PROJECT SUMMARY OF THE APRIL 1991 CLASS II INSPECTION AT THE ARCO PETROLEUM PRODUCTS COMPANY CHERRY POINT REFINERY

by
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ABSTRACT

A Class II inspection was conducted on April 8-10, 1991, at the ARCO Petroleum Products Company Cherry Point Refinery (ARCO). Sediments were collected near the ARCO outfall on April 16, 1991, as part of the inspection. Inspection results were within daily maximum and daily average NPDES permit limits. Some differences in Ecology laboratory results and ARCO laboratory results for BOD_5, TSS, COD, and hexavalent chromium were noted. Also, amphipod and echinoderm larvae mortality was observed in the edge of dilution zone sediment and echinoderm larvae mortality was observed in the background sediment.

INTRODUCTION

A Class II inspection was conducted on April 8-10, 1991, at the ARCO Petroleum Products Company Cherry Point Refinery (ARCO). The inspection was conducted by Tapas Das and Marc Heffner of the Ecology Environmental Investigations Compliance Monitoring Unit. Brian Lynch represented ARCO and provided on-site assistance. ENSR Consulting and Engineering (ENSR) was retained by ARCO to accompany Ecology and split samples with Ecology during the inspection. Laurie Ihle represented ENSR.

Sediments were collected near the ARCO outfall on April 16, 1991, as part of the inspection. Bernie Strong, Scott Noble, and Marc Heffner represented Ecology and collected the sediments. Ardea Enterprises, Inc. (Ardea) was retained by ARCO to accompany Ecology

and split samples with Ecology during the sediment sampling. Michael Kyte and Dale Dickinson represented Ardea.

The ARCO Cherry Point Refinery is approximately twelve miles northwest of Bellingham. The facility refines approximately 180,000 barrels of oil per day to produce gasoline, diesel fuel, and other petroleum based products. The plant wastewater discharge is via a single outfall into the Strait of Georgia. The discharge includes treated process wastewater, stormwater that is treated as necessary, and treated sanitary wastewater. The discharge is regulated by NPDES permit WA-002290-0, which was issued on March 1, 1990, and expires March 1, 1995.

The inspection was designed to focus on the wastewater treatment system and receiving water sediments. Specific objectives included:

1. verify NPDES permit self monitoring;

2. assess effluent toxicity with bioassays and pollutant scans;

3. assess secondary wastewater treatment plant loading and treatment efficiency; and

4. assess receiving water sediments with bioassays and chemical analyses.

PROCEDURES

Ecology collected composite and grab samples of secondary influent (after the API separator), trickling filter effluent, settled stormwater, and final effluent. Ecology Isco composite samplers were set up to collect equal volumes of sample every 30 minutes for 24 hours. Sampler configurations and locations are summarized in Appendix A.

ARCO also collected an effluent composite sample. The sampler was set to collect equal volumes of sample every 15 minutes for 24 hours.

All composite samples were split and all grab samples taken in pairs for Ecology and ARCO analysis. Samples collected, sampling times and parameters analyzed are summarized in Appendix B.

Receiving water sediments were collected by Ecology with a 0.1 m^2 van Veen grab sampler at two stations; one at a background site and near the edge of the dilution zone (Appendix A). Sediment collection at a third station near the outfall was unsuccessfully attempted. Dale Dickinson accompanied Ecology in the Ardea boat to help locate station positions. At each station, the top two centimeters of sample from successive grab samples were collected. VOA bottles for Ecology and ARCO analysis were filled from the first grab. The remainder of the first grab and subsequent grabs were put in a two gallon stainless steel bucket. When the bucket was full, the contents of the bucket were homogenized and put in

appropriate containers for Ecology analysis. One additional grab was collected and added to the bucket. The contents of the bucket were homogenized and put in appropriate containers for ARCO analysis. Samples collected, sampling times and parameters analyzed are summarized in Appendix B.

Samples for Ecology analysis were placed on ice and delivered to the Ecology Manchester Laboratory. Analytical procedures and laboratories doing the analysis are summarized in Appendix C.

Samples for ARCO analysis were handled in one of two ways. NPDES permit parameters were analyzed by or for ARCO as is typically done for self-monitoring (Appendix B). Additional parameters were analyzed by contract labs and the results were included in an ENSR report for ARCO (ENSR, 1991).

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Sampling

Water and sampling quality assurance/quality control (QA/QC) steps included priority pollutant cleaning all sampling equipment, including the composite samplers, prior to the inspection. Also, a field transfer/equipment blank was collected prior to sampling. The QA/QC procedures are summarized in Appendix D.

Sediment sampling QA/QC steps included collecting only sediment not in direct contact with the sampler and pre-inspection priority pollutant cleaning of equipment that would contact the samples (Appendix D).

Field chain of custody was maintained on all samples.

General Chemistry Analysis

Holding times, duplicate analysis results, spike recoveries, and check standard results met Ecology quality standards for most general chemistry parameters. Weak and dissociable cyanide and phenolics analysis of sediment samples had low spike recoveries. Total cyanide and phenolics analysis of sediment samples were done after the recommended holding time had been exceeded. Total-P and phenolics analysis of water samples were done after the recommended holding time had been exceeded. A "J" qualifier (J = estimated value) is attached to sediment total cyanide data, sediment weak and dissociable cyanide, water Total-P data, and all phenolics data.

Priority Pollutant Organics Analysis

Holding times, method blanks, surrogate recoveries, and matrix spike and spike duplicate data met Ecology standards for data use without further qualification.

Priority Pollutant Metals Analysis

Holding times, method blanks, laboratory control sample data, and matrix spike and spike duplicate data met Ecology standards for data use without further qualification, with one exception. Selenium spike duplicate results for the water sample analyzed (22%) were slightly greater than target limits (+/-20%): all water sample selenium results are qualified with an "N" qualifier (N = value not within control limits).

Bioassays

Control results, reference toxicant results, and test solution chemistry data (dissolved oxygen, pH, etc. as applicable) were acceptable for all organisms tested.

RESULTS AND SUMMARY

Results are presented in relation to the inspection objectives.

Objective 1 - Verify NPDES permit self monitoring

Table 1 NPDES Permit Limits/Inspection Results Comparison

- inspection results were within daily maximum and daily average permit limits

Table 2 Split Sample Results Comparison for Permit Parameters

- There were serious differences in the Ecology laboratory and ARCO laboratory results for some of the BOD_5, COD, and TSS split sample results. There was also some variability in hexavalent chromium results.

- split sample results for the other parameters look reasonable

Objective 2 - Assess effluent toxicity with bioassays and pollutant scans

Table 3 Ecology Effluent Bioassay Results

- No significant toxicity was noted in:
  Daphnia magna - survival test
  Echinoderm sperm cell - fertilization test
  Rainbow trout - survival test
  Sheepshead minnow - survival portion of test

- Toxicity was noted as follows:
  Bivalve larvae (acute and chronic NOEC = 35% effluent)
  Fathead minnow (acute NOEC = 50% effluent)
  Sheepshead minnow (chronic NOEC = 50% effluent)

- Erratic rainbow trout behavior was noted in the 100% effluent sample at test termination

Table 4 Comparison of Ecology and ARCO Effluent Bioassay Results

- ARCO and Ecology results were similar. ARCO found end points to occur at slightly lower effluent concentrations in the bivalve larvae and echinoderm sperm cell bioassays.

Table 5 Organic Compounds Detected by Ecology and Comparison with EPA Water Quality Criteria

- The BTEX compounds and 2-butanone (MEK) were the organics detected at the highest concentrations in the influent sample.

- Organics were removed from the wastewater by the treatment process. No measurements were made to determine if the losses were due to compound destruction, volatilization, or attachment to sludge.

- Only two compounds were detected in the effluent; both at estimated concentrations.

- In the effluent, all concentrations were less than Water Quality Criteria (EPA, 1986).

- A complete listing of parameters analyzed by Ecology and analytical results is included in Appendix E. Tentatively identified compounds (TICs) are noted in Appendix F.

Table 6 Comparison of Organic Compounds Detected by Ecology and ARCO Analysis of Water Samples

- ARCO results and Ecology results are similar

Table 7 Metals Scan Results

- There were some differences in Ecology and ARCO cadmium, selenium, and hexavalent chromium analytical results. Most other Ecology and ARCO results compare well.

- Ecology had high detection limits for arsenic and copper.

Table 8 Comparison of Effluent Metals Concentrations to EPA Water Quality Criteria

- Concentrations of several metals exceeded one or more of the EPA toxicity criteria (EPA, 1986).

Objective 3 - Assess secondary wastewater treatment plant loading and treatment efficiency.

Table 9 Ecology Laboratory General Chemistry Results

Influent
- TSS low (34 mg/L)
- BOD_5 moderate (220 mg/L)
- TS high (5930 mg/L)

Trickling Filter
- No net BOD_5 reduction
- TSS had increased (97 mg/L)
- May serve as a selector for the activated sludge system

Stormwater
- BOD_5, COD, and TOC concentrations are similar to final effluent concentrations
- TSS concentration greater than final effluent concentration

Effluent
- Low BOD_5 (<10 mg/L)
- Low TSS (14-19 mg/L)
- Cyanide, total phenolics, and oil and grease concentrations less than influent concentrations
- Nutrient concentrations roughly the same through the treatment process (some reduction in total-P)

Table 10 Organic Compound Removal by the Trickling Filter

- VOA compound concentrations reduced 44-85%
- BNA compound concentrations reduced 6-53%
- No measurements were made to determine if the losses were due to compound destruction or volatilization.

Objective 4 - Assess receiving water sediments with bioassays and chemical analysis

Table 11 Ecology Sediment Bioassay Results

- Significant amphipod mortality was observed in the Sed-2 (edge dilution) sample.

- Nearly complete echinoderm larvae mortality was observed in the Sed-1 (background) and Sed-2 (edge dilution) samples.

- Worms and sea anemones were observed in the sediments during collection.

- A sediment sample near the outfall could not be collected (see Appendix A).

Table 12 Comparison of Ecology and ARCO Sediment Bioassay Results

- ARCO found no amphipod mortality in either sample - Ecology found mortality in the Sed-2 (edge dilution) sample.

- ARCO did not do an echinoderm larvae test.

Table 13 Comparison of Ecology and ARCO Sediment Results with Marine Sediment Criteria

- Ecology detected some toluene, ethylbenzene, and total xylenes in the Sed-1 (background) sample. There are no Ecology Marine Sediment Standards for these compounds (Ecology, 1991). Other Ecology and ARCO VOA results were similar.

- Ecology and ARCO BNA, pesticide/PCB, and metals results were similar. All detected organics were estimated concentrations.

- One compound (at an estimated concentration) in Sed-1 (background) was the only compound in the sediment samples exceeding Ecology Marine Sediment Standards (Ecology, 1991).

- A complete listing of parameters analyzed by Ecology and analytical results is included in Appendix E. Tentatively identified compounds (TICs) are noted in Appendix F.

RECOMMENDATIONS

- Differences in Ecology laboratory results and ARCO laboratory results for BOD_5, TSS, COD, and hexavalent chromium were noted. In some cases, these differences were substantial. Sample splits should be made during future inspections to determine if differences commonly occur and corrective action is necessary. The Ecology Quality Assurance Section may provide useful information for a corrective action strategy.

- Bivalve larvae, fathead minnow, and sheepshead minnow bioassays should be considered when selecting sensitive species for routine testing.

- The amphipod and echinoderm larvae mortality observed in the sediments should be investigated.

REFERENCES

Ecology, 1991. Sediment Management Standards, Chapter 173-204 WAC. Washington State Department of Ecology, April, 1991.

ENSR, 1991. Chemical and Bioassay Test Results - Enhanced Class II Inspection - April, 1991. ARCO Products Company Cherry Point Refinery - Blaine, Washington, October, 1991.

EPA, 1986. Quality Criteria for Water, EPA 440/5-86-001. U.S. Environmental Protection Agency.

Noble, Scott, 1991. ARCO Class II Results of Salmonid Bioassay, memo to Marc Heffner. Washington State Department of Ecology, May 24, 1991.

Table 1 – NPDES Permit Limits/Inspection Results Comparison – ARCO, April 1991.

	Effluent Limits								
			Location:	Ef-1	Ef-2	Ef-3	Ef-4	Ef-arco
			Type:	Grab	Grab	Comp	H-Comp	Comp
			Date:	4/9	4/9	4/9	4/9	4/9
			Time:	1055	1440	***	**	***
			Lab Log #:	158140	158141	158142	158143	158144
	Daily Average	Daily Maximum	Laboratory					
BOD5 (lbs/day)	1190	2140	Ecology			<314		<314
			ARCO			470		423
COD (lbs/day)	8240	16,500	Ecology			1568		1662
			ARCO			2665		2665
TSS (lbs/day)	950	1540	Ecology			439		564
			ARCO			815		878
Oil and Grease (lbs/day)	350	650	Ecology	50	<31			
			ARCO	138	122			
Total Phenolics (lbs/day)	7.1	16.5	Ecology			0.6J		0.3J
			ARCO			<3		3.1
NH3-N (lbs/day)	830	1790	Ecology			176		R
			ARCO			229		232
Sulfide (lbs/day)	6.4	14.1	Ecology	<3	<3			
			ARCO	<3	<3			
Total Chromium (lbs/day)	11.9	27	Ecology			1.6		2.2
			ARCO			<1.6		1.9
Hexavalent Chromium (lbs/day)	0.9	1.9	Ecology			0.6		0.6
			ARCO			<0.6		0.6
pH	within range of 6.0 to 9.0		Ecology	8.1	8.0			
			ARCO	7.9	7.8			
F-Coliform (#/100mL)	200	400	Ecology	6H	17H			
			ARCO	++	++			
Chlorine (mg/L)	—	1.0	Ecology	<0.1	<0.1			
			ARCO	0.04	0.04			
Salmonid Bioassay (% survival)	80% survival in min. of 65% effluent		Ecology				100	
			ARCO				100	
Flow (MGD)	—	—				3.76 *		3.76 *

Ef Final effluent sample
* Flow rate provided by ARCO
** Equal volumes collected with the 1055 and 1440 grab samples
*** Composite samples were collected from midnight to midnight
++ Test invalidated due to contamination by foreign organisms
— No limit
H Exceeded holding time requirements
J The analyte was positively identified. The associated numerical result is and estimate.
R Sampling or analytical error resulted in unusable data.

Table 2 – Split Sample Results Comparison for Permit Parameters – ARCO, April 1991.

	Location:	Inf-1	Inf-2	Inf-3	Tf-ef-1	Tf-ef-2	Tf-ef-3	Strm-3	Ef-1	Ef-2	Ef-3	Ef-arco
	Type:	Grab	Grab	Comp	Grab	Grab	Comp	Grab	Grab	Grab	Comp	Comp
	Date:	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9
	Time:	1155	1605	***	1225	1510	***	1705	1055	1440	***	***
	Lab Log #:	158131	158132	158133	158134	158135	158136	158139	158140	158141	158142	158144
Parameter	Laboratory *											
BOD5 (mg/L)	Ecology			220			220	<10			<10	<10
	ARCO			18			25	3			15	13.5
COD (mg/L)	Ecology			420			330	35			50	53
	ARCO			887			699	102			85	85
TSS (mg/L)	Ecology			34			97	60			14	18
	ARCO			87			68	89			26	28
Oil and Grease (mg/L)	Ecology	32	19		30	26		<1	1.6	<1		
	ARCO	45	24		53	27		4.4	4.4	3.9		
Total Phenolics (mg/L)	Ecology			5.9 J			3.9J	0.01J			0.02J	<0.01J
	ARCO			4.1			3.0	0.1			<0.1	0.1
NH3-N (mg/L)	Ecology			3.5			4.7	1.7			5.6	R
	ARCO			4.3			5.8	2.4			7.3	7.4
Sulfide (mg/L)	Ecology	<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	<0.1		
	ARCO	<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	<0.1		
Total Chromium (mg/L)	Ecology			0.53			0.70	0.06			0.05	0.07
	ARCO			0.53			0.28	0.04			<0.05	0.06
Hexavalent	Ecology			0.121			0.173	0.022	0.016	0.046	0.019	0.018
Chromium (mg/L)	ARCO			<0.02			<0.02	<0.02	<0.02	<0.02	<0.02	0.02
F-Coliform(#/100mL)	Ecology								6 H	17 H		
	ARCO								++	++		
Chlorine (mg/L)	Ecology								<0.1	<0.1		
	ARCO								0.04	0.04		
pH	Ecology		7.6		7.6	7.6			8.1	8.0		
	ARCO		7.5		7.5	7.4			7.9	7.8		
Temperature (C)	Ecology	28.0	30.6		29.3	29.7			15.7	16.3		
	ARCO	35.6	36.7		32.8	33.9			15.6	16.1		

Inf – Influent sample
Tf-ef – Trickling filter effluent sample
Ef – Final effluent sample
*** Composite samples were collected from midnight to midnight
R – Sampling or analytical error resulted in unusable data

++ Test invalidated due to contamination by foreign organisms
J – The analyte was positively identified. The associated numerical result is an estimate.
H – Exceeded holding time requirements
* ARCO lab analysis done by the ARCO laboratory or, if parameter analysis is usually contracted out, by the usual contract laboratory

Table 3 – Ecology Effluent Bioassay Results – ARCO, April, 1991

NOTE: All tests were run on the effluent (Ef-4 sample - lab log # 158143)

Daphnia magna - 48 hour survival test
(Daphnia magna)

Sample	# Tested*	Percent Survival
Control	20	100
25 % Effluent	20	100
50 % Effluent	20	100
100 % Effluent	20	100

LC50 = >100 % effluent
LOEC = >100 % effluent

* 4 replicates of 5 organisms each

Bivalve Larvae - 48 hour survival and development test
Pacific oyster *(Crassostrea gigas)*

	Effluent		Brine Control ***	
Sample **	Average % Mortality *	Average % Abnormal and Dead *	Average % Mortality	Average % Abnormal and Dead
Seawater Control	-0.6	1.3		
4.4 % Solution	8.9	9.8	9.7	11.0
8.75 % Solution	8.9	9.1	17.4	18.1
17.5 % Solution	4.9	5.0	19.4	20.6
35 % Solution	1.2	2.8	-4.5	-2.6
70 % Solution	26.2 +	98.5 +	18.1	18.7

Acute	Chronic
LC50 = >70 % effluent	EC50 = 48.3% effluent
NOEC = 35 % effluent	NOEC = 35 % effluent
LOEC = 70 % effluent	LOEC = 70 % effluent

* Average of 3 replicates – effluent data adjusted using control results
** salinity for effluent and brine control tests adjusted with concentrated brine solution
*** 4.5 ppt seawater substituted for effluent
\+ Result significantly different (p=0.05) from the control

Echinoderm Sperm Cell Fertilization Test
(Strongylocentrotus purpuratus)

Sample Concentration **	% Fertilized Eggs *
Lab Water Control	81.3
Brine control ***	74.3
3.1 % Sample	88.3
6.2 % Sample	80.5
12.5 % Sample	86.5
25 % Sample	80.5
50 % Sample	78.0

NOEC = >50 % effluent

* Average of 4 replicates
** Salinity adjusted with concentrated brine
*** Brine control prepared with concentrated brine and deionized water

Table 3 (cont'd) – Ecology Effluent Bioassay Results – ARCO, April, 1991

Fathead Minnow – 48 hour survival test
(Pimephales promelas)

Sample	# Tested *	Percent Survival
Control	30	100
1.56 % Effluent	30	100
3.12 % Effluent	30	100
6.25 % Effluent	30	100
12.5 % Effluent	30	100
25 % Effluent	30	100
50 % Effluent	30	100
100 % Effluent	30	50

NOEC = 50 % effluent
LC50 = 100 % effluent

* 3 replicates of 10 organisms each

Rainbow Trout – 96 hour survival test
(Oncorhynchus mykiss)

Sample	# Tested	Percent Survival
Control	28	100
65% Effluent	30	100
100% Effluent	30	97 *

* Several fish in 100% concentration were stressed at test termination—erratic swimming and standing on head (Noble, 1991).

Sheepshead Minnow – 7 day survival and growth test
(Cyprinodon variegatus)

Sample *+	# Tested *	Percent Survival	Average Weight per Fish (mg)
Control	40	100	1.99
ASW **	40	100	2.29
Brine Control *	40	100	1.84
6.25 % Effluent	40	100	1.92
12.5 % Effluent	40	100	2.02
25 % Effluent	40	100	2.01
50 % Effluent	40	100	2.10
100 % Effluent	40	98	1.60

Acute	Chronic
LOEC = >100 % effluent	NOEC = 50 % effluent
LC50 = >100 % effluent	LOEC = 100 % effluent

* 4 replicates of 10 organisms each
** ASW stands for Artificial Sea Water–made by dissolving sea salts in deionized water
*** the brine control was made by diluting concentrated brine with deionized water
*+ 100% effluent salinity adjusted with sea salts: other concentrations salinity adjusted with concentrated brine

NOEC – no observable effects concentration
LOEC – lowest observable effects concentration
LC50 – lethal concentration for 50% of the organisms
EC50 – effect concentration for 50% of the organisms

Table 4 – Comparison of Ecology and ARCO Effluent Bioassay Results – ARCO, April, 1991

Species	Test Duration	End Point	RESULTS	
			Ecology	ARCO *
Daphnia magna	48 hr	LC50	>100% effluent	>100% effluent
Bivalve Larvae				
survival	48 hr	LC50	>70% effluent	62% effluent
development	48 hr	NOEC	35% effluent	12.5% effluent
Echinoderm Sperm Cell	20 min	NOEC	>50% effluent	50% effluent
Fathead Minnow	48 hr	LC50	100% effluent	>100% effluent
Sheepshead Minnow				
survival	7 day	LC50	>100% effluent	>100% effluent
growth	7 day	NOEC	50% effluent	50% effluent
Rainbow Trout	96 hr	% survival in 65% effluent	100%	100%
		% survival in 100% effluent	97%	100%

* ARCO analysis by contract lab (ENSR, 1991)

Table 5 – Organic Compounds Detected by Ecology and Comparison with EPA Water Quality Criteria – ARCO, April 1991

	Location:	INF-1	INF-2	TF-EF-1	TF-EF-2	STRM-3	EF-1	EF-2	EPA Water Quality Criteria (EPA, 1986)			
	Type:	Grab	Grab	Grab	Grab	Grab	Grab	Grab				
	Date:	4/9	4/9	4/9	4/9	4/9	4/9	4/9				
	Time:	1155	1605	1225	1510	1705	1055	1440	Acute Fresh	Chronic Fresh	Acute Marine	Chronic Marine
	Lab Log#:	158131	158132	158134	158135	158139	158140	158141				
(Group)	**VOA Compounds**	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
	2-Butanone (MEK)	500 U	17000	500 U	2500 U	10 U	10 U	10 U				
	Benzene	14000 D	28000	4700	10000	11	5 U	5 U	5,300 *		5,100 *	700 *
	Toluene	20000 D	77000 D	7400	24000	29	4 J	5 U	17,500 *		6,300 *	5,000 *
	Ethylbenzene	1800	16000	590	2500	4 J	5 U	5 U	32,000 *		430 *	
	Total Xylenes	12000 D	83000 D	6700	21000	51	5 U	5 U				

	Location:	INF-3	TF-EF-3	STRM-3	EF-3	EPA Water Quality Criteria (EPA, 1986)			
	Type:	Comp	Comp	Grab	Comp				
	Date:	4/9	4/9	4/9	4/9				
	Time:	***	***	1705	***	Acute Fresh	Chronic Fresh	Acute Marine	Chronic Marine
	Lab Log#:	158133	158136	158139	158142				
	BNA Compounds	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
	Phenol	1900 D	1000 D	10 U	10 U	10,200 *	2,560 *	5,800 *	
	2-Methylphenol	1000 D	770 D	10 U	10 U				
	4-Methylphenol	540 D	400 D	10 U	10 U				
	2,4-Dimethylphenol	980 D	920 D	10 U	10 U	2,120 *			
n	Naphthalene	530 D	250 D	10 U	10 U	2,300 *	620 *	2,350 *	
	2-Methylnaphthalene	510 D	320 D	10 U	10 U				
n	Fluorene	33 DJ	26 DJ	10 U	10 U			300 *(n)	
n	Phenanthrene	66 DJ	56 DJ	10 U	10 U			300 *(n)	
i	Bis(2-Ethylhexyl)Phthalate	100 U	100 U	10 U	6 J	940 *(i)	3 *(i)	2,944 *(i)	3.4 *(i)

INF Influent sample
TF-EF Trickling filter effluent sample
STRM Stormwater sample
EF Final effluent sample
*** Composite samples were collected from midnight to midnight
U The analyte was not detected at or above the reported result
D The result was derived from an analysis of a sample that required a secondary dilution
J The analyte was positively identified. The associated numerical result is an estimate
* Insufficient data to develop criteria. Value presented is the LOEL-Lowest Observed Effects Level.
i Total Phthalate Esters
n Total Polynuclear Aromatic Hydrocarbons
(i) Phthalate Esters criteria
(n) Polynuclear Aromatic Hydrocarbons criteria

Table 6 – Comparison of Organic Compounds Detected by Ecology and ARCO Analysis of Water Samples – ARCO, April 1991

Location:	INF-1		INF-2		TF-EF-1		TF-EF-2		STRM-3		EF-1		EF-2	
Type:	Grab		Grab		Grab		Grab		Grab		Grab		Grab	
Date:	4/9		4/9		4/9		4/9		4/9		4/9		4/9	
Time:	1155		1605		1225		1510		1705		1055		1440	
Lab:	Ecology	ARCO *	Ecology	ARCO *	Ecology	ARCO *	Ecology	ARCO *	Ecology	ARCO *	Ecology	ARCO *	Ecology	ARCO *
VOA Compounds	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
Acetone	500 U	1100	2500 U	1100	500 U	760 J	2500 U	1200	10 U	4 J	10 U	10 U	10 U	10 U
2-Butanone (MEK)	500 U	1000 U	17000	1000 U	500 U	1000 U	2500 U	1000 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzene	14000 D	9100	28000	19000	4700	3300	10000	8400	11	7	5 U	5 U	5 U	5 U
Toluene	20000 D	14000	77000 D	47000 D	7400	4900	24000	19000	29	37	4 J	3 J	5 U	2 J
Ethylbenzene	1800	1100	16000	5500	590	410 J	2500	1900	4 J	2 J	5 U	5 U	5 U	5 U
Total Xylenes	12000 D	5300	83000 D	27000	6700	2600	21000	11000	51	23	5 U	2 J	5 U	1 J

Location:	INF-3		TF-EF-3		STRM-3		EF-3	
Type:	Comp		Comp		Grab		Comp	
Date:	4/9		4/9		4/9		4/9	
Time:	***		***		1705		***	
Lab:	Ecology	ARCO *	Ecology	ARCO *	Ecology	ARCO *	Ecology	ARCO *
BNA Compounds	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)
Phenol	1900 D	2000 D	1000 D	1500 D	10 U	10 U	10 U	3 J
Benzyl Alcohol	100 U	34	100 U	40	10 U	10 U	10 U	10 U
2-Methylphenol	1000 D	1000 D	770 D	960 D	10 U	10 U	10 U	10 U
4-Methylphenol	540 D	1200 D	400 D	1000 D	10 U	10 U	10 U	2 J
2,4-Dimethylphenol	980 D	990 D	920 D	990 D	10 U	10 U	10 U	10 U
Naphthalene	530 D	520 D	250 D	250	10 U	10 U	10 U	10 U
2-Methylnaphthalene	510 D	520 D	320 D	310	10 U	10 U	10 U	10 U
Dibenzofuran	100 U	18	100 U	18 J	10 U	10 U	10 U	10 U
Fluorene	33 DJ	28	26 DJ	28	10 U	10 U	10 U	10 U
Phenanthrene	66 DJ	31	56 DJ	32	10 U	10 U	10 U	10 U
Pyrene	100 U	4 J	100 U	7 J	10 U	10 U	10 U	10 U
Chrysene	100 U	4 J	100 U	6 J	10 U	10 U	10 U	10 U
Bis(2-Ethylhexyl)Phthalate	100 U	2 J	100 U	20 U	10 U	10 U	6 J	10 U
Pesticides/PCBs								
Endrin	0.10 U	0.09	0.10 U	0.12 U				
4,4'-DDE	0.10 U	0.04 U	0.10 U	0.15				

INF Influent sample
TF-EF Trickling filter effluent sample
STRM Stormwater sample
EF Final effluent sample
* ARCO analysis by contract lab (ENSR, 1991)
*** Composite samples were collected from midnight to midnight

U The analyte was not detected at or above the reported result.
J The analyte was positively identified. The associated numerical result is an estimate.
D The result was derived from an analysis of a sample that required a secondary dilution
☐ Compound detected

Table 7 – Metals Scan Results – ARCO, April 1991

Location:	Trns Blk	INF-3		TF-EF-3		STRM-3		EF-1	EF-2	EF-3		EF-ARCO	SED-1	SED-2
Type:	Grab	Comp		Comp		Grab		Grab	Grab	Comp		Comp	Bkgrd	Edge Dil
Date:	4/8	4/9		4/9		4/9		4/9	4/9	4/9		4/9	4/16	4/16
Time:	1545	***		***		1705		1055	1440	***		***	1520–1630	1730–1845
Lab Log#:	158130	158133		158136		158139		158140	158141	158142		158144	168145	168146
Laboratory:	Ecology	Ecology	ARCO +	Ecology	ARCO +	Ecology	ARCO +	Ecology	Ecology	Ecology	ARCO +	Ecology	Ecology	Ecology
Metals*	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(mg/Kg**)	(mg/Kg**)
Antimony	60	60 U	40 U	60 U	40 U	60 U	40 U			60 U	40 U	60 U	2.3 U	2.9 U
Arsenic	1 U	100 U	4.0 U	100 U	4.0 U	10 U	3.6			100 U	2.4	100 U	1.3	1.9
Beryllium	5 U	5 U	4.1	5 U	4.7	5 U	1.0 U			5 U	1.2	5 U	0.19 U	0.24 U
Cadmium	5 U	104	5.0 U	6 U	5.0 U	5 U	5.0 U			58	5.0 U	66	3.2	2.8
Chromium	10 U	590	623	780	615	60	20.1			60	54	60	18	21
Chromium (Total)	10 U	530	530	700	280	60	40			50	50 U	70		
Chromium (Hexavalent)	5	121	20 U	173	20 U	22	20 U	16 ++	46 ++	19	20 U	18		
Copper	25 U	25 U	14.9	25 U	14.9	25 U	17.3			25 U	5.0 U	25 U	7.3	9.3
Copper – Dissolved	5 U	20	5.2	17	5.0 U	5 U	7.3			12	5.5			
Lead	5 U	6	19.5	8	22.4	8	6.8			5 U	3.0 U	5 U	0.31	2.5
Mercury	0.2 U	0.9	0.20 U	0.4	0.25	0.2 U	0.20 U			0.2 U	0.20 U	0.7	0.014	0.1 U
Nickel	5 U	167	200	187	213	48	36.4			74	81.8	72	14	16
Selenium	5 NU	50 NU	192	50 NU	193	5 NU	3.5			50 NU	119	50 NU	0.19 U	0.24 U
Silver	10 U	10 U	10 U	10 U	10 U	10 U	10 U			10 U	10 U	10 U	0.38	0.48 U
Thallium	10 U	10	11.8	10 U	10.5	10 U	2.0 U			10 U	10 U	10 U	0.38 U	0.38 U
Zinc	20 U	330	359	400	385	170	167			70	65.4	110	32	42

Trns Blk Transfer blank
INF Influent sample
TF–EF Trickling filter effluent sample
STRM Stormwater sample
EF Final effluent sample
SED Marine sediment sample
* Total Recoverable Metals unless otherwise noted
** Total Metals based on dry weight
*** Composite samples were collected from midnight to midnight
U The analyte was not detected at or above the reported result.
N Spiked sample recovery not within control limits
\+ Total Cr and Hex Cr were analyzed by the in-house or contract lab typically doing the analysis. Other ARCO analysis by contract lab (ENSR, 1991).
++ ARCO result – 20 U

Table 8 – Comparison of Effluent Metals Concentrations to EPA Water Quality Criteria – ARCO, April 1991.

Location:	EF-3		EF-ARCO		EPA Water Quality Criteria (EPA, 1986)			
Type:	Comp		Comp					
Date:	4/9		4/9					
Time:	***		***		Fresh Acute	Fresh Chronic	Marine Acute	Marine Chronic
Lab Log#:	158142		158144					
Laboratory:	Ecology	ARCO +	Ecology					
Metals*	(ug/L)	(ug/L)	(ug/L)		(ug/L)	(ug/L)	(ug/L)	(ug/L)
Antimony	60 U	40 U	60 U		9,000 **	1,600 **	–	–
Arsenic	100 U	2.4	100 U		360	190	69	36
Beryllium	5 U	1.2	5 U		130 **	5.3 **	–	–
Cadmium	58	5.0 U	66		7.1 ++	1.7 ++	43	9.3
Chromium (Total)	50		70					
Chromium (Trivalent)					2,700 ++	320 ++	–	–
Chromium (Hexavalent)	19		18		16	11	1,100	50
Copper	25 U	5.0 U	25 U		29 ++	19 ++	2.9	–
Copper – Dissolved	12	5.5						
Lead	5 U	3.0 U	5 U		160 ++	6.3 ++	140	5.6
Mercury	0.2 U	0.20 U	0.7		2.4	0.012	2.1	0.025
Nickel	74	81.8	72		2200 ++	250 ++	75	8.3
Selenium	50 NU	119	50 NU		260	35	410	54
Silver	10 U	10 U	10 U		10 ++	0.12	2.3	–
Thallium	10 U	10 U	10 U		1,400 **	40 **	2,130 **	–
Zinc	70	65.4	110		183 ++	166 ++	95	86

EF Final effluent sample
* Total Recoverable Metals unless otherwise indicated
** Insufficient data to develop criteria. Value presented is LOEL – Lowest Observed Effects Level.
*** Composite samples were collected from midnight to midnight
☐ Concentration exceeds one or more water quality criteria.
U The analyte was not detected at or above the reported result.
N Spiked sample recovery not within control limits
– Data not available to develop criterion
\+ Total Cr and Hex Cr were analyzed by the in-house or contract lab typically doing the analysis. Other ARCO analysis by contract lab (ENSR, 1991).
++ Hardness dependent criterion. Based on hardness of 170 mg/L $CaCO_3$

Table 9 – Ecology Laboratory General Chemistry Results – ARCO, April 1991.

Location:	Trns Blk	Inf-1	Inf-2	Inf-3	Tf-ef-1	Tf-ef-2	Tf-ef-3	Strm-3	Ef-1	Ef-2	Ef-3	Ef-4	Ef-arco	Sed-1	Sed-2
Type:	Grab	Grab	Grab	Comp	Grab	Grab	Comp	Grab	Grab	Grab	Comp	Gr-comp	Comp	Bkgrd	Edge Dil
Date:	4/8	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/16	4/16
Time:	1545	1155	1605	***	1225	1510	***	1705	1055	1440	***	*+*	***	1520-1630	1730-1845
Lab Log #:	158130	158131	158132	158133	158134	158135	158136	158139	158140	158141	158142	158143	158144	168145	168146
LABORATORY ANALYSIS															
Conductivity (umhos/cm)				7620			7440	439			5480	5530	5510		
Alkalinity (mg/L CaCO3)				420			374	38.5			322		321		
Hardness (mg/L CaCO3)				156			154	50.4			170	162	168		
TS (mg/L)				5930			5650	394			4070		4090		
TNVS (mg/L)				5680			5370	316			3870		3830		
TSS (mg/L)				34			97	60			14	13	18		
TNVSS (mg/L)				22			44	63			12		26		
% Solids														67.0	58.5
% Volatile Solids														2.6	4.3
BOD5 (mg/L)				220			220	< 10			< 10		< 10		
COD (mg/L)				420			330	35			50		53		
TOC (mg/L)				124			122	15.1			22.5		24.8		
TOC (% dr wt)														0.65	1.3
NH3-N (mg/L)				3.47			4.7	1.72			5.57		0.046		
NO2+NO3-N (mg/L)				0.673			0.273	0.341			0.103		0.103		
Phosphorous – Total (mg/L)				2.72J			2.27J	0.209J			0.525J		0.499J		
Oil and Grease (mg/L)		32	19		30	26		<1	1.6	<1					
Oil and Grease (mg/Kg – wet wt)														104	80
F-Coliform MF (#/100 mL)									6H	17H					
F-Coliform MPN (#/100 mL)									<20 H	40 H					
Cyanide (total – ug/L)	<5	828	699	640	843	853	567	<5	8	13	8				
Cyanide (wk & dis – ug/L)	<5	559	371	428	510	430	406	<5	<5	<5	<5				
Cyanide (total mg/Kg – wet wt)														0.054 J	0.048 J
Cyanide (wk & dis mg/Kg – wet wt)														0.040 J	0.037 J
Phenolics – Total (mg/L)	<0.005J			5.91J			3.88J	0.013J			0.015J		<0.005J		
Phenolics – Total (mg/Kg – wet wt)														<0.10 J	<0.10 J
Grain Size (%)															
gravel (+10 mesh)														0	3
sand (20-230 mesh)														71	57
silt (5-8 phi)														21	28
clay (9-12 phi)														8	12
FIELD OBSERVATIONS															
Temperature (C)		28.0	30.6		29.3	29.7		11.1	15.7	16.3					
Temperature – cooled (C)				3.2			4.8				3.2				
pH		7.9	7.6	9.2	7.6	7.6	8.8	7.7	8.1	8.0	8.3				
Conductivity (umhos/cm)		6900	5870	6510	6640	6900	6170	380	4840	5170	5010				
Sulfide (mg/L)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Chlorine (mg/L)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				

Trns Blk – Transfer blank
Inf – Influent sample
Tf-ef – Trickling filter effluent sample
Strm – Stormwater sample
Ef – Final effluent sample

Sed – Marine sediment sample
Gr-comp – grab composite sample
Comp – composite sample
Ef-arco – composite sample collected by ARCO

*** Composite samples were collected from midnight to midnight
+ Equal volumes collected with the 1055 and 1440 grab samples
J – The analyte was positively identified. The associated numerical result is an estimate.
H – Exceeded holding time requirements

Table 10 – Organic Compound Removal by the Trickling Filter – ARCO, April 1991

	Location:	INF-1		TF-EF-1			INF-2		TF-EF-2		
	Type:	Grab		Grab			Grab		Grab		
	Date:	4/9		4/9			4/9		4/9		
	Time:	1155		1225			1605		1510		
	Lab Log#:	158131		158134			158132		158135		
(Group)	**VOA Compounds**	(ug/L)		(ug/L)		Percent Removal	(ug/L)		(ug/L)		Percent Removal
	2-Butanone (MEK)	500	U	500	U		17000		2500	U	85
	Benzene	14000	D	4700		66	28000		10000		64
	Toluene	20000	D	7400		63	77000	D	24000		69
	Ethylbenzene	1800		590		67	16000		2500		84
	Total Xylenes	12000	D	6700		44	83000	D	21000		75

	Location:	INF-3		TF-EF-3		
	Type:	Comp		Comp		
	Date:	4/9		4/9		
	Time:	***		***		
	Lab Log#:	158133		158136		
	BNA Compounds	(ug/L)		(ug/L)		Percent Removal
	Phenol	1900	D	1000	D	47
	2-Methylphenol	1000	D	770	D	23
	4-Methylphenol	540	D	400	D	26
	2,4-Dimethylphenol	980	D	920	D	6
n	Naphthalene	530	D	250	D	53
	2-Methylnaphthalene	510	D	320	D	37
n	Fluorene	33	DJ	26	DJ	21
n	Phenanthrene	66	DJ	56	DJ	15
i	Bis(2-Ethylhexyl)Phthalate	100	U	100	U	

INF Influent sample
TF-EF Trickling filter effluent sample
*** Composite samples were collected from midnight to midnight
U The analyte was not detected at or above the reported result
D The result was derived from an analysis of a sample that required a secondary dilution
J The analyte was positively identified. The associated numerical result is an estimate
* Insufficient data to develop criteria. Value presented is the LOEL–Lowest Observed Effects Level.
i Total Phthalate Esters
n Total Polynuclear Aromatic Hydrocarbons

Table 11 – Ecology Sediment Bioassay Results – ARCO, April 1991

Echinoderm Larvae - 96 hour survival and development test
(Strongylocentrotus purpuratus)

Sample	Percent Survival*	Percent Normal Development *
Control	99.4	87.4
Sed-1 (168145)	0.5	0
Sed-2 (168146)	0.7	0

* Based on average of 5 replicate analyses

Amphipod - 10 day survival test
(Rheopoxynius abronius)

Sample	Number Tested +	Percent Survival	Survival per replicate *	Total Emergence Events per replicate *
Control	100	93	18.6 (+/- 1.1)	9.6 (+/- 4.0)
Sed-1 (168145)	100	81	16.2 (+/- 2.2)	12.2 (+/- 8.6)
Sed-2 (168146)	100	53 **	10.6 (+/- 2.5)**	18.2 (+/- 15.9)

+ five replicates of 20 organisms per replicate
* Mean (standard deviation)
** Results significantly different ($p<0.05$) than control

Sed-1 Background
Sed-2 Edge Dilution

Table 12 – Comparison of Ecology and ARCO Sediment Bioassay Results – ARCO, April, 1991

			RESULTS			
			SED-1 bckgrd		SED-2 edge dil	
Species	Test Duration	End Point	Ecology	ARCO +	Ecology	ARCO +
Echinodern Larvae						
survival	96 hr	% survival	0.5%	–	0.7%	–
development	96 hr	% normal	0%	–	0%	–
Amphipod						
survival	10 day	% survival	81%	**	53%	**
emergence	10 day	total emergence events	12.2(+/-8.6)*	***	18.2(+/-15.9)*	***

* Mean(+/– standard deviation) per replicate – 20 organisms per replicate
** ARCO numbering different – survival ranged from 92–94% in the sediments tested
*** ARCO numbering different – emergence ranged from 2.4–4.2 events in the sediments tested
– Not analyzed
\+ ARCO analysis by contract lab (ENSR, 1991)

Table 13 – Comparison of Ecology and ARCO Sediment Results with Marine Sediment Criteria – ARCO, April 1991

Location:	SED-1				SED-2				Marine Sediment Standards (a)
Type:	Bkgrd				Edge Dil				
Date:	4/16				4/16				
Time:	1520–1630				1730–1845				
Lab:	Ecology		ARCO *		Ecology		ARCO *		
Percent solids	67.0		73.1		58.5		62.7		
Percent volatile solids	2.6		0.61		4.3		1.3		
TOC (percent dry wt basis)	0.65		0.68		1.3		2.0		
VOA Compounds	(ug/Kg dry wt)	(mg/Kg TOC)	(ug/Kg dry wt)	(mg/Kg TOC)	(ug/Kg dry wt)	(mg/Kg TOC)	(ug/Kg dry wt)	(mg/Kg TOC)	(mg/Kg TOC)
Acetone	15 U	2.3 U	15 U	2.2 U	17 U	1.3 U	9 J	0.5 J	–
1,1,1,-Trichloroethane	8 J	1.2 J	7 U	1.0 U	11 J	0.8 J	8 U	0.4 U	–
Toluene	68	10	7 U	1.0 U	8 U	0.6 U	8 U	0.4 U	–
Ethylbenzene	92	14	7 U	1.0 U	8 U	0.6 U	8 U	0.4 U	–
Total Xylenes	520	80	7 U	1.0 U	8 U	0.6 U	8 U	0.4 U	–
BNA Compounds	(ug/Kg dry wt)	(mg/Kg TOC)	(ug/Kg dry wt)	(mg/Kg TOC)	(ug/Kg dry wt)	(mg/Kg TOC)	(ug/Kg dry wt)	(mg/Kg TOC)	(mg/Kg TOC)
Acenaphthene	110 J	17 J	980 U	144 U	1100 U	85 U	1100 U	55 U	16
Phenanthrene	610 J	94 J	980 U	144 U	1100 U	85 U	210 J	11 J	100
Anthracene	190 J	29 J	980 U	144 U	1100 U	85 U	1100 U	55 U	220
Fluoranthene	550 J	85 J	980 U	144 U	1100 U	85 U	220 J	11 J	160
Pyrene	560 J	86 J	980 U	144 U	1100 U	85 U	170 J	8.5 J	1000
Benzo(a)Anthracene	210 J	32 J	980 U	144 U	1100 U	85 U	1100 U	55 U	110
Chrysene	170 J	26 J	980 U	144 U	1100 U	85 U	1100 U	55 U	110
Benzo(b)Fluoranthene	170 J	26 J	980 U	144 U	1100 U	85 U	1100 U	55 U	230 (b)
Benzo(k)Fluoranthene	130 J	20 J	980 U	144 U	1100 U	85 U	1100 U	55 U	230 (b)
Benzo(a)Pyrene	170 J	26 J	980 U	144 U	1100 U	85 U	1100 U	55 U	99
Bis(2-Ethylhexyl)Phthalate	980 U	151 U	120 J	18 J	1100 U	85 U	720 J	36 J	47
Metals	(mg/Kg dry wt)		(mg/Kg dry wt)		(mg/Kg dry wt)		(mg/Kg dry wt)		(mg/Kg dry wt)
Antimony	2.3 U		10.6 U		2.9 U		8.6 U		–
Arsenic	1.3		3.6		1.9		3.9		57
Beryllium	0.19 U		0.44		0.24 U		0.81		–
Cadmium	3.2		1.3 U		2.8		1.1 U		5.1
Chromium	18		17.7		21		23.2		260
Copper	7.3		10.7		9.3		15.0		390
Lead	0.31		3.7		2.5		5.4		450
Mercury	0.014		0.14 U		0.1 U		0.15 U		0.41
Nickel	14		19.9		16		25.0		–
Selenium	0.19 U		0.61 U		0.24 U		0.88 U		–
Silver	0.38		2.6 U		0.48 U		2.1 U		6.1
Thallium	0.38 U		0.40 U		0.38 U		0.59 U		–
Zinc	32		33.7		42		48.2		410

(a) Listed in Table 1 (Ecology, 1991)
U The analyte was not detected at or above the reported result.
J The analyte was positively identified. The associated numerical result is an estimate.
– No standard
(b) Standard listed is for Total Benzofluoranthenes, i.e., sum of the concentrations of the b, j, and k isomers

☐ Exceeds sediment standard
* ARCO analysis by contract lab (ENSR, 1991)

APPENDICES

Appendix A - Sampling Station Locations - ARCO, April 1991.

Influent (Inf) - influent to the secondary treatment system collected at the outlet of the API separator.

The composite sampler intakes were positioned just upstream of the API effluent weir above the afterbay. The sample strainers were suspended approximately one foot below the water surface.

The grab samples were collected as the water fell over the weir into the afterbay. Brian Lynch collected the grab samples under Ecology supervision. Brian collected the samples wearing a respirator.

Trickling filter effluent (Tf-ef) - effluent from the trickling filter.

The composite sample was collected from the wetwell which collected flow from the trickling filter underdrains. The sample strainers were suspended approximately 1.5 feet below the water surface.

Grab samples were collected from the discharge of the water pumped through the ARCO in line monitoring meters.

Stormwater Lagoon discharge (Strm) - flow from the stormwater retention lagoon.

The sample was collected from the vault just downstream of the lagoon outlet and upstream of the sanitary package plant input. The samples were collected using an ARCO weighted frame "thief" sampler. A clean bottle was inserted for sample collection and the sampler tripping mechanism was not used. Most stormwater lagoon water was being routed through the secondary treatment system during the inspection. Stormwater flow to the final settling pond was the result of a leaky valve at the stormwater retention pond outlet.

Effluent (Ef) - wastewater treatment plant final effluent.

The samples were collected from outfall line taps in the effluent pump house. The grab samples were taken from the tap usually used by ARCO for grab sample collection.

The composite sample was collected from a tap about ten feet from the grab tap. A priority pollutant cleaned stainless steel bucket placed underneath the tap and kept continuously overflowing and well mixed. The sampling tubes were suspended at approximately mid-depth of the bucket.

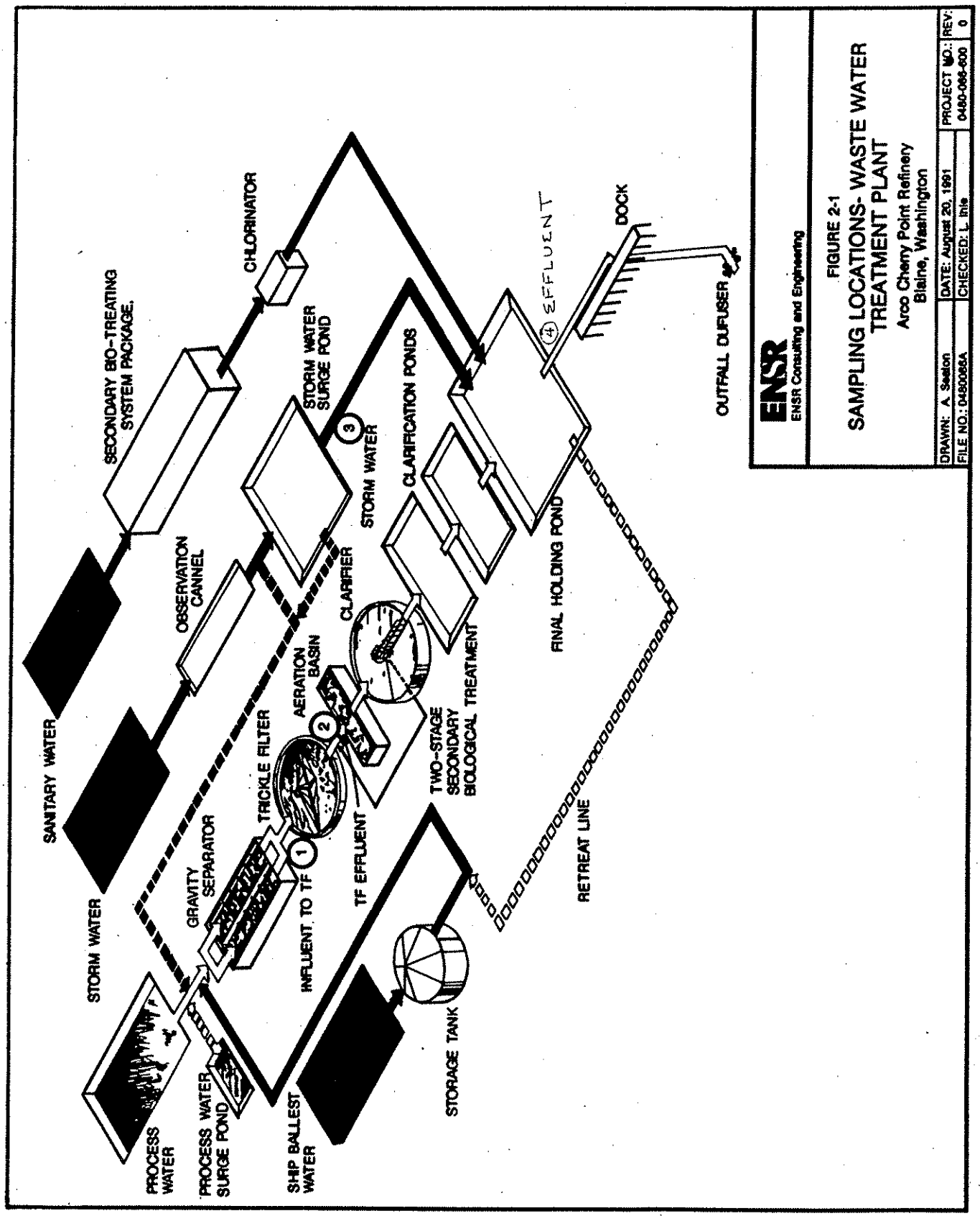
Sediment (Sed) - receiving water sediments collected in the vicinity of the ARCO outfall.

Sed-1 - Background sample - Sediment was collected approximately 1200 feet north of the diffuser. The sample was collected within 15 yards of a marker buoy set up by the ARCO consultant (Ardea Enterprises, Inc.). (approximate Lat 48N,51',51": Long 122W,45',36")

Sed-2 - Edge Dilution - Sample was collected approximately 225 feet SSE of the diffuser. The sample was collected between the second and third pilings SE of the outfall, just to the east of the catwalk. (approximate Lat 48N,51',36": Long 122W,45',24")

Sed-3 - At Diffuser - Sample could not be collected. Location was by the ARCO dock near the diffuser. Three sampler casts resulted in shells, a large rope, and a hose. (Lat 48N,51',39": Long 122W,45',26")

Appendix A (cont'd) - Sampling Station Locations - ARCO, April 1991 (figure from ENSR, 1991).



Appendix B – Sampling Schedule and Parameters Analyzed – ARCO, April 1991.

Location:	Trns Blk	Inf-1	Inf-2	Inf-3	Tf-ef-1	Tf-ef-2	Tf-ef-3	Strm-3	Ef-1	Ef-2	Ef-3	Ef-4	Ef-arco	Sed-1	Sed-2
Type:		Grab	Grab	Comp	Grab	Grab	Comp	Grab	Grab	Grab	Comp	H-Comp	Comp	Bkgrd	Edge Dil
Date:	4/8	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/16	4/16
Time:	1545	1155	1605	***	1225	1510	***	1705	1055	1440	***	*+*	***	1520-1630	1730-1845
Lab Log #:	158130	158131	158132	158133	158134	158135	158136	158139	158140	158141	158142	158143	158144	168145	168146
GENERAL CHEMISTRY															
Conductivity				E			E	E			E	E	E		
Alkalinity				E			E	E			E		E		
Hardness				E			E	E			E	E	E		
TS				E			E	E			E		E		
TNVS				E			E	E			E		E		
TSS				E A			E A	E A			E A	E	E A		
TNVSS				E			E	E			E		E		
% Solids														E	E
% Volatile Solids														E	E
BOD5				E A			E A	E A			E A		E A		
COD				E A			E A	E A			E A		E A		
TOC (water)				E			E	E			E		E		
TOC (soil)														E	E
NH3-N				E A			E A	E A			E A		E A		
NO2+NO3-N				E			E	E			E		E		
Phosphorous – Total				E			E	E			E		E		
Oil and Grease (water)		E A	E A		E A	E A		E A	E A	E A					
Oil and Grease (sediment)														E	E
F-Coliform MF									E A	E A					
F-Coliform MPN									E	E					
Grain Size														E	E
Cyanide total	E	E	E	E	E	E	E	E	E	E	E				
Cyanide (wk & dis)	E	E	E	E	E	E	E	E	E	E	E				
Cyanide (total wet wt)														E	E
Cyanide (wk & dis wet wt)														E	E
ORGANICS															
VOC (water)	E	E	E		E	E		E	E	E					
VOC (soil)														E	E
BNAs (water)				E			E	E			E				
BNAs (soil)														E	E
Pest/PCB (water)	E			E			E	E			E				
Pest/PCB (soil)														E	E
Phenolics Total(water)	E			E A			E A	E A			E A		E A		
Phenolics Total(soil)														E	E
METALS															
PP Metals	E			E			E	E			E		E	E	E
Soluble Cu	E			E			E	E			E				
Total chromium	E			E A			E A	E A			E A		E A		
Hexavalent chromium	E			E A			E A	E A	E A	E A	E A		E A		
BIOASSAYS															
Salmonid (acute 65%)												E			
Salmonid (acute 100%)												E			
Daphnia magna (acute)												E			
Bivalve Larvae (chronic)												E			
Fathead Minnow (acute)												E			
Sheepshead Minnow (chronic)												E **			
Echinoderm sperm cell fertilization												E			
Echinoderm larvae (solid)														E	E
Amphipod (solid acute)														E	E
FIELD OBSERVATIONS															
Temp		E A *	E A *	E	E A *	E A *	E	E	E A *	E A *	E				
pH		E	E A *	E	E A *	E A *	E	E	E A *	E A *	E				
Conductivity		E	E	E	E	E	E	E	E	E	E				
Sulfide		E A	E A	E	E A	E A	E	E A	E A	E A	E				
Chlorine		E	E	E	E	E	E	E	E A	E A	E				

Trns Blk Transfer Blank
Inf Influent sample
Tf-ef Trickling filter effluent sample
Strm Stormwater sample
Ef Final Effluent sample
Sed Sediment sample

E Samples analyzed by Ecology – split taken by ARCO for analysis by their consultant (ENSR)
E A Sample analyzed by Ecology and ARCO – ARCO analysis conducted by ARCO laboratory
* ARCO measurement taken from continuous monitoring device
** Chronic renewal test, samples collected April 8, 10, and 12
*** Composite samples were collected from midnight to midnight
+ Equal volumes collected with the 1055 and 1440 grab samples

Appendix C – Ecology Analytical Methods and Laboratories – ARCO, April 1991

Parameter	Method Used for Ecology Analysis	Laboratory Performing Analysis
GENERAL CHEMISTRY		
Conductivity	EPA, 1979: 120.1	Ecology
Alkalinity	EPA, 1979: 310.1	Ecology
Hardness	EPA, 1979: 130.2	Ecology
TS	EPA, 1979: 160.3	Ecology
TNVS	EPA, 1979: 160.4	Ecology
TSS	EPA, 1979: 160.2	Ecology
TNVSS	EPA, 1979: 160.4	Ecology
% Solids	EPA, 1979: 160.3	Amtest
% Volatile Solids	EPA, 1979: 160.4	Amtest
BOD5	EPA, 1979: 405.1	Amtest
COD	EPA, 1979: 410.1	Amtest
TOC (water)	EPA, 1979: 415.2	Ecology
TOC (soil)	EPA, 1986a	Amtest
NH3-N	EPA, 1979: 350.1	Amtest
NO2+NO3-N	EPA, 1979: 353.2	Amtest
Phosphorous - Total	EPA, 1979: 365.3	Amtest
Oil and Grease	EPA, 1979: 413.1	Amtest
F-Coliform MF	APHA, 1989: 9222D	Ecology
F-Coliform MPN	APHA, 1989: 9221C	Ecology
Grain Size	EPA, 1986a	Soil Technology
Cyanide total	EPA, 1979: 335.2mod	Amtest
Cyanide (wk & dis)	APHA, 1989: 4500-CN I.	Amtest
Cyanide (total dry wt)	EPA,1979: 335.2mod	Amtest
Cyanide (wk & dis dry wt)	APHA, 1989: 4500-CN I.	Amtest
ORGANICS		
VOC (water)	EPA, 1984: 624	Weyerhaeuser
VOC (soil)	EPA, 1986b: 8240	Weyerhaeuser
BNAs (water)	EPA, 1984: 625	Weyerhaeuser
BNAs (soil)	EPA, 1986b: 8270	Weyerhaeuser
Pest/PCB (water)	EPA, 1984: 608	Weyerhaeuser
Pest/PCB (soil)	EPA, 1986b: 8080	Weyerhaeuser
Phenolics Total	EPA, 1979: 420.2	Amtest
METALS		
PP Metals	EPA, 1979: 200	Sound Analytical Services
Soluble Cu	EPA, 1979: 200	Sound Analytical Services
Hexavalent chromium	EPA, 1979: 200	Sound Analytical Services
BIOASSAYS		
Salmonid (acute 65%)	Ecology, 1981	Ecology
Salmonid (acute 100%)	Ecology, 1981	Ecology
Daphnia magna (acute)	EPA, 1985	Ecology
Bivalve Larvae (chronic)	ASTM, 1989	Northwestern Aquatic Sciences
Fathead Minnow (acute)	EPA, 1985	Ecology
Sheepshead Minnow (chronic)	EPA, 1987	International Technology Corp.
Echinoderm sperm cell fertilization	Dinnel,1987	ERC Environmental
Echinoderm larvae (solid)	EPA, 1990	ERC Environmental
Amphipod (solid acute)	EPA, 1986a	Northwestern Aquatic Sciences

APHA, 1989. Standard Methods for the Examination of Water and Wastewater. 17th Ed.

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EPA, 1979. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 (Rev. March, 1983).

EPA, 1984. 40 CFR Part 136, October 26, 1984.

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EPA, 1986b. Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846, 3rd. ed.,November, 1986.

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EPA, 1990. Recommended Protocols for Conducting Laboratory Bioassays on Puget Sound Sediments, U.S. EPA Region 10.

Appendix D - Cleaning for Priority Pollutant Sampling and Field Transfer Blank Procedures - ARCO, April 1991.

PRIORITY POLLUTANT SAMPLING EQUIPMENT CLEANING PROCEDURES

1. Wash with laboratory detergent.
2. Rinse several times with tap water.
3. Rinse with 10% HNO_3 solution.
4. Rinse three (3) times with distilled/deionized water.
5. Rinse with high purity methylene chloride.
6. Rinse with high purity acetone.
7. Allow to dry and seal with aluminum foil.

FIELD TRANSFER BLANK PROCEDURE

1. Pour organic free water directly into appropriate bottles for parameters to be analyzed from grab samples (VOA).

2. Run approximately 1L of organic free water through a compositor and discard.

3. Run approximately 6L of organic free water through the same compositor and put the water into appropriate bottles for parameters to be analyzed from composite samples (BNA, Pesticide/PCB, cyanide, phenolics, and metals).

Appendix E – VOA, BNA, and Pesticide/PCB Scan Results – ARCO, April 1991

	Location:		TRNS BLNK	INF-1	INF-2	TF-EF-1	TF-EF-2	STRM-3	EF-1	EF-2	SED-1	SED-2
	Type:		Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Bkgrd	Edge dil
	Date:		4/8	4/9	4/9	4/9	4/9	4/9	4/9	4/9	4/16	4/16
	Time:		1545	1155	1605	1225	1510	1705	1055	1440	1520–1630	1730–1845
	Lab Log#:		158130	158131	158132	158134	158135	158139	158140	158141	168145	168146
(Group)	VOA Compounds		(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg*)	(ug/Kg*)
a	Chloromethane		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
a	Bromomethane		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
a	Methylene Chloride		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
a	Chloroform		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
a	Carbon Tetrachloride		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
a	Bromodichloromethane		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
a	Dibromochloromethane		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
a	Bromoform		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
	Chloroethane		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
	Vinyl Chloride		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
	1,1-Dichloroethane		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
	1,2-Dichloroethane		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
b	1,1-Dichloroethene		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
b	1,2-Dichloroethene (total)		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
c	1,1,1-Trichloroethane	++	5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 J	11 J
c	1,1,2-Trichloroethane		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
	Trichloroethene		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
f	1,1,2,2-Tetrachloroethane		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
	Tetrachloroethene		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
d	1,2-Dichloropropane		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
e	cis-1,3-Dichloropropene		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
e	trans-1,3-Dichloropropene		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
	Acetone		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
	2-Butanone (MEK)	++	10 U	500 U	17000	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
	4-Methyl-2-Pentanone (MIBK)		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
	2-Hexanone		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
	Vinyl Acetate		10 U	500 U	2500 U	500 U	2500 U	10 U	10 U	10 U	15 U	17 U
	Carbon Disulfide		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
	Benzene	++	5 U	14000 D	28000	4700	10000	11	5 U	5 U	8 U	8 U
	Toluene	++	5 U	20000 D	77000 D	7400	24000	29	4 J	5 U	68	8 U
	Ethylbenzene	++	5 U	1800	16000	590	2500	4 J	5 U	5 U	92	8 U
	Styrene		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U
	Total Xylenes	++	5 U	12000 D	83000 D	6700	21000	51	5 U	5 U	520	8 U
g	Chlorobenzene		5 U	250 U	1300 U	250 U	1300 U	5 U	5 U	5 U	8 U	8 U

TRNS BLNK Transfer blank
INF Influent sample
TF-EF Trickling filter effluent sample
STRM Stormwater sample
EF Final effluent sample
SED Marine sediment sample
U The analyte was not detected at or above the reported result.
J The analyte was positively identified. The associated numerical result is an estimate.
D The result was derived from an analysis of a sample that required a secondary dilution.

++ Compound detected in one or more samples
* Dry weight basis
a Total Halomethanes
b Total Dichloroethenes
c Total Trichloroethanes
d Total Dichloropropanes
e Total Dichloropropenes
f Total Tetrachloroethanes
g Total Chlorinated Benzenes (excluding Dichlorobenzenes)

Appendix E (cont'd) – VOA, BNA, and Pesticide/PCB Scan Results – ARCO, April 1991

Location:		INF-3	TF-EF-3	STRM-3	EF-3	SED-1	SED-2
Type:		Comp	Comp	Grab	Comp	Bkgrd	Edge dil
Date:		4/9	4/9	4/9	4/9	4/16	4/16
Time:		***	***	1705	***	1520-1630	1730-1845
Lab Log#:		158133	158136	158139	158142	168145	168146
(Group)	BNA Compounds	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/Kg*)	(ug/Kg*)
	Hexachloroethane	100 U	100 U	10 U	10 U	980 U	1100 U
	Hexachlorobutadiene	100 U	100 U	10 U	10 U	980 U	1100 U
	Hexachlorocyclopentadiene	100 U	100 U	10 U	10 U	980 U	1100 U
j	Bis(2-Chloroethyl)Ether	100 U	100 U	10 U	10 U	980 U	1100 U
j	Bis(2-Chloroisopropyl)Ether	100 U	100 U	10 U	10 U	980 U	1100 U
j	Bis(2-Chloroethoxy)Methane	100 U	100 U	10 U	10 U	980 U	1100 U
k	N-Nitroso-di-n-Propylamine	100 U	100 U	10 U	10 U	980 U	1100 U
k	N-Nitrosodiphenylamine	100 U	100 U	10 U	10 U	980 U	1100 U
	Isophorone	100 U	100 U	10 U	10 U	980 U	1100 U
n	Naphthalene ++	530 D	250 D	10 U	10 U	980 U	1100 U
	2-Methylnaphthalene ++	510 D	320 D	10 U	10 U	980 U	1100 U
n	Acenaphthylene	100 U	100 U	10 U	10 U	980 U	1100 U
n	Acenaphthene ++	100 U	100 U	10 U	10 U	110 J	1100 U
n	Fluorene ++	33 DJ	26 DJ	10 U	10 U	980 U	1100 U
n	Phenanthrene ++	66 DJ	56 DJ	10 U	10 U	610 J	1100 U
n	Anthracene ++	100 U	100 U	10 U	10 U	190 J	1100 U
n	Fluoranthene ++	100 U	100 U	10 U	10 U	550 J	1100 U
n	Pyrene ++	100 U	100 U	10 U	10 U	560 J	1100 U
n	Benzo(a)Anthracene ++	100 U	100 U	10 U	10 U	210 J	1100 U
n	Chrysene ++	100 U	100 U	10 U	10 U	170 J	1100 U
n	Benzo(b)Fluoranthene ++	100 U	100 U	10 U	10 U	170 J	1100 U
n	Benzo(k)Fluoranthene ++	100 U	100 U	10 U	10 U	130 J	1100 U
n	Benzo(a)Pyrene ++	100 U	100 U	10 U	10 U	170 J	1100 U
n	Indeno(1,2,3-cd)Pyrene	100 U	100 U	10 U	10 U	980 U	1100 U
n	Dibenzo(a,h)Anthracene	100 U	100 U	10 U	10 U	980 U	1100 U
n	Benzo(g,h,i)Perylene	100 U	100 U	10 U	10 U	980 U	1100 U
h	1,2-Dichlorobenzene	100 U	100 U	10 U	10 U	980 U	1100 U
h	1,3-Dichlorobenzene	100 U	100 U	10 U	10 U	980 U	1100 U
h	1,4-Dichlorobenzene	100 U	100 U	10 U	10 U	980 U	1100 U
g	1,2,4-Trichlorobenzene	100 U	100 U	10 U	10 U	980 U	1100 U
g	Hexachlorobenzene	100 U	100 U	10 U	10 U	980 U	1100 U
m	2-Chloronaphthalene	100 U	100 U	10 U	10 U	980 U	1100 U
i	Dimethyl Phthalate	100 U	100 U	10 U	10 U	980 U	1100 U
i	Diethyl Phthalate	100 U	100 U	10 U	10 U	980 U	1100 U
i	Di-n-Butyl Phthalate	100 U	100 U	10 U	10 U	980 U	1100 U
i	Butylbenzyl Phthalate	100 U	100 U	10 U	10 U	980 U	1100 U
i	Bis(2-Ethylhexyl)Phthalate ++	100 U	100 U	10 U	6 J	980 U	1100 U
i	Di-n-Octyl Phthalate	100 U	100 U	10 U	10 U	980 U	1100 U
	Nitrobenzene	100 U	100 U	10 U	10 U	980 U	1100 U
o	2,4-Dinitrotoluene	100 U	100 U	10 U	10 U	980 U	1100 U
o	2,6-Dinitrotoluene	100 U	100 U	10 U	10 U	980 U	1100 U
	3,3'-Dichlorobenzidine	200 U	200 U	20 U	20 U	2000 U	2200 U
	Phenol ++	1900 D	1000 D	10 U	10 U	980 U	1100 U
	2-Methylphenol ++	1000 D	770 D	10 U	10 U	980 U	1100 U
	4-Methylphenol ++	540 D	400 D	10 U	10 U	980 U	1100 U
	2,4-Dimethylphenol ++	980 D	920 D	10 U	10 U	980 U	1100 U
l	2-Nitrophenol	100 U	100 U	10 U	10 U	980 U	1100 U
l	4-Nitrophenol	500 U	500 U	50 U	50 U	4800 U	5300 U
l	2,4-Dinitrophenol	500 U	500 U	50 U	50 U	4800 U	5300 U
l	4,6-Dinitro-2-Methylphenol	500 U	500 U	50 U	50 U	4800 U	5300 U
	2-Chlorophenol	100 U	100 U	10 U	10 U	980 U	1100 U
	2,4-Dichlorophenol	100 U	100 U	10 U	10 U	980 U	1100 U
	4-Chloro-3-Methylphenol	100 U	100 U	10 U	10 U	980 U	1100 U
	2,4,5-Trichlorophenol	500 U	500 U	50 U	50 U	4800 U	5300 U
	2,4,6-Trichlorophenol	100 U	100 U	10 U	10 U	980 U	1100 U
	Pentachlorophenol	500 U	500 U	50 U	50 U	4800 U	5300 U
p	4-Chlorophenyl Phenylether	100 U	100 U	10 U	10 U	980 U	1100 U
p	4-Bromophenyl Phenylether	100 U	100 U	10 U	10 U	980 U	1100 U

Appendix E (cont'd) – VOA, BNA, and Pesticide/PCB Scan Results – ARCO, April 1991

Location:	TRNS BLNK	INF-3	TF-EF-3	STRM-3	EF-3	SED-1	SED-2
Type:	Grab	Comp	Comp	Grab	Comp	Bkgrd	Edge dil
Date:	4/8	4/9	4/9	4/9	4/9	4/16	4/16
Time:	1545	***	***	1705	***	1520-1630	1730-1845
Lab Log#:	158130	158133	158136	158139	158142	168145	168146

(Group)	BNA Compounds														
			(ug/L)		(ug/L)		(ug/L)		(ug/L)		(ug/Kg*)		(ug/Kg*)		
	2-Nitroaniline		500	U	500	U	50	U	50	U	4800	U	5300	U	
	3-Nitroaniline		500	U	500	U	50	U	50	U	4800	U	5300	U	
	4-Nitroaniline		500	U	500	U	50	U	50	U	4800	U	5300	U	
	4-Chloroaniline		100	U	100	U	10	U	10	U	980	U	1100	U	
	Benzyl Alcohol		100	U	100	U	10	U	10	U	980	U	1100	U	
	Benzoic Acid		500	U	500	U	50	U	50	U	4800	U	5300	U	
	Dibenzofuran		100	U	100	U	10	U	10	U	980	U	1100	U	
	Pest/PCB Compounds														
	Aldrin	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
	Dieldrin	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
v	alpha-Chlordane	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
v	gamma-Chlordane	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
s	Endosulfan I	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
s	Endosulfan II	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
s	Endosulfan Sulfate	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
t	Endrin	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
t	Endrin Ketone	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
r	Heptachlor	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
r	Heptachlor Epoxide	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
q	alpha-BHC	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
q	beta-BHC	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
q	delta-BHC	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
q	gamma-BHC (Lindane)	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	24	U	27	U
u	4,4'-DDT	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
u	4,4'-DDE	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
u	4,4'-DDD	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	48	U	55	U
	Toxaphene	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	480	U	550	U
	Methoxychlor	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
w	Aroclor-1016	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
w	Aroclor-1221	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
w	Aroclor-1232	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
w	Aroclor-1242	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
w	Aroclor-1248	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	240	U	270	U
w	Aroclor-1254	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	480	U	550	U
w	Aroclor-1260	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	480	U	550	U

TRNS BLNK Transfer blank
INF Influent sample
TF-EF Trickling filter effluent sample
STRM Stormwater sample
EF Final effluent sample
SED Marine sediment sample
* Dry weight basis
*** Composite samples collected from midnight to midnight
++ compound detected in one or more samples
U The analyte was not detected at or above the reported result.
J The analyte was positively identified. The associated numerical result is an estimate.
D The result was derived from an analysis of a sample that required a secondary dilution
h Total Dichlorobenzenes
i Total Phthalate Esters
j Total Chloroalkyl Ethers
k Total Nitrosamines
l Total Nitrophenols
m Total Chlorinated Naphthalenes
n Total Polynuclear Aromatic Hydrocarbons
o Total Dinitrotoluenes
p Total Haloethers
q Total BHCs
r Heptachlor
s Endosulfan
t Endrin
u DDT plus metabolites
v Total Chlordane
w Total Aroclors (PCBs)

Appendix F – VOA, BNA, and Pesticide/PCB Tentatively Identified Compounds (TICs) – ARCO, April 1991

TICs are noted on the attached lab data sheets. The EPA sample numbers on the data sheets correspond to the log lab numbers noted below.

Location:	TRNS BLNK	INF-1	INF-2	TF-EF-1	TF-EF-2	STRM-3	EF-1	EF-2
Type:	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab
Date:	4/8	4/9	4/9	4/9	4/9	4/9	4/9	4/9
Time:	1545	1155	1605	1225	1510	1705	1055	1440
Lab Log#:	**	158131	158132	158134	158135	158139	158140	158141

Location:	INF-3	TF-EF-3	STRM-3	EF-3	SED-1	SED-2
Type:	Comp	Comp	Grab	Comp	Bkgrd	Edge dil
Date:	4/9	4/9	4/9	4/9	4/16	4/16
Time:	***	***	1705	***	1520–1630	1730–1845
Lab Log#:	158133	158136	158139	158142	168145	168146

TRNS BLNK Transfer blank
INF Influent sample
TF-EF Trickling filter effluent sample
STRM Stormwater sample
EF Final effluent sample
SED Marine sediment sample
JN There is evidence the analyte is present. The associated numerical value is an estimate.
*** Composite samples collected from midnight to midnight

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158131

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5432 SAS No.: SDG No.: 158130

Matrix: (soil/water) WATER Lab Sample ID: 69454

Sample wt/vol: 0.10 (g/mL) ML Lab File ID: B4844

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. Date Analyzed: 04/21/91

Column (pack/cap) CAP Dilution Factor: ~~1.0~~ 50. 6.6.91 [illegible]

Number TICs found: 3

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 120923	Cyclopentanone	7.57	300	JN
~~2. 541059~~	~~Cyclotrisiloxane, hexamethyl~~	~~16.49~~	~~250~~	~~BJ~~
3. 611143	Benzene, 1-ethyl-2-methyl-	25.61	1100	JN

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158131DL

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5432 SAS No.: SDG No.: 158130

Matrix: (soil/water) WATER Lab Sample ID: 69454DL

Sample wt/vol: 0.020 (g/mL) ML Lab File ID: B4890

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. Date Analyzed: 04/23/91

Column (pack/cap) CAP Dilution Factor: ~~10~~ 250.
6.6.91

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
~~1. 541059~~	~~Cyclotrisiloxane, hexamethyl~~	~~16.22~~	~~25000~~	~~BJ~~
2.	Unknown	26.27	8500	JN

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158132

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5432 SAS No.: SDG No.: 158130

Matrix: (soil/water) WATER Lab Sample ID: 69455

Sample wt/vol: 0.020 (g/mL) ML Lab File ID: B4845

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. Date Analyzed: 04/21/91

Column (pack/cap) CAP Dilution Factor: ~~1.0~~ 250 6m 6.6.91

Number TICs found: 10

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 107835	Pentane, 2-methyl-	4.08	3500	JN
2.	Unknown	7.58	6500	JN
3.	Unknown hydrocarbon	12.74	1500	JN
4. 111659	Octane	14.79	1500	JN
~~5. 541059~~	~~Cyclotrisiloxane, hexamethyl~~	~~16.49~~	~~5500~~	~~BJ~~
6. 103651	Benzene, propyl-	25.17	4800	JN
7. 611143	Benzene, 1-ethyl-2-methyl-	25.64	18000	JN
8. 108678	Benzene, 1,3,5-trimethyl-	26.02	7300	JN
9.	Unknown	26.47	1300	JN
10. 611143	Benzene, 1-ethyl-2-methyl-	26.76	4800	JN

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158132DL

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5432 SAS No.: SDG No.: 158130

Matrix: (soil/water) WATER Lab Sample ID: 69455DL

Sample wt/vol: 0.004 (g/mL) ML Lab File ID: B4891

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. Date Analyzed: 04/23/91

Column (pack/cap) CAP Dilution Factor: ~~10~~ 1250

Gm 6-6-91

Number TICs found: 3

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
~~1. 541059~~	~~Cyclotrisiloxane, hexamethyl~~	~~16.22~~	~~61000~~	~~BJ~~
2. 620144	Benzene, 1-ethyl-3-methyl-	25.37	10000	JN
3.	Unknown	26.27	26000	JN

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158135

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5432 SAS No.: SDG No.: 158130

Matrix: (soil/water) WATER Lab Sample ID: 69458

Sample wt/vol: 0.020 (g/mL) ML Lab File ID: B4847

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. Date Analyzed: 04/21/91

Column (pack/cap) CAP Dilution Factor: ~~10~~ 250.

6.6.91 [illegible]

Number TICs found: 3

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
~~1. 541059~~	~~Cyclotrisiloxane, hexamethyl~~	~~16.47~~	~~12000~~	~~BJ~~
2. 620144	Benzene, 1-ethyl-3-methyl-	25.59	1800	J
3.	Unknown	26.47	6300	J

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158139

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5432 SAS No.: SDG No.: 158130

Matrix: (soil/water) WATER Lab Sample ID: 69460

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: B4829

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. Date Analyzed: 04/18/91

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 2

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
~~1. 541059~~	~~Cyclotrisiloxane, hexamethyl~~	~~16.57~~	~~9.0~~	~~J~~
2.	UNKNOWN	26.67	6.0	J

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158141

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5432 SAS No.: SDG No.: 158130

Matrix: (soil/water) WATER Lab Sample ID: 69462

Sample wt/vol: 5.0 (g/mL) ML Lab File ID: B4843

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. Date Analyzed: 04/21/91

Column (pack/cap) CAP Dilution Factor: 1.0

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

Number TICs found: 3

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	4.53	6.0	J
~~2. 541059~~	~~Cyclotrisiloxane, hexamethyl~~	~~16.49~~	~~29~~	~~BJ~~
3.	Unknown	26.51	12	J

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TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158133DL

Lab Name: WEYERHAEUSER Contract: MAGOON

Lab Code: WEYER Case No.: 05432 SAS No.: SDG No.: 69453

Matrix: (soil/water) WATER Lab Sample ID: 69456DL

Sample wt/vol: 1000 (g/mL) ML Lab File ID: BN0501D

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. dec. Date Extracted: 04/12/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 05/02/91

GPC Cleanup: (Y/N) N pH: Dilution Factor: 10

Number TICs found: 21

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 100-41-4	BENZENE, ETHYL-	5.53	1300	JX JN
2. 108-38-3	BENZENE, 1,3-DIMETHYL-	5.72	4600	JX
3. 95-47-6	BENZENE, 1,2-DIMETHYL-	6.17	2100	JX
4. 611-14-3	BENZENE, 1-ETHYL-2-METHYL-	7.55	1300	JX
5. 95-63-6	BENZENE, 1,2,4-TRIMETHYL-	7.68	720	JX
6. 526-73-8	BENZENE, 1,2,3-TRIMETHYL-	8.23	1700	JX
7. 124-18-5	DECANE	8.30	420	JX
8. 2870-04-4	BENZENE, 2-ETHYL-1,3-DIMETHY	9.55	1200	JX
9. 62016-37-9	OCTANE, 2,4,6-TRIMETHYL-	10.37	580	JX
10. 17301-32-5	UNDECANE, 4,7-DIMETHYL-	12.34	610	JX
11. 62108-21-8	DECANE, 6-ETHYL-2-METHYL-	14.20	1000	JX
12.	UNKNOWN	15.95	950	JX
13.	UNKNOWN	17.60	930	JX
14. 544-76-3	HEXADECANE	19.19	780	JX
15. 629-78-7	HEPTADECANE	20.67	680	JX
16. 54105-67-8	HEPTADECANE, 2,6-DIMETHYL-	20.75	440	JX
17.	UNKNOWN	22.20	290	JX
18.	UNKNOWN	23.42	500	JX
19.	UNKNOWN	24.70	1700	JX
20.	UNKNOWN	25.94	1100	JX
21. 629-97-0	DOCOSANE	27.11	630	JX

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158136DL

Lab Name: WEYERHAEUSER Contract: MAGOON

Lab Code: WEYER Case No.: 05432 SAS No.: SDG No.: 69453

Matrix: (soil/water) WATER Lab Sample ID: 69459DL

Sample wt/vol: 1000 (g/mL) ML Lab File ID: BN0501E

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. dec. Date Extracted: 04/12/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 05/02/91

GPC Cleanup: (Y/N) N pH: Dilution Factor: 10

Number TICs found: 21

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 100-41-4	BENZENE, ETHYL-	5.52	360	~~JX~~ JN
2. 108-38-3	BENZENE, 1,3-DIMETHYL-	5.68	2000	~~JX~~
3. 95-47-6	BENZENE, 1,2-DIMETHYL-	6.13	890	~~JX~~
4. 611-14-3	BENZENE, 1-ETHYL-2-METHYL-	7.55	700	~~JX~~
5. 526-73-8	BENZENE, 1,2,3-TRIMETHYL-	8.22	830	~~JX~~
6. 124-18-5	DECANE	8.30	310	~~JX~~
7. 62016-37-9	OCTANE, 2,4,6-TRIMETHYL-	10.37	680	~~JX~~
8.	UNKNOWN	11.54	290	~~JX~~
9.	UNKNOWN	12.34	550	~~JX~~
10. 62108-21-8	DECANE, 6-ETHYL-2-METHYL-	14.19	940	~~JX~~
11.	UNKNOWN	15.95	910	~~JX~~
12. 62238-13-5	DECANE, 2,3,7-TRIMETHYL-	16.99	320	~~JX~~
13.	UNKNOWN	17.60	640	~~JX~~
14. 544-76-3	HEXADECANE	19.17	680	~~JX~~
15. 36475-50-0	TETRADECANAL, O-METHYLOXIME	20.65	610	~~JX~~
16. 54105-67-8	HEPTADECANE, 2,6-DIMETHYL-	20.75	430	~~JX~~
17.	UNKNOWN	22.20	250	~~JX~~
18.	UNKNOWN	23.42	430	~~JX~~
19.	UNKNOWN	24.70	1600	~~JX~~
20.	UNKNOWN	25.94	1100	~~JX~~
21. 629-97-0	DOCOSANE	27.11	630	~~JX~~

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

158142

Lab Name: WEYERHAEUSER Contract: MAGOON

Lab Code: WEYER Case No.: 05432 SAS No.: SDG No.: 69453

Matrix: (soil/water) WATER Lab Sample ID: 69463

Sample wt/vol: 1000 (g/mL) ML Lab File ID: 2BN10419E

Level: (low/med) LOW Date Received: 04/11/91

% Moisture: not dec. dec. Date Extracted: 04/12/91

Extraction: (SepF/Cont/Sonc) CONT Date Analyzed: 04/19/91

GPC Cleanup: (Y/N) N pH: Dilution Factor: 1.0

Number TICs found: 3

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	10.30	18	~~JX~~ JN
2.	UNKNOWN	15.50	16	~~JX~~ ↓
3. 112-50-5	ETHANOL, 2-[2-(2-ETHOXYETHOX	19.82	5.8	~~JX~~ ↓

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

168145

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5500 SAS No.: _____ SDG No.: 168145

Matrix: (soil/water) SOIL Lab Sample ID: 69954

Sample wt/vol: 5.0 (g/mL) G Lab File ID: A7709

Level: (low/med) LOW Date Received: 04/19/91

% Moisture: not dec. 34 Date Analyzed: 04/22/91

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 10

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 108872	Cyclohexane, methyl-	7.83	88	J
2. 592278	Heptane, 2-methyl-	9.97	120	J
3. 589811	Heptane, 3-methyl-	10.37	83	J
4. 111659	Octane	11.77	89	J
5. 926829	Heptane, 3,5-dimethyl-	13.82	82	J
6. 52896874	Heptane, 4-(1-methylethyl)-	20.92	83	J
7. 103651	Benzene, propyl-	21.42	59	J
8. 611143	Benzene, 1-ethyl-2-methyl-	21.90	80	J
9. 526738	Benzene, 1,2,3-trimethyl-	22.29	48	J
10. 124185	Decane	22.99	110	J

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

168146

Lab Name: WEYERHAEUSER Contract: 046-5751

Lab Code: WEYER Case No.: 5500 SAS No.: _____ SDG No.: 168145

Matrix: (soil/water) SOIL Lab Sample ID: 69955

Sample wt/vol: 5.0 (g/mL) G Lab File ID: A7710

Level: (low/med) LOW Date Received: 04/19/91

% Moisture: not dec. 41 Date Analyzed: 04/23/91

Column (pack/cap) CAP Dilution Factor: 1.0

Number TICs found: 1

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 76131	Ethane, 1,1,2-trichloro-1,2,	2.32	340	JN

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

~~69954~~ 168145

Lab Name: WEYERHAEUSER Contract: MAGOON

Lab Code: WEYER Case No.: 05500 SAS No.: SDG No.: 69954

Matrix: (soil/water) SOIL Lab Sample ID: 168145

Sample wt/vol: 30.6 (g/mL) G Lab File ID: 2BN10515L

Level: (low/med) LOW Date Received: 04/19/91

% Moisture: not dec. 34 dec. Date Extracted: 05/02/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05/16/91

GPC Cleanup: (Y/N) Y pH: 7.0 DILUTION FACTOR: 1.0

Number TICs found: 7

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	~~5.15~~	~~49000~~	~~JX~~ JN
2. 100-52-7	BENZALDEHYDE (ACN)(DOT)	7.58	540	JX
3. 10544-50-0	SULFUR, MOL. (S8)	25.62	760	JX
4.	UNKNOWN	27.02	690	JX
5.	UNKNOWN	29.09	4400	JX
6.	UNKNOWN	33.29	5100	JX
7. 57-88-5	CHOLESTEROL	36.61	1100	JX

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SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

~~69955~~ 168146

Lab Name: WEYERHAEUSER Contract: MAGOON

Lab Code: WEYER Case No.: 05500 SAS No.: SDG No.: 69954

Matrix: (soil/water) SOIL Lab Sample ID: 168146

Sample wt/vol: 30.8 (g/mL) G Lab File ID: 2BN10508N

Level: (low/med) LOW Date Received: 04/19/91

% Moisture: not dec. 41 dec. Date Extracted: 05/02/91

Extraction: (SepF/Cont/Sonc) SONC Date Analyzed: 05/09/91

GPC Cleanup: (Y/N) Y pH: 7.3 DILUTION FACTOR: 1.0

Number TICs found: 6

CONCENTRATION UNITS:
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	22.92	620	~~JX~~ JN
2. 10544-50-0	SULFUR, MOL. (S8)	24.17	1100	~~JX~~
3.	UNKNOWN	25.77	560	~~JX~~
4.	UNKNOWN	27.81	7000	~~JX~~
5.	UNKNOWN	31.96	5100	~~JX~~
6.	UNKNOWN	35.17	1100	~~JX~~

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