SPATIAL TRENDS IN TCDD/TCDF CONCENTRATIONS IN SEDIMENT AND BOTTOM FISH COLLECTED IN LAKE ROOSEVELT (COLUMBIA RIVER)

by
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INTRODUCTION

In June 1990, as part of Ecology's investigation of contaminants in Lake Roosevelt, a series of sediment and bottom fish samples were collected from Lake Roosevelt and vicinity for analysis of polychlorinated dibenzo-*p*-dioxins (PCDDs) and -dibenzofurans (PCDFs). The objective of the survey was to evaluate the transport and distribution of these compounds through the lake. The source of PCDDs and PCDFs is the Celgar bleached kraft pulp mill in Castlegar, B.C., approximately 30 river miles above the international border. Celgar was established in the early 1960s and does not have effluent treatment. Previous Ecology reports describe results from analysis of Lake Roosevelt sportfish and suspended matter samples (Johnson *et al.*, 1991 a,b). Background information on PCDDs/PCDFs and the Celgar issue can be found in the sportfish report. Analytical support for the present study was provided by EPA.

METHODS

Sampling

Figure 1 shows where sediment and fish were collected. Six sites were sampled in Lake Roosevelt between the border and Grand Coulee Dam, and one site each in the Spokane River (the major tributary to Lake Roosevelt), and Rufus Woods Lake (the Columbia River reservoir below Lake Roosevelt, formed by Chief Joseph Dam). The Spokane samples were collected behind Long Lake Dam. One sample each of sediments and fish were collected at each location. Appendix A has detailed descriptions of the sampling sites. The field work was conducted during June 26-28, 1990.

Each sediment sample was a composite of three grabs taken with a stainless steel 0.1 m^2 van Veen grab sampler. Only the top 2-cm surface layer was taken for analysis. Sediments were transferred to stainless steel beakers and homogenized by stirring with stainless steel spoons. Spoons and beakers had been washed with Liqui-Nox® detergent, followed by rinsing with Milli-Q® water, pesticide-grade acetone, and pesticide-grade hexane. Sample containers were 8 oz. amber glass with teflon lid-liners, specially cleaned for low-level organics analysis (I-CHEM, Hayward, California, series 300). The samples were stored on ice in the field.

Largescale suckers (*Catostomus macrocheilus*) were collected for analysis. This species is a bottom dweller that feeds on a variety of organisms such as crustaceans, insect larvae, snails, and detritus (Wydoski and Whitney, 1979). Apart from their benthic habit, largescale suckers were selected because they are available throughout the study area and because results from an earlier Ecology survey (Johnson *et al.*, 1988) suggested they do not move extensively through the lake.

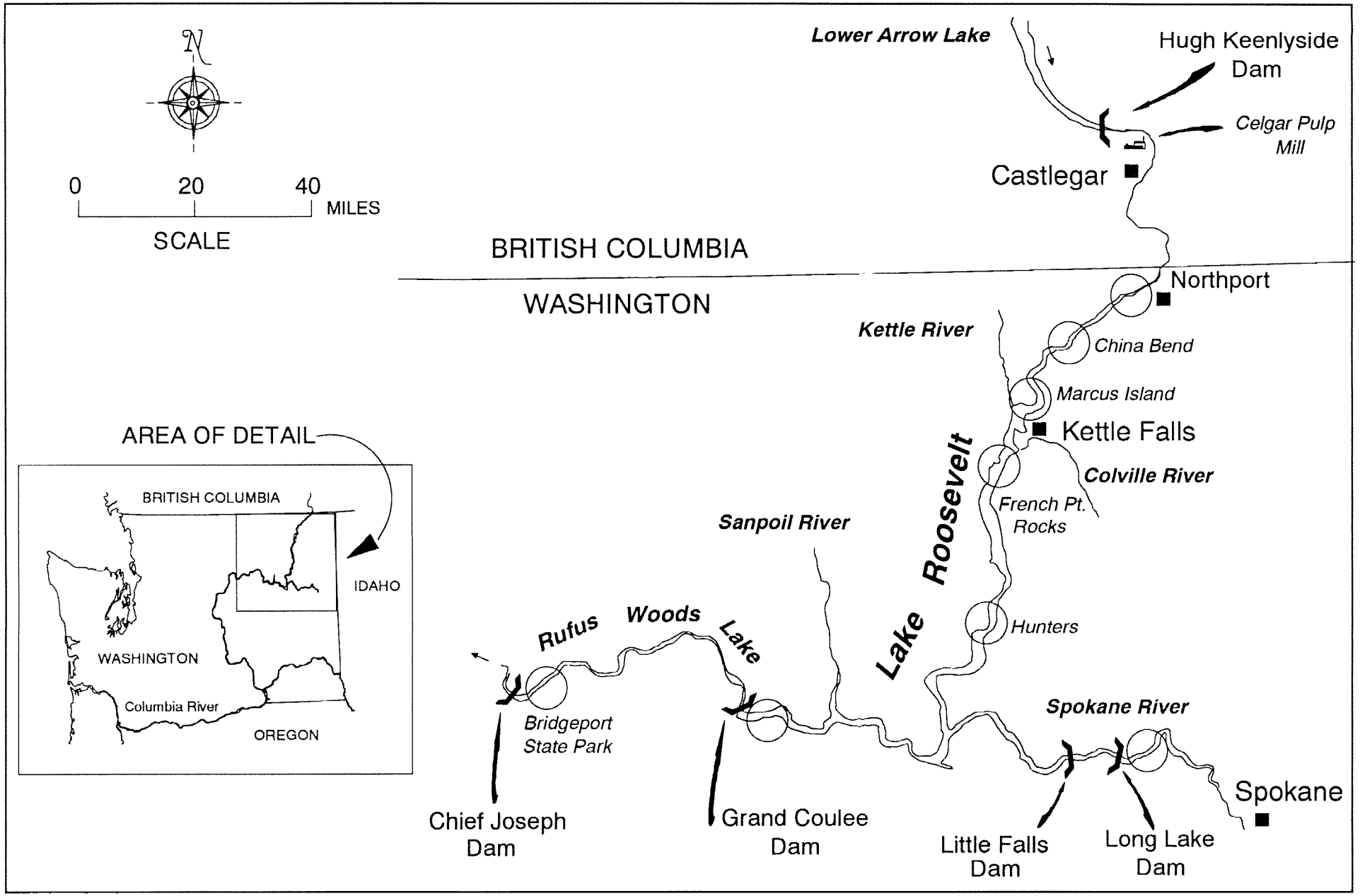

Figure 1. Location of Sediment and Bottom Fish Samples Collected by Ecology, June 1990

The fish were collected by electro-shocking. After recording the total length and weight of each specimen, they were individually wrapped in aluminum foil, placed in polyethylene bags, and stored on ice. The fish were analyzed as composites of five whole fish per sample.

Analysis

The samples were analyzed for all 2,3,7,8-substituted PCDDs and PCDFs except octachlorodibenzodioxin and octachlorodibenzofuran. Ancillary analyses included percent total organic carbon (TOC) and grain size in sediment samples, and percent lipid in fish samples.

PCDD/PCDF and lipid analyses were done by the EPA Environmental Research Laboratory in Duluth, Minnesota. Sample preparation and analysis followed methods described in EPA (1990) and EPA *et al.*, (1990). TOC and grain size were analyzed at Analytical Resources Inc. and Hart Crowser, respectively, both of Seattle, Washington. Analytical methods for TOC and grain size are described in Tetra Tech, Inc. (1986).

Quality assurance procedures followed during PCDD/PCDF analysis were established by the EPA Duluth laboratory (EPA 1990; EPA *et al.*, 1990). All data included in the present report passed EPA's quality assurance criteria.

Duplicate samples were submitted to each laboratory to assess the precision of their analysis. The results are in Table 1. Close agreement was achieved between duplicates. The relative percent difference between duplicate analyses for 2,3,7,8- tetrachlorodibenzo-*p*-dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF), the major contaminants of concern in Lake Roosevelt, ranged from 2.7 - 13%.

RESULTS AND DISCUSSION

The results of sediment sample analyses are in Table 2. Sediments collected in upper Lake Roosevelt (i.e., above Kettle Falls) consisted of coarse sand and had a low TOC content. Sediments collected below Kettle Falls, including those in Rufus Woods Lake and the Spokane River, were composed of mostly fine material and had TOC concentrations an order of magnitude above those in upper Lake Roosevelt.

Detection of target PCDDs and PCDFs in the sediments was almost exclusively limited to TCDF and, in one instance, TCDD. Not shown in Table 2 are data on trace amounts of several other 2,3,7,8 - substituted PCDDs/PCDFs in one or two samples. The complete analytical results, showing these data as well as detection limits for compounds not detected in sediment and fish samples, are in Appendix B[1].

[1]Appendix B includes data on several non-2,3,7,8-substituted congeners. These were reported for internal laboratory purposes.

Table 1. Precision of Duplicate Analyses.

Variable	Matrix	Sample Location	Analysis 1	Analysis 2	RPD
2,3,7,8-TCDD (pg/g)	Sediment	Northport	ND	ND	--
2,3,7,8-TCDF (pg/g)	"	"	ND	ND	--
Percent Fines ($\leq$ 62 μm)	"	"	0	0	0%
Percent TOC	"	"	0.07	0.14	67%
2,3,7,8-TCDD (pg/g)	Sediment	French Pt. Rocks	3.7	3.4	8.4%
2,3,7,8-TCDF (pg/g)	"	"	174	159	9.0%
Percent Fines	"	"	67	84	22%
Percent TOC	"	"	2.34	2.47	5.4%
2,3,7,8-TCDD (pg/g)	Whole Fish	Northport	1.7	1.5	13%
2,3,7,8-TCDF (pg/g)	"	"	33	30	9.5
Percent Lipid	"	"	6.8	6.4	6.1%
2,3,7,8-TCDD (pg/g)	Whole Fish	French Pt. Rocks	2.3	2.2	4.4%
2,3,7,8-TCDF (pg/g)	"	"	37	36	2.7%
Percent Lipid	"	"	8.2	8.5	3.6%

RPD = relative percent difference (range as percent of duplicate mean)
ND = not detected

Table 2. TCDD/TCDF Concentrations in Sediment Samples (pg/g, dry; parts per trillion).

EPA Sample No.	Location	Approximate River Mile	Sampling Depth (ft)	Percent Fines ($\leq$ 62 μm)	Percent TOC	2,3,7,8-TCDD	2,3,7,8-TCDF
			Lake Roosevelt				
DJ022602*	Northport	735	70	0	0.10	ND(1.4)	ND(1.9)
DJ022605	China Bend	724	54	0	0.04	ND(1.4)	ND(1.4)
DJ022607	Marcus Island	709	80	0	0.25	ND(1.4)	ND(2.3)
DJ022609**	French Pt. Rocks	692	86	76	2.40	3.6	166
DJ022612	Hunters	661	105	88	1.08	ND(3.9)	117
DJ022616	Grand Coulee	601	155	97	1.58	ND(2.4)	78
			Rufus Woods Lake				
DJ022618	Bridgeport St. Park	546	120	63	1.26	ND(1.7)	30
			Spokane River				
DJ022614	Long Lake	39	72	99	2.62	ND(1.4)	2.7

ND = not detected; detection limit shown in parenthesis
* QA duplicate sample no. is DJ022603 (duplicate mean shown here)
** QA duplicate sample no. is DJ022610 (duplicate mean shown here)

A low concentration of TCDD (3.6 pg/g; parts per trillion) was detected in the sediments at one site only, off French Point Rocks just below Kettle Falls. TCDF was detected in sediments from five of the eight sampling sites, including Rufus Woods Lake (30 pg/g) and the Spokane River at Long Lake (2.7 pg/g). Although much higher concentrations of TCDF occurred in Lake Roosevelt (up to 166 pg/g), no TCDF was detected in sediments above Kettle Falls (i.e., Marcus Island, China Bend, and Northport). Possible reasons from this are discussed later in the report.

Table 3 summarizes the results for whole fish samples. Although efforts were made to obtain comparable size fish for each sample, there were significant differences between sampling sites (Kruskal - Wallis test, $p \leq .05$). Ecology results from analysis of multiple samples of other Lake Roosevelt fish species have shown that size differences of this order are not an important source of variability in TCDD/TCDF data (Johnson *et al.*, 1991). The complete length/weight data are in Appendix C. Lipid content was more variable than fish size, ranging from 2% - 10.1%. The potential effect of lipid in interpreting these data is discussed later.

TCDD and TCDF were the only congeners detected in fish samples. Both compounds were detected more frequently in fish tissue than in sediment. TCDD was detected in all Lake Roosevelt fish samples (0.9 - 2.6 pg/g), but not in fish from Rufus Woods Lake or the Spokane River. Fish from all sites had detectable concentrations of TCDF (0.6 - 48 pg/g). Samples from Rufus Woods Lake (4.6 pg/g) and the Spokane River (0.6 pg/g) had the lowest TCDF concentrations.

Table 3. TCDD/TCDF Concentrations in Whole Largescale Sucker Samples (pg/g, wet; parts per trillion)

EPA Sample No.	Location	Approximate River Mile	Mean Length (mm)	Mean Weight (g)	Percent Lipid	2,3,7,8-TCDD	2,3,7,8-TCDF
			Lake Roosevelt				
DJ022601*	Northport	733	469	1,054	6.6	1.6	32
DJ022604	China Bend	722	486	1,143	5.6	1.1	17
DJ022606	Marcus Island	709	524	1,500	9.4	2.6	48
DJ022608**	French Pt. Rocks	697	484	1,188	8.4	2.2	36
DJ022611	Hunters	661	527	1,303	5.3	0.9	19
DJ022615	Grand Coulee	600	504	1,195	10.1	0.9	23
			Rufus Woods Lake				
DJ022617	Bridgeport St. Park	546	505	960	2.4	ND(0.7)	4.6
			Spokane River				
DJ022613	Long Lake	37	437	815	5.4	ND(0.7)	0.6

ND = not detected; detection limit shown in parenthesis
* QA duplicate sample no. is QD120490 (duplicate mean shown here)
** QA duplicate sample no. is QDD12049 (duplicate mean shown here)

Results for the Spokane suggest this river is not an important PCDD/PCDF source to Lake Roosevelt. Only trace amounts of TCDF were detected in the sediments (2.7 pg/g) or in fish (0.6 pg/g). TCDF is commonly detected at or slightly above this level in fish from uncontaminated waters in Washington (Beak Consultants, Inc. 1989; Johnson *et al.*, 1991a; Serdar *et al.*, 1991-in prep.).

The downstream trends observed in concentrations of TCDD and TCDF in sediment and fish samples (excluding the Spokane River) are illustrated in Figure 2. As described above, neither TCDD nor TCDF were detected in sediments from the upper reaches of Lake Roosevelt. The first detection of these compounds (and only detection of TCDD) occurred in the sediments off French Point Rocks, about 53 river miles below the border and 83 miles below Celgar. This site also had the highest TOC concentration in the sediments. Numerous studies show sediments having more organic matter sorb greater amounts of hydrophobic, nonionic organic compounds like TCDD and TCDF.

Beginning at French Point Rocks, there was a consistent trend in decreasing concentrations of TCDF in the sediments down into Rufus Woods Lake. An approximate 60% reduction in TCDF concentrations was found between sediments collected in Lake Roosevelt near Grand Coulee Dam (78 pg/g) and those from Rufus Woods Lake (30 pg/g).

Downstream trends in TCDD and TCDF concentrations in fish followed patterns similar to those found in the sediments. Concentrations in fish from the two most upstream sites (Northport and China Bend) were lower than several of the downstream samples. As with sediment, a trend toward decreasing concentrations in fish became evident within the Kettle Falls - Grand Coulee reach. The reduction in TCDF concentrations in fish collected above and below Grand Coulee Dam was approximately 80% (23 pg/g vs. 4.6 pg/g), comparable to findings for the sediments.

One possible explanation for the lower level of sediment contamination in upper Lake Roosevelt is the velocity of the Columbia River which results in the upper reaches being an erosional rather than depositional environment. This is reflected in the coarse grain size and low TOC content of the sediment samples obtained from Northport, China Bend, and Marcus Island. Although there are probably localized areas of sediment accumulation here, the transition to conditions favoring deposition appears to occur in the region of Kettle Falls where fine sediments were first encountered. Results of Ecology's 1986 survey of metals concentrations in Lake Roosevelt showed a similar distribution of cadmium and mercury in the sediments, which was closely correlated with percent fines (Johnson *et al.*, 1988). Because uptake from the sediments or through food chains linked to the sediments are major routes of PCDD/PCDF accumulation in fish, the lower level of sediment contamination in the upper lake would be expected to result in reduced concentrations in fish like largescale suckers that live in association with the bottom.

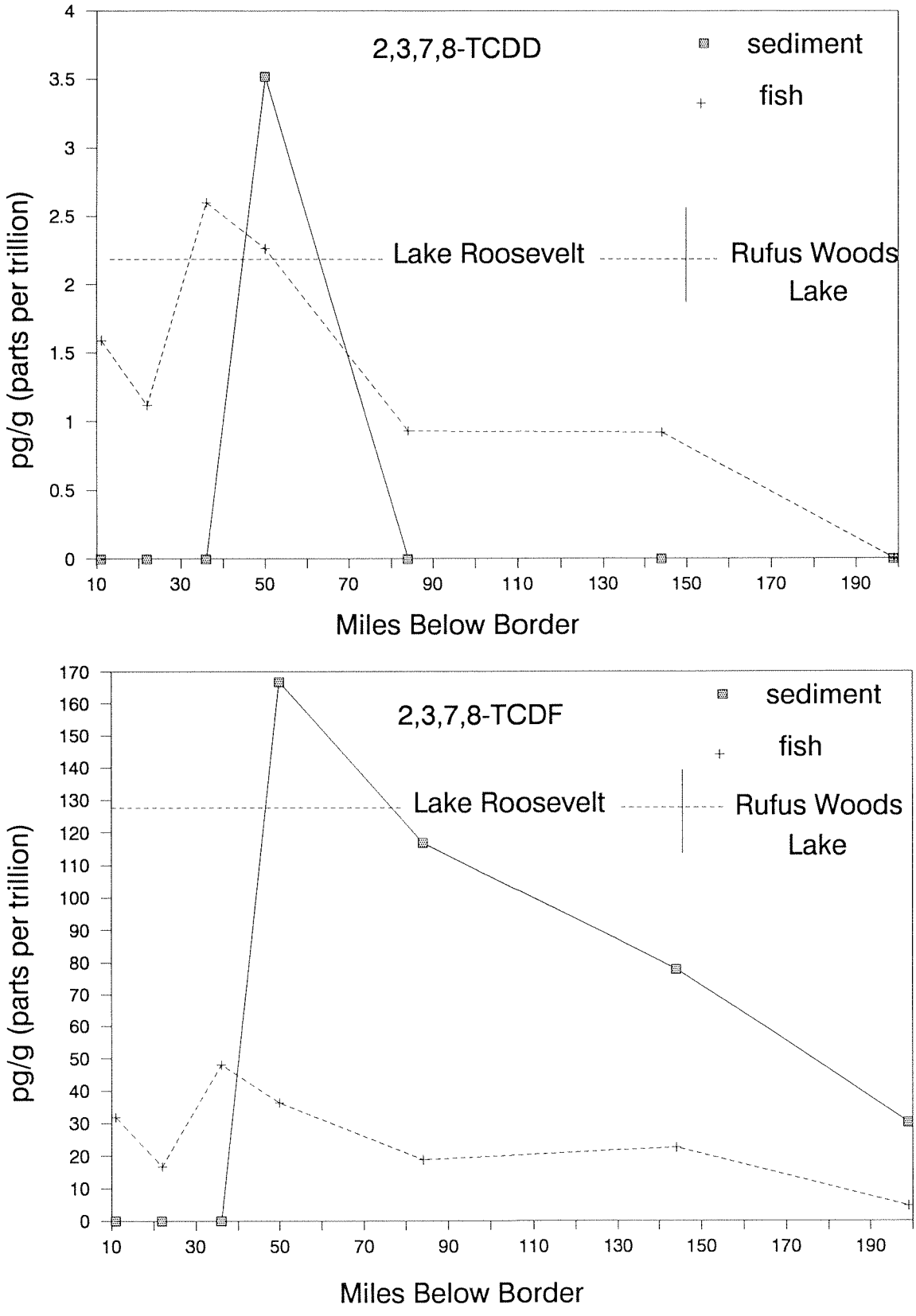

Figure 2. 2,3,7,8-TCDD/TCDF Trends through Lake Roosevelt

Differences in lipid content were also considered as a possible reason why the highest TCDD and TCDF concentrations were not found in fish collected near the border. Because these compounds are lipid soluble, lipid content has a strong influence on their bioaccumulation. Although lipid content of the Northport and China Bend samples was at the lower end of the range observed in Lake Roosevelt, normalizing the fish tissue data to lipid did not appreciably change the trends shown in Figure 2.

The relationship between levels of TCDD and TCDF in sediment and fish may be useful in setting goals for sediment quality in Lake Roosevelt or as means of predicting impacts to fisheries from process changes at Celgar. EPA (Cook, 1987) proposed a simple bioavailability index (BI) to relate sediment contamination to expected fish tissue concentrations. BI is the ratio between contaminant concentrations in fish (wet weight) and sediment (dry weight) normalized to percent lipid and TOC, respectively.

Results of the present study were used to calculate BI ratios for TCDF (Table 4). In spite of the fact the data were obtained over a large geographical area, the BI was consistent, averaging 0.07 (range 0.03 - 0.11). These results are in good agreement with findings from EPA field studies in Petenwell Reservoir on the Wisconsin River (Kuehl *et al.*, 1987). Petenwell, like Lake Roosevelt, receives pulp and paper mill discharges. Based on analysis of whole carp and sediments, EPA reported an average BI of 0.06 for TCDF. The same EPA study found a BI of 0.27 for TCDD. A BI for TCDD could only be calculated for the one site in Lake Roosevelt where TCDD was detected in the sediments. This value was 0.17.

Table 4. Bioavailability of 2,3,7,8-TCDF from Sediments in Lake Roosevelt and Vicinity

	Fish Tissue			Sediment			Bioavailability
Location	% Lipid	pg/g wet	pg/g lipid	% TOC	pg/g dry	pg/g TOC	Index (BI)
Lake Roosevelt							
French Pt. Rocks	8.4	36	429	2.40	166	6,920	0.06
Hunters	5.3	19	358	1.08	117	10,800	0.03
Grand Coulee	10.1	23	228	1.58	78	4,940	0.05
Rufus Woods Lake							
Bridgeport St. Park	2.4	4.6	192	1.26	30	2,380	0.08
Spokane River							
Long Lake	5.4	0.6	11	2.62	2.7	103	0.11
						mean =	0.07

Bioavailability Index (BI) = pg/g lipid ÷ pg/g TOC

BI ratios could be used, for example, to predict what reduction in the level of sediment contamination in Lake Roosevelt would be required to bring fish tissue TCDD and TCDF concentrations below detection limits. Method detection limits for TCDD/TCDF are typically 1 pg/g. Assuming an average TOC of 2% in the sediments (Table 2) and average lipid content of 7% in whole fish (Table 3), a BI of 0.07 predicts sediment concentrations below approximately 4 pg/g of TCDF would result in less than 1 pg/g in fish tissue. Similar calculations for TCDD give approximately 2 pg/g (using EPA's BI of 0.27) and 1 pg/g (using the BI of 0.17 from the single Ecology data point) as the level in sediments below which TCDD would not accumulate to detectable concentrations in fish tissue. A similar approach may apply to edible fish tissue.

SUMMARY AND CONCLUSIONS

Results of this survey showed long distance transport of TCDD and TCDF through Lake Roosevelt, with the latter compound still detectable at slightly elevated levels in whole fish samples collected over 200 river miles below the Celgar pulp mill. The Spokane River did not appear to be an important source of either TCDD or TCDF to Lake Roosevelt.

Significant deposition of these contaminants to the bottom sediments of Lake Roosevelt appeared to first occur in the region of Kettle Falls, approximately 53 miles below the border. This was the only site where TCDD was detected in the sediments. The distribution of TCDD and TCDF in whole fish samples from Lake Roosevelt resembled the pattern in the sediments. A consistent ratio in TCDF concentrations was observed between fish and sediments throughout the study area, averaging 0.07 on a lipid/TOC normalized basis. This ratio may have predictive value for sediment quality goals in Lake Roosevelt or impacts to fisheries from process changes at Celgar.

There was substantial downstream attenuation of TCDD and TCDF, both within Lake Roosevelt and between lower Lake Roosevelt and Rufus Woods Lake. In the case of TCDF this amounted to a reduction in the level of contamination between the two lakes of 60 - 80%, these figures being based on analysis of limited numbers of samples. TCDD was not detected in sediment or whole fish samples from Rufus Woods Lake.

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APPENDIX A

Appendix A. Location of Sediment and Fish Samples.

Water Body	Station Name	Approximate River Mile	Description	Latitude x Longitude
		Sediment Samples		
Lake Roosevelt (Columbia River)	Northport	735	100' downstream of Smelter Rock	48°55'23"x117°45'35"
"	China Bend	724	0.3 mile downstream of dike, 0.3 mile off right* bank	48°49'6"x117°56'6"
"	Marcus Island	709	0.2 mile off middle of Marcus Island	48°40'15"x118°3'22"
"	French Pt. Rocks	692	0.7 mile upstream of French Pt. Rocks, 0.3 mile off right bank	48°30'28"x118°10'41"
"	Hunters	661	mid-channel between NPS boat launch and Nez Perce Creek	48°7'55"x118°13'52"
"	Grand Coulee	601	1 mile downstream of Plum Pt., 0.2 mile off left bank	47°56'28"x118°56'37"
Rufus Woods Lake (Columbia River)	Bridgeport State Park	546	mid-channel off park boat launch	47°59'37"x119°37'6"
Long Lake (Spokane River)	Long Lake	39	mid-channel off DNR campground boat launch	47°49'48"x117°45'13"

* viewed facing downstream

Appendix A (cont'd).

Water Body	Station Name	Approximate River Mile	Description
		Fish Samples	
Lake Roosevelt (Columbia River)	Northport	733	left bank, Northport to Onion Creek
"	China Bend	722	off Flat Creek
"	Marcus Island	709	left bank, Marcus Island to Pingston Creek
"	French Pt. Rocks	697	off Martin Creek and left bank either side of Rickey Pt.
"	Hunters	661	off Nez Perce Creek
"	Grand Coulee	600	both shorelines, Spring Canyon Campground to 0.5 mile upstream
Rufus Woods Lake (Columbia River)	Bridgeport State Park	546	left bank opposite state park
Long Lake (Spokane River)	Long Lake	37	left bank opposite DNR campground to 0.5 mile downstream

APPENDIX B

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3473 SCC #: DJO22601 ERL-D Loc.: 1506

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.80	553.25	63	0.0000	33.43
2,3,6,7- TCDF		0.00	1.00	63	0.9300	ND
3,4,6,7- TCDF		0.00	1.00	63	0.4800	ND
2,3,7,8- TCDD	1746-01-6	0.68	35.73	71	0.0000	1.69
1,2,3,7,8- PeCDF	57117-41-6	2.01	1.00	71	1.6800	ND
2,3,4,7,8- PeCDF	57117-31-6	2.04	1.00	71	2.0300	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	71	1.6800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	80	1.2700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	68	2.7600	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	68	2.7600	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	68	2.7600	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	68	2.7600	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	83	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	83	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	83	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	78	5.3200	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	78	5.3200	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.79	1.00	78	7.1400	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 5.03
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3473 SCC #: QD120490 ERL-D Loc.: 1723

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.79	217.02	69	0.0000	30.33
2,3,6,7- TCDF		0.00	1.00	69	0.5300	ND
3,4,6,7- TCDF		0.00	1.00	69	0.5300	ND
2,3,7,8- TCDD	1746-01-6	0.70	9.00	77	0.0000	1.49
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	93	1.6700	ND
2,3,4,7,8- PeCDF	57117-31-6	1.16	1.00	93	1.7800	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	93	1.6700	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	106	1.2700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	94	2.7500	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	94	2.7500	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	94	2.7500	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	94	2.7500	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	117	1.6600	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	117	1.6600	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	117	1.6600	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	94	5.2900	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	94	5.2900	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.43	1.00	94	7.1400	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 4.52
Percent contribution of 2378 TCDF, 23478 PeCDF, 2378 TCDD and 12378 PeCDD to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3473 SCC #: DJ022602 ERL-D Loc.: 1514

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.56	1.00	32	1.8800	ND
2,3,6,7- TCDF		0.00	1.00	32	0.9500	ND
3,4,6,7- TCDF		0.00	1.00	32	0.9500	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	50	1.3500	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	60	3.3600	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	60	3.3600	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	60	3.3600	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	66	2.5400	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	57	5.5100	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	57	5.5100	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	57	5.5100	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	57	5.5100	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	70	3.3300	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	70	3.3300	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	70	3.3300	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	1.06	24.40	53	10.6100	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	53	10.6100	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.16	61.19	53	0.0000	43.55

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 0.44
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 0

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3473 SCC #: DJ022603 ERL-D Loc.: 1515

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.47	1.00	41	1.8600	ND
2,3,6,7- TCDF		0.00	1.00	41	0.9800	ND
3,4,6,7- TCDF		0.00	1.00	41	0.9800	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	44	1.3500	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	54	3.3700	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	54	3.3700	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	54	3.3700	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	57	2.5500	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	1.84	1.00	55	5.6900	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	55	5.5200	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	55	5.5200	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	55	5.5200	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	66	3.3400	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	66	3.3400	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	66	3.3400	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	45	10.7300	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	45	10.6400	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.97	1.00	45	14.3600	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 0.00
Percent contribution of 2378 TCDF, 23478 PeCDF, 2378 TCDD and 12378 PeCDD to total TEF value: 0

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3474 SCC #: DJ022604 ERL-D Loc.: 1516

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.78	215.11	62	0.0000	16.76
2,3,6,7- TCDF		0.00	1.00	62	0.4800	ND
3,4,6,7- TCDF		0.00	1.00	62	0.4800	ND
2,3,7,8- TCDD	1746-01-6	0.66	12.14	65	0.0000	1.12
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	83	1.6900	ND
2,3,4,7,8- PeCDF	57117-31-6	1.15	1.00	83	1.7100	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	83	1.6900	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	91	1.2700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	86	2.7700	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	86	2.7700	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	86	2.7700	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	86	2.7700	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	104	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	104	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	104	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	96	5.3300	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	96	5.3300	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.18	5.09	96	7.1600	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 2.80
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3474 SCC #: DJ022605 ERL-D Loc.: 1517

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	1.14	1.00	42	1.3700	ND
2,3,6,7- TCDF		0.00	1.00	42	0.9500	ND
3,4,6,7- TCDF		0.00	1.00	42	0.9500	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	44	1.3500	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	48	3.3600	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	48	3.3600	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	48	3.3600	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	54	2.5400	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	46	5.5200	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	46	5.5200	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	46	5.5200	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	46	5.5200	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	54	3.3400	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	54	3.3400	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	54	3.3400	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	36	10.6300	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	36	10.6300	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.00	1.00	36	14.2700	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 0.00
Percent contribution of 2378 TCDF, 23478 PeCDF, 2378 TCDD and 12378 PeCDD to total TEF value: 0

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3475 SCC #: DJ022606 ERL-D Loc.: 1518

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.76	659.99	62	0.0000	48.07
2,3,6,7- TCDF		0.00	1.00	62	1.2000	ND
3,4,6,7- TCDF		0.00	1.00	62	0.4700	ND
2,3,7,8- TCDD	1746-01-6	0.70	45.34	69	0.0000	2.60
1,2,3,7,8- PeCDF	57117-41-6	1.87	1.00	74	1.6800	ND
2,3,4,7,8- PeCDF	57117-31-6	1.73	23.37	74	1.6800	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	74	1.6800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	80	1.2700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	70	2.7600	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	70	2.7600	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	70	2.7600	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	70	2.7600	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	86	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	86	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	86	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	75	5.3100	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	75	5.3100	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.02	4.98	75	7.1600	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 7.39
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3475 SCC #: DJ022607 ERL-D Loc.: 1519

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.55	1.00	48	2.3300	ND
2,3,6,7- TCDF		0.00	1.00	48	0.9500	ND
3,4,6,7- TCDF		0.00	1.00	48	0.9500	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	51	1.3500	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	54	3.3700	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	54	3.3700	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	54	3.3700	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	58	2.5500	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	50	5.5400	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	50	5.5400	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	50	5.5400	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	50	5.5400	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	57	3.3500	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	57	3.3500	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	57	3.3500	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	34	10.6600	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	34	10.6600	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.00	1.00	34	14.3100	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 0.00
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 0

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3476 SCC #: DJ022608 ERL-D Loc.: 1520

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.76	410.34	67	0.0000	36.79
2,3,6,7- TCDF		0.00	1.00	67	0.4800	ND
3,4,6,7- TCDF		0.00	1.00	67	0.4800	ND
2,3,7,8- TCDD	1746-01-6	0.69	59.96	71	0.0000	2.31
1,2,3,7,8- PeCDF	57117-41-6	1.10	1.00	78	1.6800	ND
2,3,4,7,8- PeCDF	57117-31-6	1.75	22.08	78	1.6800	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	78	1.6800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.40	1.00	82	1.3200	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	75	2.7500	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	75	2.7500	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	75	2.7500	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	75	2.7500	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	82	1.6600	ND
1,2,3,6,7,8- HxCDD	57753-85-7	1.29	8.72	82	1.6600	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	82	1.6600	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.97	6.76	76	5.3000	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	76	5.3000	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.75	1.00	76	7.1200	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 6.18
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 99

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3476 SCC #: QDD12049 ERL-D Loc.: 1724

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.79	297.02	56	0.0000	36.01
2,3,6,7- TCDF		0.00	1.00	56	0.5100	ND
3,4,6,7- TCDF		0.00	1.00	56	0.5100	ND
2,3,7,8- TCDD	1746-01-6	0.72	35.36	62	0.0000	2.22
1,2,3,7,8- PeCDF	57117-41-6	1.31	1.00	70	1.6900	ND
2,3,4,7,8- PeCDF	57117-31-6	1.45	25.19	70	1.6900	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	70	1.6900	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	75	1.2700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	70	2.7700	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	70	2.7700	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	70	2.7700	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	70	2.7700	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	77	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.95	1.00	77	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	77	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	76	5.3300	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	76	5.3300	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.24	1.00	76	7.1500	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 5.81
Percent contribution of 2378 TCDF, 23478 PeCDF, 2378 TCDD and 12378 PeCDD to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3476 SCC #: DJ022609 ERL-D Loc.: 1521

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.80	215.42	54	0.0000	174.38
2,3,6,7- TCDF		0.89	1.00	54	17.9800	ND
3,4,6,7- TCDF		0.00	1.00	54	1.5900	ND
2,3,7,8- TCDD	1746-01-6	0.71	11.48	57	0.0000	3.68
1,2,3,7,8- PeCDF	57117-41-6	2.00	1.00	60	5.1600	ND
2,3,4,7,8- PeCDF	57117-31-6	1.51	16.72	60	3.5900	ND
2,3,4,6,7- PeCDF	70648-29-9	1.43	1.00	60	3.5900	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	69	2.5500	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	63	5.5400	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	63	5.5400	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	63	5.5400	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	63	5.5400	ND
1,2,3,4,7,8- HxCDD	32598-13-3	1.26	1.00	73	3.3500	ND
1,2,3,6,7,8- HxCDD	57753-85-7	1.98	1.00	73	7.4500	ND
1,2,3,7,8,9- HxCDD	19408-74-3	1.37	6.13	73	3.3500	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	1.00	33.21	53	10.6700	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	53	10.6700	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.00	71.92	53	0.0000	28.33

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 23.09
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 98

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3476 SCC #: DJO22610 ERL-D Loc.: 1522

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.81	81.29	50	0.0000	159.34
2,3,6,7- TCDF		0.83	9.70	50	0.0000	19.01
3,4,6,7- TCDF		0.00	1.00	50	2.7400	ND
2,3,7,8- TCDD	1746-01-6	0.81	8.70	50	0.0000	3.36
1,2,3,7,8- PeCDF	57117-41-6	2.04	1.00	68	5.5400	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	68	3.3700	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	68	3.3700	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	71	3.0100	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	1.53	1.00	67	5.5400	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	67	5.5400	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	67	5.5400	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	67	5.5400	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	72	3.3500	ND
1,2,3,6,7,8- HxCDD	57753-85-7	1.32	6.75	72	0.0000	4.97
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	72	3.3500	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	1.08	24.24	31	0.0000	10.81
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	31	10.6600	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.29	1.00	31	53.3200	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 19.90
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 97

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3477 SCC #: DJ022611 ERL-D Loc.: 1523

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.76	282.41	60	0.0000	18.85
2,3,6,7- TCDF		0.00	1.00	60	0.4700	ND
3,4,6,7- TCDF		0.00	1.00	60	0.4700	ND
2,3,7,8- TCDD	1746-01-6	0.65	16.81	67	0.0000	0.93
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	80	1.6800	ND
2,3,4,7,8- PeCDF	57117-31-6	1.11	1.00	80	1.6800	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	80	1.6800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	90	1.2700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	83	2.7600	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	83	2.7600	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	83	2.7600	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	83	2.7600	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	93	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	93	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	93	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	86	5.3100	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	86	5.3100	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.72	1.00	86	7.1300	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 2.82
Percent contribution of 2378 TCDF, 23478 PeCDF, 2378 TCDD and 12378 PeCDD to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3477 SCC #: DJ022612 ERL-D Loc.: 1524

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.80	65.47	44	0.0000	116.78
2,3,6,7- TCDF		0.69	8.52	44	0.0000	15.19
3,4,6,7- TCDF		0.00	1.00	44	2.5700	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	45	3.8900	ND
1,2,3,7,8- PeCDF	57117-41-6	1.40	18.30	63	3.3600	ND
2,3,4,7,8- PeCDF	57117-31-6	1.35	10.70	63	3.3600	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	63	3.3600	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	62	2.5400	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	56	5.5200	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	56	5.5200	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	56	5.5200	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	56	5.5200	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	57	3.3400	ND
1,2,3,6,7,8- HxCDD	57753-85-7	1.53	1.00	57	7.6400	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	57	3.3400	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	1.27	1.00	14	23.8900	QR(ND)
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	14	10.6300	QR(ND)
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.51	1.00	14	50.8900	QR(ND)

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 12.40
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 99

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3478 SCC #: DJ022613 ERL-D Loc.: 1525

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.88	16.27	57	0.0000	0.60
2,3,6,7- TCDF		0.00	1.00	57	0.4800	ND
3,4,6,7- TCDF		0.00	1.00	57	0.4800	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	69	0.6700	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	79	1.6800	ND
2,3,4,7,8- PeCDF	57117-31-6	2.06	1.00	79	1.6800	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	79	1.6800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	81	1.2700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	82	2.7600	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	82	2.7600	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	82	2.7600	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	82	2.7600	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	93	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	93	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	93	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	85	5.3100	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	85	5.3100	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.70	1.00	85	7.1300	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 0.06
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3478 SCC #: DJ022614 ERL-D Loc.: 1526

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.65	8.40	34	0.0000	2.69
2,3,6,7- TCDF		1.18	1.00	34	2.7000	ND
3,4,6,7- TCDF		0.00	1.00	34	1.1100	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	36	1.3500	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	47	3.3800	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	47	3.3800	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	47	3.3800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	48	2.5700	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	48	5.5400	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	48	5.5400	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	48	5.5400	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	48	5.5400	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	44	3.3500	ND
1,2,3,6,7,8- HxCDD	57753-85-7	1.38	8.72	44	0.0000	6.87
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	44	3.3500	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	1.13	62.49	9	0.0000	QR(89)
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	9	11.1100	QR(ND)
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.34	1.00	9	83.9000	QR(ND)

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 1.85
Percent contribution of 2378 TCDF, 23478 PeCDF, 2378 TCDD and 12378 PeCDD to total TEF value: 15

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3479 SCC #: DJ022615 ERL-D Loc.: 1527

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.76	319.00	54	0.0000	22.57
2,3,6,7- TCDF		0.00	1.00	54	0.6400	ND
3,4,6,7- TCDF		0.00	1.00	54	0.4800	ND
2,3,7,8- TCDD	1746-01-6	0.76	13.32	63	0.0000	0.92
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	76	1.6900	ND
2,3,4,7,8- PeCDF	57117-31-6	1.48	6.88	76	1.6900	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	76	1.6900	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	82	1.2800	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	71	2.7700	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	71	2.7700	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	71	2.7700	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	71	2.7700	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	83	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	83	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	83	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	71	5.3300	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	71	5.3300	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.08	8.67	71	7.1600	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 2.57
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3479 SCC #: DJ022616 ERL-D Loc.: 1528

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.81	102.60	49	0.0000	77.88
2,3,6,7- TCDF		0.68	16.70	49	0.0000	12.68
3,4,6,7- TCDF		0.00	1.00	49	1.5700	ND
2,3,7,8- TCDD	1746-01-6	0.64	1.00	50	2.4400	ND
1,2,3,7,8- PeCDF	57117-41-6	1.27	1.00	66	4.4300	ND
2,3,4,7,8- PeCDF	57117-31-6	2.09	1.00	66	5.1300	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	66	3.4800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	67	2.6300	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	62	5.7100	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	62	5.7100	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	62	5.7100	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	62	5.7100	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	67	3.4500	ND
1,2,3,6,7,8- HxCDD	57753-85-7	1.35	6.38	67	0.0000	3.43
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	67	4.1600	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	1.15	31.50	23	0.0000	QR(18)
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	23	11.0000	QR(ND)
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.94	28.20	23	0.0000	QR(32)

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 8.63
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 90

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3480 SCC #: DJ022617 ERL-D Loc.: 1529

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.78	107.08	58	0.0000	4.63
2,3,6,7- TCDF		0.00	1.00	58	0.4900	ND
3,4,6,7- TCDF		0.00	1.00	58	0.4800	ND
2,3,7,8- TCDD	1746-01-6	0.78	1.00	68	0.6800	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	80	1.6900	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	80	1.6900	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	80	1.6900	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	86	1.2800	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	76	2.7700	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	76	2.7700	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	76	2.7700	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	76	2.7700	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	91	1.6700	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	91	1.6700	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	91	1.6700	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.00	1.00	78	5.3300	ND
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	78	5.3300	ND
1,2,3,4,6,7,8- HpCDD	37871-00-4	0.00	1.00	78	7.1600	ND

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 0.46
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 100

NDS PHASE II: BIOACCUMULATIVE POLLUTANT STUDY

EPISODE #: 3480 SCC #: DJ022618 ERL-D Loc.: 1530

DATA for BIOSIGNIFICANT POLYCHLORINATED DIBENZODIOXINS AND FURANS:

Analyte	CAS No.:	Ion Ratio	S/N	%REC	Det. Lim.	Amount(pg/g)
2,3,7,8- TCDF	51207-31-9	0.84	77.03	53	0.0000	30.15
2,3,6,7- TCDF		0.84	9.92	53	0.0000	3.88
3,4,6,7- TCDF		0.00	1.00	53	1.1800	ND
2,3,7,8- TCDD	1746-01-6	0.00	1.00	51	1.7400	ND
1,2,3,7,8- PeCDF	57117-41-6	0.00	1.00	63	3.3800	ND
2,3,4,7,8- PeCDF	57117-31-6	0.00	1.00	63	3.3800	ND
2,3,4,6,7- PeCDF	70648-29-9	0.00	1.00	63	3.3800	ND
1,2,3,7,8- PeCDD	40321-76-4	0.00	1.00	63	2.5500	ND
1,2,3,4,6,7- HxCDF *	19408-74-3					
1,2,3,4,7,8- HxCDF	70648-26-9	0.00	1.00	59	5.5400	ND
1,2,3,6,7,8- HxCDF	57117-44-9	0.00	1.00	59	5.5400	ND
2,3,4,6,7,8- HxCDF	60851-34-5	0.00	1.00	59	5.5400	ND
1,2,3,7,8,9- HxCDF	72918-21-9	0.00	1.00	59	5.5400	ND
1,2,3,4,7,8- HxCDD	32598-13-3	0.00	1.00	61	3.3500	ND
1,2,3,6,7,8- HxCDD	57753-85-7	0.00	1.00	61	3.3500	ND
1,2,3,7,8,9- HxCDD	19408-74-3	0.00	1.00	61	3.3500	ND
1,2,3,4,6,7,8- HpCDF	67562-39-4	0.78	1.00	22	13.9300	QR(ND)
1,2,3,4,7,8,9- HpCDF	55673-89-7	0.00	1.00	22	10.7900	QR(ND)
1,2,3,4,6,7,8- HpCDD	37871-00-4	1.46	1.00	22	31.2000	QR(ND)

*: Coelutes with 123478 HxCDF on DB5 30 M.

Toxicity Equivalency Concentration: 3.02
Percent contribution of 2378 TCDF,
23478 PeCDF, 2378 TCDD and 12378 PeCDD
to total TEF value: 100

APPENDIX C

Appendix C. Lengths and Weights of Fish Samples.

Station Name	Total Length (mm)	Total Weight (g)
LAKE ROOSEVELT (COLUMBIA RIVER)		
Northport	486	1245
	502	1259
	425	799
	480	965
	451	1003
China Bend	482	1192
	524	1458
	532	1223
	436	805
	455	1036
Marcus Island	507	1402
	559	1848
	495	1195
	550	1495
	511	1560
French Pt. Rocks	489	1141
	532	1282
	457	1289
	456	1046
	484	1183
Hunters	525	1462
	491	1051
	545	1400
	561	1476
	515	1128
Grand Coulee	548	1325
	534	1587
	515	1218
	469	993
	452	850
RUFUS WOODS LAKE (COLUMBIA RIVER)		
Bridgeport St. Park	395	666
	520	1145
	531	1145
	536	1570
	545	1272
LONG LAKE (SPOKANE RIVER)		
Long Lake	439	956
	438	778
	410	641
	450	848
	449	854