Water Body No. WA-CR-9010
Segment No. 26-00-04

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May 28, 1991

TO: Carl Nuechterlein and Steve Saunders

FROM: Art Johnson, Dave Serdar, and Keith Seiders

SUBJECT: PCDDs/PCDFs in Columbia River Suspended Particulate Matter

During October 1990, we collected a sample of suspended particulate matter (SPM) from the Columbia River at Northport (Figure 1) for analysis of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). This effort was part of Ecology's investigation into the impact on Lake Roosevelt of discharges from the Celgar bleached kraft pulp mill in Castlegar, B.C., approximately 30 river miles above the border. Northport is located ten river miles below the border.

The objectives of this study were to make the first direct determination of PCDD/PCDF concentrations in Columbia River water, obtain a preliminary estimate of loads to Lake Roosevelt, and provide data to the Water Quality Program and EPA to assist in refinement of the Columbia River total maximum daily load (TMDL) for 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). The field work was coordinated with an extensive Environment Canada study of water quality in the border reach of the Columbia River which included analysis of SPM samples for PCDDs/PCDFs. The Canadian results are not yet available.

Northport was selected as the sampling site in an effort to be upstream of depositional areas (i.e., PCDD/PCDF sinks) in Lake Roosevelt, yet sufficiently downstream of the closest major tributary, the Pend Oreille River, to allow for adequate mixing. The latter assumption was based on distance below the Pend Oreille confluence (ten river miles) and the several sharp intervening bends in this turbulent reach of the river (Figure 2). No actual measurements were made to confirm mixing.

SPM was analyzed rather than whole water samples because PCDDs/PCDFs have a low solubility in water, but a high affinity for particulates. The low suspended solids concentrations in this part of the river and sample size required for analysis called for use of centrifuge techniques to concentrate sufficient material.

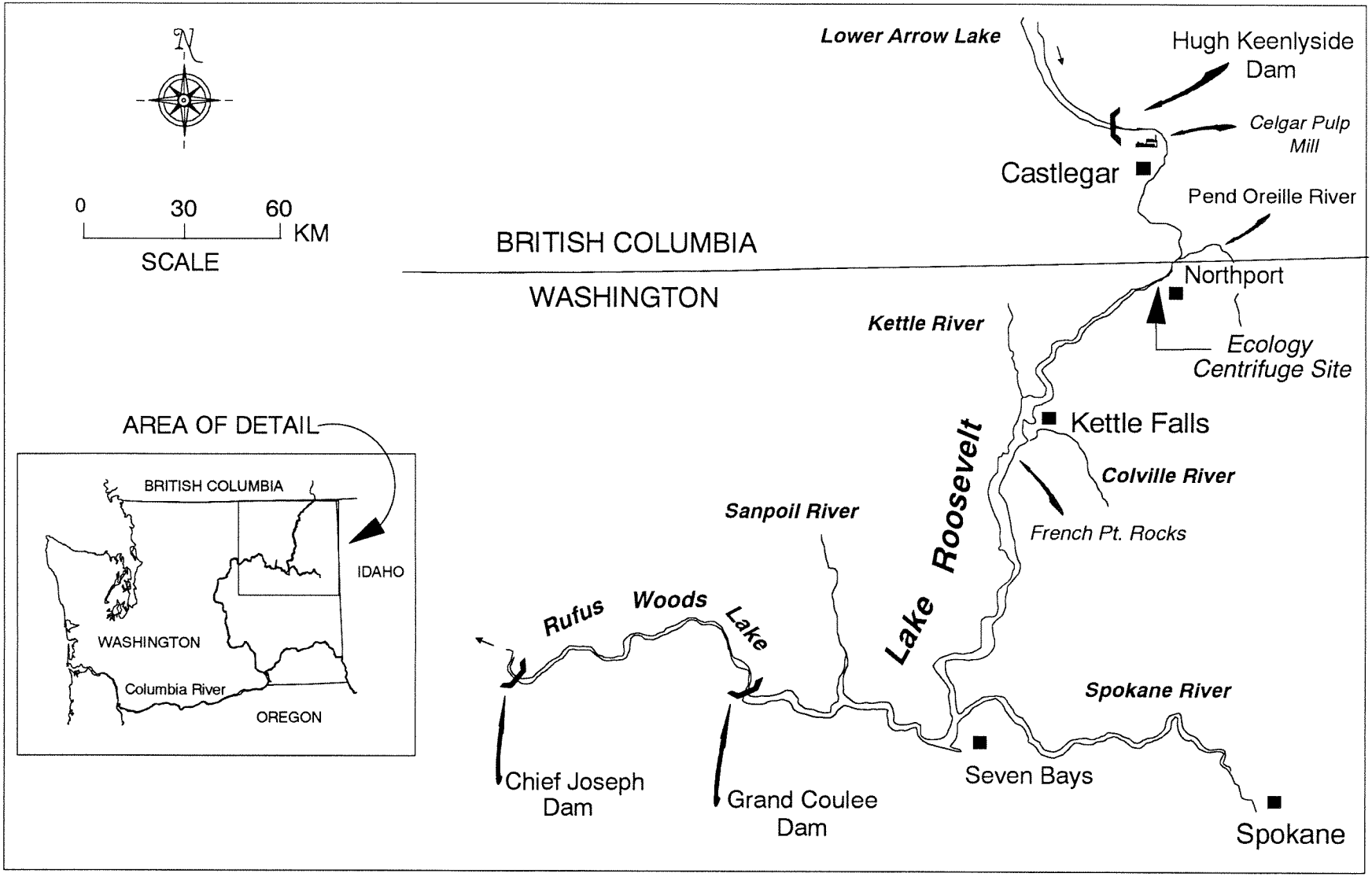

Figure 1. Location of Ecology Suspended Particulate Matter Sample, October 9 - 12, 1990

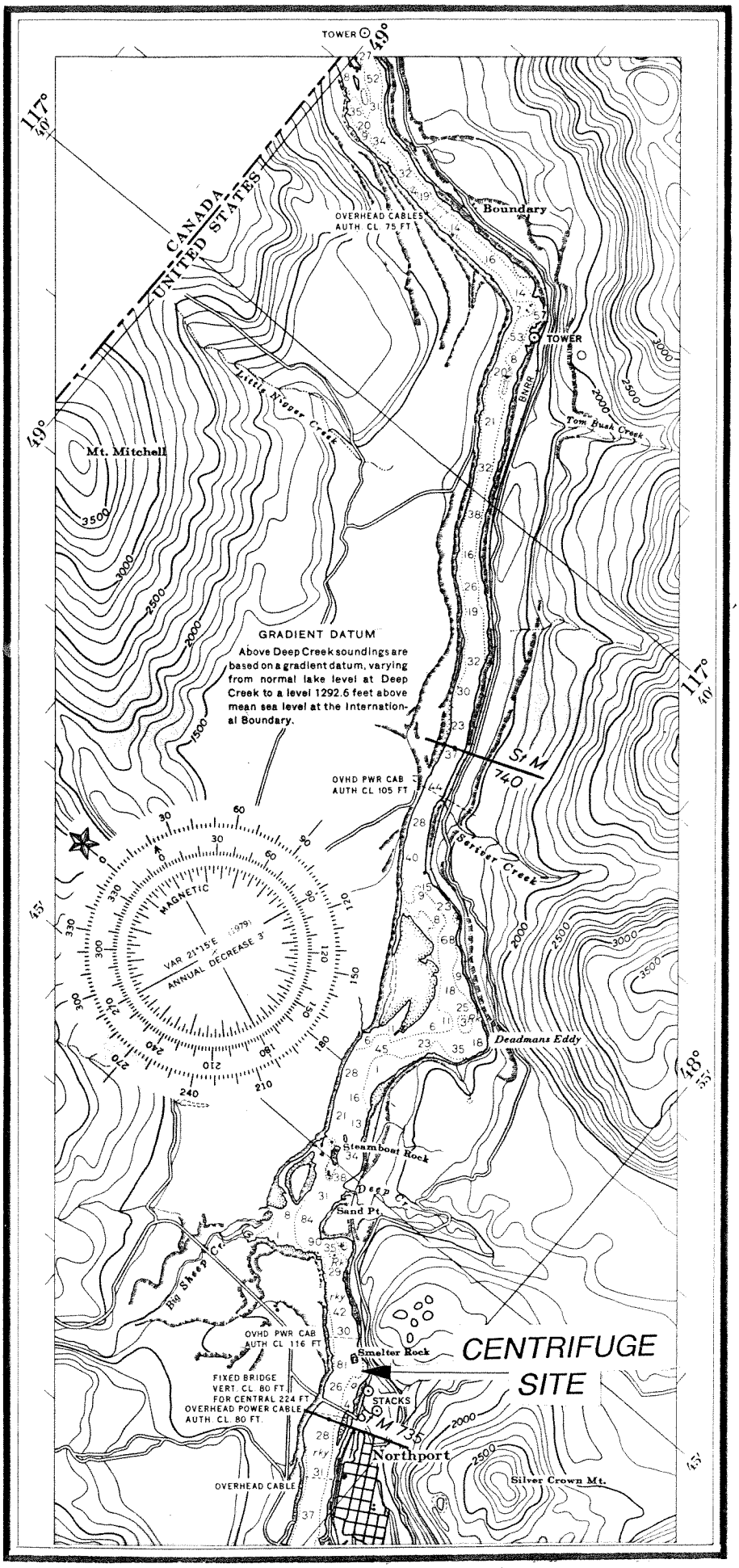

Figure 2. SPM Sampling Site

The limitations of the data obtained during this study should be stressed:

1) The results are from analysis of a single sample and may not be representative of long-term average concentrations. The Celgar effluent data and Lake Roosevelt bottom sediment data to which the SPM results are compared in this report, tend to support a conclusion that the SPM sample was representative. These data, however, are also based on single samples.

2) The distribution of PCDDs/PCDFs between the soluble and particulate phases was not determined. Therefore, our back-calculation from concentrations in SPM to concentrations in whole water may be underestimates.

Two Sedisamp System II continuous centrifuges (model 101IL) were used to collect the SPM sample. They were operated simultaneously over a period of approximately 57 hours starting at 2315 hours, October 9 and ending 0836 hours, October 12. Environment Canada certified that the Celgar mill was operating normally during this time (Tuominen, personal communication).

The intake was situated in five feet of water off a man-made gravel bar extending into the Columbia River from the left bank at the Northport boat launch. The influent line consisted of teflon and polyethylene tubing fitted with a coarse stainless steel strainer. The depth of the intake was periodically adjusted in one foot intervals between 1 and 4 feet from the surface to obtain a depth integrated sample of the water column.

The flow rate was 1.2 gallons per minute. A total of 4,082 gallons of water were passed through the centrifuges, yielding approximately 90 grams (wet) of material. Total suspended solids and total organic carbon concentrations in the intake water were low, averaging 2.0 ± 0.5 mg/L and 3.3 ± 0.1 mg/L, respectively. Only slight fluctuations were observed in these or other water quality variables monitored during the sampling period (Table 1).

The SPM sample was analyzed for PCDDs and PCDFs by Alta Analytical Laboratory, El Dorado Hills, California, using isotope dilution, high resolution GC/MS (EPA Method 8290). Total organic carbon and percent solids were determined using methods described in the Puget Sound Protocols (EPA, 1986). The results are summarized in Table 2. The complete data are in Appendix A, including analysis of a centrifuge blank prepared as part of a separate Ecology study.

PCDDs and PCDFs substituted at positions 2, 3, 7, and 8 are of primary concern because of their high toxicity and bioaccumulation potential. There are 17 congeners with this configuration. Six of these -- two PCDDs and four PCDFs -- were detected in the SPM sample: 1,2,3,4,7,8-HpCDD; OCDD; 2,3,7,8-TCDF; 1,2,3,7,8-PeCDF; 2,3,4,7,8-PeCDF; and OCDF.

Table 1. Water Quality of the Columbia River at Northport, October 9-12, 1990. (mean ± SD, n = 8; samples at centrifuge intake)

Variable	Result
Specific Conductance	148 ± 2 μmhos/cm
Temperature	13.0 ± 0.6 °C
pH	8.2 ± 0.2 units
Total Suspended Solids	2.0 ± 0.5 mg/L
Total Organic Carbon	3.3 ± 0.1 mg/L

Table 2. PCDDs/PCDFs Detected in Columbia River Suspended Particulate Matter (SPM) Collected at Northport, October 9-12, 1990 (pg/g, dry; parts per trillion).

Compound	Analysis #1	Analysis #2	Mean ± Range
PCDDs:			
1,2,3,4,6,7,8-HpCDD	9.7	12	11 ± 1
Total HpCDD	21	27	24 ± 3
OCDD	65	83	74 ± 9
PCDFs:			
2,3,7,8-TCDF	88	110	99 ± 22
Total TCDF	170	240	205 ± 70
1,2,3,7,8-PeCDF	1.0	1.1	1.0 ± 0.1
2,3,4,7,8-PeCDF	1.2	1.5	1.4 ± 0.2
Total PeCDF	3.8	4.8	4.3 ± 0.5
Total HpCDF	2.8	5.5	4.2 ± 1.4
OCDF	3.9	5.3	4.6 ± 0.7
% total organic carbon	7.8	7.5	7.6 ± 0.2
% solids	24.1	28.3	26.2 ± 2.2

2,3,7,8-TCDF was present in the highest concentration (99 ± 22 pg/g, dry; parts per trillion), followed by OCDD (74 ± 9 pg/g), and 1,2,3,4,6,7,8,-HpCDD (11 ± 1 pg/g). Concentrations of other 2,3,7,8-substituted compounds were less than 5 pg/g. 2,3,7,8-TCDD, the most toxic of the PCDDs/PCDFs, was not detected in SPM at detection limits of 0.77 - 0.91 pg/g.

Based on the mean total suspended solids concentration in the river and the mean of duplicate PCDD/PCDF analyses on the SPM sample, whole water concentrations were estimated to be 0.20 pg/L (parts per quadrillion) of 2,3,7,8-TCDF, 0.38 pg/L of total 2,3,7,8-substituted PCDDs/PCDFs, and 0.63 pg/L of total PCDDs/PCDFs. The detection limits achieved in the analysis of SPM were theoretically sufficient to have detected 2,3,7,8-TCDD concentrations in the river on the order of 0.002 pg/L, assuming total partition to SPM.

There are no EPA aquatic life criteria for the PCDDs/PCDFs detected in SPM. Laboratory experiments show toxic effects of 2,3,7,8-TCDF to fish can occur on exposure to concentrations in the low parts per trillion range (Mehrle *et al.*, 1988), well above the concentration we calculated.

The average river flow during the sampling period was 61,600 cfs, with a range of 59,900 - 63,400 cfs (USGS NASQAN station 12399500, Columbia River @ International Boundary). Using this figure and the above estimates of water concentrations, loads to Lake Roosevelt were calculated to be 30 mg/day of 2,3,7,8-TCDF, 57 mg/day of total 2,3,7,8-substituted PCDDs/PCDFs, and 95 mg/day of total PCDDs/PCDFs. If one assumes the 2,3,7,8-TCDD concentration in the SPM sample was at the detection limits achieved for this compound, our results suggest the 2,3,7,8-TCDD load was less than 0.3 mg/day.

The load estimate of 30 mg/day obtained for 2,3,7,8-TCDF agrees well with the limited data presently available on the 2,3,7,8-TCDF load from the Celgar mill. The Canadian Pulp & Paper Association (1989) reported a 2,3,7,8-TCDF concentration of 310 pg/L in a whole water sample of Celgar effluent collected in early 1989. Coupled with the average plant flow of 40.0 cfs during Ecology's SPM collection (Crozier, personal communication), this concentration also results in a 2,3,7,8-TCDF load to the Columbia of 30 mg/day. The only other PCDD/PCDF detected in this sample was 44 pg/L of total HxCDD. Detection limits for 2,3,7,8-TCDD were 14 pg/L.

Comparison of our results with the limited data on PCDDs/PCDFs in Lake Roosevelt bottom sediments suggests the SPM sample may be a reasonable representation of the material being deposited in the lake. Table 3 compares the concentrations of PCDDs/PCDFs in SPM with those in a sediment sample collected by Ecology off French Point Rocks near Kettle Falls during 1990 (see Figure 1). This site is approximately 43 river miles below Northport. Ecology sediment samples collected upstream of Kettle Falls have not had detectable amounts of PCDDs or PCDFs, probably due to their being composed of coarse sand rather than the fine material deposited further downstream. A report describing the results of Ecology's bottom sediment survey in more detail is currently being prepared (Johnson *et. al.*, 1991-in prep.).

Table 3. Comparison of 2,3,7,8-substituted PCDDs/PCDFs Detected in Columbia River Suspended Particulate Matter (SPM) and a Lake Roosevelt Bottom Sediment Sample off French Point Rocks (mean ± range of duplicate analyses in pg/g, dry; parts per trillion).

Compound	Suspended Particulate Matter	Bottom Sediments
PCDDs:		
2,3,7,8-TCDD	ND(0.8-0.9)	3.5 ± 0.2
1,2,3,7,8,9-HxCDD	ND(0.8-1.1)	2.1*
1,2,3,6,7,8-HxCDD	ND	5.0*
1,2,3,4,6,7,8-HpCDD	11 ± 1	28*
OCDD	74 ± 9	NA
PCDFs:		
2,3,7,8-TCDF	99 ± 22	167 ± 7.5
1,2,3,7,8-PeCDF	1.0 ± 0.1	ND(3.0)
2,3,4,7,8-PeCDF	1.4 ± 0.2	2.8*
1,2,3,4,6,7,8-HpCDF	ND(1.1-1.7)	8.1 ± 2.7
OCDF	4.6 ± 0.7	NA

ND = not detected; detection limit in parenthesis
NA = not analyzed
* = detected in one duplicate only

PCDDs and PCDFs detected in common between bottom sediment and SPM samples were 2,3,7,8-TCDF, 1,2,3,4,6,7,8-HpCDD, and 2,3,4,7,8-PeCDF, the first two compounds being dominant congeners in both media. For these three compounds, concentrations in SPM and bottom sediments agree within a factor of 2, with the higher concentrations occurring in the sediments. Although 2,3,7,8-TCDD was not detected in SPM, it was detected at 3.5 pg/g in the bottom sediments.

REFERENCES:

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Crozier, R. personal communication. Ministry of Environment, Nelson, B.C., 1991.

Johnson, A., D. Serdar, and D. Norton. (in prep.). PCDD/PCDF Trends Through Lake Roosevelt (Columbia River). Washington Department of Ecology, Olympia, WA, 1991.

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

Tetra Tech, Inc. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. prepared for EPA Region 10, Office of Puget Sound, Seattle, 1986.

Tuominen, T. personal communication. Environment Canada, Vancouver, B.C., 1990.

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APPENDIX A

Complete Results of PCDD/PCDF Analysis on Columbia River SPM

ALTA

PCDD & PCDF
EPA METHOD 8290

Sample ID: 418250
Lab ID: 10065-001-SA
Matrix: Sediment

Date Received: 10/25/90
Date Extracted: 10/31/90
Sample Amount: 10.07 g

ICAL ID: I8290CAL
QC Lot: LC1031S
Units: pg/g

Compound	Conc.	D.L.	Ratio	S/N Ratio	Qualifier
2,3,7,8-TCDD	ND	0.77			
Total TCDD	ND	0.77			
1,2,3,7,8-PeCDD	ND	0.51			
Total PeCDD	ND	0.51			
1,2,3,4,7,8-HxCDD	ND	0.87			
1,2,3,6,7,8-HxCDD	ND	0.68			
1,2,3,7,8,9-HxCDD	ND	0.75			
Total HxCDD	ND	2.0			
1,2,3,4,6,7,8-HpCDD	9.7		1.04	>10:1	
Total HpCDD	21		1.04	>10:1	
OCDD	65		0.88	>10:1	B
2,3,7,8-TCDF	88		0.80	>10:1	F
Total TCDF	170		0.77	>10:1	
1,2,3,7,8-PeCDF	1.0		1.44	4:1	
2,3,4,7,8-PeCDF	1.2		1.38	5:1	
Total PeCDF	3.8		1.45	5:1	
1,2,3,4,7,8-HxCDF	ND	0.25			
1,2,3,6,7,8-HxCDF	ND	0.19			
2,3,4,6,7,8-HxCDF	ND	0.22			
1,2,3,7,8,9-HxCDF	ND	0.29			
Total HxCDF	ND	0.29			
1,2,3,4,6,7,8-HpCDF	ND	1.1			
1,2,3,4,7,8,9-HpCDF	ND	0.52			
Total HpCDF	2.8		1.10	9:1	
OCDF	3.9		0.91	>10:1	

Analyst:

Reviewer:

ALTA

PCDD & PCDF
EPA METHOD 8290

Sample ID: 418250
Lab ID: 10065-001-SA

Isotopic Recovery Results

Internal Standard:	% R	Ratio	Qualifier
^{13}C-2,3,7,8-TCDD	83	0.79	
^{13}C-1,2,3,7,8-PeCDD	94	1.57	
^{13}C-1,2,3,6,7,8-HxCDD	79	1.27	
^{13}C-1,2,3,4,6,7,8-HpCDD	71	1.05	
^{13}C-OCDD	65	0.90	
^{13}C-2,3,7,8-TCDF	78	0.80	
^{13}C-1,2,3,7,8-PeCDF	80	1.58	
^{13}C-1,2,3,4,7,8-HxCDF	67	1.27	
^{13}C-1,2,3,4,6,7,8-HpCDF	59	0.45	
Clean-up Recovery Standard:			
^{37}Cl-2,3,7,8-TCDD	77	NA	

Dates Analyzed:

DB-5: 11/08/90 DB-225: 11/12/90 SP-2331: NA

Analyst: [signature] Reviewer: BM

ALTA

PCDD & PCDF
EPA METHOD 8290

Sample ID: 418250DUP
Lab ID: 10065-001-DUP
Matrix: Sediment

Date Received: 10/25/90
Date Extracted: 10/31/90
Sample Amount: 9.99 g

ICAL ID: 18290CAL
QC Lot: LC1031S
Units: pg/g

Compound	Conc.	D.L.	Ratio	S/N Ratio	Qualifier
2,3,7,8-TCDD	ND	0.91			
Total TCDD	ND	0.91			
1,2,3,7,8-PeCDD	ND	0.54			
Total PeCDD	ND	0.54			
1,2,3,4,7,8-HxCDD	ND	1.3			
1,2,3,6,7,8-HxCDD	ND	1.0			
1,2,3,7,8,9-HxCDD	ND	1.1			
Total HxCDD	ND	2.4			
1,2,3,4,6,7,8-HpCDD	12		1.01	>10:1	
Total HpCDD	27		1.05	>10:1	
OCDD	83		0.87	>10:1	B
2,3,7,8-TCDF	110		0.79	>10:1	F
Total TCDF	240		0.76	>10:1	
1,2,3,7,8-PeCDF	1.1		1.53	4:1	
2,3,4,7,8-PeCDF	1.5		1.43	5:1	
Total PeCDF	4.8		1.42	5:1	
1,2,3,4,7,8-HxCDF	ND	0.35			
1,2,3,6,7,8-HxCDF	ND	0.27			
2,3,4,6,7,8-HxCDF	ND	0.32			
1,2,3,7,8,9-HxCDF	ND	0.42			
Total HxCDF	ND	0.42			
1,2,3,4,6,7,8-HpCDF	ND	1.7			
1,2,3,4,7,8,9-HpCDF	ND	0.56			
Total HpCDF	5.5		1.12	9:1	
OCDF	5.3		0.88	>10:1	

Analyst:

Reviewer:

ALTA

PCDD & PCDF
EPA METHOD 8290

Sample ID: 418250DUP
Lab ID: 10065-001-DUP

Isotopic Recovery Results

Internal Standard:	% R	Ratio	Qualifier
^{13}C-2,3,7,8-TCDD	96	0.77	
^{13}C-1,2,3,7,8-PeCDD	107	1.60	
^{13}C-1,2,3,6,7,8-HxCDD	82	1.25	
^{13}C-1,2,3,4,6,7,8-HpCDD	90	1.05	
^{13}C-OCDD	62	0.92	
^{13}C-2,3,7,8-TCDF	81	0.80	
^{13}C-1,2,3,7,8-PeCDF	88	1.57	
^{13}C-1,2,3,4,7,8-HxCDF	72	0.52	
^{13}C-1,2,3,4,6,7,8-HpCDF	59	0.44	
Clean-up Recovery Standard:			
^{37}Cl-2,3,7,8-TCDD	84	NA	

Dates Analyzed:

DB-5: 11/08/90 DB-225: 11/12/90 SP-2331: NA

Analyst: [signature] Reviewer: [signature]

ALTA

PCDD & PCDF
MATRIX SPIKE

Sample ID: 418250MS
Lab ID: 10065-001-MS
Matrix: Sediment

Date Received: 10/25/90
Date Extracted: 10/31/90
Sample Amount: 10.00 g

ICAL ID: I8290CAL
QC LOT: LC1031S
Units: pg/g

COMPOUND	AMOUNT SPIKED	SAMPLE (pg/g)	MS (pg/g)	MS (%)
2,3,7,8-TCDD	20	ND	18.2	91
1,2,3,7,8-PeCDD	20	ND	17.5	88
1,2,3,4,7,8-HxCDD	50	ND	48	96
1,2,3,6,7,8-HxCDD	50	ND	48	96
1,2,3,7,8,9-HxCDD	50	ND	45	90
1,2,3,4,6,7,8-HpCDD	50	12	55	86
OCDD	100	65	144	79
2,3,7,8-TCDF	20	108	131	115
1,2,3,7,8-PeCDF	20	1.6	20	92
2,3,4,7,8-PeCDF	50	1.5	21	98
1,2,3,4,7,8-HxCDF	50	ND	37	74
1,2,3,6,7,8-HxCDF	50	ND	56	112
2,3,4,6,7,8-HxCDF	50	ND	48	96
1,2,3,7,8,9-HxCDF	50	ND	48	96
1,2,3,4,6,7,8-HpCDF	50	1.7	50	100
1,2,3,4,7,8,9-HpCDF	50	ND	58	117
OCDF	100	5.3	97	91

Analyst: [signature]

Reviewer: [signature]

ALTA

PCDD & PCDF
MATRIX SPIKE

Lab ID: 10065-001-MS

Internal Standard Recoveries:

COMPOUND	MS %REC	QUALIFIER
^{13}C-2,3,7,8-TCDD	100	
^{13}C-1,2,3,7,8-PeCDD	111	
^{13}C-1,2,3,6,7,8-HxCDD	87	
^{13}C-1,2,3,4,6,7,8-HpCDD	93	
^{13}C-OCDD	65	
^{13}C-2,3,7,8-TCDF	77	
^{13}C-1,2,3,7,8-PeCDF	89	
^{13}C-1,2,3,4,7,8-HxCDF	95	
^{13}C-1,2,3,4,6,7,8-HpCDF	92	

Clean-up Recovery:

^{37}Cl-2,3,7,8-TCDD	89

Dates Analyzed:

DB-5: 11/08/90 DB-225: 11/12/90 SP-2331: NA

Analyst: [signature] Reviewer: [signature]

ALTA

PCDD & PCDF
EPA METHOD 8290

METHOD BLANK
Lab ID: 10065-001-MB
Matrix: Sediment

Date Received: NA
Date Extracted: 10/31/90
Sample Amount: 10.00 g

ICAL ID: I8290CAL
QC Lot: LC1031S
Units: pg/g

Compound	Conc.	D.L.	Ratio	S/N Ratio	Qualifier
2,3,7,8-TCDD	ND	0.82			
Total TCDD	ND	0.82			
1,2,3,7,8-PeCDD	ND	0.88			
Total PeCDD	ND	0.88			
1,2,3,4,7,8-HxCDD	ND	1.4			
1,2,3,6,7,8-HxCDD	ND	0.89			
1,2,3,7,8,9-HxCDD	ND	0.93			
Total HxCDD	ND	1.4			
1,2,3,4,6,7,8-HpCDD	ND	0.97			
Total HpCDD	ND	2.9			
OCDD	8.9		0.90		C
2,3,7,8-TCDF	ND	0.18			F
Total TCDF	ND	0.54			
1,2,3,7,8-PeCDF	ND	0.81			
2,3,4,7,8-PeCDF	ND	0.81			
Total PeCDF	ND	0.81			
1,2,3,4,7,8-HxCDF	ND	0.27			
1,2,3,6,7,8-HxCDF	ND	0.27			
2,3,4,6,7,8-HxCDF	ND	0.32			
1,2,3,7,8,9-HxCDF	ND	0.39			
Total HxCDF	ND	0.39			
1,2,3,4,6,7,8-HpCDF	ND	0.34			
1,2,3,4,7,8,9-HpCDF	ND	0.45			
Total HpCDF	ND	0.45			
OCDF	ND	0.85			

Analyst: ____

Reviewer: [signature]

ALTA

PCDD & PCDF
EPA METHOD 8290

METHOD BLANK
Lab ID: 10065-001-MB

Isotopic Recovery Results

Internal Standard	% R	Ratio	Qualifier
^{13}C-2,3,7,8-TCDD	98	0.85	
^{13}C-1,2,3,7,8-PeCDD	117	1.57	
^{13}C-1,2,3,4,7,8-HxCDD	90	1.28	
^{13}C-1,2,3,4,6,7,8-HpCDD	79	1.04	
^{13}C-OCDD	67	0.90	
^{13}C-2,3,7,8-TCDF	78	0.80	
^{13}C-1,2,3,7,8-PeCDF	74	1.56	
^{13}C-1,2,3,4,7,8-HxCDF	68	0.52	
^{13}C-1,2,3,4,6,7,8-HpCDF	58	0.44	
Clean-up Recovery Standard:			
^{37}Cl-2,3,7,8-TCDD	84	NA	

Dates Analyzed:

DB-5: 11/08/90 **DB-225:** 11/12/90 **SP-2331:** NA

Centrifuge Blank

TRIANGLE LABORATORIES, INC.
PCDD/PCDF 2378X ANALYSIS (b) 07/18/90

FILE NAME....: S214404 CLIENT ID....: WSDE TLI NUMBER....: 30-116-2
CONCAL.....: S902143 SAMPLE ID....: 168405
ANALYST.....: MC ANALYSIS DATE: 07/08/90 PROJECT NUMBER: 15632
SAMPLE SIZE..: 924.20 ml SAMPLE MATRIX: WATER DATE RECEIVED.: 05/02/90
ICAL DATE....: 06/27/90 SAMPLE ORIGIN: n/a DATE COLLECTED: / /
SPIKE FILE...: SPX2372K SHIPMENT NO...: WEYCO

NAME	CONC(ppt)	NUMBER	DL	EMPC	RATIO	RT	FLAGS
2378-TCDD	ND		0.01				—
12378-PeCDD	ND		0.01				—
123478-HxCDD	ND		0.01				—
123678-HxCDD	ND		0.008				—
123789-HxCDD	ND		0.01				—
1234678-HpCDD	ND		0.02				—
OCDD	0.13				0.80	51:46	B
2378-TCDF	ND		0.005				—
12378-PeCDF	ND		0.01				—
23478-PeCDF	ND		0.01				—
123478-HxCDF	ND		0.008				—
123678-HxCDF	ND		0.005				—
234678-HxCDF	ND		0.01				—
123789-HxCDF	ND		0.01				—
1234678-HpCDF	ND		0.008				—
1234789-HpCDF	ND		0.02				—
OCDF	ND		0.05				—
TOTAL TCDD	ND		0.01				—
TOTAL PeCDD	ND		0.01				—
TOTAL HxCDD	ND		0.01				—
TOTAL HpCDD	ND		0.02				—
TOTAL TCDF	ND		0.005				—
TOTAL PeCDF	ND		0.01				—
TOTAL HxCDF	ND		0.008				—
TOTAL HpCDF	ND		0.01				—

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FILE NAME....:	S214404	CLIENT ID....:	WSDE	TLI NUMBER....:	30-116-2
CONCAL.....:	S902143	SAMPLE ID....:	168405		
ANALYST.....:	MC	ANALYSIS DATE:	07/08/90	PROJECT NUMBER:	15632
SAMPLE SIZE..:	924.20 ml	SAMPLE MATRIX:	WATER	DATE RECEIVED.:	05/02/90
ICAL DATE....:	06/27/90	SAMPLE ORIGIN:	n/a	DATE COLLECTED:	/ /
SPIKE FILE...:	SPX2372K			SHIPMENT NO...:	WEYCO

SURROGATE RECOVERY SUMMARY (TYPE B)

NAME	CONC (ppt)	% REC.	RATIO	RT	FLAGS
37Cl-TCDD	1.9	85.6		31:12	
13C12-PeCDF 234	1.7	78.7	1.57	36:06	
13C12-HxCDF 478	1.5	71.4	0.52	40:13	
13C12-HxCDD 478	2.0	92.3	1.20	41:22	Q
13C12-HpCDF 789	1.7	77.1	0.42	47:02	

ALTERNATE STANDARDS RECOVERY SUMMARY (TYPE B)

NAME	CONC (ppt)	% REC.	RATIO	RT	FLAGS
13C12-HxCDF 789	1.9	85.6	0.51	42:20	
13C12-HxCDF 234	2.0	91.5	0.50	41:10	Q

INTERNAL STANDARDS RECOVERY SUMMARY

NAME	CONC (ppt)	% REC.	RATIO	RT	FLAGS
13C12-2378-TCDF	1.6	71.7	0.78	30:22	
13C12-2378-TCDD	1.5	67.9	0.81	31:11	
13C12-PeCDF 123	1.4	62.5	1.49	35:08	
13C12-PeCDD 123	1.7	78.1	1.48	36:35	
13C12-HxCDF 678	1.2	57.5	0.52	40:23	
13C12-HxCDD 678	1.7	77.6	1.17	41:30	
13C12-HpCDF 678	1.3	58.1	0.42	44:49	
13C12-HpCDD 678	1.4	64.1	1.00	46:21	
13C12-OCDD	0.98	22.5	0.86	51:44	V

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