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**Dioxin, Furan and Chlorinated Phenolic
Content of Wastewater Suspended Solids -
Data Summary Report**

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**Environment Canada
Fraser Pollution Abatement
Fraser River Action Plan**

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1. INTRODUCTION

The Fraser River Action Plan, a six-year basin-wide program, was initiated in 1991 to assess the condition of the river (FRAP, 1992). Determining the quality and quantity of wastewater discharges and estimating contaminant loadings was a component of Environmental Protection Branch's contribution to the program.

Polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) are ubiquitous environmental contaminants and have recently received a great deal of research attention in determining their sources and impacts (Dioxin'95, 1995; BCMELP, 1995a). Pulp mills in the mid-1980s were identified as significant sources of dioxins and furans. Loadings from that source and the associated environmental contamination have been shown to have decreased appreciably since the implementation of new regulations and the substitution of elemental chlorine with chlorine dioxide in the bleaching process (BCMELP, 1994; BCMELP, 1995b).

Depending upon the octanol-water partition coefficient K_{ow} , which provides a direct estimate of partitioning tendency from water to organic media, the higher K_{ow} compounds such as PCDD/DFs would be expected to be largely found associated with the organically rich and fine suspended matter in some wastewaters. Merriman, 1988 identified dioxins and furans associated with centrifuged pulp mill effluent suspended solids.

With the process changes made by pulp mills to reduce PCDD/PCDF levels, the formation of lower K_{ow} chlorinated phenolic compounds also decreased with increasing chlorine dioxide substitution. Many chlorinated phenolics, particularly the more highly substituted compounds, were virtually eliminated before secondary treatment (Pryke et al., 1993, NCASI, 1995).

This report includes the results of a limited number of centrifuge-concentrated suspended solids samples which were collected over 1993 to 1995, in an effort to more completely characterize a variety of wastewater sources for PCDDs, PCDFs and chlorinated phenolics (Figure 1 and 2). On several occasions, the centrifuging was scheduled to be conducted concurrently with more "traditional" wastewater (whole effluent) characterization studies (IRC, 1994). Those data are identified for reference purposes only and are not discussed herein. The results from a limited number of pulp mill suspended solids samples collected prior to the process changes being made, are also included for comparative purposes.

2. CENTRIFUGE SUSPENDED SOLIDS COLLECTION

An Envirodat Sedisamp System II Model 100IL (modified Alfa-Laval MAB103B) continuous-flow centrifuge was used to collect a concentrated suspended solids sample at the point of effluent discharge into the receiving environment. The

centrifuge was operated at 4L/minute and long enough to collect a 300-500g (wet weight) sample. Once the samples were removed from the centrifuge bowl, they were either frozen immediately in the field over dry ice or frozen in a freezer with hours of collection. The samples were retained frozen at -20°C until analyzed. Centrifuge operation, clean-up procedures and sample handling procedures are reported in more detail elsewhere (Mitchell, 1994).

Centrifuging was conducted concurrently with whole effluent sampling on two occasions, at pulp mill sites (IRC, 1994).

2.1 Whole Effluent Total Suspended Solids Samples

Grab whole effluent samples were collected on several occasions (2-3 times) over the centrifuging period.. The samples were stored in coolers with ice and shipped or delivered directly to the Pacific Environment Science Centre for analysis. Samples were stored a 4°C until analyzed by gravimetric analysis after drying at 105°C for one hour (PESC, 19--).

3. ANALYTICAL METHODS FOR SUSPENDED SOLIDS CONTAMINANTS

3.1 Suspended Solids Dioxins/Furans - AXYS (Axys Analytical Services) Methods - DX-SL(S)-01/Ver.1 and DX-S-01/Ver.2

In summary, each sample was spiked with an aliquot of surrogate standard solution containing ¹³C-labelled dioxin and furan congeners to allow quantification of the target analytes and measure extraction efficiency.

A subsample of wet sample was ground with sodium sulphate and extracted by refluxing in a soxhlet apparatus. The extract was backwashed with base and then acid and processed through the four cleanup columns (silica, alumina, carbon, alumina). An aliquot of ¹³C-labelled recovery standard was added to each extract prior to analysis by high resolution gas chromatography and high resolution mass spectrometric detection (HRGC/HRMS). The method closely followed the Environment Canada reference method adapted for use with a sludge sample (Environment Canada, 1992). The methods are reported in more detail in Appendix A1.

The wastewater sources sampled along with the respective PCDD/PCDF analytical methods are listed in Table 1 for: Nwood (Northwood Pulp Mill), Canfor (Canadian Forest Products Pulp Mill), QRP (Quesnel River Pulp Mill), Cboo (Cariboo Pulp Mill), Lansdowne (Prince George Central STP), Annacis and Lulu (GVRD STPs) and Clark Drive (GVRD Combined Sewer Overflow to Burrard Inlet).

3.2 Suspended Solids Chlorinated Phenolics - AXYS (Axs Analytical Services) Methods - CP-SL-05/Ver.1, CP-S-01/Ver.3 and CP-S-01/Ver.1

In summary, each sample was spiked with an aliquot of a solution containing ¹³C-labelled chlorinated phenolic compounds prior to analysis to allow quantification of the target analytes and measure extraction efficiency. A subsample of sludge was derivitized by reaction with acetic anhydride. The acetylated compounds were extracted with hexane and the extract dried over anhydrous sodium sulphate. The extract was cleaned up by column chromatography on silica gel prior for analysis by HRGC/LRMS. The methods are reported in more detail in Appendix A2 and are listed in Table 1.

3.3 Pulp Mill Suspended Solids Samples Prior To Process Changes

The methods for sample collection and handling were the same as described above. The analytical methods for samples collected in 1990 and analyzed by AXYS (Seachem at that time) and those collected in 1991 and analyzed by EnviroTest Laboratories (ETL) are reported in Appendix A3.

Table 1: Wastewater Sources and Dioxin/Furan and Chlorinated Phenolics Methods for Suspended Solids

Sample Source	Dioxin Method	Sample Source	Dioxin Method	Sample Source	Dioxin Method
PULP MILLS		MUNICIPAL SEWAGE		COMBINED SEWER OVERFLOW	
Nwood 04/11/93 25/10/94	DX-SL-01/Ver.1 DX-S-01/Ver.1	Landsdowne 03/11/93	DX-SL-01/Ver.1	Clark Drive 22/03/93 06/04/94	DX-S-01/Ver.1
Canfor 05/11/93 23/11/93*	DX-SL-01/Ver.1 DX-SL-01/Ver.1	Annacis 03/03/94 22/08/95 21/11/95	DX-SL-01/Ver.1 DX-S-01/Ver.2 DX-S-01/Ver.2		
QRP 01/11/93	DX-SL-01/Ver.1	Lulu 12/05/94	DX-S-01/Ver.1		
Cboo 02/11/93	DX-SL-01/Ver.1				
Wey 08/11/93*	DX-SL-01/Ver.1				

* whole effluent samples collected (IRC, 1994)

Sample Source	Chlorinated Phenolic Method	Sample Source	Chlorinated Phenolic Method	Sample Source	Chlorinated Phenolic Method
PULP MILLS		MUNICIPAL SEWAGE		COMBINED SEWER OVERFLOW	
Nwood 04/11/93 25/10/94	CP-SL-05/Ver.1 CP-S-01/Ver.3	Landsdowne 03/11/93	CP-SL-05/Ver.1	Clark Drive 06/04/94	CP-S-01/Ver.1
Canfor 05/11/93 23/11/93* 24/10/94	CP-SL-05/Ver.1 CP-SL-05/Ver.1 CP-S-01/Ver.3	Annacis 03/03/94 22/08/95 21/11/95	CP-SL-05/Ver.1 CP-S-01/Ver.3 CP-S-01/Ver.3		
QRP 01/11/93	CP-SL-05/Ver.1	Lulu 12/05/94	CP-S-01/Ver.1		
Cboo 02/11/93	CP-SL-05/Ver.1				
Wey 08/11/93*	CP-SL-05/Ver.1				

Figure 1: Location of Wastewater Sources for Suspended Solids

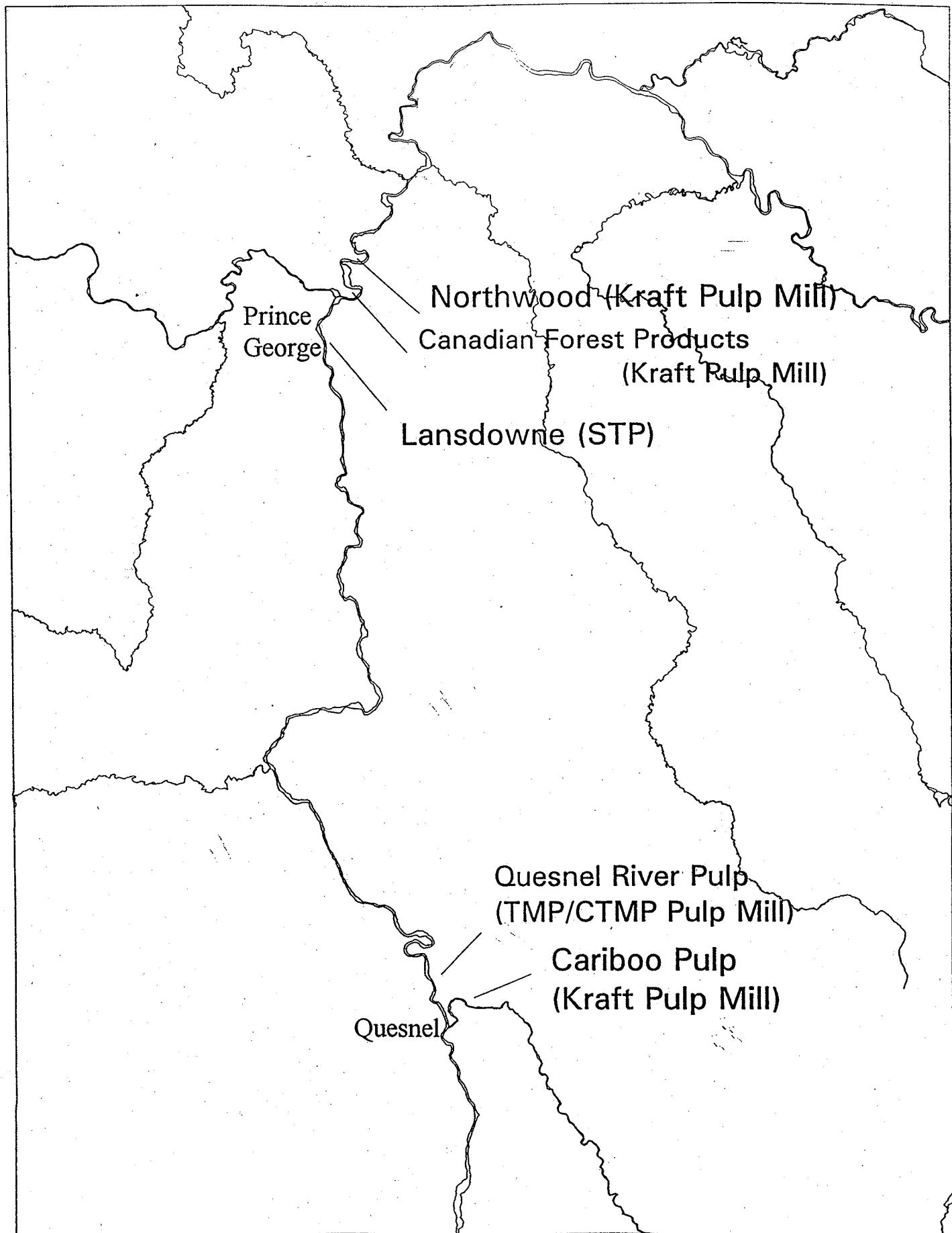
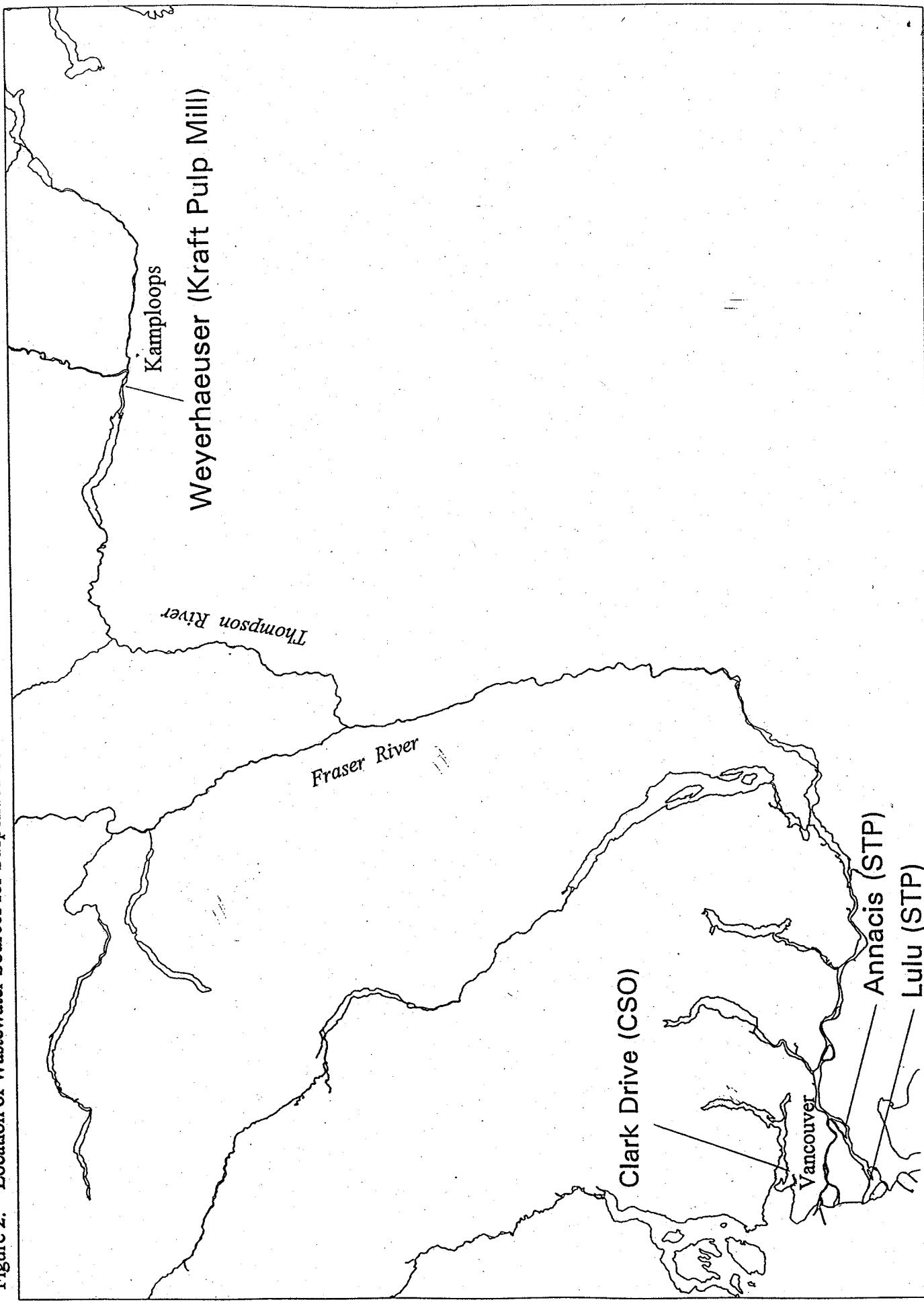


Figure 2: Location of Wastewater Sources for Suspended Solids



4. RESULTS

The sample collection details (centrifuge operation time, effluent volume and TSS concentration, sample storage time) are presented in Appendix A1. Details of pulp mill operations are also reported in Appendix A1.

The suspended solids contaminant loading was calculated (dry weight contaminant concentration x the daily loading of suspended solids) and is presented in units of micrograms per day for dioxins/furans and milligrams per day for chlorophenolics. The daily total suspended solids (TSS) effluent loading was calculated from the effluent TSS concentration and the daily effluent volume discharged or in the case of the pulp mills, the daily loading reported to Environment Canada in their monthly reports. For the CSO results, the loading is expressed on a daily (24h) basis. However, the actual CSO annual loading, which depends upon the actual number of hours of discharge per year and varies annually with rainfall, would be the most appropriate comparison to be made with the annual loading of the other wastewaters.

4.1 Dioxins/Furans

The sample results are reported in Appendix B1 and any procedural blank positive identifications are also reported. A procedural blank of NDR 8.6 pg/g O₈CDD and NDR 6.6 pg/g O₈CDF was reported for the one sample batch and 0.8 pg/g O₈CDD in another. The results are not procedural blank corrected. The results are surrogate recovery corrected and the individual sample recoveries are reported in Appendix C1(a). The spiked matrix reference sample recoveries for the sample batches (were they were included) are reported in Appendix C1(c). There didn't appear to anything in the surrogate recoveries or spiked matrix samples do indicate any unusual problems with the results.

4.1.1 Pulp Mill Dioxin Samples Prior to Chlorine Dioxide Substitution

The sample results and surrogate recoveries for centrifuge-concentrated suspended solids, collected prior to the bleached kraft pulp mills making process changes to reduce dioxin levels are reported in Appendix B2 and C1(b) respectively. The collection and sample handling procedures were the same as for the post-chlorine dioxide substitution samples.

4.2 Chlorinated Phenolics

The sample results are reported in Appendix B3 and any procedural blank positive identifications are also reported. There was nothing in the procedural blank results that indicated that any of the sample results would be unduly affected and required correction. The results are surrogate recovery corrected

and the individual sample recoveries are reported in Appendix C2(a). For the August 1995 and November 1995 Annacis STP samples, the GC/MS data for chlorophenolic analysis was complicated by the presence of interferences and a modified quantification procedure was used. An additional cleanup step on a gel permeation column was used to remove interferences from the extracts. The ^{13}C surrogates used to make the individual analyte corrections are listed in Appendix C2(b). The spiked matrix reference sample recoveries for each sample batch (were they were included) are reported in Appendix C2(c).

5. DISCUSSION

5.1 Dioxins/Furans

The suspended solids discharged from the wastewaters tested are high in organic content and ranged from a low of ~25% for the CSO to as high ~50% for the pulp mills (Derksen, 1997). These discharges represent major sources of particulate carbon into the Fraser system.

While the data set can not be considered extensive, some general observations can be made. The 2,3,7,8-substituted congener(s) concentration reported in terms of Toxic Equivalents (TEQs) clearly reflects the reduction in pulp mill loadings as a consequence of bleaching and other process changes (Table 2). The TEQ prior to process changes varied with the bleached kraft pulp mill and ranged between 1.7-10.2 mg/d ($n = 5$, Table 3). The post-process change bleached kraft pulp mill TEQ loading was reduced and ranged between 0.08-0.34 mg/d ($n = 5$; Weyerhaeuser sample may not have been representative as the sample was collected xx days after the ASB being dredged). For the total dioxin+furan homologue loading, the pre-process change loading ranged between 28-113 mg/d to a post-process change range of 5.8-13.6 mg/d (Table 3).

In comparison, the Annacis Waste Treatment Plant (WTTP) had an estimated TEQ loading range of 0.17 - 1.4 mg/d and a mean value 0.63 mg/d ($n = 3$, Table 3) and a total dioxin+furan homologue loading range of 47.1 - 242 mg/d (mean value = 124 mg/d).

On an annual basis and assuming the results reasonably reflect the temporal discharge quality, some crude annual estimates for various wastewater TEQs were calculated (Table 2). For the individual pulp mills, the difference between pre and post-process changes reflects an approximate 98% reduction. This is similar to the reported reduction for the Fraser River between 1990 and 1993 of 85% for TCDF and over 98% for TCDD (BCMELP, 1994). The Annacis WWTP average loading of 220 mg/yr might be expected to be reduced, in the order of 75% to 55 mg/yr, as a consequence of secondary treatment and a reduced suspended solids loading.

Table 2: Estimated Annual 2,3,7,8-Substituted Congener TEQ Loading for Various Wastewater Sources

	Annual Suspended Solids Loading (tonne)	Suspended Solids Average 2,3,7,8-Substituted Congener TEQ (pg/g)	Annual 2,3,7,8-Substituted Congener TEQ Loading (mg/yr)
PULPMILLS			
Pre-Process Change	(1990/91)	759 (n=1) 802 (n=2) 250 (n=2)	2960 2970 925
Nwood Canfor Cariboo	3,900 3,700 3,700		
Post-Process Change	(1994)	16.8 (n=2) 23 (n=2) 207 (average of above)	60 94 30
Nwood Canfor Cariboo	3,600 4,100 1,500		
MUNICIPAL WWTPs			
Annacis -Primary Treatment Annacis - [Secondary Treatment]	8,200 [2,050]	27 (n=3) 27 (per above assumed)	220 55
MUNICIPAL			
Clarke CSO* Glenbrook CSO	1,730 51	75.6 (n=2) 75.6 (per above assumed)	130 3.8

* loading estimated from annual volume and suspended solids data provided by J. Ellis of GVRD.

5.2 Chlorinated Phenolics

The lower chlorinated phenolic derivatives (LCPDs) and higher chlorinated phenolic derivatives (HCPDs) identified by NCASI, 1994 were selected to compare the various wastewaters to (Table 4). The LCPDs included: chlorophenols (CP) 4-CP and 2,6-DCP and 2,4/2,5-DCP; chlorocatechols (CC) 4-CC and 4,5-DCC; chlorovanillins (CV) 6-CV and 5,6-DCV; and chlorosyringaldehyde (CSA) 2,6-DCSA. The HCPDs included: chlorophenols 2,4,6-TCP and 2,4,5-TCP and 2,3,4,6-TeCP and PCP; chloroguaiacols (CG) 3,4,6-TCG and 3,4,5-TCG and 4,5,6-TCG and TeCG; chlorocatechols 3,4,6-TCC and 3,4,5-TCC and TeCC; and chlorosyringol (CS) 3,4,5-TCS.

The LCPDs have a lower log K_{ow} than the HCPDs and in general are relatively nonlipophilic, having a range from 1.76 for the monochlorovanillins to 3.2 for the dichloroguaiacols. By contrast, HCPDs such as the trichloroguaiacols range from 3.83 to 4.15 for 4,5,6-TCP and 3,4,5-TCP respectively and 4.61 for 3,4,5,6-TeCG.

Table 3: Comparison of Wastewater 2,3,7,8-Substituted Congener Toxic Equivalent Loading and Homologue Distribution

Waste Water Source	2,3,7,8-Substituted Congener TEQ (mg/d)	Total Dioxin + Furan Homologues (mg/d)	% T4 CDD	% P5 CDD	% H6 CDD	% H7 CDD	% H8 CDD	% T4 CDF	% P5 CDF	% H6 CDF	% H7 CDF	% H8 CDF
Pre-Pulp Mill Process Changes												
Nwood 29/11/90	6.3	41.1	12.3	5.9	11.5	2.6	2.8	52.4	11.0	0.8	0.2	0.4
Canfor 27/11/90	7.0	77.4	7.4	2.8	3.3	8.6	34.2	29.9	5.8	1.5	2.7	3.9
Canfor 4/04/91	10.2	96.7	7.9	3.7	19.8	1.6	-	58.5	7.7	0.8	-	-
Cboo 30/10/90	1.7	27.7	6.4	9.2	20.1	8.4	16.7	29.0	7.4	1.3	0.5	1.0
Cboo 3/04/91	5.8	113	1.7	0.4	7.4	11.6	20.5	46.1	4.9	0.6	3.5	3.3
Post-Pulp Mill Process Changes												
Nwood 4/11/93	0.08	5.8	0.7	0.4	10.3	14.6	56.0	10.9	1.1	1.5	2.0	2.5
Nwood 25/10/94	0.33	13.6	0.8	0.3	8.2	12.2	51.4	21.5	2.0	1.0	0.2	2.4
Canfor 5/11/93	0.30	9.0	2.4	1.6	32.2	9.8	24.1	17.7	3.1	2.4	4.2	2.6
Canfor 23/11/93	0.13	6.6	2.6	2.1	33.3	9.7	19.2	21.0	5.4	3.3	3.3	-
QRP 1/11/93	0.0007	0.23	-	-	-	20.7	79.3	-	-	-	-	-
Cboo 2/11/93	0.34	9.2	2.9	3.0	42.9	9.7	14.0	22.9	2.6	1.0	0.5	0.5
(Weyer 8/11/93)	(3.2)	(48.1)	2.0	0.9	6.6	2.6	2.8	81.1	3.1	0.5	0.2	0.1
Municipal WTCS												
Landsdowne 4/11/93	0.01	4.1	0.3	0.5	2.5	13.3	70.6	0.7	1.1	3.3	3.5	4.2
Annacis 0/03/94	1.4	242	23.1	16.8	11.5	6.5	24.1	8.3	2.9	2.2	2.9	1.7
Annacis 22/08/95	0.17	47.1	0.8	1.0	2.9	12.0	71.0	1.1	0.6	2.1	3.9	4.6
Annacis 21/11/95	0.62	82.9	4.5	3.8	5.6	13.1	52.6	10.5	3.4	1.7	1.9	2.9
Lulu 12/05/94	0.29	29.3	4.0	5.2	4.0	10.3	45.8	7.0	6.0	5.7	6.0	6.0
Municipal CSO												
Clarke 22/03/93	1.9	837	-	-	1.2	11.3	76.5	0.2	0.3	1.9	4.3	4.3
Clarke 6/04/94	1.8	455	0.2	0.5	2.9	12.9	64.4	0.7	1.0	4.3	8.4	4.8

The results reflect a small and varied data set. However, it appears that for the LCPDs, in the bleached kraft pulp mill samples, that 4,5-DCC was consistently detected (0.7-144 g/d) while in the municipal samples 2,4/2,5-DCP was most evident (0.7-2 g/d). For the HCPDs, in the bleached kraft pulp mill samples 3,4,5-TCC (0.08-137 g/d) and 3,4,6-TCC (0.04-16 g/d) were consistently detected while in the municipal samples PCP (0.1-2.2 g/d) was consistently detected.

11. Lower chlorinated phosphoric derivatives

Table 4: Estimated Loading of Select LCPDs Associated with Suspended Solids from Various Wastewater Sources

TSS Source & (sample dry wt)	4-CP (mg/d)	2,6-DCP (mg/d)	2,4/2,5-DCP (mg/d)	4-CC (mg/d)	4,5-DCC (mg/d)	6-CV (mg/d)	5,6-CV (mg/d)	2,6-DCSA (mg/d)
PULP MILLS								
Nwood 04/11/93 (0.32g) 25/10/94 (1.87g)			65		8028 966			
Canfor 05/11/93 (0.27g) 23/11/93 (0.24g) 24/10/94 (1.30g)				638	144293 83652 689	2538		
QRP 01/11/93 (0.16g)				1279	6312	980		
Cboo 02/11/93 (0.39g)					18945			
Wey 08/11/93 (0.31g)								
MUNICIPAL SEWAGE								
Landsdowne 03/11/93 (0.27g)								
Annacis 03/03/94 (0.52g) 22/08/95 (2.76g) 21/11/95 (2.94g)	670 53	361 174	2009 1215	180 69	335			
Lulu 12/05/94 (2.24g)	75	33	670	19				
COMBINED SEWER OVERFLOW****								
06/04/94 (1.65g)		25	270					

Higher Chlorophenolic Derivatives

Table 5: Estimated Loading of Select HCPDs Associated with Suspended Solids from Various Wastewater Sources

TSS Source & (sample dry wt)	2,4,6-TCP (mg/d)	2,4,5-TCP (mg/d)	2,3,4,6-TeCP (mg/d)	PCP (mg/d)	3,4,6-TCG (mg/d)	3,4,5-TCG (mg/d)	4,5,6-TCG (mg/d)	3,4,5,6-TeCG (mg/d)	3,4,5-TCC (mg/d)	3,4,5,6-TeCC (mg/d)	3,4,5-TCS (mg/d)
PULP MILLS											
Nwood											
04/11/93 (0.32g)											
25/10/94 (1.87g)											
Cantor	1186										
05/11/93 (0.27g)	475										
23/11/93 (0.24g)											
24/10/94 (1.30g)											
QRP											
01/11/93 (0.16g)											
Cboo	299										
Wey											
08/11/93 (0.31g)											
MUNICIPAL SEWAGE											
Landsdowne											
03/11/93 (0.27g)											
Annacis	785										
03/03/94 (0.52g)	4121										
22/08/95 (2.75g)	561										
21/11/95 (2.94g)											
Lulu	922										
12/05/94 (2.24g)											
COMBINED SEWER OVERFLOW****											
06/04/94 (1.65g)											
					3154						

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APPENDICES

APPENDIX: A1 - DIOXIN ANALYTICAL METHOD
APPENDIX: A2 - CHLOROPHENOLIC ANALYTICAL METHOD

APPENDIX: A3 - Wastewater Sources and Centrifuge Sample Collection Details

Sample Source	Period of Operation (minutes)	Sample Source	Period of Operation (minutes)	Sample Source	Period of Operation (minutes)
PULP MILLS		MUNICIPAL SEWAGE		COMBINED SEWER OVERFLOW	
Nwood 04/11/93 25/10/94		Landsdowne 03/11/93*		Clark Drive 22/03/93 06/04/94	
Canfor 05/11/93 23/11/93		Annacis 03/03/94* 22/08/95** 21/11/95*			
QRP 01/11/93		Lulu 12/05/94**			
Cboo 02/11/93					
Wey 08/11/93					

* effluent not chlorinated, ** effluent chlorinated and dechlorinated

Sample Source	Whole Effluent TSS (mg/L)	Daily Flow (m3/d)	Sample Source	Whole Effluent TSS (mg/L)	Daily Flow (m3/d)	Sample Source	Whole Effluent TSS (mg/L)	Daily Flow (m3/d)
PULP MILLS			MUNICIPAL SEWAGE			COMBINED SEWER OVERFLOW		
Nwood 04/11/93 25/10/94			Landsdowne 03/11/93			Clark Drive 06/04/94		
Canfor 05/11/93 23/11/93* 24/10/94			Annacis 03/03/94 22/08/95 21/11/95					
QRP 01/11/93			Lulu 12/05/94					
Cboo 02/11/93								
Wey 08/11/93*								

Sample Source	Period of Storage (months)	Sample Source	Period of Storage (months)	Sample Source	Period of Storage (months)
PULP MILLS		MUNICIPAL SEWAGE		COMBINED SEWER OVERFLOW	
Nwood 04/11/93 25/10/94		Landsdowne 03/11/93*		Clark Drive 22/03/93 06/04/94	
Canfor 05/11/93 23/11/93		Annacis 03/03/94* 22/08/95** 21/11/95*			
QRP 01/11/93		Lulu 12/05/94**			
Cboo 02/11/93					
Wey 08/11/93					

APPENDIX: B1 - DIOXIN RESULTS

APPENDIX B1

Northwood - November 4 1993 - Biosolids Dioxin/Furan Results

DIOXIN

2,3,7,8

1,2,3,7,8

1,2,3,4,7,8

1,2,3,6,7,8

1,2,3,7,8,9

1,2,3,4,6,7,8

O8

pb NDR 8.6

(pg/g) (Loading ug/d*)

(2,3,7,8)

(2.1)

20.74

0.6

5.93

<0.6

9.4

92.83

4.5

44.44

43

424.63

330

3258.75

(pg/g) (Loading ug/d*)

(Total)

T4CDD

P5CDD

H6CDD

H7CDD

O8CDD

% of total

0.7

0.4

10.3

0.0

0.0

14.6

56.0

FURAN

2,3,7,8

1,2,3,7,8

2,3,4,7,8

1,2,3,4,7,8

1,2,3,6,7,8

1,2,3,7,8,9

2,3,4,6,7,8

1,2,3,4,6,7,8

1,2,3,4,7,8,9

O8

pb NDR 6.8

(Toxic Equivalent pg/g)

(2,3,7,8)

2.1

20.74

0.3

2.96

0.94

9.28

0.45

4.44

0.43

4.25

0.33

3.26

Overall (Total)

5821.31

DIOXIN

(2,3,7,8)

2,3,7,8

2.1

20.74

1,2,3,7,8

0.3

2.96

1,2,3,4,7,8

0.94

9.28

1,2,3,6,7,8

0.45

4.44

1,2,3,7,8,9

0.43

4.25

O8

0.33

3.26

FURAN

(2,3,7,8)

2,3,7,8

3.1

30.61

1,2,3,7,8

0.09

0.89

2,3,4,7,8

0.16

1.58

1,2,3,4,7,8

0.16

1.58

1,2,3,6,7,8

0.16

1.58

1,2,3,7,8,9

0.16

1.58

2,3,4,6,7,8

0.16

1.58

1,2,3,4,6,7,8

0.16

1.58

1,2,3,4,7,8,9

0.16

1.58

O8

0.015

0.15

TEQ Total

7.92

78.16

*TSS Loading (9875 kg/d)

pb = procedural blank

NDR = peak detected but did not meet quantification criteria

APPENDIX B1

Northwood October 25 1994 Biosolids Dioxin/Furan Results

	(pg/g) (2,3,7,8)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN			(Total)		
2,3,7,8	5.8	73.71	T4CDD	8.2	104.21
1,2,3,7,8	<1.0		P5CDD	3	38.13
1,2,3,4,7,8	<2.0		H6CDD	88	1118.39
1,2,3,6,7,8	14	177.93			0.0
1,2,3,7,8,9	6.5	82.61			0.0
1,2,3,4,6,7,8	69	876.92	H7CDD	130	1652.17
O8	550	6989.95	O8CDD	550	6989.95
					51.4
FURAN					
2,3,7,8	130	1652.17	T4CDF	230	2923.07
1,2,3,7,8	6.7	85.15	P5CDF	21	266.89
2,3,4,7,8	5.7	72.44			0.0
1,2,3,4,7,8	3.2	40.67	H6CDF	11	139.80
1,2,3,6,7,8	<2				1.0
1,2,3,7,8,9	<2				0.0
2,3,4,6,7,8	<2				0.0
1,2,3,4,6,7,8	8.4	106.76	H7CDF	2	25.42
1,2,3,4,7,8,9	<3				0.0
O8	26	330.43	O8CDF	26	330.43
			Overall (Total)	13588.46	
DIOXIN	(2,3,7,8)				
2,3,7,8	5.8	73.71			
1,2,3,7,8					
1,2,3,4,7,8					
1,2,3,6,7,8	1.4	17.79			
1,2,3,7,8,9	0.65	8.26			
1,2,3,4,6,7,8	0.69	8.77			
O8	0.55	6.99			
FURAN	(2,3,7,8)				
2,3,7,8	13	165.22			
1,2,3,7,8	0.335	4.26			
2,3,4,7,8	2.85	36.22			
1,2,3,4,7,8	0.32	4.07			
1,2,3,6,7,8					
1,2,3,7,8,9					
2,3,4,6,7,8					
1,2,3,4,6,7,8	0.084	1.07			
1,2,3,4,7,8,9					
O8	0.026	0.33			
TEQ Total	25.71	326.68			

*TSS Loading (12709 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Canfor - November 5 1993 - Biosolids Dioxin/Furan Results

DIOXIN	(pg/g) (2,3,7,8)	(Loading ug/d*)	(pg/g)		(Loading ug/d*)	% of total
			(Total)			
2,3,7,8	9.9	143.19	T4CDD	15	216.96	2.4
1,2,3,7,8	2.1	30.37	P5CDD	10	144.64	1.6
1,2,3,4,7,8	0.8	11.57	H6CDD	200	2892.80	32.2
1,2,3,6,7,8	29	419.46				0.0
1,2,3,7,8,9	13	188.03				0.0
1,2,3,4,6,7,8	33	477.31	H7CDD	61	882.30	9.8
O8 pb NDR 8.6	150	2169.60	O8CDD	150	2169.60	24.1
FURAN						
2,3,7,8	40	578.56	T4CDF	110	1591.04	17.7
1,2,3,7,8	3.7	53.52	P5CDF	19	274.82	3.1
2,3,4,7,8	NDR 2.3		H6CDF	15	216.96	2.4
1,2,3,4,7,8	5.1	73.77				0.0
1,2,3,6,7,8	1.7	24.59				0.0
1,2,3,7,8,9	<0.7					0.0
2,3,4,6,7,8	<0.7					0.0
1,2,3,4,6,7,8	12	173.57	H7CDF	26	376.06	4.2
1,2,3,4,7,8,9	1.4	20.25				0.0
O8 pb NDR 6.8	16	231.42	O8CDF	16	231.42	2.6
(Toxic Equivalent pg/g)						
DIOXIN	(2,3,7,8)		Overall (Total)		8996.61	
2,3,7,8	9.9	143.19				
1,2,3,7,8	1.05	15.19				
1,2,3,4,7,8	0.08	1.16				
1,2,3,6,7,8	2.9	41.95				
1,2,3,7,8,9	1.3	18.80				
1,2,3,4,6,7,8	0.33	4.77				
O8	0.15	2.17				
FURAN						
2,3,7,8	4	57.86				
1,2,3,7,8	0.185	2.68				
2,3,4,7,8						
1,2,3,4,7,8	0.51	7.38				
1,2,3,6,7,8	0.17	2.46				
1,2,3,7,8,9						
2,3,4,6,7,8						
1,2,3,4,6,7,8	0.12	1.74				
1,2,3,4,7,8,9	0.014	0.20				
O8	0.016	0.23				
TEQ Total	20.73	299.77				

*TSS Loading (14464 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Canfor - November 5 1993 - Biosolids Dioxin/Furan Results (blind duplicate)

	(pg/g) (2,3,7,8)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN			(Total)		
2,3,7,8	11	159.10	T4CDD	16	231.42
1,2,3,7,8	2.3	33.27	P5CDD	12	173.57
1,2,3,4,7,8	0.6	8.68	H6CDD	220	3182.08
1,2,3,6,7,8	31	448.38			0.0
1,2,3,7,8,9	15	216.96			0.0
1,2,3,4,6,7,8	35	506.24	H7CDD	65	940.16
O8 pb NDR 8.6	160	2314.24	O8CDD	160	2314.24
					23.5
FURAN					
2,3,7,8	47	679.81	T4CDF	120	1735.68
1,2,3,7,8	4.1	59.30	P5CDF	27	390.53
2,3,4,7,8	3.10	44.84	H6CDF	20	289.28
1,2,3,4,7,8	6.2	89.68			2.9
1,2,3,6,7,8	2.1	30.37			0.0
1,2,3,7,8,9	<0.6				0.0
2,3,4,6,7,8	0.9	13.02			0.0
1,2,3,4,6,7,8	12	173.57	H7CDF	25	361.60
1,2,3,4,7,8,9	1.5	21.70			3.7
O8 pb NDR 6.8	17	245.89	O8CDF	17	245.89
			Overall (Total)	9864.45	
DIOXIN	(Toxic Equivalent pg/g) (2,3,7,8)				
2,3,7,8	11	159.10			
1,2,3,7,8	1.15	16.63			
1,2,3,4,7,8	0.06	0.87			
1,2,3,6,7,8	3.1	44.84			
1,2,3,7,8,9	1.5	21.70			
1,2,3,4,6,7,8	0.35	5.06			
O8	0.16	2.31			
FURAN	(2,3,7,8)				
2,3,7,8	4.7	67.98			
1,2,3,7,8	0.205	2.97			
2,3,4,7,8	1.55	22.42			
1,2,3,4,7,8	0.62	8.97			
1,2,3,6,7,8	0.21	3.04			
1,2,3,7,8,9					
2,3,4,6,7,8	0.09	1.30			
1,2,3,4,6,7,8	0.12	1.74			
1,2,3,4,7,8,9	0.015	0.22			
O8	0.017	0.25			
TEQ Total	24.85	359.39	*TSS Loading (14464 kg/d)		
			pb = procedural blank		
			NDR = peak detected but did not meet		
			quantification criteria		

APPENDIX B1

Canfor - November 23 1993 - Biosolids Dioxin/Furan Results

	(pg/g)		(pg/g)	(Loading ug/d*)	% of total
DIOXIN	(2,3,7,8)		(Total)		
2,3,7,8	<0.8		T4CDD	10	169.68
1,2,3,7,8	1.5	25.45	P5CDD	8	135.74
1,2,3,4,7,8	<0.7		H6CDD	130	2205.84
1,2,3,6,7,8	20	339.36			33.3
1,2,3,7,8,9	8.7	147.62			0.0
1,2,3,4,6,7,8	20	339.36	H7CDD	38	644.78
O8 pb NDR 8.6	75	1272.60	O8CDD	75	1272.60
					19.2
FURAN					
2,3,7,8	30	509.04	T4CDF	82	1391.38
1,2,3,7,8	3.8	64.48	P5CDF	21	356.33
2,3,4,7,8	NDR 2.7				5.4
1,2,3,4,7,8	3.9	66.18	H6CDF	13	220.58
1,2,3,6,7,8	1.7	28.85			3.3
1,2,3,7,8,9	<0.8				0.0
2,3,4,6,7,8	1.2	20.36			0.0
1,2,3,4,6,7,8	6.5	110.29	H7CDF	13	220.58
1,2,3,4,7,8,9	<0.7				3.3
O8 pb NDR 6.8	NDR 7.3		O8CDF	NDR 7.3	0.0
	(Toxic Equivalent pg/g)		Overall (Total)	6617.52	
DIOXIN	(2,3,7,8)				
2,3,7,8					
1,2,3,7,8	0.75	12.73			
1,2,3,4,7,8					
1,2,3,6,7,8	2	33.94			
1,2,3,7,8,9	0.87	14.76			
1,2,3,4,6,7,8	0.2	3.39			
O8	0.075	1.27			
FURAN	(2,3,7,8)				
2,3,7,8	3	50.90			
1,2,3,7,8	0.19	3.22			
2,3,4,7,8					
1,2,3,4,7,8	0.39	6.62			
1,2,3,6,7,8	0.17	2.88			
1,2,3,7,8,9					
2,3,4,6,7,8	0.12	2.04			
1,2,3,4,6,7,8	0.065	1.10			
1,2,3,4,7,8,9					
O8					
TEQ Total	7.83	132.86			

*TSS Loading (16968 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

QRP - NOVEMBER 1 1993 - Biosolids Dioxin/Furan Results

	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN	(2,3,7,8)		(Total)		
2,3,7,8	<1.1		T4CDD	<1.1	0.0
1,2,3,7,8	<0.9		P5CDD	<0.9	0.0
1,2,3,4,7,8	<1.0		H6CDD	<1.0	0.0
1,2,3,6,7,8	<1.0				0.0
1,2,3,7,8,9	<1.0				0.0
1,2,3,4,6,7,8	3.4	47.16	H7CDD	3.4	47.16
O8 pb NDR 8.6	13	180.31	O8CDD	13	180.31
					20.7
FURAN					79.3
2,3,7,8	<1.0		T4CDF	<1.0	0.0
1,2,3,7,8	<1.0		P5CDF	<1.0	0.0
2,3,4,7,8	<1.0		H6CDF	<1.0	0.0
1,2,3,4,7,8	<1.0				0.0
1,2,3,6,7,8	<1.0				0.0
1,2,3,7,8,9	<1.0				0.0
2,3,4,6,7,8	<1.0				0.0
1,2,3,4,6,7,8	<1.5		H7CDF	<1.5	0.0
1,2,3,4,7,8,9	<1.5				0.0
O8 pb NDR 6.8	NDR 5.9		O8CDF	NDR 5.9	0.0
			Overall (Total)	227.47	
DIOXIN	(2,3,7,8)				
2,3,7,8					
1,2,3,7,8					
1,2,3,4,7,8					
1,2,3,6,7,8					
1,2,3,7,8,9					
1,2,3,4,6,7,8	0.034	0.47			
O8	0.013	0.18			
FURAN	(2,3,7,8)				
2,3,7,8					
1,2,3,7,8					
2,3,4,7,8					
1,2,3,4,7,8					
1,2,3,6,7,8					
1,2,3,7,8,9					
2,3,4,6,7,8					
1,2,3,4,6,7,8					
1,2,3,4,7,8,9					
O8					
TEQ Total	0.05	0.65			

*TSS Loading (13870 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Cariboo - November 2 1993 - Biosolids Dioxin/Furan Results

	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN	(2,3,7,8)		(Total)		
2,3,7,8	47	154.58	T4CDD	82	269.70
1,2,3,7,8	13	42.76	P5CDD	85	279.57
1,2,3,4,7,8	2.2	7.24	H6CDD	1200	3946.80
1,2,3,6,7,8	160	526.24			42.9
1,2,3,7,8,9	67	220.36			0.0
1,2,3,4,6,7,8	120	394.68	H7CDD	270	888.03
O8 pb NDR 8.6	390	1282.71	O8CDD	390	1282.71
FURAN					14.0
2,3,7,8	240	789.36	T4CDF	640	2104.96
1,2,3,7,8	5.2	17.10	P5CDF	74	243.39
2,3,4,7,8	3.8	12.50	H6CDF	27	88.80
1,2,3,4,7,8	2.6	8.55			1.0
1,2,3,6,7,8	1.4	4.60			0.0
1,2,3,7,8,9	<0.5				0.0
2,3,4,6,7,8	1.4	4.60	H7CDF	13	42.76
1,2,3,4,6,7,8	NDR 9.8		O8CDF	14	46.05
1,2,3,4,7,8,9	0.6	1.97			0.5
O8 pb NDR 6.8	14	46.05			0.0
	(Toxic Equivalent pg/g)		Overall (Total)	9192.76	
DIOXIN	(2,3,7,8)				
2,3,7,8	47	154.58			
1,2,3,7,8	6.5	21.38			
1,2,3,4,7,8	0.22	0.72			
1,2,3,6,7,8	16	52.62			
1,2,3,7,8,9	6.7	22.04			
1,2,3,4,6,7,8	1.2	3.95			
O8	0.39	1.28			
FURAN	(2,3,7,8)				
2,3,7,8	24	78.94			
1,2,3,7,8	0.26	0.86			
2,3,4,7,8	1.9	6.25			
1,2,3,4,7,8	0.26	0.86			
1,2,3,6,7,8	0.14	0.46			
1,2,3,7,8,9					
2,3,4,6,7,8	0.14	0.46			
1,2,3,4,6,7,8					
1,2,3,4,7,8,9	0.006	0.02			
O8	0.014	0.05			
TEQ Total	104.73	344.46			

*TSS Loading (3289 kg/d)

pb = procedural blank

NDR = peak detected but did not meet quantification criteria

APPENDIX B1

Weyerhaeuser - November 8 1993 - Biosolids Dioxin/Furan Results (duplicate)

	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN	(2,3,7,8)		(Total)		
2,3,7,8	81	718.07	T4CDD	100	886.50
1,2,3,7,8	7.6	67.37	P5CDD	40	354.60
1,2,3,4,7,8	1.3	11.52	H6CDD	470	4166.55
1,2,3,6,7,8	68	602.82			0.0
1,2,3,7,8,9	34	301.41			0.0
1,2,3,4,6,7,8	50	443.25	H7CDD	130	1152.45
O8	pb NDR 8.6	140	O8CDD	140	1241.10
FURAN					
2,3,7,8	2200	19503.00	T4CDF	4300	38119.50
1,2,3,7,8	30	265.95	P5CDF	160	1418.40
2,3,4,7,8	38.00	336.87	H6CDF	21	186.17
1,2,3,4,7,8	6.3	55.85			0.0
1,2,3,6,7,8	NDR 2.0				0.0
1,2,3,7,8,9	NDR 0.7				0.0
2,3,4,6,7,8	1.6	14.18	H7CDF	10	88.65
1,2,3,4,6,7,8	4.5	39.89	O8CDF	.5	44.33
1,2,3,4,7,8,9	NDR 0.7				0.0
O8	pb NDR 6.8	5	44.33		
	(Toxic Equivalent pg/g)		Overall (Total)	47658.24	
DIOXIN	(2,3,7,8)				
2,3,7,8	81	718.07			
1,2,3,7,8	3.8	33.69			
1,2,3,4,7,8	0.13	1.15			
1,2,3,6,7,8	6.8	60.28			
1,2,3,7,8,9	3.4	30.14			
1,2,3,4,6,7,8	0.5	4.43			
O8	0.14	1.24			
FURAN	(2,3,7,8)				
2,3,7,8	220	1950.30			
1,2,3,7,8	1.5	13.30			
2,3,4,7,8	19	168.44			
1,2,3,4,7,8	0.63	5.58			
1,2,3,6,7,8					
1,2,3,7,8,9					
2,3,4,6,7,8	0.16	1.42			
1,2,3,4,6,7,8	0.045	0.40			
1,2,3,4,7,8,9					
O8	0.005	0.04			
TEQ Total	337.11	2988.48			

*TSS Loading (8865 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Weyerhaeuser - November 8 1993 - Biosolids Dioxin/Furan Results

DIOXIN	(pg/g) (2,3,7,8)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
2,3,7,8	85	753.53	T4CDD	110	975.15
1,2,3,7,8	8.1	71.81	P5CDD	51	452.12
1,2,3,4,7,8	1.1	9.75	H6CDD	360	3191.40
1,2,3,6,7,8	71	629.42			0.0
1,2,3,7,8,9	24	212.76			0.0
1,2,3,4,6,7,8	56	496.44	H7CDD	140	1241.10
O8 pb NDR 8.6	150	1329.75	O8CDD	150	1329.75
FURAN					
2,3,7,8	2400	21276.00	T4CDF	4400	39006.00
1,2,3,7,8	32	283.68	P5CDF	170	1507.05
2,3,4,7,8	38	336.87			0.0
1,2,3,4,7,8	5.9	52.30	H6CDF	26	230.49
1,2,3,6,7,8	2.9	25.71			0.0
1,2,3,7,8,9	1.2	10.64			0.0
2,3,4,6,7,8	1.8	15.96			0.0
1,2,3,4,6,7,8	4.6	40.78	H7CDF	12	106.38
1,2,3,4,7,8,9	1	8.87	O8CDF	5.5	48.76
O8 pb NDR 6.8	5.5				0.1
			Overall (Total)	48088.19	
DIOXIN	(Toxic Equivalent pg/g) (2,3,7,8)				
2,3,7,8	85	753.53			
1,2,3,7,8	4.05	35.90			
1,2,3,4,7,8	0.11	0.98			
1,2,3,6,7,8	7.1	62.94			
1,2,3,7,8,9	2.4	21.28			
1,2,3,4,6,7,8	0.56	4.96			
O8	0.15	1.33			
FURAN	(2,3,7,8)				
2,3,7,8	240	2127.60			
1,2,3,7,8	1.6	14.18			
2,3,4,7,8	19	168.44			
1,2,3,4,7,8	0.59	5.23			
1,2,3,6,7,8	0.29	2.57			
1,2,3,7,8,9	0.12	1.06			
2,3,4,6,7,8	0.18	1.60			
1,2,3,4,6,7,8	0.046	0.41			
1,2,3,4,7,8,9	0.01	0.09			
O8	0.0055	0.05			
TEQ Total	361.21	3202.14			

*TSS Loading (8865 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Landsdowne - November 4 1993 - Suspended Solids Dioxin/Furan Results

		(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN		(2,3,7,8)		(Total)		
2,3,7,8		<0.8		T4CDD	16	13.66
1,2,3,7,8		NDR 2.8		P5CDD	22	18.79
1,2,3,4,7,8		3.8	3.25	H6CDD	120	102.48
1,2,3,6,7,8		20	17.08			0.0
1,2,3,7,8,9		10	8.54			0.0
1,2,3,4,6,7,8		330	281.82	H7CDD	640	546.56
O8	pb NDR 8.6	3400	2903.60	O8CDD	3400	2903.60
FURAN						70.6
2,3,7,8		5.8	4.95	T4CDF	36	30.74
1,2,3,7,8		1.2	1.02	P5CDF	53	45.26
2,3,4,7,8		NDR 2.1		H6CDF	160	136.64
1,2,3,4,7,8		7.6	6.49			3.3
1,2,3,6,7,8		7	5.98			0.0
1,2,3,7,8,9		NDR 3.8				0.0
2,3,4,6,7,8		5.1	4.36	H7CDF	170	145.18
1,2,3,4,6,7,8		NDR 140		O8CDF	200	170.80
1,2,3,4,7,8,9		6.1	5.21			4.2
O8	pb NDR 6.8	200	170.80			
		(Toxic Equivalent pg/g)		Overall (Total)	4113.72	
DIOXIN		(2,3,7,8)				
2,3,7,8						
1,2,3,7,8						
1,2,3,4,7,8		0.38	0.32			
1,2,3,6,7,8		2	1.71			
1,2,3,7,8,9		1	0.85			
1,2,3,4,6,7,8		3.3	2.82			
O8		3.4	2.90			
FURAN		(2,3,7,8)				
2,3,7,8		0.58	0.50			
1,2,3,7,8		0.06	0.05			
2,3,4,7,8						
1,2,3,4,7,8		0.76	0.65			
1,2,3,6,7,8		0.7	0.60			
1,2,3,7,8,9						
2,3,4,6,7,8		0.51	0.44			
1,2,3,4,6,7,8						
1,2,3,4,7,8,9		0.061	0.05			
O8		0.2	0.17			
TEQ Total		12.95	11.06			

*TSS Loading (854 kg/d)

pb = procedural blank

NDR = peak detected but did not meet quantification criteria

APPENDIX B1

Annacis - March 3 1994 - Suspended Solids Dioxin/Furan Results

DIOXIN	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
		(2,3,7,8)	(Total)		
2,3,7,8	6.4	162.07	T4CDD	2200	55712.80
1,2,3,7,8	19	481.16	P5CDD	1600	40518.40
1,2,3,4,7,8	22	557.13	H6CDD	1100	27856.40
1,2,3,6,7,8	43	1088.93			0.0
1,2,3,7,8,9	29	734.40			0.0
1,2,3,4,6,7,8	310	7850.44	H7CDD	620	15700.88
O8	pb NDR 8.6	2300	O8CDD	2300	58245.20
FURAN					
2,3,7,8	100	2532.40	T4CDF	790	20005.96
1,2,3,7,8	14	354.54	P5CDF	280	7090.72
2,3,4,7,8	16	405.18			0.0
1,2,3,4,7,8	12	303.89	H6CDF	210	5318.04
1,2,3,6,7,8	13	329.21		0.00	0.0
1,2,3,7,8,9	8.8	222.85			0.0
2,3,4,6,7,8	2.1	53.18	H7CDF	280	7090.72
1,2,3,4,6,7,8	130	3292.12			2.9
1,2,3,4,7,8,9	50	1266.20	O8CDF	160	4051.84
O8	pb NDR 6.8	160			1.7
		(Toxic Equivalent pg/g)	Overall (Total)	241590.96	
DIOXIN	(2,3,7,8)				
2,3,7,8	6.4	162.07			
1,2,3,7,8	9.5	240.58			
1,2,3,4,7,8	2.2	55.71			
1,2,3,6,7,8	4.3	108.89			
1,2,3,7,8,9	2.9	73.44			
1,2,3,4,6,7,8	3.1	78.50			
O8	2.3	58.25			
FURAN	(2,3,7,8)				
2,3,7,8	10	253.24			
1,2,3,7,8	0.7	17.73			
2,3,4,7,8	8	202.59			
1,2,3,4,7,8	1.2	30.39			
1,2,3,6,7,8	1.3	32.92			
1,2,3,7,8,9	0.88	22.29			
2,3,4,6,7,8	0.21	5.32			
1,2,3,4,6,7,8	1.3	32.92			
1,2,3,4,7,8,9	0.5	12.66			
O8	0.16	4.05			
TEQ Total	54.95	1391.55			

*TSS Loading (25324 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Annacis - August 22 1995 - Suspended Solids Dioxin/Furan Results

DIOXIN	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
	(2,3,7,8)	(Total)			
2,3,7,8	<0.6		T4CDD	14	360.61
1,2,3,7,8	1.6	41.21	P5CDD	18	463.64
1,2,3,4,7,8	<1.4		H6CDD	53	1365.17
1,2,3,6,7,8	7.8	200.91			0.0
1,2,3,7,8,9	4.5	115.91			0.0
1,2,3,4,6,7,8	120	3090.96	H7CDD	220	5666.76
O8	1300	33485.40	O8CDD	1300	33485.40
FURAN					
2,3,7,8	3.3	85.00	T4CDF	20	515.16
1,2,3,7,8	<0.8		P5CDF	11	283.34
2,3,4,7,8	0.9	23.18			0.0
1,2,3,4,7,8	2.3	59.24	H6CDF	38	978.80
1,2,3,6,7,8	1.7	43.79			0.0
1,2,3,7,8,9	<1.4				0.0
2,3,4,6,7,8	<1.4				0.0
1,2,3,4,6,7,8	30	772.74	H7CDF	72	1854.58
1,2,3,4,7,8,9	<2.0				0.0
O8	84	2163.67	O8CDF	84	2163.67
DIOXIN	(Toxic Equivalent pg/g)		Overall (Total)	47137.14	
	(2,3,7,8)				
2,3,7,8					
1,2,3,7,8	0.8	20.61			
1,2,3,4,7,8					
1,2,3,6,7,8	0.78	20.09			
1,2,3,7,8,9	0.45	11.59			
1,2,3,4,6,7,8	1.2	30.91			
O8	1.3	33.49			
FURAN	(2,3,7,8)				
2,3,7,8	0.33	8.50			
1,2,3,7,8					
2,3,4,7,8	0.45	11.59			
1,2,3,4,7,8	0.23	5.92			
1,2,3,6,7,8	0.17	4.38			
1,2,3,7,8,9					
2,3,4,6,7,8					
1,2,3,4,6,7,8	0.3	7.73			
1,2,3,4,7,8,9					
O8	0.084	2.16			
TEQ Total	6.09	156.97			

*TSS Loading (25758 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Annacis - November 21 1995 - Suspended Solids Dioxin/Furan Results

	(pg/g) (2,3,7,8)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN			(Total)		
2,3,7,8	2.9	90.36	T4CDD	120	3739.20
1,2,3,7,8	5.2	162.03	P5CDD	100	3116.00
1,2,3,4,7,8	3.1	96.60	H6CDD	150	4674.00
1,2,3,6,7,8	18	560.88			0.0
1,2,3,7,8,9	8.7	271.09			0.0
1,2,3,4,6,7,8	160	4985.60	H7CDD	350	10906.00
O8	1400	43624.00	O8CDD	1400	43624.00
FURAN					
2,3,7,8	39	1215.24	T4CDF	280	8724.80
1,2,3,7,8	5	155.80	P5CDF	90	2804.40
2,3,4,7,8	6.6	205.66			0.0
1,2,3,4,7,8	2.6	81.02	H6CDF	46	1433.36
1,2,3,6,7,8	2.9	90.36			0.0
1,2,3,7,8,9	<1.0				0.0
2,3,4,6,7,8	2.5	77.90			0.0
1,2,3,4,6,7,8	21	654.36	H7CDF	50	1558.00
1,2,3,4,7,8,9	<1.6				0.0
O8	76	2368.16	O8CDF	76	2368.16
	(Toxic Equivalent pg/g)		Overall (Total)	82947.92	

DIOXIN	(2,3,7,8)	
2,3,7,8	2.9	90.36
1,2,3,7,8	2.6	81.02
1,2,3,4,7,8	0.31	9.66
1,2,3,6,7,8	1.8	56.09
1,2,3,7,8,9	0.87	27.11
1,2,3,4,6,7,8	1.6	49.86
O8	1.4	43.62

FURAN	(2,3,7,8)	
2,3,7,8	3.9	121.52
1,2,3,7,8	0.25	7.79
2,3,4,7,8	3.3	102.83
1,2,3,4,7,8	0.26	8.10
1,2,3,6,7,8	0.29	9.04
1,2,3,7,8,9		
2,3,4,6,7,8	0.25	7.79
1,2,3,4,6,7,8	0.21	6.54
1,2,3,4,7,8,9		
O8	0.076	2.37

TEQ Total 20.02 623.70

*TSS Loading (31160.kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Lulu - May 12 1994 - Suspended Solids Dioxin/Furan Results

DIOXIN	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
	(2,3,7,8)	(Total)			
2,3,7,8	7.5	31.42	T4CDD	280	1172.92
1,2,3,7,8	21	87.97	P5CDD	360	1508.04
1,2,3,4,7,8	10	41.89	H6CDD	280	1172.92
1,2,3,6,7,8	43	180.13			0.0
1,2,3,7,8,9	23	96.35			0.0
1,2,3,4,6,7,8	460	1926.94	H7CDD	720	3016.08
O8	pb 0.8	3200	O8CDD	3200	13404.80
FURAN					
2,3,7,8	90	377.01	T4CDF	490	2052.61
1,2,3,7,8	22	92.16	P5CDF	420	1759.38
2,3,4,7,8	36	150.80			0.0
1,2,3,4,7,8	24	100.54	H6CDF	400	1675.60
1,2,3,6,7,8	26	108.91			0.0
1,2,3,7,8,9	3.8	15.92			0.0
2,3,4,6,7,8	28	117.29			0.0
1,2,3,4,6,7,8	NDR 210		H7CDF	420	1759.38
1,2,3,4,7,8,9	12	50.27			0.0
O8	420	1759.38	O8CDF	420	1759.38
(Toxic Equivalent pg/g)			Overall (Total)	29281.11	
DIOXIN	(2,3,7,8)				
2,3,7,8	7.5	31.42			
1,2,3,7,8	10.5	43.98			
1,2,3,4,7,8	1	4.19			
1,2,3,6,7,8	4.3	18.01			
1,2,3,7,8,9	2.3	9.63			
1,2,3,4,6,7,8	4.6	19.27			
O8	3.2	13.40			
FURAN					
2,3,7,8	(2,3,7,8)				
2,3,7,8	9	37.70			
1,2,3,7,8	1.1	4.61			
2,3,4,7,8	18	75.40			
1,2,3,4,7,8	2.4	10.05			
1,2,3,6,7,8	2.6	10.89			
1,2,3,7,8,9	0.38	1.59			
2,3,4,6,7,8	2.8	11.73			
1,2,3,4,6,7,8	0.12	0.50			
1,2,3,4,7,8,9	0.42	1.76			
TEQ Total	70.22	294.15	*TSS Loading (4189 kg/d) pb = procedural blank NDR = peak detected but did not meet quantification criteria		

APPENDIX B1

Clarke CSO - March 22 1993 - Suspended Solids Dioxin/Furan Results

	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total	
DIOXIN	(2,3,7,8)		(Total)			
2,3,7,8	<2.1		T4CDD	<2.1	0.0	
1,2,3,7,8	NDR 11		P5CDD	<4.8	0.0	
1,2,3,4,7,8	31	794.59	H6CDD	380	9740.16	1.2
1,2,3,6,7,8	67	1717.34			0.0	
1,2,3,7,8,9	43	1102.18			0.0	
1,2,3,4,6,7,8	2000	51264.00	H7CDD	3700	94838.40	11.3
O8	25000	640800.00	O8CDD	25000	640800.00	76.5
FURAN						
2,3,7,8	14	358.85	T4CDF	58	1486.66	0.2
1,2,3,7,8	NDR 4.4		P5CDF	97	2486.30	0.3
2,3,4,7,8	9.8	251.19	H6CDF	630	16148.16	1.9
1,2,3,4,7,8	26	666.43			0.0	
1,2,3,6,7,8	18	461.38			0.0	
1,2,3,7,8,9	<2.7				0.0	
2,3,4,6,7,8	16	410.11	H7CDF	1400	35884.80	4.3
1,2,3,4,6,7,8	4.3	110.22			0.0	
1,2,3,4,7,8,9	30	768.96	O8CDF	1400	35884.80	4.3
O8	1400	35884.80				
	(Toxic Equivalent pg/g)		Overall (Total)	837269.28		
DIOXIN	(2,3,7,8)					
2,3,7,8						
1,2,3,7,8						
1,2,3,4,7,8	3.1	79.46				
1,2,3,6,7,8	6.7	171.73				
1,2,3,7,8,9	4.3	110.22				
1,2,3,4,6,7,8	20	512.64				
O8	25	640.80				
FURAN	(2,3,7,8)					
2,3,7,8	1.4	35.88				
1,2,3,7,8						
2,3,4,7,8	4.9	125.60				
1,2,3,4,7,8	2.6	66.64				
1,2,3,6,7,8	1.8	46.14				
1,2,3,7,8,9						
2,3,4,6,7,8	1.6	41.01				
1,2,3,4,6,7,8	0.043	1.10				
1,2,3,4,7,8,9	0.3	7.69				
O8	1.4	35.88				
TEQ Total	73.14	1874.80				

*TSS Loading (25632 kg/d)

pb = procedural blank

NDR = peak detected but did not meet quantification criteria

APPENDIX B1

Clarke CSO - April 6 1994 - Suspended Solids Dioxin/Furan Results

	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total	
DIOXIN	(2,3,7,8)		(Total)			
2,3,7,8	1.7	38.30	T4CDD	31	698.49	
1,2,3,7,8	13	292.92	P5CDD	99	2230.67	
1,2,3,4,7,8	28	630.90	H6CDD	580	13068.56	
1,2,3,6,7,8	92	2072.94			0.0	
1,2,3,7,8,9	71	1599.77			0.0	
1,2,3,4,6,7,8	1500	33798.00	H7CDD	2600	58583.20	
O8	13000	292916.00	O8CDD	13000	292916.00	
FURAN					64.4	
2,3,7,8	21	473.17	T4CDF	140	3154.48	
1,2,3,7,8	3.2	72.10	P5CDF	200	4506.40	
2,3,4,7,8	7.5	168.99	H6CDF	870	19602.84	
1,2,3,4,7,8	32	721.02			4.3	
1,2,3,6,7,8	32	721.02			0.0	
1,2,3,7,8,9	<0.3				0.0	
2,3,4,6,7,8	23	518.24			0.0	
1,2,3,4,6,7,8	680	15321.76	H7CDF	1700	38304.40	
1,2,3,4,7,8,9	35	788.62			0.0	
O8	pb 0.8	970	21856.04	O8CDF	970	21856.04
				Overall (Total)	454921.08	

	(Toxic Equivalent pg/g)
DIOXIN	(2,3,7,8)
2,3,7,8	1.7
1,2,3,7,8	6.5
1,2,3,4,7,8	2.8
1,2,3,6,7,8	9.2
1,2,3,7,8,9	7.1
1,2,3,4,6,7,8	15
O8	13

	(2,3,7,8)
FURAN	
2,3,7,8	2.1
1,2,3,7,8	0.16
2,3,4,7,8	3.75
1,2,3,4,7,8	3.2
1,2,3,6,7,8	3.2
1,2,3,7,8,9	
2,3,4,6,7,8	2.3
1,2,3,4,6,7,8	6.8
1,2,3,4,7,8,9	0.35
O8	0.97

TEQ Total 78.13 1760.43

*TSS Loading (22532 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B1

Clarke CSO - April 6 1994 - Suspended Solids Dioxin/Furan Results (duplicate)

DIOXIN	(pg/g) (2,3,7,8)	(Loading ug/d*)	(Total)	(pg/g)	(Loading ug/d*)	% of total
2,3,7,8	1.2	27.04	T4CDD	31	698.49	0.1
1,2,3,7,8	13	292.92	P5CDD	95	2140.54	0.5
1,2,3,4,7,8	28	630.90	H6CDD	570	12843.24	2.7
1,2,3,6,7,8	91	2050.41				0.0
1,2,3,7,8,9	68	1532.18				0.0
1,2,3,4,6,7,8	1600	36051.20	H7CDD	2700	60836.40	12.8
O8	pb 0.8	14000	O8CDD	14000	315448.00	66.5
FURAN						
2,3,7,8	17	383.04	T4CDF	120	2703.84	0.6
1,2,3,7,8	4.8	108.15	P5CDF	200	4506.40	1.0
2,3,4,7,8	7.7	173.50			0.00	0.0
1,2,3,4,7,8	31	698.49	H6CDF	800	18025.60	3.8
1,2,3,6,7,8	31	698.49			0.0	0.0
1,2,3,7,8,9	<0.8				0.0	0.0
2,3,4,6,7,8	22	495.70	H7CDF	1600	36051.20	7.6
1,2,3,4,6,7,8	640	14420.48	O8CDF	930	20954.76	4.4
1,2,3,4,7,8,9	38	856.22				0.0
O8	930	20954.76				
(Toxic Equivalent pg/g)			Overall (Total)		474208.47	

DIOXIN	(2,3,7,8)	
2,3,7,8	1.2	27.04
1,2,3,7,8	6.5	146.46
1,2,3,4,7,8	2.8	63.09
1,2,3,6,7,8	9.1	205.04
1,2,3,7,8,9	6.8	153.22
1,2,3,4,6,7,8	16	360.51
O8	14	315.45

FURAN	(2,3,7,8)	
2,3,7,8	1.7	38.30
1,2,3,7,8	0.24	5.41
2,3,4,7,8	3.85	86.75
1,2,3,4,7,8	3.1	69.85
1,2,3,6,7,8	3.1	69.85
1,2,3,7,8,9		
2,3,4,6,7,8	2.2	49.57
1,2,3,4,6,7,8	6.4	144.20
1,2,3,4,7,8,9	0.38	8.56
O8	0.93	20.95

TEQ Total 78.30 1764.26

*TSS Loading (22532 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX: B2 - DIOXIN RESULTS

APPENDIX B2

Northwood November 29 1990 Biosolids Dioxin/Furan Results (SEAKEM)

	(pg/g) (2,3,7,8)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
DIOXIN			(Total)		
2,3,7,8	560	4642.40	T4CDD	610	5056.90
1,2,3,7,8	90	746.10	P5CDD	294	2437.26
1,2,3,4,7,8	<3.1		H6CDD	570	4725.30
1,2,3,6,7,8	88	729.52			11.5
1,2,3,7,8,9	59	489.11			0.0
1,2,3,4,6,7,8	77	638.33	H7CDD	130	1077.70
O8	140	1160.60	O8CDD	140	1160.60
FURAN					2.8
2,3,7,8	1200	9948.00	T4CDF	2600	21554.00
1,2,3,7,8	86	712.94	P5CDF	546	4526.34
2,3,4,7,8	27	223.83			11.0
1,2,3,4,7,8	3.6	29.84	H6CDF	40	331.60
1,2,3,6,7,8	NDR 1.3				0.8
1,2,3,7,8,9	1.6	13.26			0.0
2,3,4,6,7,8	3	24.87	H7CDF	9.6	79.58
1,2,3,4,6,7,8	4.9	40.62			0.2
1,2,3,4,7,8,9	<0.5		O8CDF	22	182.38
O8	22	182.38			0.4
	(Toxic Equivalent pg/g)		Overall (Total)	41131.66	
DIOXIN	(2,3,7,8)				
2,3,7,8	560	4642.40			
1,2,3,7,8	45	373.05			
1,2,3,4,7,8					
1,2,3,6,7,8	8.8	72.95			
1,2,3,7,8,9	5.9	48.91			
1,2,3,4,6,7,8	0.77	6.38			
O8	0.14	1.16			
FURAN	(2,3,7,8)				
2,3,7,8	120	994.80			
1,2,3,7,8	4.3	35.65			
2,3,4,7,8	13.5	111.92			
1,2,3,4,7,8	0.36	2.98			
1,2,3,6,7,8					
1,2,3,7,8,9	0.16	1.33			
2,3,4,6,7,8	0.3	2.49			
1,2,3,4,6,7,8	0.049	0.41			
1,2,3,4,7,8,9					
O8	0.022	0.18			
TEQ Total	759.30	6294.61			

*TSS Loading (8290 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B2

Canfor November 27 1990 Biosolids Dioxin/Furan Results (SEAKEM)

DIOXIN	(pg/g) (2,3,7,8)	(Loading ug/d*)	(pg/g) (Total)	(Loading ug/d*)	% of total
2,3,7,8	780	5163.60	T4CDD	860	5693.20
1,2,3,7,8	135	893.70	P5CDD	325	2151.50
1,2,3,4,7,8	17	112.54	H6CDD	380	2515.60
1,2,3,6,7,8	50	331.00			0.0
1,2,3,7,8,9	64	423.68			0.0
1,2,3,4,6,7,8	620	4104.40	H7CDD	1000	6620.00
O8	4000	26480.00	O8CDD	4000	26480.00
FURAN					
2,3,7,8	1700	11254.00	T4CDF	3500	23170.00
1,2,3,7,8	110	728.20	P5CDF	675	4468.50
2,3,4,7,8	25	165.50			0.0
1,2,3,4,7,8	11	72.82	H6CDF	170	1125.40
1,2,3,6,7,8	6.4	42.37			0.0
1,2,3,7,8,9	<1.0				0.0
2,3,4,6,7,8	5.7	37.73			0.0
1,2,3,4,6,7,8	120	794.40	H7CDF	320	2118.40
1,2,3,4,7,8,9	6.4	42.37			0.0
O8	460	3045.20	O8CDF	460	3045.20
	(Toxic Equivalent pg/g)		Overall (Total)	77387.80	
DIOXIN	(2,3,7,8)				
2,3,7,8	780	5163.60			
1,2,3,7,8	67.5	446.85			
1,2,3,4,7,8	1.7	11.25			
1,2,3,6,7,8	5	33.10			
1,2,3,7,8,9	6.4	42.37			
1,2,3,4,6,7,8	6.2	41.04			
O8	4	26.48			
FURAN	(2,3,7,8)				
2,3,7,8	170	1125.40			
1,2,3,7,8	5.5	36.41			
2,3,4,7,8	12.5	82.75			
1,2,3,4,7,8	1.1	7.28			
1,2,3,6,7,8	0.64	4.24			
1,2,3,7,8,9					
2,3,4,6,7,8	0.57	3.77			
1,2,3,4,6,7,8	1.2	7.94			
1,2,3,4,7,8,9	0.064	0.42			
O8	0.46	3.05			
TEQ Total	1062.83	7035.96			

*TSS Loading (6620 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B2

Canfor April 4 1991 Biosolids Dioxin/Furan Results (ETL)

	(2,3,7,8)		(pg/g)	(Loading ug/d*)	
	(Total)				% of total
DIOXIN					
2,3,7,8	360	6792.84	T4CDD	405	7641.95
1,2,3,7,8	42	792.50	P5CDD	192	3622.85
1,2,3,4,7,8	<3.6		H6CDD	1015	19152.04
1,2,3,6,7,8	130	2452.97			0.0
1,2,3,7,8,9	65	1226.49			0.0
1,2,3,4,6,7,8	80	1509.52	H7CDD	80	1509.52
O8	<12		O8CDD	-	0.0
FURAN					
2,3,7,8	1200	22642.80	T4CDF	3000	56607.00
1,2,3,7,8	72	1358.57	P5CDF	394	7434.39
2,3,4,7,8	32	603.81	H6CDF	41	773.63
1,2,3,4,7,8	<3.5				0.8
1,2,3,6,7,8	<2.8				0.0
1,2,3,7,8,9	<6.1				0.0
2,3,4,6,7,8	<5.8				0.0
1,2,3,4,6,7,8	<5.3		H7CDF	-	0.0
1,2,3,4,7,8,9	<13		O8CDF	-	0.0
O8	<19				
	(Toxic Equivalent pg/g)		Overall (Total)	96741.36	

DIOXIN	(2,3,7,8)	
2,3,7,8	360	6792.84
1,2,3,7,8	21	396.25
1,2,3,4,7,8		
1,2,3,6,7,8	13	245.30
1,2,3,7,8,9	6.5	122.65
1,2,3,4,6,7,8	0.8	15.10
O8		

FURAN	(2,3,7,8)	
2,3,7,8	120	2264.28
1,2,3,7,8	3.6	67.93
2,3,4,7,8	16	301.90
1,2,3,4,7,8		
1,2,3,6,7,8		
1,2,3,7,8,9		
2,3,4,6,7,8		
1,2,3,4,6,7,8		
1,2,3,4,7,8,9		
O8		

TEQ Total 540.90 10206.24

*TSS Loading (18869 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B2

Cariboo October 30 1990 Biosolids Dioxin/Furan Results (SEAKEM)

DIOXIN	(pg/g)	(Loading ug/d*)	(pg/g)	(Loading ug/d*)	% of total
	(2,3,7,8)	(Total)			
2,3,7,8	85	1156.00	T4CDD	130	1768.00
1,2,3,7,8	22	299.20	P5CDD	187	2543.20
1,2,3,4,7,8	10	136.00	H6CDD	410	5576.00
1,2,3,6,7,8	50	680.00			0.0
1,2,3,7,8,9	40	544.00			0.0
1,2,3,4,6,7,8	88	1196.80	H7CDD	170	2312.00
O8	340	4624.00	O8CDD	340	4624.00
FURAN					
2,3,7,8	120	1632.00	T4CDF	590	8024.00
1,2,3,7,8	6.1	82.96	P5CDF	151	2053.60
2,3,4,7,8	3.1	42.16			0.0
1,2,3,4,7,8	1.3	17.68	H6CDF	27	367.20
1,2,3,6,7,8	0.7	9.52			0.0
1,2,3,7,8,9	<0.3				0.0
2,3,4,6,7,8	2	27.20	H7CDF	10	136.00
1,2,3,4,6,7,8	5.2	70.72			0.5
1,2,3,4,7,8,9	<0.3				0.0
O8	20	272.00	O8CDF	20	272.00
			Overall (Total)	27676.00	
DIOXIN	(2,3,7,8)				
2,3,7,8	85	1156.00			
1,2,3,7,8	11	149.60			
1,2,3,4,7,8	1	13.60			
1,2,3,6,7,8	5	68.00			
1,2,3,7,8,9	4	54.40			
1,2,3,4,6,7,8	0.88	11.97			
O8	0.34	4.62			
FURAN	(2,3,7,8)				
2,3,7,8	12	163.20			
1,2,3,7,8	0.305	4.15			
2,3,4,7,8	1.55	21.08			
1,2,3,4,7,8	0.13	1.77			
1,2,3,6,7,8	0.07	0.95			
1,2,3,7,8,9					
2,3,4,6,7,8	0.2	2.72			
1,2,3,4,6,7,8	0.052	0.71			
1,2,3,4,7,8,9					
O8	0.02	0.27			
TEQ Total	121.55	1653.04			

*TSS Loading (13600 kg/d)

pb = procedural blank

NDR = peak detected but did not meet
quantification criteria

APPENDIX B2

Cariboo April 3 1991 Biosolids Dioxin/Furan Results (ETL)

DIOXIN	(pg/g) (2,3,7,8)	(Loading ug/d*)	(Total)	(pg/g)	(Loading ug/d*)	% of total
2,3,7,8	170	1967.92	T4CDD	170	1967.92	1.7
1,2,3,7,8	38	439.89	P5CDD	38	439.89	0.4
1,2,3,4,7,8	<3.9		H6CDD	721	8346.30	7.4
1,2,3,6,7,8	120	1389.12				0.0
1,2,3,7,8,9	51	590.38				0.0
1,2,3,4,6,7,8	580	6714.08	H7CDD	1130	13080.88	11.6
O8	2000	23152.00	O8CDD	2000	23152.00	20.5
FURAN						
2,3,7,8	2400	27782.40	T4CDF	4500	52092.00	46.1
1,2,3,7,8	77	891.35	P5CDF	477	5521.75	4.9
2,3,4,7,8	80	926.08				0.0
1,2,3,4,7,8	<4.0		H6CDF	63	729.29	0.6
1,2,3,6,7,8	<3.7					0.0
1,2,3,7,8,9	<6.3					0.0
2,3,4,6,7,8	<5.2					0.0
1,2,3,4,6,7,8	74	856.62	H7CDF	344	3982.14	3.5
1,2,3,4,7,8,9	<9.1		O8CDF	320	3704.32	0.0
O8	320	3704.32				3.3
	(Toxic Equivalent pg/g)		Overall (Total)	113016.49		
DIOXIN	(2,3,7,8)					
2,3,7,8	170	1967.92				
1,2,3,7,8	19	219.94				
1,2,3,4,7,8						
1,2,3,6,7,8	12	138.91				
1,2,3,7,8,9	5.1	59.04				
1,2,3,4,6,7,8	5.8	67.14				
O8	2	23.15				
FURAN	(2,3,7,8)					
2,3,7,8	240	2778.24				
1,2,3,7,8	3.85	44.57				
2,3,4,7,8	40	463.04				
1,2,3,4,7,8						
1,2,3,6,7,8						
1,2,3,7,8,9						
2,3,4,6,7,8						
1,2,3,4,6,7,8	0.74	8.57				
1,2,3,4,7,8,9						
O8	0.32	3.70				
TEQ Total	498.81	5774.22				

*TSS Loading (11576 kg/d)

pb = procedural blank

NDR = peak detected but did not meet quantification criteria

APPENDIX: B3 - CHLOROPHENOLIC RESULTS

APPENDIX B3

Northwood - November 4 1993 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<18		3-	NDR 61	
2,6-di	<22		4-	NDR 206	
2,4/2,5-di	NDR 34		3,4di	<14	
3,5-di	<20		3,6-di	81	800
2,3-di	<19		3,5-di	NDR 21	
3,4-di	<13		4,5-di	813	8028
2,4,6-tri	<14		3,4,6-tri	113	1116
2,3,6-tri	<11		3,4,5-tri	256	2528
2,3,5-tri	<11		3,4,5,6-tetra	163	1610
2,4,5-tri	<9.4				
2,3,4-tri	<11				
3,4,5-tri	<10				
2,3,5,6-tetra	<15		Chlorovanillin		
2,3,4,6-tetra	<17		5-	<88	
2,3,4,5-tetra	<10		6-	<106	
penta	<26		5,6-di	<39	
Chloroguaiacol					
6-	<7.5		Chlorosyringol		
4-	NDR 16		3,5	<30	
5-	<8.8		3,4,5-tri	<16	
3,4-di	<16				
4,6-di	<17		Chlorosyringaldehyde		
4,5-di	NDR 20		2-	<26	
3,4,6-tri	<12		2,6-di	<69	
3,4,5-tri	<13				
4,5,6-tri	<8.8				
3,4,5,6-tetra	<16				
			Sample size 0.32gdry		
			Daily TSS loading kg/d		9875

APPENDIX B3

Northwood - October 25 1994 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<0.32		3-	NDR 1.3	
2,6-di	<0.55		4-	8.6	109
2,4/2,5-di	5.1	65	3,4-di	NDR 5.0	
3,5-di	<0.96		3,6-di	<2.3	
2,3-di	<0.82		3,5-di	NDR 9.4	
3,4-di	<0.6		4,5-di	76	966
2,4,6-tri	NDR 1.1		3,4,6-tri	3.2	41
2,3,6-tri	<0.37		3,4,5-tri	6.2	79
2,3,5-tri	<0.39		3,4,5,6-tetra	NDR 2.6	
2,4,5-tri	<0.23				
2,3,4-tri	<0.29				
3,4,5-tri	NDR 0.68				
2,3,5,6-tetra	<0.52				
2,3,4,6-tetra	NDR 0.58				
2,3,4,5-tetra	<0.36				
penta	1.6	20			
Chloroguaiacol					
6-	<0.31				
4-	NDR 8.9				
5-	NDR 1.4				
3,4-di	NDR 1.2				
4,6-di	<0.36				
4,5-di	NDR 3.9				
3,4,6-tri	<0.3				
3,4,5-tri	2.3	29			
4,5,6-tri	<0.23				
3,4,5,6-tetra	<0.5				
			Sample size 1.78gdry		
			Daily TSS loading kg/d		12709

APPENDIX B3

Canfor - November 5 1993 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<16		3-	NDR 71	
2,6-di	<20		4-	NDR 126	
2,4/2,5-di	NDR 141		3,4-di	<13	
3,5-di	<19		3,6-di	268	3876
2,3-di	<18		3,5-di	119	1721
3,4-di	<13		4,5-di	9976	144293
2,4,6-tri	82	1186	3,4,6-tri	171	2473
2,3,6-tri	<12		3,4,5-tri	4764	68906
2,3,5-tri	<12		3,4,5,6-tetra	432	6248
2,4,5-tri	<9.7		Chlorovanillin		
2,3,4-tri	<10		5-	<74	
3,4,5-tri	<10		6-	<97	
2,3,5,6-tetra	<16		5,6-di	<35	
2,3,4,6-tetra	<18		Chlorosyringol		
2,3,4,5-tetra	<10		3,5	<36	
penta	<28		3,4,5-tri	<16	
Chloroguaiacol			Chlorosyringaldehyde		
6-	<7.3		2-	<25	
4-	NDR 14		2,6-di	<51	
5-	<8.9				
3,4-di	<16				
4,6-di	40	579			
4,5-di	201	2907			
3,4,6-tri	<12				
3,4,5-tri	893	12916	Sample size 0.27gdry		
4,5,6-tri	253	3659	Daily TSS loading kg/d		
3,4,5,6-tetra	49	709			14464

APPENDIX B3

Canfor - November 5 1993 - Biosolids Chlorophenolics

Blind Duplicate

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<27		3-	NDR 43	
2,6-di	<27		4-	NDR 102	
2,4/2,5-di	NDR 94		3,4-di	<16	
3,5-di	<24		3,6-di	189	2734
2,3-di	<23		3,5-di	102	1475
3,4-di	<16		4,5-di	8149	117867
2,4,6-tri	66	955	3,4,6-tri	167	2415
2,3,6-tri	<14		3,4,5-tri	4293	62094
2,3,5-tri	<14		3,4,5,6-tetra	407	5887
2,4,5-tri	<11		Chlorovanillin		
2,3,4-tri	<12		5-	<57	
3,4,5-tri	<12		6-	80	1157
2,3,5,6-tetra	<20		5,6-di	<37	
2,3,4,6-tetra	<22		Chlorosyringol		
2,3,4,5-tetra	<13		3,5	<40	
penta	<33		3,4,5-tri	<14	
Chloroguaiacol			Chlorosyringaldehyde		
6-	<10		2-	<16	
4-	<12		2,6-di	<45	
5-	<12				
3,4-di	<17				
4,6-di	29	419			
4,5-di	175	2531			
3,4,6-tri	<15				
3,4,5-tri	669	9676	Sample size 0.29gdry		
4,5,6-tri	204	2951	Daily TSS loading kg/d		
3,4,5,6-tetra	37	535			14464

APPENDIX B3

Canfor - November 23 1993 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)	
4-	<34		3-	NDR 74		
2,6-di	<39		4-	NDR 196		
2,4/2,5-di	NDR 94		3,4di	<27		
3,5-di	<35		3,6-di	442	7500	
2,3-di	<33		3,5-di	145	2460	
3,4-di	<23		4,5-di	4930	83652	
2,4,6-tri	28	475	3,4,6-tri	187	3173	
2,3,6-tri	<19		3,4,5-tri	8075	137017	
2,3,5-tri	<19		3,4,5,6-tetra	578	9808	
2,4,5-tri	<17		Chlorovanillin			
2,3,4-tri	<20		5-	<94		
3,4,5-tri	<18		6-	<119		
2,3,5,6-tetra	<36		5,6-di	<73		
2,3,4,6-tetra	<39		Chlorosyringol			
2,3,4,5-tetra	<23		3,5	<85		
penta	<50		3,4,5-tri	<27		
Chloroguaiacol						
6-	<20		Chlorosyringaldehyde			
4-	<25		2-	<29		
5-	<24		2,6-di	<85		
3,4-di	<38		Sample size 0.24gdry			
4,6-di	<39		Daily TSS loading kg/d			
4,5-di	170	2885			16968	
3,4,6-tri	<27					
3,4,5-tri	11.05	18750				
4,5,6-tri	374	6346				
3,4,5,6-tetra	53	899				

APPENDIX B3

Canfor - October 24 1994 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<1.4		3-	NDR 22	
2,6-di	<1.0		4-	88	638
2,4/2,5-di	NDR 3.5		3,4di	NDR 20	
3,5-di	<1.8		3,6-di	NDR 3.6	
2,3-di	<1.6		3,5-di	NDR 20	
3,4-di	<1.1		4,5-di	95	689
2,4,6-tri	NDR 2.2		3,4,6-tri	21	152
2,3,6-tri	<0.78		3,4,5-tri	150	1088
2,3,5-tri	<0.81		3,4,5,6-tetra	59	428
2,4,5-tri	<0.52		Chlorovanillin		
2,3,4-tri	<0.65		5-	NDR 17	
3,4,5-tri	<0.63		6-	350	2538
2,3,5,6-tetra	<0.64		5,6-di	<1.6	
2,3,4,6-tetra	NDR 0.53		Chlorosyringol		
2,3,4,5-tetra	<1.2		3,5	<1.8	
penta	1.6	12	3,4,5-tri	<0.94	
Chloroguaiacol			Chlorosyringaldehyde		
6-	<0.92		2-	<1.0	
4-	51	370	2,6-di	<3.4	
5-	7	51	Sample size 1.30gdry		
3,4-di	4.3	31	Daily TSS loading kg/d		
4,6-di	<1.1				7250
4,5-di	49	355			
3,4,6-tri	<1.8				
3,4,5-tri	39	283			
4,5,6-tri	<1.4				
3,4,5,6-tetra	12	87			

APPENDIX B3

QRP - November 1 1993 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<20		3-	<38	
2,6-di	<29		4-	<59	
2,4/2,5-di	<23		3,4di	<29	
3,5-di	<27		3,6-di	<37	
2,3-di	<26		3,5-di	<27	
3,4-di	<18		4,5-di	<39	
2,4,6-tri	<17		3,4,6-tri	<28	
2,3,6-tri	<13		3,4,5-tri	<23	
2,3,5-tri	<13		3,4,5,6-tetra	<21	
2,4,5-tri	<11				
2,3,4-tri	<12		Chlorovanillin		
3,4,5-tri	<11		5-	<119	
2,3,5,6-tetra	<31		6-	<147	
2,3,4,6-tetra	<34		5,6-di	<47	
2,3,4,5-tetra	<20				
penta	<38		Chlorosyringol		
			3,5	<37	
			3,4,5-tri	<20	
			Chlorosyringaldehyde		
			2-	<22	
			2,6-di	<47	
Chloroguaiacol					
6-	<12				
4-	<15				
5-	<15				
3,4-di	<22				
4,6-di	50	694			
4,5-di	<20				
3,4,6-tri	<18				
3,4,5-tri	<21				
4,5,6-tri	<13				
3,4,5,6-tetra	<15				

Sample size 0.16gdry

Daily TSS loading kg/d

13870

APPENDIX B3

Cariboo - November 2 1993 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<13		3-	NDR 28	
2,6-di	<19		4-	389	1279
2,4/2,5-di	NDR 76		3,4-di	44	145
3,5-di	<17		3,6-di	273	898
2,3-di	<16		3,5-di	293	964
3,4-di	<12		4,5-di	1919	6312
2,4,6-tri	91	299	3,4,6-tri	278	914
2,3,6-tri	<9.1		3,4,5-tri	3233	10633
2,3,5-tri	<8.6		3,4,5,6-tetra	748	2460
2,4,5-tri	<6.1		Chlorovanillin		
2,3,4-tri	<7.1		5-	<66	
3,4,5-tri	<6.6		6-	298	980
2,3,5,6-tetra	<17		5,6-di	NDR 39	
2,3,4,6-tetra	<19		Chlorosyringol		
2,3,4,5-tetra	<11		3,5	<25	
penta	61	201	3,4,5-tri	<18	
Chloroguaiacol					
6-	<6.6		Chlorosyringaldehyde		
4-	NDR 18		2-	<11	
5-	NDR 44		2,6-di	NDR 71	
3,4-di	35	115	Sample size 0.39gdry		
4,6-di	308	1013	Daily TSS loading kg/d		3289
4,5-di	1313	4318			
3,4,6-tri	35	115			
3,4,5-tri	2324	7644			
4,5,6-tri	556	1829			
3,4,5,6-tetra	172	566			

APPENDIX B3

Weyerhaeuser - November 8 1993 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<19		3-	NDR 67	
2,6-di	<31		4-	NDR 280	
2,4,2,5-di	NDR 53		3,4-di	63	558
3,5-di	<27		3,6-di	267	2367
2,3-di	<26		3,5-di	NDR 80	
3,4-di	<18		4,5-di	2137	18945
2,4,6-tri	<21		3,4,6-tri	1803	15984
2,3,6-tri	<16		3,4,5-tri	935	8289
2,3,5-tri	<16		3,4,5,6-tetra	2671	23678
2,4,5-tri	<15				
2,3,4-tri	<17		Chlorovanillin		
3,4,5-tri	<15		5-	<187	
2,3,5,6-tetra	<27		6-	<227	
2,3,4,6-tetra	<29		5,6-di	<51	
2,3,4,5-tetra	<17				
penta	<41		Chlorosyringol		
			3,5	<45	
Chloroguaiacol			3,4,5-tri	<11	
6-	<13				
4-	NDR 33		Chlorosyringaldehyde		
5-	<16		2-	<42	
3,4-di	<31		2,6-di	<25	
4,6-di	<32				
4,5-di	<27				
3,4,6-tri	<21				
3,4,5-tri	34	301			
4,5,6-tri	NDR 40				
3,4,5,6-tetra	34	301	Sample size 0.31gdry		
			Daily TSS loading kg/d		8865

APPENDIX B3

Landsdowne STP - November 3 1993 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	<21		3-	<25	
2,6-di	<22		4-	<37	
2,4/2,5-di	NDR 157		3,4di	120	102
3,5-di	<19		3,6-di	55	47
2,3-di	<19		3,5-di	<13	
3,4-di	<13		4,5-di		
2,4,6-tri	NDR 25		3,4,6-tri	<61	
2,3,6-tri	<10		3,4,5-tri	<50	
2,3,5-tri	<10		3,4,5,6-tetra	<21	
2,4,5-tri	<8.2				
2,3,4-tri	NDR 12		Chlorovanillin		
3,4,5-tri	<9.0		5-	<82	
2,3,5,6-tetra	<13		6-	<105	
2,3,4,6-tetra	<15		5,6-di		
2,3,4,5-tetra	<9.0				
penta	127	108	Chlorosyringol		
			3,5	<40	
Chloroguaiacol			3,4,5-tri	<7.5	
6-	<7.4				
4-	<9.0		Chlorosyringaldehyde		
5-	<9.0		2-	<21	
3,4-di	<18		2,6-di	<63	
4,6-di	<19				
4,5-di	<16				
3,4,6-tri	<13				
3,4,5-tri	<14				
4,5,6-tri	<9.7				
3,4,5,6-tetra	<7.5				

Sample size 0.27gdry
Daily TSS loading kg/d

APPENDIX B3

Annacis STP - March 3 1994 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)	
4-	<32		3-	<29		
2,6-di	<24		4-	<44		
2,4/2,5-di	NDR 73		3,4-di	<32		
3,5-di	<20		3,6-di	<40		
2,3-di	<20		3,5-di	<32		
3,4-di	<13		4,5-di	NDR 131		
2,4,6-tri	31	785	3,4,6-tri	<44		
2,3,6-tri	<17		3,4,5-tri	<36		
2,3,5-tri	<18		3,4,5,6-tetra	<211		
2,4,5-tri	<16		Chlorovanillin			
2,3,4-tri	<18		5-	<120		
3,4,5-tri	<16		6-	<145		
2,3,5,6-tetra	<47		5,6-di	<73		
2,3,4,6-tetra	<51		Chlorosyringol			
2,3,4,5-tetra	<31		3,5	<76		
penta	87	2203	3,4,5-tri	<16		
Chloroguaiaacol						
6-	<9.8		Chlorosyringaldehyde			
4-	<12		2-	<44		
5-	<12		2,6-di	<225		
3,4-di	<32		Sample size 0.52gdry			
4,6-di	<35		Daily TSS loading kg/d			
4,5-di	<26		25324			
3,4,6-tri	<34					
3,4,5-tri	<35					
4,5,6-tri	<25					
3,4,5,6-tetra	<28					

APPENDIX B3

Annacis STP - March 3 1994 - Biosolids Chlorophenolics

Duplicate

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)	
4-	<40		3-	<25		
2,6-di	<22		4-	<36		
2,4/2,5-di	NDR 72		3,4-di	<30		
3,5-di	<19		3,6-di	<36		
2,3-di	<18		3,5-di	<30		
3,4-di	<12		4,5-di	NDR 115		
2,4,6-tri	32	810	3,4,6-tri	<40		
2,3,6-tri	<17		3,4,5-tri	<36		
2,3,5-tri	<18		3,4,5,6-tetra	<24		
2,4,5-tri	<16		Chlorovanillin			
2,3,4-tri	<18		5-	<108		
3,4,5-tri	<16		6-	<133		
2,3,5,6-tetra	<43		5,6-di	<65		
2,3,4,6-tetra	<47		Chlorosyringol			
2,3,4,5-tetra	<27		3,5	<79		
penta	87	2203	3,4,5-tri	<14		
Chloroguaiacol						
6-	<9		Chlorosyringaldehyde			
4-	<11		2-	<40		
5-	<10		2,6-di	<361		
3,4-di	<29		Sample size 0.56gdry			
4,6-di	<32		Daily TSS loading kg/d			
4,5-di	<24				25324	
3,4,6-tri	<28					
3,4,5-tri	<29					
4,5,6-tri	<21					
3,4,5,6-tetra	<24					

APPENDIX B3

Annacis STP - August 22 1995 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)		Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	26	670		3-	NDR 9.8	
2,6-di	14	361		4-	7	180
2,4/2,5-di	78	2009		3,4-di	490	12621
3,5-di	NDR 4.5			3,6-di	NDR 31	
2,3-di	<0.26			3,5-di	320	8243
3,4-di	NDR 0.82			4,5-di	13	335
2,4,6-tri	160	4121		3,4,6-tri	12	309
2,3,6-tri	<0.14			3,4,5-tri	65	1674
2,3,5-tri	<0.14			3,4,5,6-tetra	<0.19	
2,4,5-tri	NDR 2.4					
2,3,4-tri	<0.14			Chlorovanillin		
3,4,5-tri	2.2	57		5-	NDR 9.6	
2,3,5,6-tetra	<0.63			6-	NDR 12	
2,3,4,6-tetra	22	567		5,6-di	NDR 16	
2,3,4,5-tetra	1.4	36				
penta	47	1211		Chlorosyringol		
				3,5-	<1.0	
				3,4,5-tri	<0.77	
Chloroguaiacol				Chlorosyringaldehyde		
6-	NDR 4.6			2-	<0.42	
4-	5.7	147		2,6-di	NDR 4.1	
5-	NDR 29					
3,4-di	2.1	54				
4,6-di	5.8	149				
4,5-di	18	464				
3,4,6-tri	1.2	31				
3,4,5-tri	NDR 7.7					
4,5,6-tri	<0.18					
3,4,5,6-tetra	2	52				
				Sample size 2.76 g dry		
				Daily TSS loading kg/d		25758

APPENDIX B3

Annacis STP - August 22 1995 - Biosolids Chlorophenolics

Duplicate

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)	
4-	24	618	3-	5.7	147	
2,6-di	14	361	4-	4.6	118	
2,4/2,5-di	77	1983	3,4-di	410	10561	
3,5-di	NDR 5.6		3,6-di	NDR 33		
2,3-di	<0.26		3,5-di	240	6182	
3,4-di	NDR 1.0		4,5-di	11	283	
2,4,6-tri	150	3864	3,4,6-tri	NDR 4.5		
2,3,6-tri	<0.14		3,4,5-tri	48	1236	
2,3,5-tri	<0.14		3,4,5,6-tetra	<0.19		
2,4,5-tri	NDR 4.0		Chlorovanillin			
2,3,4-tri	NDR 0.97					
3,4,5-tri	2.3	59	5-	NDR 14		
2,3,5,6-tetra	<0.52		6-	NDR 6.6		
2,3,4,6-tetra	16	412	5,6-di	NDR 10		
2,3,4,5-tetra	1.6	41	Chlorosyringol			
penta	47	1211	3,5	<0.82		
Chloroguaiacol						
6-	NDR 1.5		3,4,5-tri	NDR 1.3		
4-	6.8	175	Chlorosyringaldehyde			
5-	NDR 17		2-	NDR 0.61		
3,4-di	1.8	46	2,6-di	<0.64		
4,6-di	4.5	116				
4,5-di	14	361	Sample size 2.71 g dry			
3,4,6-tri	1.8	46	Daily TSS loading kg/d			
3,4,5-tri	2.9	75				
4,5,6-tri	NDR 25					
3,4,5,6-tetra	2.1	54				

APPENDIX B3

Annacis STP - November 21 1995 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)	
4-	1.7	53	3-	1.5	47	
2,6-di	5.6	174	4-	2.2	69	
2,4/2,5-di	39	1215	3,4-di	NDR 56		
3,5-di	NDR 1.7		3,6-di	19	592	
2,3-di	<0.56		3,5-di	20	623	
3,4-di	3.6	112	4,5-di	NDR 25		
2,4,6-tri	18	561	3,4,6-tri	<4.8		
2,3,6-tri	<0.81		3,4,5-tri	<4.6		
2,3,5-tri	<0.40		3,4,5,6-tetra	<4.7		
2,4,5-tri	NDR 4.2		Chlorovanillin			
2,3,4-tri	<0.36		5-	<2.1		
3,4,5-tri	4.2	131	6-	<2.4		
2,3,5,6-tetra	<1.2		5,6-di	<1.5		
2,3,4,6-tetra	52	1620	Chlorosyringol			
2,3,4,5-tetra	2.4	75	3,5	<1.7		
penta	63	1963	3,4,5-tri	<1.9		
Chloroguaiacol						
6-	NDR 0.42		Chlorosyringaldehyde			
4-	NDR 1.3		2-	<1.3		
5-	NDR 0.82		2,6-di	<1.7		
3,4-di	9.1	284	Sample size 2.94 g dry			
4,6-di	3.6	112	Daily TSS loading kg/d			
4,5-di	2.2	69	31160			
3,4,6-tri	<0.86					
3,4,5-tri	2.8	87				
4,5,6-tri	<0.69					
3,4,5,6-tetra	<1.1					

APPENDIX B3

Annacis STP - November 21 1995 - Biosolids Chlorophenolics

Duplicate

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	2.3	72	3-	1.4	44
2,6-di	5.7	178	4-	1.7	53
2,4/2,5-di	41	1278	3,4-di	NDR 40	
3,5-di	NDR 1.5		3,6-di	17	530
2,3-di	<0.39		3,5-di	20	623
3,4-di	3.6	112	4,5-di	NDR 23	
2,4,6-tri	18	561	3,4,6-tri	<2.5	
2,3,6-tri	<0.58		3,4,5-tri	<2.4	
2,3,5-tri	<0.29		3,4,5,6-tetra	<5.2	
2,4,5-tri	NDR 3.8				
2,3,4-tri	<0.68		Chlorovanillin		
3,4,5-tri	4.8	150			
2,3,5,6-tetra	<0.78		5-	<1.3	
2,3,4,6-tetra	50	1558	6-	<1.5	
2,3,4,5-tetra	1.7	53	5,6-di	<0.97	
penta	62	1932			
Chloroguaiacol			Chlorosyringol		
6-	NDR 0.32		3,5	<1.1	
4-	NDR 1.4		3,4,5-tri	<1.4	
5-	NDR 0.52				
3,4-di	8.9	277	Chlorosyringaldehyde		
4,6-di	3.2	100			
4,5-di	1.5	47	2-	<0.86	
3,4,6-tri	<0.65		2,6-di	<1.1	
3,4,5-tri	3	93			
4,5,6-tri	<0.52				
3,4,5,6-tetra	<0.84				
Sample size 2.89 g dry					
Daily TSS loading kg/d					
31160					

APPENDIX B3

Lulu STP - May 12 1994 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	18	75	3-	NDR 12	
2,6-di	7.9	33	4-	4.5	19
2,4/2,5-di (pb 0.6)	160	670	3,4-di	560	2346
3,5-di	<0.65		3,6-di	NDR 24	
2,3-di	NDR 2.4		3,5-di	380	1592
3,4-di	<0.8		4,5-di	NDR 37	
2,4,6-tri	220	922	3,4,6-tri	3.5	15
2,3,6-tri	<0.49		3,4,5-tri	24	101
2,3,5-tri	<0.48		3,4,5,6-tetra	<1.0	
2,4,5-tri	NDR 3.6				
2,3,4-tri	<0.6		Chlorovanillin		
3,4,5-tri	<0.9		5-	NA	
2,3,5,6-tetra	<0.71		6-	NA	
2,3,4,6-tetra	17	71	5,6-di	NA	
2,3,4,5-tetra penta	NDR 1.9	113			
	27		Chlorosyringol		
			3,5	NA	
			3,4,5-tri	NA	
Chloroguaiacol			Chlorosyringaldehyde		
6-	<0.34		2-	NA	
4-	<1.5		2,6-di	NA	
5-	<3.0				
3,4-di	<0.7				
4,6-di	2.6	11			
4,5-di	NDR 4.5				
3,4,6-tri	<0.77				
3,4,5-tri	<1.0				
4,5,6-tri	<0.56				
3,4,5,6-tetra	<1.4				

Sample size 2.24gdry

Daily TSS loading kg/d

4189

APPENDIX B3

Lulu STP - May 12 1994 - Biosolids Chlorophenolics

duplicate

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	6.5	27	3-	<1.8	
2,6-di	7.9	33	4-	<1.1	
2,4/2,5-di (pb 0.6)	160	670	3,4-di	220	922
3,5-di	<1.7		3,6-di	NDR 24	
2,3-di	NDR 8.6		3,5-di	270	1131
3,4-di	<1.0		4,5-di	NDR 150	
2,4,6-tri	220	922	3,4,6-tri	2.6	11
2,3,6-tri	<0.74		3,4,5-tri	8.6	36
2,3,5-tri	<0.73		3,4,5,6-tetra	<0.38	
2,4,5-tri	NDR 13				
2,3,4-tri	<1.5		Chlorovanillin		
3,4,5-tri	<0.75		5-	NA	
2,3,5,6-tetra	<1.3		6-	NA	
2,3,4,6-tetra	21	88	5,6-di	NA	
2,3,4,5-tetra	NDR 2.2				
penta	23	96	Chlorosyringol		
Chloroguaiacol					
6-	NQ		3,5	NA	
4-	NQ		3,4,5-tri	NA	
5-	NQ				
3,4-di	<1.7		Chlorosyringaldehyde		
4,6-di	<1.3		2-	NA	
4,5-di	NDR 3.2		2,6-di	NA	
3,4,6-tri	<4.9				
3,4,5-tri	<6.6				
4,5,6-tri	<3.6				
3,4,5,6-tetra	<1.4				
Sample size 2.33gdry					
Daily TSS loading kg/d					
4189					

APPENDIX B3

Clarke CSO - April 6 1994 - Biosolids Chlorophenolics

Chlorophenol	Solids (ng/g)	Solids (mg/d)	Chlorocatechol	Solids (ng/g)	Solids (mg/d)
4-	NDR 6.9		3-	<0.99	
2,6-di	1.1	25	4-	<0.6	
2,4/2,5-di (pb 0.6)	12	270	3,4-di	NDR 110	
3,5-di	<0.49		3,6-di	17	383
2,3-di	<0.43		3,5-di	<3.8	
3,4-di	NDR 1.4		4,5-di	NDR 61	
2,4,6-tri	NDR 5.4		3,4,6-tri	NDR 3.5	
2,3,6-tri	<0.38		3,4,5-tri	<0.57	
2,3,5-tri	<0.36		3,4,5,6-tetra	NQ	
2,4,5-tri	NDR 2.3				
2,3,4-tri	<0.41		Chlorovanillin		
3,4,5-tri	NDR 1.0		5-	NA	
2,3,5,6-tetra	NDR 2.1		6-	NA	
2,3,4,6-tetra	9.5	214	5,6-di	NA	
2,3,4,5-tetra	1.7	38			
penta	140	3154	Chlorosyringol		
			3,5	NA	
			3,4,5-tri	NA	
			Chlorosyringaldehyde		
			2-	NA	
			2,6-di	NA	
Chloroguaiacol					
6-	<0.24				
4-	<0.2				
5-	NDR 2.0				
3,4-di	<1.2				
4,6-di	<0.9				
4,5-di	NDR 1.4				
3,4,6-tri	<1.0				
3,4,5-tri	<1.4				
4,5,6-tri	<0.74				
3,4,5,6-tetra	<0.7				

Sample size 1.65gdry
Daily TSS loading kg/d* 22532
(* estimated for 24 period from a 2hr :50 min. event)

APPENDIX: C1 - DIOXIN SURROGATES AND SPIKED SAMPLES

Appendix C1-a : Sample ^{13}C Surrogate (%) Recovery

^{13}C Surrogate/Sample	Nwood 04/11/93	Nwood 25/10/94	Canfor 05/11/93	Canfor 05/11/93*	Canfor 23/11/94	QRP 01/11/03	Cboo 02/11/93
T4CDF (2,3,7,8)	82	110	77	73	74	61	82
T4CDD (2,3,7,8)	94	98	88	88	89	73	91
P5CDF (1,2,3,7,8)	73	110	63	80	82	63	74
P5CDD (1,2,3,7,8)	79	110	62	110	72	69	71
H6CDF (1,2,3,4,7,8)	68	90	62	58	63	55	68
H6CDD (1,2,3,6,7,8)	74	100	70	65	68	51	77
H7CDF (1,2,3,4,6,7,8)	66	89	57	47	45	47	50
H7CDD (1,2,3,4,6,7,8)	85	86	73	59	54	46	64
O8CDD	66	66	48	39	(29)	31	39

* blind duplicate sample

+ (duplicate sample)

^{13}C Surrogate/Sample	Weyer 08/11/93	Landsdwyn 03/11/93	Annacis 03/03/94	Annacis 22/08/95	Annacis 21/11/95	Lulu 12/05/94	Clarke 06/04/94
T4CDF (2,3,7,8)	88	73+	71	57	82	51	100
T4CDD (2,3,7,8)	93	93	86	74	93	53	100
P5CDF (1,2,3,7,8)	81	93	65	61	93	67	96
P5CDD (1,2,3,7,8)	78	110	69	60	78	54	100
H6CDF (1,2,3,4,7,8)	72	66	59	47	70	61	60
H6CDD (1,2,3,6,7,8)	100	73	69	58	73	50	92
H7CDF (1,2,3,4,6,7,8)	51	46	47	44	65	58	59
H7CDD (1,2,3,4,6,7,8)	59	57	59	59	63	38	83
O8CDD	42	31	36	42	54	32	70

() recovery outside of surrogate recovery range (30-130%) recommended by Environment Canada 1992 for Octa CDD/CDF.

Appendix C1-b : 1990/91 Pulp Mill Samples - Sample ^{13}C Surrogate (%) Recovery

^{13}C Surrogate/Sample	Nwood 29/11/90 (Seakem)	Canfor 27/11/90 (Seakem)	Cboo 30/10/90 (Seakem)	Canfor 4/04/91 (ETL)	Cboo 3/04/91 (ETL)
T4CDF (2,3,7,8)	91	107	93	92	97
T4CDD (2,3,7,8)	78	85	99	113	100
P5CDF (1,2,3,7,8)	-	-	-	110	90
P5CDD (1,2,3,7,8)	86	98	88	134	82
H6CDF (1,2,3,4,7,8)	-	-	-	97	70
H6CDD (1,2,3,6,7,8)	80	89	83	83	63
H7CDF (1,2,3,4,6,7,8)	-	-	-	48	44
H7CDD (1,2,3,4,6,7,8)	85	85	96	32	38
O8CDD	86	89	97	38	(29)

Appendix C1-c : Spiked Sample 2,3,7,8-Substituted Congener (%) Recoveries

	April 11/94	October 24/95	February 6/96
Dioxin			
2,3,7,8	105	89	106
1,2,3,7,8	106	110	110
1,2,3,4,7,8	106	96	111
1,2,3,6,7,8	93	92	106
1,2,3,7,8,9	97	98	100
1,2,3,4,6,7,8	100	100	102
O8	127	100	93
Furan			
2,3,7,8	103	80	110
1,2,3,7,8	100	96	122
2,3,4,7,8	124	89	100
1,2,3,4,7,8	117	104	116
1,2,3,6,7,8	120	97	111
1,2,3,7,8,9	116	107	98
2,3,4,6,7,8	121	128	115
1,2,3,4,6,7,8	98	117	119
1,2,3,4,7,8,9	89	94	104
O8	78	83	101
Sample Batch	Nwood 4/11/93 Cfor 5/11/93 Cfor 23/11/93 QRP 1/11/93 Cboo 2/11/93 Weyer 8/11/93 Landsdwn 4/11/93 Annacis 3/03/94	Annacis 22/08/95	Annacis 21/11/95
¹³ C Surrogate (%) Recovery			
T4CDF	68	100	73
T4CDD	68	110	78
P5CDF	68	130	89
P5CDD	120	98	85
H6CDF	62	120	81
H6CDD	66	110	82
H7CDF	54	110	66
H7CDD	62	110	65
O8CDD	63	100	54

APPENDIX: C2 - CHLOROPHENOLIC SURROGATES AND SPIKED SAMPLES

Appendix C2-a : Sample ^{13}C Surrogate (%) Recovery

^{13}C Surrogate/Sample	Nwood 04/11/93	Nwood 25/10/94	Canfor 05/11/93	Canfor 23/11/93	Canfor 24/10/94	QRP 01/11/03	Cboo 02/11/93
4-Chlorophenol	94	110	110	100	60	100	74
2,4-Dichlorophenol-d3	80	-	84	95	-	85	66
2,4-Dichlorophenol	120	130	120	130	86	120	97
4-Chlorguauiacol	90	130	90	87	77	82	72
2,4,6-Trichlorophenol	120	110	120	110	78	110	92
2,4,5-Trichlorophenol	110	120	100	95	94	100	95
5-Chlorovanillin	79	130	87	72	32	66	66
2,3,4,5-Tetrachlorophenol	93	120	110	84	90	92	93
4,5-Dichlorocatechol	100	42	100	100	50	98	92
4,5,6-Trichloroguauiacol	11	98	100	95	72	100	89
Pentachlorophenol	79	77	80	77	56	73	73
3,4,5,6-Tetrachloroguauiacol	120	83	110	100	60	110	100
3,4,5,6-Tetrachlorocatechol	58	26	76	75*	27	100	74

^{13}C Surrogate/Sample	Weyer 08/11/93	Landsdwn 03/11/93	Annacis 03/03/94	Annacis 22/08/95	Annacis 21/11/95	Lulu 12/05/94	Clarke 06/04/94
4-Chlorophenol	130	80	110	59	55	56	120
2,4-Dichlorophenol-d3	110	96	90	-	-	80	120
2,4-Dichlorophenol	160	140	130	49	51	61	120
4-Chlorguauiacol	100	110	89	*	47	51	110
2,4,6-Trichlorophenol	130	140	110	**	45	58	110
2,4,5-Trichlorophenol	120	130	93	48	52	60	98
5-Chlorovanillin	77	160	57	*	36	-	-
2,3,4,5-Tetrachlorophenol	110	130	76	42	42	60	100
4,5-Dichlorocatechol	110	130	80	*	11	12	22
4,5,6-Trichloroguauiacol	120	120	74	*	47	43	78
Pentachlorophenol	93	92	60	27	20	28	68
3,4,5,6-Tetrachloroguauiacol	130	130	89	30	28	31	85
3,4,5,6-Tetrachlorocatechol	94	80	16	*	7	14	<5

* surrogate recovery not available due to interferences; compounds normally calculated using this surrogate were quantified with pentachlorophenol- ^{13}C .

** surrogate recovery not available due to interferences; compounds normally calculated using this surrogate were quantified with 2,4,5-trichlorophenol- ^{13}C .

Appendix C2-b : List of Compounds Routinely Used With ^{13}C Surrogates

^{13}C Surrogate	Compounds
4-Chlorophenol	
2,4-Dichlorophenol-d3	
2,4-Dichlorophenol	
4-Chlorguauiacol	
2,4,6-Trichlorophenol	
2,4,5-Trichlorophenol	
5-Chlorovanillin	
2,3,4,5-Tetrachlorophenol	
4,5-Dichlorocatechol	
4,5,6-Trichloroguauiacol	
Pentachlorophenol	
3,4,5,6-Tetrachloroguauiacol	
3,4,5,6-Tetrachlorocatechol	

Appendix C2-c Spiked Matrix (%) Recovery

Chlorophenol	Spiked Matrix (%) Recovery			Chlorocatechol			
	(%) May 13/94	(%) Apr 05/95	(%) Nov 23/95		(%) May 13/94	(%) Apr 05/95	(%) Nov 23/95
4-	99	120	117	3-	127	150	52
2,6-di	102	95	136	4-	173	180	33
2,4/2,5-di	95	110	107	3,4di	87	90	35
3,5-di	84	100	42	3,6-di	91	89	42
2,3-di	100	100	123	3,5-di	98	94	19
3,4-di	110	110	76	4,5-di	131	120	16
2,4,6-tri	117	100	128	3,4,6-tri	121	110	28
2,3,6-tri	118	110	148	3,4,5-tri	139	120	22
2,3,5-tri	120	110	100	3,4,5,6-tetra	82	120	24
2,4,5-tri	100	110	100	Chlorovanillin			
2,3,4-tri	118	120	142				
3,4,5-tri	109	110	65				
2,3,5,6-tetra	85	100	132				
2,3,4,6-tetra	104	100	141				
2,3,4,5-tetra	94	110	105				
penta	126	97	97				
				Chlorosyringol			
					3,5	107	79
					3,4,5-tri	97	84
				Chlorosyringaldehyde			
6-	120	93	91				
4-	114	98	100				
5-	110	110	100				
3,4-di	108	97	118				
4,6-di	120	80	106				
4,5-di	125	100	123				
3,4,6-tri	72	95	96				
3,4,5-tri	100	110	68				
4,5,6-tri	108	100	109				
3,4,5,6-tetra	91	110	106				

Appendix C2-c cont'd

Samples and Surrogate (%) Recovery

Samples	Samples and Surrogate (%) Recovery				
	May 13/94 1993	(%) Apr 05/95 1994	(%) Nov 23/95 1995	(%) Aug 22 1995	(%) May 12 1995
Nwood Nov 4 Canfor Nov 5 Canfor Nov 23 QRP Nov 1 Cboo Nov 2 Weyer Nov 8 Landsdw Nov 3	Nwood Oct 25 Canfor Oct 24 Canfor Nov 23 QRP Nov 1 Cboo Nov 2 Weyer Nov 8 Landsdw Nov 3	Annacis Aug 22 Annacis Nov 21 Clarke Apr 6	Lulu May 12 Annacis Nov 21 Clarke Apr 6		
Annacis Mar 3					
Surrogate 13C Recovery					
4-Chlorophenol	42	49	66		
2,4-Dichlorophenol-d3	44	-	-		
2,4-Dichlorophenol	56	63	73		
4-Chloroguaiaacol	56	71	77*		
2,4,6-Trichlorophenol	51	66	81**		
2,4,5-Trichlorophenol	58	79	62		
5-Chlorovanillin	64	54	53*		
2,3,4,5-Tetrachlorophenol	72	93	74		
4,5-Dichlorocatechol	84	50	14*		
4,5,6-Trichloroguaiaacol	77	74	83*		
Pentachlorophenol	55	74	81		
3,4,5,6-Tetrachloroguaiaacol	77	71	66		
3,4,5,6-Tetrachlorocatechol	80	244	17*		

* compounds normally calculated using these surrogates were quantified using pentachlorophenol-13C to be consistent with sample data
 ** compounds normally calculated using this surrogate were quantified using 2,4,5-trichlorophenol-13C to be consistent with sample data