						
Total Phenols (ug/L)			352			97
Chlorate (mg/L)	330	400	370	400	460	420

U = not detected at or above reported value

J = estimated value

APPENDIX B.2 ORGANIC HALOGEN RESULTS (mg/L) - BOISE CASCADE, APRIL 1992					
Location:	ASB	ASB	Final	Alkaline	Acid
Source:	Influent	Effluent	Effluent	Sewer	Sewer
Method:	ISCOcomp	ISCOcomp	ISCOcomp	grabcomp	grabcomp
Date:	April 8	April 7-8	April 7-8	April 7-8	April 8
Time:	0000-1200	0600-0600	0600-0600	0835;1315	0845;1300
Sample Number:	158239	158246	158252	158257	158260
AOX	23.9	19.6	11.4	137	120
AOX-duplicate	22.7	19.7	12.9	136	120
DOX	23.1	20.0	14.2	141*	167
(breakthrough)	(5%)	(1%)	(1%)	(18%)	(9%)
DOX-duplicate	25.9	24.3	17.4*	113*	164
(breakthrough)	(8%)	(19%)	(14%)	(15%)	(6%)
TOX	8.2*	30.1*	17.6*	81.4*	108
(breakthrough)	(19%)	(20%)	(12%)	(38%)	(8%)
TOX-duplicate	15.3*	22.6	19.6*	78.7*	NA
(breakthrough)	(20%)	(7%)	(19%)	(35%)	-

NOTE: see Appendix D for analytical methods used
*Exceeds 10% breakthrough criterion specified in method
NA = not analyzed

APPENDIX B.3 EOX RESULTS - BOISE CASCADE, APRIL 1992						
Location:	Primary	ASB	Badger Is	Old Outfall	Port Kelley	Hat Rock
Source:	Sludge	Sludge	Sediment	Sediment	Sediment	Sediment
Method:	grabcomp	grabcomp	grabcomp	grabcomp	grabcomp	grabcomp
Date:	April 14	April 14	April 14	April 14	April 13	April 13
Time:	1230	1300-1330	-	-	-	-
Sample Number:	168270	168271	168272	168273	168274	168275
EOX (mg/Kg, dry)	10 U	1,200	10 U	10 U	10 U	10 U

U = not detected at or above reported value

APPENDIX B.4 DIOXIN/FURAN RESULTS (pg/L or ng/Kg, dry) - BOISE CASCADE, APRIL 1992

Location:	Transfer	ASB	ASB	Final	Alkaline	Acid
Source:	Blank	Influent	Effluent	Effluent	Sewer	Sewer
Method:	grab	ISCOcomp	ISCOcomp	ISCOcomp	grabcomp	grabcomp
Date:	April 6	April 8	April 7-8	April 7-8	April 7-8	April 8
Time:	1400	0000-1200	0600-0600	0600-0600	0835;1315	0845;1300
Sample Number:	158230	158239	158246	158252	158257	158260
2,3,7,8-TCDD	3.7 U	4.3 U	5.4	2.9 E	12.7 E	3.6 U
1,2,3,7,8-PeCDD	5.1 U	6.5 U	6.7 U	6.3 U	13.0 U	5.4 U
1,2,3,4,7,8-HxCDD	9.7 U	10.9 U	11.6 U	12.3 U	21.0 U	8.6 U
1,2,3,6,7,8-HxCDD	6.0 U	6.8 U	7.2 U	7.7 U	13.1 U	5.4 U
1,2,3,7,8,9-HxCDD	8.1 U	9.2 U	9.7 U	10.4 U	17.7 U	7.2 U
1,2,3,4,6,7,8-HpCDD	31.4 B	33.7 B	42.7 EB	34.6 B	71.5 B	37.7 B
OCDD	147 B	220 B	219 B	166 B	358 EB	182 B
2,3,7,8-TCDF	2.6 B	15.3 B	48.3 B	29.0 B	24.3 B	3.8 B
1,2,3,7,8-PeCDF	3.3 U	4.1 U	4.2 U	4.0 U	7.8 U	3.2 U
2,3,4,7,8-PeCDF	3.4 U	4.2 U	4.3 U	4.1 U	7.9 U	4.9 U
1,2,3,4,7,8-HxCDF	5.1 U	6.3 U	6.3 U	6.5 U	12.3 U	4.9 U
1,2,3,6,7,8-HxCDF	3.6 U	4.4 U	4.5 U	4.6 U	8.7 U	3.5 U
2,3,4,6,7,8-HxCDF	5.0 U	6.1 U	3.2 B	6.3 U	7.3 EB	4.8 U
1,2,3,7,8,9-HxCDF	5.8 U	7.1 U	7.1 U	7.3 U	13.9 U	5.5 U
1,2,3,4,6,7,8-HpCDF	6.0 U	6.7 U	6.5 U	7.2 U	14.1 U	5.1 U
1,2,3,4,7,8,9-HpCDF	10.2 U	11.4 U	11.0 U	12.3 U	24.1 U	8.7 U
OCDF	21.3 U	23.0 U	17.8 U	23.5 U	44.9 U	15.4 U
TCDD (total)	3.7 U	4.3 U	5.4	5.8 E	12.7 E	3.6 U
PeCDD (total)	5.1 U	6.5 U	6.7 U	6.3 U	13.0 U	5.4 U
HxCDD (total)	3.8 E	8.6 U	8.2	6.6	9.7	5.5 E
HpCDD (total)	31.4 B	33.7 B	69.3 EB	63.0 B	71.5 B	37.7 B
TCDF (total)	2.6 U	15.3 B	73.8 B	29.0 B	28.7 B	3.8 B
PeCDF (total)	3.3 U	4.1 U	4.2 U	4.0 U	7.9 U	3.2 U
HxCDF (total)	4.8 U	5.8 U	3.0 B	6.0 U	6.9 EB	4.5 U
HpCDF (total)	7.5 U	8.4 U	8.1 U	9.1 U	17.8 U	6.4 U

U = not detected at or above reported value
B = analyte also found in laboratory blank
E = estimated maximum possible concentration
P = poorly resolved GC peaks
Q = quantitative interference

APPENDIX B.4 (continued)

Location:	Primary	ASB	Badger Is	Old Outfall	Port Kelley	Hat Rock
Source:	Sludge	Sludge	Sediment	Sediment	Sediment	Sediment
Method:	grabcomp	grabcom	grabcomp	grabcomp	grabcomp	grabcomp
Date:	April 14	April 14	April 14	April 14	April 13	April 13
Time:	1230	1300-1330	-	-	-	-
Sample Number:	168270	168271	168272	168273	168274	168275
2,3,7,8-TCDD	1.8	520	0.3 E	1.0	0.9 U	1.2
1,2,3,7,8-PeCDD	1.3 U	40.4 U	0.5 U	0.7 U	1.3 U	0.4 E
1,2,3,4,7,8-HxCDD	1.7 U	17.3 U	0.8 U	0.8 U	1.7 U	0.5 E
1,2,3,6,7,8-HxCDD	1.5 E	13.5	0.5 U	0.4 E	1.1 U	1.1
1,2,3,7,8,9-HxCDD	2.2	24.3	0.6 U	0.9	1.4 U	1.6
1,2,3,4,6,7,8-HpCDD	33.7 B	82.9 B	8.3 EB	14.6 B	5.9 EB	26.9 B
OCDD	161 B	517 B	39.7 B	75.7 B	23.8 B	155 B
2,3,7,8-TCDF	8.9	1590	4.4	16.3	1.2	18.4
1,2,3,7,8-PeCDF	0.8 U	31.7 U	0.3 U	0.2 E	0.8 U	0.4
2,3,4,7,8-PeCDF	0.6 E	32.2 U	0.3 U	0.4	0.8 U	0.5
1,2,3,4,7,8-HxCDF	1.0 U	9.6 U	0.4 U	0.4 U	0.9 U	0.5
1,2,3,6,7,8-HxCDF	0.7 U	6.8 U	0.3 U	0.3 U	0.6 U	0.2 U
2,3,4,6,7,8-HxCDF	1.6 BP	9.4 U	0.5 BP	0.7 BPQ	0.9 U	0.8 BPQ
1,2,3,7,8,9-HxCDF	1.1 U	10.8 U	0.4 U	0.4 U	1.0 U	0.3 U
1,2,3,4,6,7,8-HpCDF	1.6	8.8 U	0.8	2.1	0.8 U	3.0
1,2,3,4,7,8,9-HpCDF	1.4 U	15.1 U	0.7 U	0.6 U	1.3 U	0.4 U
OCDF	4.5	36.5 E	1.8 U	12.7	3.5 U	9.8
TCDD (total)	4.5	520 Q	0.6 E	1.0	0.9 U	1.2
PeCDD (total)	0.8	40.4 U	0.4 E	0.7 U	1.3 U	1.1
HxCDD (total)	2.1 B	135 B	2.0 B	5.1 B	1.3 U	13.0 B
HpCDD (total)	65.2 B	169 B	8.7 B	29.7 B	10.5 EB	54.3 B
TCDF (total)	22.4	3990	8.3	33.5	1.2	49.2
PeCDF (total)	2.7 E	347 EQ	0.6	3.3	0.8 U	1.4
HxCDF (total)	1.5 B	38.4 B	0.5 B	3.3 BQ	0.8 U	3.9 B
HpCDF (total)	2.0	11.2 U	1.0	6.4	1.0 U	9.1

U = not detected at or above reported value
B = analyte also found in laboratory blank
E = estimated maximum possible concentration
P = poorly resolved GC peaks
Q = quantitative interference

APPENDIX B.4 (continued)

Location:	Method		Method	
Source:	Blank for		Blank for	
Method:	Water		Solids	
Date:	Samples		Samples	
Time:	-		-	
Sample Number:	-		-	
2,3,7,8-TCDD	3.8	U	0.5	U
1,2,3,7,8-PeCDD	6.0	U	0.7	U
1,2,3,4,7,8-HxCDD	10.1	U	1.0	U
1,2,3,6,7,8-HxCDD	6.3	U	0.7	U
1,2,3,7,8,9-HxCDD	8.5	U	0.9	U
1,2,3,4,6,7,8-HpCDD	41.2	E	7.7	E
OCDD	366		31.4	
2,3,7,8-TCDF	3.6		0.4	U
1,2,3,7,8-PeCDF	4.4		0.5	U
2,3,4,7,8-PeCDF	4.3	E	0.5	U
1,2,3,4,7,8-HxCDF	6.0	U	0.6	U
1,2,3,6,7,8-HxCDF	4.2	U	0.4	U
2,3,4,6,7,8-HxCDF	6.2	E	0.6	P
1,2,3,7,8,9-HxCDF	6.7	U	0.6	U
1,2,3,4,6,7,8-HpCDF	6.7	U	0.5	U
1,2,3,4,7,8,9-HpCDF	11.4	U	0.9	U
OCDF	23.0	U	1.6	U
TCDD (total)	3.8	U	0.5	U
PeCDD (total)	6.0	U	0.7	U
HxCDD (total)	8.0	U	0.7	
HpCDD (total)	73.8	E	6.3	
TCDF (total)	3.6		0.4	U
PeCDF (total)	4.5		0.5	U
HxCDF (total)	5.9	E	0.6	
HpCDF (total)	7.3	E	0.6	U

U = not detected at or above reported value
E = estimated maximum possible concentration
P = poorly resolved GC peaks

APPENDIX B.5 VOLATILES RESULTS ON WATER (ug/L) - BOISE CASCADE, APRIL 1992

Location:	Transfer	ASB	ASB	ASB	ASB	Final
Source:	Blank	Influent	Influent	Effluent	Effluent	Effluent
Method:	grab	grab	grab	grab	grab	grab
Date:	April 6	April 7	April 8	April 7	April 7	April 7
Time:	1400	0910	1145	1000	1425	0915
Sample Number:	158230	158237	158238	158242	158243	158250
Chloromethane	2.0 U	100 U	100 U	10 U	10 U	10 U
Bromomethane	2.0 U	100 U	100 U	10 U	10 U	10 U
Vinyl Chloride	2.0 U	100 U	100 U	10 U	10 U	10 U
Chloroethane	2.0 U	100 U	100 U	10 U	10 U	10 U
Methylene Chloride	5.2 UJ	100 UJ	100 U	10 U	10 U	14 UJ
Acetone	11	1800	1900	41	30 U	30 U
Carbon Disulfide	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethane	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
trans-1,2-Dichloroethene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	1.0 U	50	50 U	5.0 U	5.0 U	5.0 U
Chloroform	1.0 U	420	280	20	19	13
1,2-Dichloroethane	5.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
2-Butanone	1.0 U	350	360	30 U	30 U	30 U
1,1,1-Trichloroethane	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Carbon Tetrachloride	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Vinyl Acetate	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Bromodichloromethane	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
1,2-Dichloropropane	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
1,3-Dichloropropene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Trichloroethene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Dibromochloromethane	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
1,1,2-Trichloroethane	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Benzene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
2-Chloroethylvinylether	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Bromoform	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-Pentanone	5.0 U	300 U	300 U	30 U	30 U	30 U
2-Hexanone	5.0 U	300 U	300 U	30 U	30 U	30 U
Tetrachloroethene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
1,1,2,2-Tetrachloroethane	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Toluene	1.0 U	50 U	50 U	9.0	8.4	8.4
Chlorobenzene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Ethylbenzene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Styrene	1.0 U	50 U	50 U	5.0 U	5.0 U	5.0 U
Total Xylenes	2.0 U	100 U	100 U	10 U	10 U	10 U
Trichlorofluoromethane	2.0 U	100 U	100 U	10 U	10 U	10 U
Trichlorotrifluoromethane	2.0 U	100 U	100 U	10 U	10 U	10 U

U = not detected at or above reported value J = estimated concentration

APPENDIX B.5 (continued)

Location:	Final		Alkaline		Alkaline		Acid		Acid	
Source:	Effluent		Sewer		Sewer		Sewer		Sewer	
Method:	grab		grab		grab		grab		grab	
Date:	April 7		April 8		April 8		April 8		April 8	
Time:	1345		0835		1315		0845		1300	
Sample Number:	158251		158255		158256		158258		158259	
Chloromethane	10	U	20	U	20	U	23		26	
Bromomethane	10	U	20	U	20	U	20	U	20	U
Vinyl Chloride	10	U	20	U	20	U	20	U	20	U
Chloroethane	10	U	20	U	20	U	20	U	20	U
Methylene Chloride	66		20	U	20		100		110	
Acetone	30	U	1500		1500		720		400	
Carbon Disulfide	5.0	U	10	U	10	U	10	U	10	U
1,1-Dichloroethene	5.0	U	10	U	10	U	10	U	10	U
1,1-Dichloroethane	5.0	U	10	U	10	U	10	U	10	U
trans-1,2-Dichloroethene	5.0	U	10	U	10	U	10	U	10	U
cis-1,2-Dichloroethene	5.0	U	10	U	10	U	10	U	10	U
Chloroform	15		390		570		290		300	
1,2-Dichloroethane	5.0	U	10	U	10	U	10	U	10	U
2-Butanone	30	U	110		120		95		44	J
1,1,1-Trichloroethane	5.0	U	10	U	10	U	10	U	10	U
Carbon Tetrachloride	5.0	U	10	U	10	U	10	U	10	U
Vinyl Acetate	5.0	U	10	U	10	U	10	U	10	U
Bromodichloromethane	5.0	U	10	U	10	U	10	U	10	U
1,2-Dichloropropane	5.0	U	10	U	10	U	10	U	10	U
1,3-Dichloropropene	5.0	U	10	U	10	U	10	U	10	U
Trichloroethene	5.0	U	10	U	10	U	10	U	10	U
Dibromochloromethane	5.0	U	10	U	10	U	10	U	10	U
1,1,2-Trichloroethane	5.0	U	10	U	10	U	10	U	10	U
Benzene	5.0	U	10	U	10	U	10	U	10	U
2-Chloroethylvinylether	5.0	U	10	U	10	U	10	U	10	U
Bromoform	5.0	U	10	U	10	U	10	U	10	U
4-Methyl-2-Pentanone	30	U	50	U	50	U	50	U	50	U
2-Hexanone	30	U	50	U	50	U	50	U	50	U
Tetrachloroethene	5.0	U	10	U	10	U	10	U	10	U
1,1,2,2-Tetrachloroethane	5.0	U	10	U	10	U	10	U	10	U
Toluene	9		10	U	10	U	10	U	10	U
Chlorobenzene	5.0	U	10	U	10	U	10	U	10	U
Ethylbenzene	5.0	U	10	U	10	U	10	U	10	U
Styrene	5.0	U	10	U	10	U	10	U	10	U
Total Xylenes	10	U	20	U	20	U	20	U	20	U
Trichlorofluoromethane	10	U	20	U	20	U	20	U	20	U
Trichlorotrifluoromethane	10	U	20	U	20	U	20	U	20	U

U = not detected at or above reported value J = estimated concentration

APPENDIX B.6 VOLATILES RESULTS ON SOLIDS (ug/Kg, dry) - BOISE CASCADE, APRIL 1992

Location:	Primary	ASB	Badger Is	Old Outfall	Port Kelley	Hat Rock
Source:	Sludge	Sludge	Sediment	Sediment	Sediment	Sediment
Method:	grabcomp	grabcomp	grabcomp	grabcomp	grabcomp	grabcomp
Date:	April 14	April 14	April 14	April 14	April 13	April 13
Time:	1230	1300-1330	-	-	-	-
Sample Number:	168270	168271	168272	168273	168274	168275
Chloromethane	45 U	91 U	15 U	17 U	14 U	24 U
Bromomethane	45 U	91 U	15 U	17 U	14 U	24 U
Vinyl Chloride	45 U	91 U	15 U	17 U	14 U	24 U
Chloroethane	45 U	91 U	15 U	17 U	14 U	24 U
Methylene Chloride	23 UJ	14 J	7 U	8 U	7 U	12 U
Acetone	1300	470 J	10 UJ	17 U	10 UJ	24 U
Carbon Disulfide	23	49	7 U	8 U	7 U	12 U
1,1-Dichloroethene	23 U	45 U	7 U	8 U	7 U	12 U
1,1-Dichloroethane	23 U	45 U	7 U	8 U	7 U	12 U
trans-1,2-Dichloroethene	23 U	45 U	7 U	8 U	7 U	12 U
cis-1,2-Dichloroethene	23 U	45 U	7 U	8 U	7 U	12 U
Chloroform	19 J	45 U	7 U	8 U	7 U	12 U
1,2-Dichloroethane	23 U	45 U	7 U	8 U	7 U	12 U
2-Butanone	140	91 U	15 U	17 U	14 U	24 U
1,1,1-Trichloroethane	23 U	45 U	7 U	8 U	7 U	12 U
Carbon Tetrachloride	23 U	45 U	7 U	8 U	7 U	12 U
Vinyl Acetate	23 U	91 U	15 U	17 U	14 U	24 U
Bromodichloromethane	23 U	45 U	7 U	8 U	7 U	12 U
1,2-Dichloropropane	23 U	45 U	7 U	8 U	7 U	12 U
cis-1,3-Dichloropropene	23 U	45 U	7 U	8 U	7 U	12 U
Trichloroethene	23 U	45 U	7 U	8 U	7 U	12 U
Dibromochloromethane	23 U	45 U	7 U	8 U	7 U	12 U
1,1,2-Trichloroethane	23 U	45 U	7 U	8 U	7 U	12 U
Benzene	23 U	45 U	7 U	8 U	7 U	12 U
trans-1,3-Dichloropropene	23 U	45 U	7 U	8 U	7 U	12 U
Bromoform	23 U	45 U	7 U	8 U	7 U	12 U
4-Methyl-2-pentanone	10 J	91 UJ	15 U	17 U	14 U	24 U
2-Hexanone	45 U	91 UJ	15 U	17 U	14 U	24 U
Tetrachloroethene	23 U	45 UJ	7 U	8 U	7 U	12 U
1,1,2,2-Tetrachloroethane	23 U	45 UJ	7 U	8 U	7 U	12 U
Toluene	45	90 J	7 U	8 U	7 U	12 U
Chlorobenzene	23 U	45 UJ	7 U	8 U	7 U	12 U
Ethylbenzene	23 U	45 UJ	7 U	8 U	7 U	12 U
Styrene	23 U	45 UJ	7 U	8 U	7 U	12 U
Total Xylenes	23 U	45 UJ	7 U	8 U	7 U	12 U

U = not detected at or above reported value J = estimated concentration

APPENDIX B.7 RESIN/FATTY ACID RESULTS (ug/L or ug/Kg, dry) - BOISE CASCADE, APRIL 1992

Location:	Transfer		ASB		ASB		Final		Primary		ASB	
Source:	Blank		Influent		Effluent		Effluent		Sludge		Sludge	
Method:	grab		ISCOcomp		ISCOcomp		ISCOcomp		grabcomp		grabcomp	
Date:	April 6		April 8		April 7-8		April 7-8		April 14		April 14	
Time:	1400		0000-1200		0600-0600		0600-0600		1230		1300-1330	
Sample Number:	158230		158239		158246		158252		168270		168271	
Hexadecanoic Acid	3	U	43	J	15		4	U	160000		93000	
Octadecanoic Acid	3	U	11	J	3	J	4	U	43000		28000	
Linoleic Acid	3	U	250	J	4	U	4	U	640000		25000	
Oleic Acid	3	U	180	J	5	U	2	J	690000	J	21000	
Pimaric Acid	3	UJ	230	J	83	J	27	J	120000	J	1E+06	J
Palmitoleic Acid	3	U	3	UJ	4	U	4	U	5100	U	5500	U
Sandaracopimaric Acid	3	U	31	J	12		4		43000		110000	J
Neoabietic Acid	3	UJ	31	J	39	J	5	J	110000	J	230000	J
Retene	3	U	3	J	4	U	4	U	5100	U	5500	U
Abietic Acid	3	U	860	J	500	J	180	J	800000		2E+06	
14-Chlorodehydroabietic Acid	3	U	4	J	3	J	1	J	5100	U	59000	
12-Chlorodehydroabietic Acid	3	U	5	J	10		3	J	5100	U	170000	
Dehydroabietic Acid	3	U	480	J	140	J	52	J	380000	J	2E+06	
Palustric Acid	3	U	NAF		44	J	13		110000	J	150000	
Dichlorostearic Acid	3	UJ	230	J	6	J	2	J	14000	J	53000	J
Isopimaric Acid	3	U	220	J	100	J	42	J	250000	J	1E+06	J
Dichlorodehydroabietic Acid	3	U	1	J	3	J	1	J	5100	U	190000	

U = not detected at or above reported value

J = estimated concentration

NAF = not analyzed for

APPENDIX B.7 (continued)

Location:	Badger Is		Old Outfall		Port Kelley		Hat Rock	
Source:	Sedimemt		Sediment		Sediment		Sediment	
Method:	grabcomp		grabcomp		grabcomp		grabcomp	
Date:	April 14		April 14		April 13		April 13	
Time:	–		–		–		–	
Sample Number:	168272		168273		168274		168275	
Hexadecanoic Acid	1700	U	2200	U	900	U	2700	U
Octadecanoic Acid	370	U	480	U	250	U	360	U
Linoleic Acid	270	U	300	U	250	U	420	U
Oleic Acid	270	U	480	U	250	U	500	U
Pimaric Acid	24	J	88	J	24	J	340	J
Palmitoleic Acid	270	U	1800		290		3300	
Sandaracopimaric Acid	270	U	300	U	250	U	46	J
Neoabietic Acid	270	UJ	300	UJ	250	UJ	420	UJ
Retene	270	U	300	U	250	U	420	U
Abietic Acid	170	J	660		170	J	2600	J
14-Chlorodehydroabietic Acid	270	U	300	U	250	U	420	U
12-Chlorodehydroabietic Acid	270	U	300	U	250	U	420	U
Dehydroabietic Acid	270	U	330		250	U	1100	
Palustric Acid	270	U	300	U	250	U	420	U
Dichlorostearic Acid	270	U	300	UJ	250	UJ	420	UJ
Isopimaric Acid	76	J	210	J	54	J	680	
Dichlorodehydroabietic Acid	270	U	300	U	250	U	420	U

U = not detected at or above reported value

J = estimated concentration

APPENDIX B.8 PHENOLICS RESULTS (ug/L or ug/Kg, dry) - BOISE CASCADE, APRIL 1992

Location:	Transfer		ASB		ASB		Final		Primary		ASB	
Source:	Blank		Influent		Effluent		Effluent		Sludge		Sludge	
Method:	grab		ISCOcomp		ISCOcomp		ISCOcomp		grabcomp		grabcomp	
Date:	April 6		April 8		April 7-8		April 7-8		April 14		April 14	
Time:	1400		0000-1200		0600-0600		0600-0600		1230		1300-1330	
Sample Number:	158230		158239		158246		158252		168270		168271	
4-Chloro-3-Methylphenol	0.4	U	0.4	U	0.4	U	0.4	U	2600	U	2800	U
Pentachlorophenol	2	U	2	U	2	U	2	U	2600	U	2800	U
2,4,6-Trichlorophenol	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	2800	U
2-Nitrophenol	0.4	U	0.4	U	0.4	U	0.4	U	2600	U	2800	U
Guaiacol	0.4	U	410		0.4	U	0.1	J	15000		1300	J
2-Methylphenol	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	2800	U
2-Chlorophenol	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	2800	U
2,4,5-Trichlorophenol	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	2800	U
4-Allylguaiacol	0.8	UJ	10	J	0.9	UJ	0.8	UJ	2600	UJ	2800	UJ
4-Propenylguaiacol	0.8	U	3		0.4	J	0.8	J	550	J	2800	U
4-Nitrophenol	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	2800	U
2,4-Dimethylphenol	0.8	U	0.8	U	0.2	J	0.1	J	2600	U	2800	U
4-Methylphenol	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	4100	
Phenol	1	U	25		1	U	1	U	3800	UJ	4100	UJ
2,4-Dichlorophenol	0.8	U	2		4		2		2600	U	2800	U
2,3,6-Trichlorophenol	0.8	U	2		6		4		2600	U	2800	U
Tetrachloroguaiacol	2	U	1	J	3		2		2600	U	2800	U
Trichlorotrimethoxybenzene	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	2800	U
Tetrachlorocatechol	2	U	3		1	J	0.8	J	2600	U	2800	U
4-Chlorocatechol	0.4	U	1		0.4	U	0.4	U	2600	U	2800	U
4,5-Dichloroguaiacol	0.8	U	18		4		4		2600	U	2800	U
Trichlorosyringol	0.8	U	0.8	U	0.9	U	0.1	J	2600	U	2800	U
4,5,6-Trichloroguaiacol	0.8	U	2		7		4		2600	U	2800	U
4,5-Dichlorocatechol	0.8	U	19		4		3		2600	U	2800	U
a-Terpineol	0.8	U	2000		0.9	U	0.8	U	41000		3000	
2,3,4-Trichlorophenol	0.8	U	0.8	U	0.9	U	0.8	U	2600	U	2800	U
4-Chloroguaiacol	0.4	U	0.4	U	0.4	U	0.4	U	2600	U	2800	U
5,6-Dichlorovanillin	2	UJ	0.5	J	0.6	J	0.9	J	2600	UJ	2800	UJ
6-Chlorovanillin	0.06	J	3	J	4	J	6	J	2600	UJ	2800	UJ
3,4,5-Trichlorocatechol	0.02	J	24	J	4	J	3	J	2600	UJ	2800	UJ
3,4,5-Trichloroguaiacol	0.05	J	8		11		7		2600	U	2800	U

U = not detected at or above reported value

J = estimated concentration

APPENDIX B.8 (continued)

Location:	Badger Is		Old Outfall		Port Kelley		Hat Rock	
Source:	Sediment		Sediment		Sediment		Sediment	
Method:	grabcomp		grabcomp		grabcomp		grabcomp	
Date:	April 14		April 14		April 13		April 13	
Time:	–		–		–		–	
Sample Number:	168272		168273		168274		168275	
4-Chloro-3-Methylphenol	130	U	150	U	130	U	210	U
Pentachlorophenol	130	U	150	U	130	U	210	U
2,4,6-Trichlorophenol	130	U	150	U	130	U	210	U
2-Nitrophenol	130	U	150	U	130	U	210	U
Guaiacol	130	U	150	U	130	U	210	U
2-Methylphenol	130	U	150	U	130	U	210	U
2-Chlorophenol	130	U	150	U	130	U	210	U
2,4,5-Trichlorophenol	130	U	150	U	130	U	210	U
4-Allylguaiacol	130	UJ	150	UJ	130	UJ	210	UJ
4-Propenylguaiacol	130	U	150	U	130	U	210	U
4-Nitrophenol	130	U	150	U	130	U	210	U
2,4-Dimethylphenol	130	U	150	U	130	U	210	U
4-Methylphenol	130	U	150	U	130	U	210	U
Phenol	200	UJ	210	UJ	180	UJ	280	UJ
2,4-Dichlorophenol	130	U	150	U	130	U	210	U
2,3,6-Trichlorophenol	130	U	150	U	130	U	210	U
Tetrachloroguaiacol	130	U	150	U	130	U	210	U
Trichlorotrimethoxybenzene	130	U	150	U	130	U	210	U
Tetrachlorocatechol	130	U	150	U	130	U	210	U
4-Chlorocatechol	130	U	150	U	130	U	210	U
4,5-Dichloroguaiacol	130	U	150	U	130	U	210	U
Trichlorosyringol	130	U	150	U	130	U	210	U
4,5,6-Trichloroguaiacol	130	U	150	U	130	U	210	U
4,5-Dichlorocatechol	130	U	150	U	130	U	210	U
a-Terpineol	130	U	150	U	130	U	210	U
2,3,4-Trichlorophenol	130	U	150	U	130	U	210	U
4-Chloroguaiacol	130	U	150	U	130	U	210	U
5,6-Dichlorovanillin	130	UJ	150	UJ	130	UJ	210	UJ
6-Chlorovanillin	130	UJ	150	UJ	130	UJ	210	UJ
3,4,5-Trichlorocatechol	130	UJ	150	UJ	130	UJ	210	UJ
3,4,5-Trichloroguaiacol	130	U	150	U	130	U	210	U

U = not detected at or above reported value
J = estimated concentration

APPENDIX B.9 METALS RESULTS (ug/L* or mg/Kg, dry) - BOISE CASCADE, APRIL 1992						
Location:	Transfer	Primary	Primary	ASB	ASB	Final
Source:	Blank	Influent	Effluent	Influent	Effluent	Effluent
Method:	grab	ISCOcomp	ISCOcomp	ISCOcomp	ISCOcomp	ISCOcomp
Date:	April 6	April 7-8	April 7-8	April 8	April 7-8	April 7-8
Time:	1400	0600-0600	0600-0600	0000-0600	0600-0600	0600-0600
Sample Number:	158230	158233	158236	158239	158246	158252
Arsenic	1.5 U	2.2 P	1.5 U	2.1 P	1.8 P	1.8 P
Lead	1.0 U	7.9	2.4 P	8.0	4.6 P	3.7 P
Thallium	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Selenium	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Mercury	0.070 U	0.074 P	0.070 U	0.082 P	0.15 P	0.72 P
Beryllium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	2.0 U	2.0 U	2.0 U	2.0 U	2.7 P	2.0 U
Chromium	5.0 U	12 P	5.6 P	12 P	15 P	9.8 P
Copper	3.0 U	41.6	17	25	18	22
Nickel	10 U	10 U	10 U	11 P	10 U	10 U
Silver	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Zinc	4.0 U	137	51.8	115	100	72.2
Antimony	30 U	30 U	30 U	30 U	30 U	30 U
Chromium VI	NA	NA	NA	10 UH	10 UH	10 UH

*total recoverable

U = not detected at or above reported value

P = detected below quantitation limit

NA = not analyzed

H = holding time exceeded

APPENDIX B.9 (continued)

Location:	Primary		ASB		Badger Is		Old Outfall		Port Kelley		Hat Rock	
Source:	Sludge		Sludge		Sediment		Sediment		Sediment		Sediment	
Method:	grabcomp		grabcomp		grabcomp		grabcomp		grabcomp		grabcomp	
Date:	April 14		April 14		April 14		April 14		April 13		April 13	
Time:	1230		1300-1330		-		-		-		-	
Sample Number:	168270		168271		168272		168273		168274		168275	
Arsenic	1.2		1.4		3.3		2.7		1.7		4.9	
Lead	10.7		24.2		11.1		9.9		5.6		39.0	
Thallium	0.25	UN	0.33	UN	0.25	UN	0.25	UN	0.25	UN	0.27	PN
Selenium	0.20	U	0.47	P	0.20	U	0.20	U	0.20	U	0.32	P
Mercury	0.0054	P	0.34		0.022	P	0.017	P	0.005	U	0.056	
Beryllium	0.10	U	0.20	P	0.26	P	0.41	P	0.17	P	0.56	P
Cadmium	1.4	P	8.0		0.79	P	0.87	P	0.4	P	3.2	
Chromium	36.9	J	233	J	11.1	J	13.6	J	9.4	J	23.8	J
Copper	41.5		102		9.7		14.8		7.4		30.1	
Nickel	13.9		21.7		11.2		12.7		9.1		20.8	
Silver	0.71	P	5.0		0.30	U	0.30	U	0.30	U	0.58	
Zinc	134	J	422	J	84.4	J	61.5	J	45.0	J	284	J
Antimony	3.0	UN	3.0	UN	3.0	UN	3.0	UN	3.0	UN	3.0	UN

U = not detected at or above reported value
P = detected below quantitation limit
N = spike recovery outside control limits
J = estimated concentration

APPENDIX B.10 SEMIVOLATILES RESULTS (ug/L) - BOISE CASCADE, APRIL 1992					
Location:	Final		Location:	Final	
Source:	Effluent		Source:	Effluent	
Method:	ISCOcomp		Method:	ISCOcomp	
Date:	April 7-8		Date:	April 7-8	
Time:	0600-0600		Time:	0600-0600	
Sample Number:	158252		Sample Number:	158252	
Benzo(a)pyrene	1	U	Benzyl Alcohol	28	U
2,4-Dinitrophenol	17	UJ	4-Bromophenylphenylether	1	U
Dibenzo(a,h)anthracene	3	U	2,4-Dimethylphenol	1	UJ
Benzo(a)anthracene	1	U	4-Methylphenol	1	U
4-Chloro-3-methylphenol	7	UJ	1,4-Dichlorobenzene	1	U
Benzoic Acid	17	UJ	4-Chloroaniline	17	U
Hexachloroethane	1	U	Phenol	1	U
Hexachlorocyclopentadiene	7	UJ	bis(2-Chloroethyl)ether	1	U
Isophorone	1	U	bis(2-Chloroethoxy)methane	1	U
Acenaphthene	1	U	bis(2-Ethylhexyl)phthalate	1	U
Diethylphthalate	2		Di-n-Octylphthalate	1	UJ
Di-n-Butylphthalate	1	U	Hexachlorobenzene	1	U
Phenanthrene	1	U	Anthracene	1	U
Butylbenzyphthalate	3	U	1,2,4-Trichlorobenzene	1	U
N-Nitrosodiphenylamine	17	UJ	2,4-Dichlorophenol	2	
Fluorene	1	U	2,4-Dinitrotoluene	3	UJ
Carbazole	7	UJ	Pyrene	1	U
Hexachlorobutadiene	3	U	Dimethylphthalate	2	
Pentachlorophenol	7	UJ	Dibenzofuran	1	U
2,4,6-Trichlorophenol	7	UJ	Benzo(ghi)perylene	1	U
2-Nitroaniline	3	UJ	Indeno(1,2,3-cd)pyrene	1	U
2-Nitrophenol	3	U	Benzo(b)fluoranthene	1	U
1-Methylnaphthalene	1	U	Fluoranthene	1	U
Naphthalene	1	U	Benzo(k)fluoranthene	1	U
2-Methylnaphthalene	1	U	Acenaphthylene	1	U
2-Chloronaphthalene	1	U	Chrysene	1	U
3,3'-Dichlorobenzidine	35	U	Retene	1	U
2-Methylphenol	1	U	4,6-Dinitro-2-methylphenol	17	UJ
1,2-Dichlorobenzene	1	U	1,3-Dichlorobenzene	1	U
2-Methylphenol	1	U	2,6-Dinitrotoluene	3	U
2,4,5-Trichlorophenol	6	J	N-Nitroso-di-propylamine	1	U
Nitrobenzene	1	U	4-Chlorophenylphenylether	1	UJ
4-Nitroaniline	17	U	bis(2-Chloroisopropyl)ether	1	UJ
4-Nitrophenol	9	UJ			

U = not detected at or above reported value

J = estimated concentration

APPENDIX B.11 PESTICIDE/PCB RESULTS (ug/L or ug/Kg, dry) - BOISE CASCADE, APRIL 1992

Location:	Final	Primary	ASB	Badger Is	Old Outfall	Port Kelley	Hat Rock
Source:	Effluent	Sludge	Sludge	Sediment	Sediment	Sediment	Sediment
Method:	ISCOcomp	grabcomp	grabcomp	grabcomp	grabcomp	grabcomp	grabcomp
Date:	April 7-8	April 14	April 14	April 14	April 14	April 13	April 13
Time:	0600-0600	1230	1300-1330	-	-	-	-
Sample Number:	158252	168270	168271	168272	168273	168274	168275
4,4'-DDT	0.2 U	40 U	200 U	10 U	9 U	10 U	20 U
Chlordane	0.7 U	400 U	2500 U	100 U	90 U	100 U	200 U
gamma-BHC	0.07 U	40 U	100 U	10 U	9 U	10 U	20 U
Dieldrin	0.2 U	40 U	630 U	10 U	9 U	10 U	20 U
Endrin	0.2 U	40 U	250 U	10 U	9 U	10 U	20 U
Methoxychlor	0.5 U	40 U	2000 U	10 U	9 U	10 U	20 U
4,4'-DDD	0.25 U	40 U	870 U	10 U	9 U	10 U	20 U
4,4'-DDE	0.07 U	40 U	100 U	10 U	9 U	10 U	20 U
Heptachlor	0.07 U	40 U	100 U	10 U	9 U	10 U	20 U
Aldrin	0.07 U	40 U	100 U	10 U	9 U	10 U	20 U
alpha-BHC	0.07 U	40 U	350 U	10 U	9 U	10 U	20 U
beta-BHC	0.07 U	40 U	580 U	10 U	9 U	10 U	20 U
delta-BHC	0.3 U	40 U	100 U	10 U	9 U	10 U	20 U
Endosulfan I	0.07 U	40 U	100 U	10 U	9 U	10 U	20 U
Heptachlor Epoxide	0.07 U	40 U	350 U	10 U	9 U	10 U	20 U
Endosulfan Sulfate	0.2 U	40 U	100 U	10 U	9 U	10 U	20 U
Endrin Aldehyde	0.4 U	60 U	150 U	10 U	9 U	10 U	20 U
Toxaphene	3.0 U	1200 U	3000 U	300 U	300 U	300 U	600 U
PCB-1260	0.7 U	400 U	1000 U	100 U	90 U	100 U	200 U
PCB-1254	0.7 U	400 U	1000 U	100 U	90 U	100 U	200 U
PCB-1221	0.7 U	400 U	1000 U	100 U	90 U	100 U	200 U
PCB-1232	0.7 U	400 U	1000 U	100 U	90 U	100 U	200 U
PCB-1248	0.7 U	400 U	1000 U	100 U	90 U	100 U	200 U
PCB-1016	0.7 U	400 U	1000 U	100 U	90 U	100 U	200 U
Endosulfan II	0.2 U	60 U	1500 U	10 U	9 U	10 U	20 U
PCB-1242	0.7 U	400 U	1000 U	100 U	90 U	100 U	200 U
Endrin Ketone	0.15 U	120 U	1200 U	10 U	9 U	10 U	20 U

U = not detected at or above reported value

APPENDIX C. ECOLOGY SAMPLING LOCATIONS - LAKE WALLULA, APRIL 1992					
SITE NAME	DESCRIPTION	RIVER MILE	DEPTH	LATITUDE	LONGITUDE
Badger Island	Left* side of river, upstream of north end Badger Island; three grab composite	318	10-12 ft.	46 06.66 46 06.72 46 06.75	118 56.69 118 56.67 118 56.70
Old Outfall	Inside bouy "A" and east side of barge channel to mill; three grab composite	316	13-18 ft.	46 05.64 46 05.64 46 05.74	118 55.41 118 55.43 118 55.63
Port Kelley	Left side of river approximately 1-1/2 miles below Port Kelley; three grab composite	311	30 ft.	46 01.03	118 57.55
Hat Rock	Approximately 1 mile below Hat Rock State Park; quarter point transect, composited	298	71-88 ft.	45 55.92 45 55.78 45 55.65	119 11.23 119 11.31 119 11.39

*viewed looking downstream

APPENDIX D. ANALYTICAL METHODS FOR BOISE CASCADE APRIL 1992 INSPECTION

ANALYSIS	REFERENCE	METHOD	LABORATORY
GENERAL CHEMISTRY:			
Conductivity	EPA (1979)	120.1	Ecology Laboratory, Manchester WA
Alkalinity	"	310.1	" " "
Hardness	"	130.2	" " "
Color	"	110.1	Laucks Testing Laboratories, Seattle WA
TS	"	160.3	" " "
TNVS	"	106.4	" " "
TSS	"	160.2	" " "
TNVS	"	106.4	" " "
BOD5	"	405.1	" " "
COD	"	410.1	Sound Analytical Services, Tacoma WA
TOC (water)	"	415.2	" " "
TOC (solids)	Tetra Tech (1986)		Sound Analytical Services, Tacoma WA
NH3-N	EPA (1979)	350.1	" " "
NO2+NO3-N	"	353.2	" " "
Total P	"	365.1	" " "
Oil and Grease	"	413.1	" " "
Chlorate	Ion Chromatography		Laucks Testing Laboratories, Seattle WA
Fecal Coliform (MF)	APHA (1989)	9222D	Ecology Laboratory, Manchester WA
Fecal Coliform (MPN)	APHA (1985)	908C	" " "
% Klebsiella	APHA (1989)	9222F	" " "
AOX	SCAN (1989)	W 9:89	" " "
TOX/DOX	APHA (1989)	5320	" " "
EOX	Dorhman Analyzer		Sound Analytical Services, Tacoma WA
Total Phenols	EPA (1979)	420.2	Ecology Laboratory, Manchester WA
Grain Size	Tetra Tech (1986)		Laucks Testing Laboratories, Seattle WA
TOXICS:			
Volatiles (water)	EPA (1986)	8240	Analytical Resources, Seattle WA
Volatiles (solids)	"	"	National Express Laboratories, Redmond WA
Semivolatiles	"	8270	Ecology Laboratory, Manchester WA
OC Pesticides/PCBs (water)	EPA (1984)	608	" " "
OC Pesticides/PCBs (solids)	EPA (1986)	8080	" " "
Resin & Fatty Acids	NCASI (1986a)	85.01	" " "
Phenolics	NCASI (1986b)	86.01	" " "
Dioxins and Furans	EPA (1986)	8290	Triangle Laboratories, Durham NC
Priority Pollutant Metals	EPA (1979)	200	Ecology Laboratory, Manchester WA
Hexavalent Chromium	EPA (1986)	7195	Sound Analytical Services, Tacoma WA
Cyanide (wk. & dissoc.)	APHA (1989)	45000-CN	Ecology Laboratory, Manchester WA

APPENDIX D. (continued)

ANALYSIS	REFERENCE	METHOD	LABORATORY
BIOASSAYS:			
Rainbow Trout	Ecology (1991)		EVS Consultants, Seattle WA
Daphnia magna	EPA (1991)		" " " "
Ceriodaphnia dubia	EPA (1989)		" " " "
Fathead Minnow	"		" " " "
Hyallela	ASTM (1991)		Parametrix, Bellevue WA
Microtox	Tetra Tech (1986)		" " "

APPENDIX E

BOISE CASCADE DUPLICATE SAMPLING RESULTS

White Paper Division

P.O. Box 500
Highway 12
Wallula, Washington 99363
509/547-2411

Boise Cascade

August 31, 1992

Mr. Art Johnson
Department of Ecology
7171 Clearwater Lane, Bldg. 8
P.O. Box 47710
Olympia, Washington 98504-7710

Dear Mr. Johnson:

As requested, I am submitting the duplicate test sampling results taken during the WDOE Class II water inspection in April, 1992.

If you have any questions regarding the test result, please contact me.

Sincerely,

BOISE CASCADE WHITE PAPER DIVISION

Dennis M. Ross

Dennis M. Ross
Environmental Control Director

/nmh

Attachment

Columbia
Analytical
Services inc.

May 20, 1992

Cheryl Benar
Boise Cascade Paper Group
White Paper Division
Highway 12
P.O. Box 500
Wallula, WA 99363

Re: **WDOE Water Inspection Project**

Dear Cheryl:

Enclosed are the results of the samples submitted to our lab on April 9, 1992. For your reference, these analyses have been assigned our work order number K922256.

Samples were run as Nitrate-Nitrite from an acid preserved bottle because the unpreserved nitrate sample was received past the recommended maximum holding time. The cyanide sample was not preserved to a pH of 12 as is required. The pH of this sample was 10.

All analyses were performed in accordance with our laboratory's quality assurance program.

Please call if you have any questions.

Respectfully submitted,

Columbia Analytical Services, Inc.

Janice M. Sedlak

Janice M. Sedlak
Project Chemist

JMS/das

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Work Order No.:**	K922256
Sample Matrix:	Water		

Inorganic Parameters
mg/L (ppm)

Sample Name:			Bleach Plant Alkaline Sewer	Bleach Plant Acid Sewer	Clarifier Inlet
Lab Code:			K2256-1	K2256-2	K2256-3
Analyte	**EPA Method**	**MRL**			
Ammonia as Nitrogen	350.3	0.05	0.40	0.43	--
Phosphorus, Total	365.3	0.01	1.6	4.3	--
Total Organic Carbon (TOC)	415.1	0.5	1,200	640	240

MRL Method Reporting Limit

Approved by JM Sedlak Date 5/21/92

U000

1317 South 13th Avenue • P.O. Box 479 • Kelso Washington 98626 • Telephone 206/577-7222 • Fax 206/636

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Boise Cascade Paper Group
Project: WDOE Water Inspection
Sample Matrix: Water

Date Received: 04/09/92
Work Order No.: K322256

Inorganic Parameters
mg/L (ppm)

Sample Name:			Final Effluent	Kenics Inlet
Lab Code:			K2256-5	K2256-6
Analyte	**EPA Method**	**MRL**		
Ammonia as Nitrogen	350.3	0.05	4.62	19.8
Chloride	300.0	0.2	--	380
Cyanide, Total	335.2	0.01	--	ND
Nitrate + Nitrite as Nitrogen	353.2	0.2	--	0.5
Phosphorus, Total	365.3	0.01	3.1	4.4
Total Organic Carbon (TOC)	415.1	0.5	72	350

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Jim Siollak Date 5/31/92

1317 South 13th Avenue • P.O. Box 479 • Kelso Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Boise Cascade Paper Group
Project: WDOE Water Inspection
Sample Matrix: Water

Date Received: 04/09/92
Work Order No.: K922256

Inorganic Parameters
mg/L (ppm)

Sample Name:			Secondary Effluent 0710	Final Effluent 0730	Method Blank
Lab Code:			K2256-7	K2256-8	K2256-MB
Analyte	**EPA Method**	**MRL**			
Ammonia as Nitrogen	350.3	0.05	--	--	ND
Chloride	300.0	0.2	--	--	ND
Cyanide, Total	335.2	0.01	--	--	ND
Nitrate + Nitrite as Nitrogen	353.2	0.2	--	--	ND
Phenolics, Total	420.1	0.01	0.15	0.06	ND
Phosphorus, Total	365.3	0.01	--	--	ND
Total Organic Carbon (TOC)	415.1	0.5	--	--	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by Jim Sedlak Date 5/21/92

00003

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-10

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Work Order No.:**	K922256
Sample Matrix:	Water		

Priority Pollutant Metals
$\mu g/L$ (ppb)

	Sample Name:		Clarifier Inlet	Secondary Effluent 0930	Kenics Inlet
	Lab Code:		K2256-3	K2256-4	K2256-6
Analyte	**EPA Method**	**MRL**			
Antimony	200.7	50	ND	ND	ND
Arsenic	206.2	5	ND	ND	ND
Beryllium	200.7	5	ND	ND	ND
Cadmium	200.7	3	ND	ND	ND
Chromium	200.7	5	13	19	16
Copper	200.7	10	31	12	13
Lead	239.2	2	4	2	3
Mercury	245.1	0.5	ND	ND	ND
Nickel	200.7	20	ND	ND	ND
Selenium	270.2	5	ND	ND	ND
Silver	200.7	10	ND	ND	ND
Thallium	279.2	5	ND	ND	ND
Zinc	200.7	10	121	88	86
Chromium, Hexavalent	7195/200.7	10	--	--	*ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit
* Sample was received past the end of the recommended maximum holding time.

Approved by [signature] Date 5/21/92

00004

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: Boise Cascade Paper Group
Project: WDOE Water Inspection
Sample Matrix: Water

Work Order No.: K922256

Priority Pollutant Metals
µg/L (ppb)

Sample Name:			Method Blank
Lab Code:			K2256-MB
Analyte	**EPA Method**	**MRL**	
Antimony	200.7	50	ND
Arsenic	206.2	5	ND
Beryllium	200.7	5	ND
Cadmium	200.7	3	ND
Chromium	200.7	5	ND
Copper	200.7	10	ND
Lead	239.2	2	ND
Mercury	245.1	0.5	ND
Nickel	200.7	20	ND
Selenium	270.2	5	ND
Silver	200.7	10	ND
Thallium	279.2	5	ND
Zinc	200.7	10	ND
Chromium, Hexavalent	7195/200.7	10	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by TMSedlak Date 5/21/92

U00

1317 South 13th Avenue • P.O. Box 479 • Kelso Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date TCLP Performed:**	04/13/92
Sample Matrix:	Water	**Date Analyzed:**	04/23/92
		Work Order No.:	K922256

Toxicity Characteristic Leaching Procedure (TCLP)
EPA Method 1311
Volatile Organic Compounds
mg/L (ppm) in TCLP Extract

			Sample Name:	**Bleach Plant Alkaline Sewer**	**Bleach Plant Acid Sewer**
			Lab Code:	**K2256-1**	**K2256-2**
Analyte	**EPA Method**	**MRL***	**Regulatory Limit♦**		
Benzene	5030/8020	0.1	0.5	ND	ND
Carbon Tetrachloride	5030/8010	0.1	0.5	ND	ND
Chlorobenzene	5030/8010	0.1	100	ND	ND
Chloroform	5030/8010	0.1	6	0.3	0.2
1,4-Dichlorobenzene	5030/8010	0.1	7.5	ND	ND
1,2-Dichloroethane	5030/8010	0.1	0.5	ND	ND
1,1-Dichloroethene	5030/8010	0.1	.7	ND	ND
Methyl Ethyl Ketone	5030/8020	1	200	ND	ND
Tetrachloroethene	5030/8010	0.1	0.7	ND	ND
Trichloroethene	5030/8010	0.1	0.5	ND	ND
Vinyl Chloride	5030/8010	0.1	0.2	ND	ND

MRL Method Reporting Limit
* MRLs are elevated because the sample(s) required diluting.
♦ From 40 CFR Part 261, et al., and *Federal Register*, March 29, 1990 and June 29, 1990
ND None Detected at or above the method reporting limit

Approved by JMSedlak Date 5/21/92

U00

1317 South 13th Avenue • P.O. Box 479 • Kelso Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date TCLP Performed:**	04/13/92
Sample Matrix:	Water	**Date Analyzed:**	04/23/92
		Work Order No.:	K922256

Toxicity Characteristic Leaching Procedure (TCLP)
EPA Method 1311
Volatile Organic Compounds
mg/L (ppm) in TCLP Extract

	Sample Name:			**Secondary Effluent 0930**	**Final Effluent**
	Lab Code:			**K2256-4**	**K2256-5**
Analyte	**EPA Method**	**MRL**	**Regulatory Limit♦**		
Benzene	5030/8020	0.05	0.5	ND	ND
Carbon Tetrachloride	5030/8010	0.05	0.5	ND	ND
Chlorobenzene	5030/8010	0.05	100	ND	ND
Chloroform	5030/8010	0.05	6	ND	ND
1,4-Dichlorobenzene	5030/8010	0.05	7.5	ND	ND
1,2-Dichloroethane	5030/8010	0.05	0.5	ND	ND
1,1-Dichloroethene	5030/8010	0.05	0.7	ND	ND
Methyl Ethyl Ketone	5030/8020	0.5	200	ND	ND
Tetrachloroethene	5030/8010	0.05	0.7	ND	ND
Trichloroethene	5030/8010	0.05	0.5	ND	ND
Vinyl Chloride	5030/8010	0.05	0.2	ND	ND

MRL Method Reporting Limit
♦ From 40 CFR Part 261, et al., and *Federal Register*, March 29, 1990 and June 29, 1990
ND None Detected at or above the method reporting limit

Approved by [signature] Date 5/21/92

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date TCLP Performed:**	04/13/92
Sample Matrix:	Water	**Date Analyzed:**	04/23/92
		Work Order No.:	K922256

Toxicity Characteristic Leaching Procedure (TCLP)
EPA Method 1311
Volatile Organic Compounds
mg/L (ppm) in TCLP Extract

			Sample Name:	**Kenics Inlet**	**Method Blank**
			Lab Code:	**K2256-6**	**K2256-MB**
Analyte	**EPA Method**	**MRL**	**Regulatory Limit♦**		
Benzene	5030/8020	0.05	0.5	ND	ND
Carbon Tetrachloride	5030/8010	0.05	0.5	ND	ND
Chlorobenzene	5030/8010	0.05	100	ND	ND
Chloroform	5030/8010	0.05	6	0.24	ND
1,4-Dichlorobenzene	5030/8010	0.05	7.5	ND	ND
1,2-Dichloroethane	5030/8010	0.05	0.5	ND	ND
1,1-Dichloroethene	5030/8010	0.05	0.7	ND	ND
Methyl Ethyl Ketone	5030/8020	0.5	200	ND	ND
Tetrachloroethene	5030/8010	0.05	0.7	ND	ND
Trichloroethene	5030/8010	0.05	0.5	ND	ND
Vinyl Chloride	5030/8010	0.05	0.2	ND	ND

MRL Method Reporting Limit
♦ From 40 CFR Part 261, et al., and *Federal Register*, March 29, 1990 and June 29, 1990
ND None Detected at or above the method reporting limit

Approved by Jim Sidlak Date 5/21/92

001

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date Extracted:**	04/14/92
Sample Matrix:	Water	**Date Analyzed:**	04/21/92
		Work Order No.:	K922256

Chlorinated Phenolic Organic Compounds
NCASI Method CP-86.01
μg/L (ppb)

Sample Name:		Secondary Effluent 0930	Final Effluent	Method Blank
Lab Code:		K2256-4	K2256-5	K2256-MB
Analyte	**MRL**			
2,6-Dichlorophenol	5	ND	ND	ND
2,4-Dichlorophenol	5	ND	ND	ND
3,5-Dichlorophenol	5	ND	ND	ND
3,4-Dichlorophenol	5	ND	ND	ND
4-Chloroguaiacol	5	ND	ND	ND
2,4,6-Trichlorophenol	5	6	ND	ND
2,3,6-Trichlorophenol	5	ND	ND	ND
2,4,5-Trichlorophenol	5	ND	ND	ND
4,5-Dichloroguaiacol	5	ND	ND	ND
3,6-Dichlorocatechol	5	ND	ND	ND
2,3,4,6-Tetrachlorophenol	5	ND	ND	ND
4,5-Dichlorocatechol	5	ND	ND	ND
3,4,5-Trichloroguaiacol	5	9	ND	ND
4,5,6-Trichloroguaiacol	5	8	ND	ND
5,6-Dichlorovanillin	5	ND	ND	ND
Pentachlorophenol	5	ND	ND	ND
3,4,5-Trichlorocatechol	5	7	ND	ND
Tetrachloroguaiacol	5	ND	ND	ND
Trichlorosyringol	5	ND	ND	ND
Tetrachlorocatechol	5	ND	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit

Approved by [signature] Date 5/21/92

1317 South 13th Avenue • P.O. Box 479 • Kelso Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WPDE Water Inspection	**Date Extracted:**	04/30/92
Sample Matrix:	Water	**Date Analyzed:**	05/15/92
		Work Order No.:	K922256

Washington State NPDES Renewal
Resin Acids, Fatty Acids, and Bleach Plant Derivatives
NCASI Method RA/FA-85.01
GC/MS Determination
µg/L (ppb)

Sample Name:		Secondary Effluent 0930	Final Effluent
Lab Code:		K2256-4	K2256-5
Analyte	**MRL**		
Tetrachloroguaiacol	10	ND	ND
Linoleic Acid	10	ND	ND
Oleic Acid/Linolenic Acid♦	10	ND	ND
Sandracopimaric Acid	10	30	19
Isopimaric Acid	10	200	130
Palustric Acid	10	32	19
Dehydroabietic Acid	10	170	110
Abietic Acid	10	780	510
9,10-Dichlorostearic Acid	10	ND	ND
Dichlorodehydroabietic Acid	10	ND	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit
♦ These compounds coelute.

Approved by Jim Sedlak Date 5/21/92

U0

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Boise Cascade Paper Group	**Date Extracted:**	04/30/92
Project:	WDOE Water Inspection	**Date Analyzed:**	05/15/92
Sample Matrix:	Water	**Work Order No.:**	K922256

Washington State NPDES Renewal
Resin Acids, Fatty Acids, and Bleach Plant Derivatives
NCASI Method RA/FA-85.01
GC/MS Determination
µg/L (ppb)

Sample Name:		**Method Blank**
Lab Code:		**K2256-MB**
Analyte	**MRL**	
Tetrachloroguaiacol	10	ND
Linoleic Acid	10	ND
Oleic Acid/Linolenic Acid♦	10	ND
Sandracopimaric Acid	10	ND
Isopimaric Acid	10	ND
Palustric Acid	10	ND
Dehydroabietic Acid	10	ND
Abietic Acid	10	ND
9,10-Dichlorostearic Acid	10	ND
Dichlorodehydroabietic Acid	10	ND

MRL Method Reporting Limit
ND None Detected at or above the method reporting limit
♦ These compounds coelute.

Approved by [signature] Date 5/21/92

U01

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-1

APPENDIX A

LABORATORY QC RESULTS

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date TCLP Performed:**	04/13/92
Sample Matrix:	Water	**Date Analyzed:**	04/23/92
		Work Order No.:	K922256

Matrix Spike Summary
Toxicity Characteristic Leaching Procedure (TCLP)
EPA Method 1311
Volatile Organic Compounds
(EPA Methods 5030/8010/8020)
mg/L (ppm) in TCLP Extract

Sample Name: Bleach Plant Alkaline Sewer
Lab Code: K2256-1

Analyte	**Spike Level***	**Sample Result**	**Spiked Sample Result**	**Percent Recovery♦**
Benzene	5.0	ND	5.5	110
Carbon Tetrachloride	5.0	ND	6.7	134
Chlorobenzene	5.0	ND	5.6	112
Chloroform	5.0	0.3	5.0	94
1,4-Dichlorobenzene	5.0	ND	5.9	118
1,2-Dichloroethane	5.0	ND	6.0	120
1,1-Dichloroethene	5.0	ND	6.5	130
Methyl Ethyl Ketone	5.0	ND	4.6	92
Tetrachloroethene	5.0	ND	6.2	124
Trichloroethene	5.0	ND	6.4	128
Vinyl Chloride	5.0	ND	6.2	124

* Sample run at 100 times dilution instead of the typical 50 times.
♦ Percent recovery information is provided in order to assess the performance of the method on this matrix.
ND None Detected at or above the method reporting limit

Approved by [signature] Date 5/21/92

U001

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-1

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date TCLP Performed:**	04/13/92
Sample Matrix:	Water	**Date Analyzed:**	04/23/92
		Work Order No.:	K922256

Surrogate Recovery Summary
Toxicity Characteristic Leaching Procedure (TCLP)
EPA Method 1311
Volatile Organic Compounds
(EPA Methods 5030/8010/8020)
in TCLP Extract

Sample Name	**Lab Code**	**Percent Recovery** 1,4-Dichlorobutane
Bleach Plant Alkaline Sewer	K2256-1	98
Bleach Plant Acid Sewer	K2256-2	101
Secondary Effluent 0930	K2256-3	102
Final Effluent	K2256-4	103
Kenics Inlet	K2256-6	101
Bleach Plant Alkaline Sewer	K2256-1MS	97
Method Blank	K2256-MB	97
	CAS Acceptance Criteria	73-133

Approved by J M Sedlak Date 5/21/92

U00

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636-1

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date TCLP Performed:**	04/13/92
Sample Matrix:	Water	**Date Analyzed:**	04/23/92
		Work Order No.:	K922256

Surrogate Recovery Summary
Toxicity Characteristic Leaching Procedure (TCLP)
EPA Method 1311
Volatile Organic Compounds
(EPA Methods 5030/8010/8020)
in TCLP Extract

Sample Name	**Lab Code**	**Percent Recovery** *α,α,α*-Trifluorotoluene
Bleach Plant Alkaline Sewer	K2256-1	108
Bleach Plant Acid Sewer	K2256-2	107
Secondary Effluent 0930	K2256-3	107
Final Effluent	K2256-4	108
Kenics Inlet	K2256-6	108
Bleach Plant Alkaline Sewer	K2256-1MS	107
Method Blank	K2256-MB	108
	CAS Acceptance Criteria	79-119

Approved by Jim Seblak Date 5/21/92

U00

1317 South 13th Avenue • P.O. Box 479 • Kelso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client:	Boise Cascade Paper Group	**Date Received:**	04/09/92
Project:	WDOE Water Inspection	**Date Extracted:**	04/30/92
Sample Matrix:	Water	**Date Analyzed:**	05/15/92
		Work Order No.:	K922256

Surrogate Recovery Summary
Resin Acids, Fatty Acids, and Bleach Plant Derivatives
NCASI Method RA/FA-85.01
GC/MS Determination

Sample Name	**Lab Code**	**Percent Recovery**	
		Heptadecanoic Acid	O-Methylpodocarpic Acid
Secondary Effluent 0930	K2256-4	70	66
Final Effluent	K2256-5	78	68
Method Blank	K2256-MB	*57	89
	CAS Acceptance Criteria	65-120	65-120

Outside of acceptance limits. Since the reduced percent recovery is for the method blank, and since the percent recovery for all of the associated samples is acceptable, it is the opinion of CAS that the quality of the sample data has not been significantly affected.

Approved by [signature] Date 5/21/92

00016

1317 South 13th Avenue • P.O. Box 479 • Kelso Washington 98626 • Telephone 206/577-7222 • Fax 206/636-

APPENDIX B

CHAIN OF CUSTODY INFORMATION

1317 South 13th Avenue • P.O. Box 479 • Keiso, Washington 98626 • Telephone 206/577-7222 • Fax 206/636

K2256

Columbia Analytical Services inc.

1317 South 13th Ave. • Kelso, WA 98626 • (206) 577-7222, FAX (206) 636-1068

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

DATE 4/8/92 PAGE 1 OF 2

PROJECT NAME WDOE Water Inspection

PROJECT MNGR Cheryl J. Bencer

COMPANY/ADDRESS Boise Cascade White Paper Div

P.O. Box 500, Hy. 12

Wallula, Wa. 99363 PHONE (509) 546-3417

SAMPLERS SIGNATURE Cheryl J. Bencer

ANALYSIS REQUESTED

SAMPLE I.D.	DATE	TIME	LAB I.D.	SAMPLE MATRIX	NUMBER OF CONTAINERS	~~Base/Neu/Acid Organics GC/MS 625/8270~~ Cl, NO2, NO3	Volatile Organics GC/MS 624/8240	Halogenated or Aromatic Volatiles 601/8010 ☐ 602/8020 ☐	Pesticides/PCBs 608/8080	Total Petroleum Hydrocarbons EPA 418.1 ☐ Oregon 418.1 ☐	TPH/Gas/BTEX 5030/8015/8020 Gas ☐ BTEX ☐	TPH/8015 Modified Diesel ☐ Hydrocarbon Scan ☐	~~TPH-HCID~~ Cr-6	TCLP Metals ☐ VOA ☐ VOA ☐ Semi Herb ☐ Pest	Metals (total) List Below (dissolved) pp metals	Cyanide	pH, Cond, Cl, SO4, PO4, F, Br NO2, NO3 (circle)	NH3-N, COD (Total-P) TKN (TOC) (circle) + T-PKCS	Total Organic Halides (TOX) 9020	Resin + Fatty Acid (1)	Guaiacols 86.01	REMARKS
Bleach Plant Alkaline Sewer	4/8/92	0830 a.m.	K2256-1		4									✓				✓				3 VOC bottles 1 plastic bottle
Bleach Plant Acid Sewer	4/8/92	0815 a.m.	-2		4									✓				✓				"
24 hr composite Clarifier Inlet	4/7/92	0700 a.m.	-3		2										✓			*✓				*TOC only
24 hr composite Secondary Effluent	4/7/92	0930 a.m.	-4		5									✓	✓							3 VOC bottles 1 glass + 1 plastic
24 hr composite Final Effluent	4/7/92	1010 a.m.	-5		6									✓				✓		✓	✓	3 VOC, 2 glass 1 plastic
24 hr composite Kenics Inlet	4/7/92	1110 a.m.	-6		8	✓							✓	✓	✓	✓		✓				3 VOC
24 hr composite Secondary Eff.	4/7/92	0930 a.m.	-4		1															✓		only enough for 1/2 bottle

RELINQUISHED BY:	RECEIVED BY:
Cheryl J. Bencer	Ruth Allison
Signature	Signature
Cheryl J. Bencer	Ruth Allison
Printed Name	Printed Name
Boise Cascade	CAS
Firm	Firm
4/8/92 0210 p.m.	4/9/92 0900
Date/Time	Date/Time

TURNAROUND REQUIREMENTS:	REPORT REQUIREMENTS	INVOICE INFORMATION:	SAMPLE RECEIPT:
___ 24 hr ___ 48 hr ___ 5 day	___ I. Routine Report	P.O. #	Shipping VIA:
___ Standard (~ 10-15 working days)	___ II. Report (includes DUP, MS, MSD, as required, may be charged as samples)	Bill to:	Shipping #:
___ Provide Verbal Preliminary Results	___ III. Data Validation Report (includes All Raw Data)		Condition:
___ Provide FAX Preliminary Results	___ IV. CLP Deliverable Report		Lab No.:
Requested Report Date			

RELINQUISHED BY:	RECEIVED BY:
Signature	Signature
Printed Name	Printed Name
Firm	Firm
Date/Time	Date/Time

SPECIAL INSTRUCTIONS/COMMENTS:

(1) NCASI Method RA/FA 85.01

Run Guaiacols on Sec. Effl. 0930 as per Janice 4/9

K2256

Columbia Analytical Services inc.

1317 South 13th Ave. • Kelso, WA 98626 • (206) 577-7222, FAX (206) 636-1068

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

DATE 4/8/92 PAGE 2 OF 2

PROJECT NAME WDOE Water Inspection

PROJECT MNGR Cheryl Benar

COMPANY/ADDRESS Boise Cascade White Paper Div

P.O. Box 500 Hy. 12

Wallula, Wa. 99363 PHONE (509) 546-3417

SAMPLERS SIGNATURE Cheryl J. Benar

ANALYSIS REQUESTED

SAMPLE I.D.	DATE	TIME	LAB I.D.	SAMPLE MATRIX	NUMBER OF CONTAINERS	Base/Neu/Acid Organics GC/MS 625/8270	Volatile Organics GC/MS 624/8240	Halogenated or Aromatic Volatiles 601/8010 ☐ 602/8020 ☐	Pesticides/PCBs 608/8080	Total Petroleum Hydrocarbons EPA 418.1 ☐ Oregon 418.1 ☐	TPH/Gas/BTEX 5030/8015/8020 Gas ☐ BTEX ☐	TPH/8015 Modified Diesel ☐ Hydrocarbon Scan ☐	TPH - HCID	TCLP Metals ☐ VOA ☐ Semi VOA ☐ Pest/Herb ☐	Metals (total or dissolved) List Below	Cyanide	pH, Cond, Cl, SO_4, PO_4, F, Br NO_2, NO_3 (circle)	NH_3-N, COD, Total-P, TKN, TOC (circle)	Total Organic Halides (TOX) 9020	T-Phenols NCASI Method CP 86.01	REMARKS
24 hr. composite Secondary Effluent	4-7-92	(4-8) 0700 a.m.	-7 mg		1															✓	
24 hr composite Final Effluent	4-7-92	(4-8) 0730 a.m.	-8 mg		1															✓	only enough for 1/2 bottle

RELINQUISHED BY:	RECEIVED BY:
Cheryl J. Benar	Ruth Allison
Signature	Signature
Cheryl J. Benar	Ruth Allison
Printed Name	Printed Name
Boise Cascade	CAS
Firm	Firm
4/8/92 02:10 p.m.	4/9/92 0900
Date/Time	Date/Time

TURNAROUND REQUIREMENTS:

___ 24 hr ___ 48 hr ___ 5 day

___ Standard (~ 10-15 working days)

___ Provide Verbal Preliminary Results

___ Provide FAX Preliminary Results

Requested Report Date _____

REPORT REQUIREMENTS

___ I. Routine Report

___ II. Report (includes DUP, MS, MSD, as required, may be charged as samples)

___ III. Data Validation Report (includes All Raw Data)

___ IV. CLP Deliverable Report

INVOICE INFORMATION:

P.O. # _____

Bill to: _____

SAMPLE RECEIPT:

Shipping VIA: _____

Shipping # _____

Condition _____

Lab No. _____

RELINQUISHED BY:	RECEIVED BY:
Signature	Signature
Printed Name	Printed Name
Firm	Firm
Date/Time	Date/Time

SPECIAL INSTRUCTIONS/COMMENTS:

Rec'd a set of Trip Blanks not listed on Chain

APPENDIX F. SUMMARY OF OTHER DIOXIN/FURAN DATA ON LAKE WALLULA SEDIMENTS

Investigator:	EPA/ODEQ	EPA/ODEQ	EPA/ODEQ	CORPS OF ENGINEERS	CORPS OF ENGINEERS
Location:	5 mi. above Boise Cascade	Boise Cascade Outfall	1 Mile Below Boise Cascade	Upper Channel Boise Cascade	Lower Channel Boise Cascade
River Mile:	321	316	315	316.5	316
Date:	1991	1991	1991	1991	1991
2,3,7,8-TCDD	0.23 U	0.23	0.21 U	0.47	0.62
1,2,3,7,8-PeCDD	0.32 U	0.27 U	0.26 U	0.10	ND
1,2,3,4,7,8-HxCDD	0.38 U	0.33 U	0.46 U	0.32	ND
1,2,3,6,7,8-HxCDD	0.34 U	0.42 U	0.38 U	0.47	ND
1,2,3,7,8,9-HxCDD	0.34 U	0.27 U	0.38 U	0.76 B	0.54
1,2,3,4,6,7,8-HpCDD	1.8	2.4	4.5	6.7 B	6.5
OCDD	11	15	29	23.6 B	36.6
2,3,7,8-TCDF	0.34	2.0	0.26 U	12.1	15.5
1,2,3,7,8-PeCDF	0.15 U	0.13 U	0.16 U	ND	0.25
2,3,4,7,8-PeCDF	0.14 U	0.15 U	0.18 U	0.23	ND
1,2,3,4,7,8-HxCDF	0.15 U	0.22 U	0.16 U	ND	0.28
1,2,3,6,7,8-HxCDF	0.12 U	0.15 U	0.15 U	ND	ND
2,3,4,6,7,8-HxCDF	0.40	0.35	0.47	ND	ND
1,2,3,7,8,9-HxCDF	0.077 U	0.062 U	0.10 U	ND	ND
1,2,3,4,6,7,8-HpCDF	1.2	1.4	2.0	0.66 B	1.4
1,2,3,4,7,8,9-HpCDF	0.11 U	0.11 U	0.16 U	ND	0.16
OCDF	1.4	1.6	5.8	2.8 B	8.6
TCDD (total)	0.38 U	0.23	0.37 U	NR	NR
PeCDD (total)	1.1 U	1.6 U	2.8 U	NR	NR
HxCDD (total)	1.1 U	0.91 U	0.46	NR	NR
HpCDD (total)	3.3	4.8	8.7	NR	NR
TCDF (total)	0.91	5.1	1.6	NR	NR
PeCDF (total)	0.33 U	0.45	0.22	NR	NR
HxCDF (total)	0.49	0.58	1.3	NR	NR
HpCDF (total)	3.2	5.3	7.7	NR	NR

U = not detected at or above reported value
B = analyte also found in laboratory blank
ND = not detected
NR = not reported