

## Port Orford Sediment Evaluation

### Abstract

Three sediment samples were collected at the Port Orford Federal Project on 8 June 1993. The samples were clean, fine to medium sands low in organic content. Metals, pesticides, PCBs, PAHs and phenols were below established concern levels. Project sediment is acceptable for unconfined in-water or upland disposal. No adverse, unacceptable environmental impacts, due to sediment quality, are expected from such disposal.

### Introduction

1. Port Orford is located about 250 miles south of the mouth of the Columbia River. It is a natural cove protected from north and west by a headland that extends seaward in a southerly direction for a distance of approximately one mile. The authorized project includes a breakwater 550 feet long, a turning basin 16 feet deep, 100 feet wide and 340 feet long (1). Sediment at the project is coarse grained sand.
2. The dock at Port Orford is used to hoist commercial fishing boats in and out of the water. The Port has two processors and two seasonal buyers. In recent years a sea urchin fishery has developed in the area.
3. The Port is maintained in two ways. During winter a submersible pump or pipeline dredge clears out the boat hoist area and deposits the sediment on a beach disposal site. The use of this site is managed to prevent damage to habitat of the endangered plant the Pink Sand Verbena. During summer the channel flusher Sandwick maintains the project.
4. The Portland District conducts sediment evaluations on an approximately 5 year rotation on its maintenance projects. Although Port Orford had never been investigated for chemical contaminants in the past based on a 'reason to believe' no contaminants were present, it was decided that contaminant analyses would be performed on the samples in order to provide background data for the District's sediment quality database.

### Methods

5. Three sediment samples were collected on 8 June 1993 using a stainless steel ponar grab sampler. These samples were taken using loading hoists that were stationed along the edge of the dock. Sample locations are shown in Figure 1. All samples were taken roughly 20 to 30 feet off the dock. Field observation indicated that samples were clean coarse sand with some resident snails present. Grain size distribution, resuspended density, void ratio, particle roundness grading and volatile solids content were measured by the USACE, North Pacific Division Materials Testing Laboratory Troutdale, Oregon. Metals, pesticides, polychlorinated biphenyls (PCBs), acid soluble sulfide (AVS), polynuclear aromatic hydrocarbons (PAHs) and phenols were measured by Columbia Analytical Associates, Kelso, Washington using EPA/USACE approved methods (2). All sampling, handling, storage and shipping of samples was conducted according to EPA/USACE approved guidelines (2). A quality assurance (QA) report regarding the chemical analyses was prepared by chemists from the North Pacific Division Materials

Testing Laboratory Troutdale, Oregon. That QA report and the raw data are enclosed.

## **Results/Discussion**

6. Samples were 99 % sand with a median grain size in the range of fine to medium sand (0.18-0.21 mm)(Table 1). Organic content was low with an average of 1.7 percent volatile solids. The results confirm those of earlier studies (1).

7. Metals concentrations were all well below established concern levels (Table 2). AVS concentrations were low as expected considering the low organic content of the sediment. AVS is the fraction of sulfur potentially available to form insoluble metal sulfides that help protect aquatic organisms from metal toxicity. Because metals levels are low in the sediment AVS concentration is not as important.

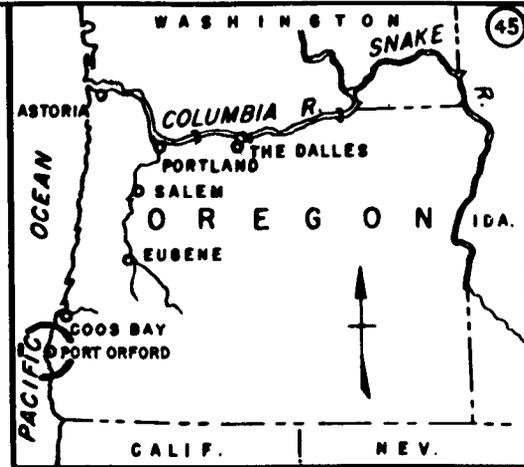
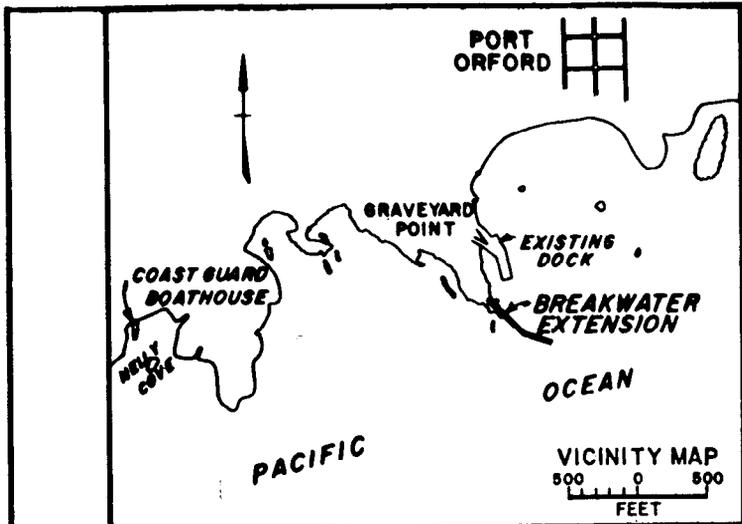
8. Organic contaminants in the sediment were low or undetected. No pesticides or PCBs were detected in the sediment. Detection limits were acceptable and below concern levels. Eight PAHs were detected in the samples. These were naphthalene (38 ppb), 2-methylnaphthalene (44 ppb), fluorene (40 ppb), phenanthrene (51-150 ppb), anthracene (40 ppb), fluoranthene (35-64 ppb), pyrene (21-37 ppb) and chrysene (21-39 ppb). Sample PO-P-3 contained the most PAHs but the total (500 ppb) was well below the concern level for total low and high molecular weight PAHs (2,410 ppb, EPA, Region 10). The phenols 3- and 4-methylphenol were detected (26 ppb). These compounds coelute so they are reported as a combined concentration and are quantified as 4-methylphenol.

## **Conclusions**

9. Sediment from Port Orford project is clean, fine to medium grain sized sand low in organic content. It is free of contaminants except for low levels of PAHs, which are expected in an area where commercial fishing boats operate and where some fuel spills and exhaust products could contribute to background PAH levels. Care should be taken to avoid contamination from these sources. This material is considered acceptable for unconfined in-water or upland disposal. No adverse unacceptable environmental impacts are expected from such disposal.

## REFERENCES

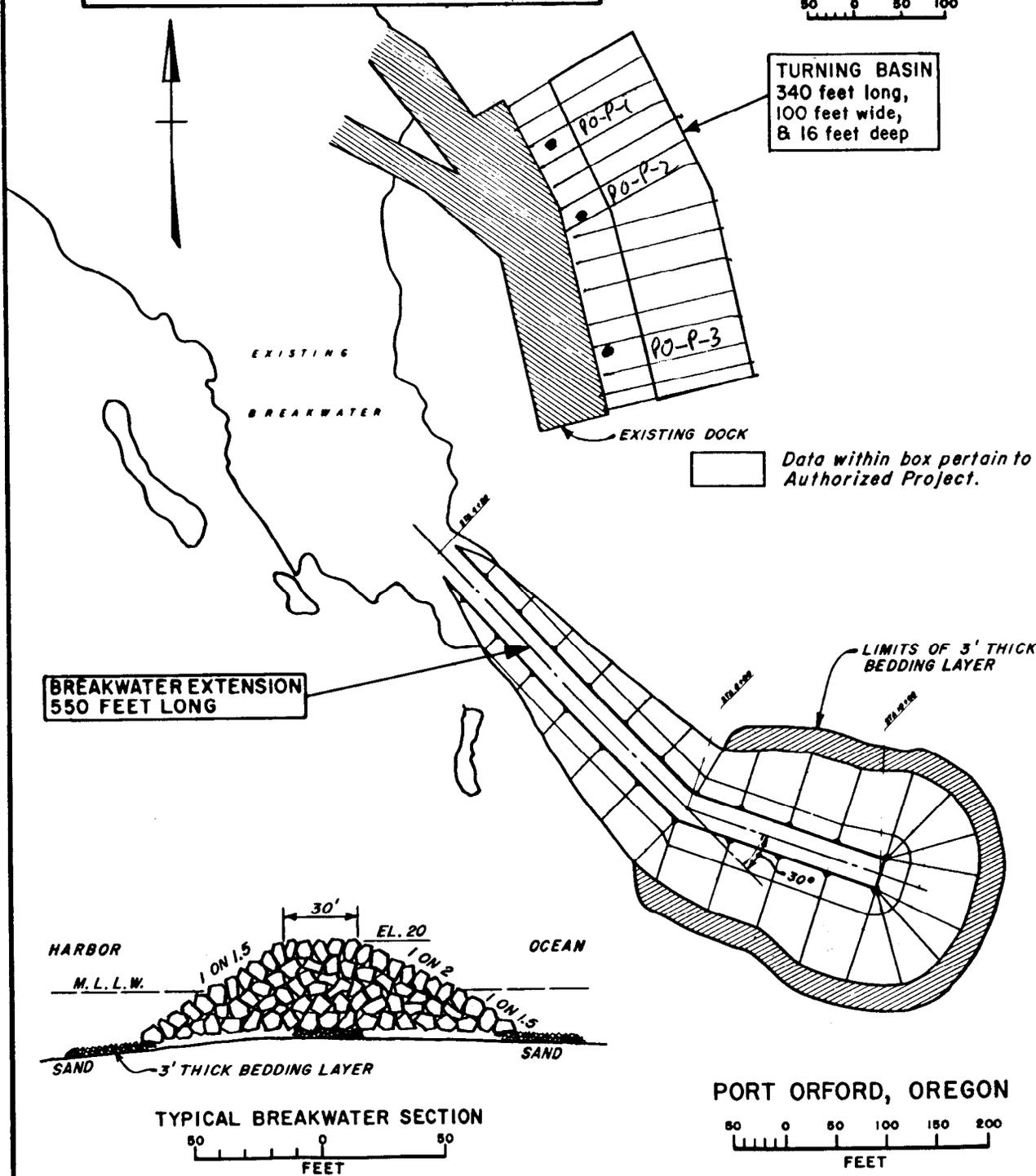
1. Navigation Branch, Operations Division, U. S. Army Corps of Engineers, Portland District. September 1991. Federal Navigation Projects: Columbia River Maintenance Disposal Plan. (Prepared by Mandaville Associates, 600 S. W. Tenth #418, Portland, Oregon 92205)
2. U. S. Environmental Protection Agency and U. S. Army Corps of Engineers. February 1991. Evaluation of Dredged Material Proposed for Ocean Disposal (Testing Manual).



**REGIONAL MAP**

SCALE IN MILES

50 0 50 100



□ Data within box pertain to Authorized Project.

**TYPICAL BREAKWATER SECTION**





DEPARTMENT OF THE ARMY  
NORTH PACIFIC DIVISION LABORATORY  
CORPS OF ENGINEERS  
1491 N.W. GRAHAM AVENUE  
TROUTDALE, OREGON 97060-9503

entered  
7-12-93

CENPD-PE-GT-L (1110-1-8100c)

28 June 93

MEMORANDUM FOR Commander, Portland District, ATTN: CENPP-PE-HR (Britton)

SUBJECT: W.O.# 93-573, Report of Soil Analysis

Project: PORT ORFORD  
Source of Material: Port Orford, Oregon  
Submitted by: CENPP-PE-HR (Britton)  
Date Sampled: --- Date Received: 9 June 1993  
Method of Test or Specification: ASTM, EM1110-2-1906  
Reference: a) DD Form 448, MIPR no. E86930076 dated 13 May 93  
b) NPD Form 300, Transmittal of Materials Samples dated 9 June

1. Enclosed is report of dredge test analysis for 3 samples submitted from the above project. Included are:

a) Enclosure 1, Results of Dredge Test Analysis.

b) Enclosures 2 through 4, Report of particle size analysis and classification tests, one for each sample submitted.

2. This completes all physical analysis requested.

Enclosures

*Timothy J. Seeman*  
TIMOTHY J. SEEMAN  
Director

Copy Furnished: CENPD-PE-GT

MFR: Routine dredge tests on 3 soil samples. Predominantly poorly graded sand. Complete copy in office files.

CENPD-PE-GT-L (93-573)

PORT ORFORD

Results of Dredge Test Analysis

<u>CENPD Sample No.</u>	<u>Resuspended Density Gm/L</u>	<u>Void Ratio</u>	<u>Volatile Solids, %</u>	<u>Specific Gravity</u>	<u>Particle Roundness Grading</u>
PO-P-1	1934	0.787	1.2	2.670	Subangular-subrounded
PO-P-2	1921	0.806	1.6	2.663	Subangular-subrounded
PO-P-3	1853	0.943	2.2	2.658	Subangular-subrounded

CENPDL No. 4694, received 9 Jun 93

\* \* \* Corps of Engineers - North Pacific Division Materials Laboratory \* \* \*  
 PORT ORFORD (93-CM-573)

Boring: -- Sample: PO-P-1 Depth: -- Lab No.: 57301

----- Sieve Analysis -----

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	544.04	0.0
No. 18	0.14	99.9
No. 35	1.13	99.1
No. 60	40.48	69.4
No. 120	127.18	3.9
No. 230	131.64	0.5
Pan	132.32	0.0

No hydrometer analysis.

*X = .226*

D85: 0.33 ✓ D60: 0.23 D50: 0.21 ✓ D30: 0.17 D15: 0.14 ✓ D10: 0.13 mm  
 Cu: 1.70 Cc: 0.92

Liquid Limit: NP Plasticity Index: NP  
 Fines Type Used for Classification: ML, SILT

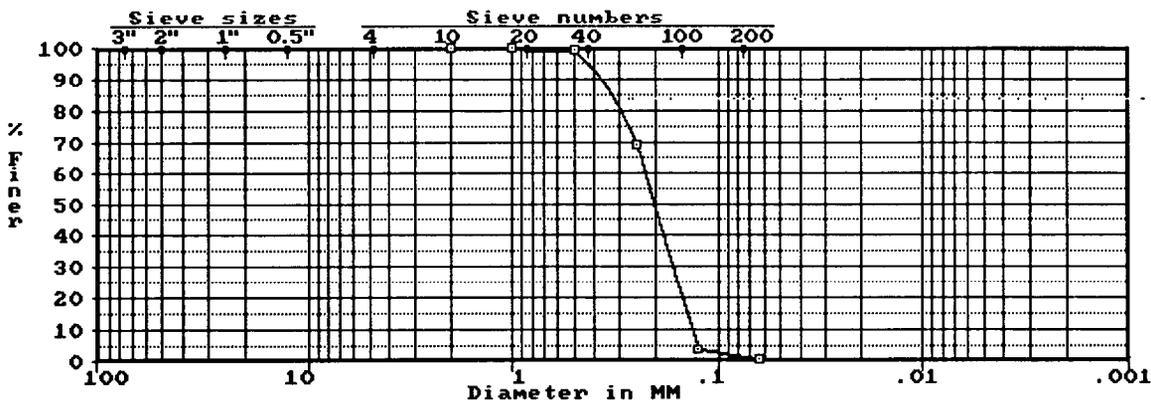
Gravel: 0.0% Sand: 98.6% Fines: 1.4%

----- ASTM D 2487 Classification -----

SP Poorly graded SAND

----- Comments -----

- VOLATILE SOLIDS = 1.2%



\* \* \* Corps of Engineers - North Pacific Division Materials Laboratory \* \* \*  
**PORT ORFORD (93-CM-573)**

Boring: -- Sample: PO-P-2 Depth: -- Lab No.: 57302

----- Sieve Analysis -----

Sieve	Cumulative Grams Retained	Percent Passing
5 In.	0.00	100.0
2.5 In.	0.00	100.0
1.25 In.	0.00	100.0
5/8 In.	0.00	100.0
5/16 In.	0.00	100.0
No. 5	0.00	100.0
No. 10	0.00	100.0
Pan	551.68	0.0
No. 18	0.13	99.9
No. 35	0.70	99.5
No. 60	29.95	78.0
No. 120	125.89	7.4
No. 230	134.88	0.8
Pan	136.01	0.0

No hydrometer analysis.

*X = .206*

D85: 0.29 ✓ D60: 0.21 D50: 0.19 ✓ D30: 0.16 D15: 0.14 ✓ D10: 0.13 mm  
 Cu: 1.64 Cc: 0.91

Liquid Limit: NP Plasticity Index: NP  
 Fines Type Used for Classification: ML, SILT

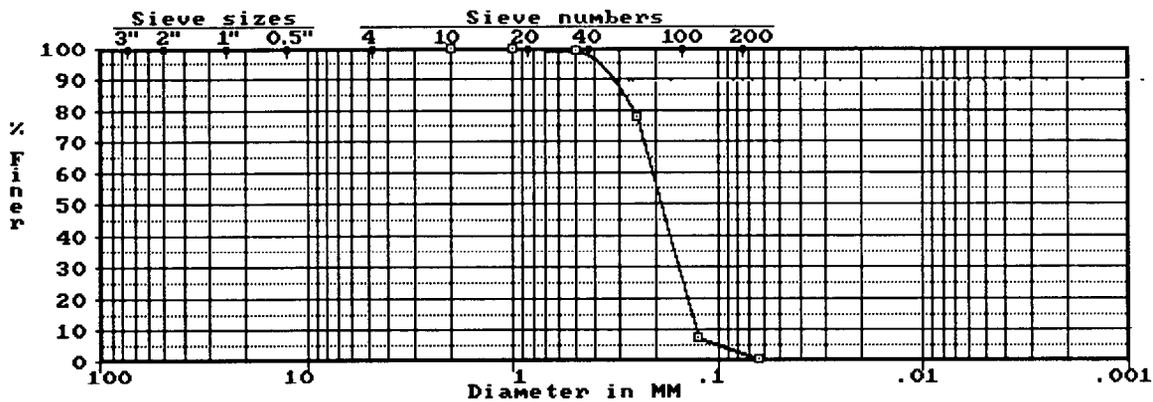
Gravel: 0.0% Sand: 97.5% Fines: 2.5%

----- ASTM D 2487 Classification -----

SP Poorly graded SAND

----- Comments -----

- VOLATILE SOLIDS = 1.6%





DEPARTMENT OF THE ARMY  
NORTH PACIFIC DIVISION LABORATORY  
CORPS OF ENGINEERS  
1481 N.W. GRAHAM AVENUE  
TROUTDALE, OREGON 97060-9503

Entered  
Aug 16, 1993  
Albert Hamilton

CENPD-PE-GT-L (1110-1-8100c)

4 Aug 93

MEMORANDUM FOR Commander, Portland District, ATTN: CENPP-PE-HR (Britton)

SUBJECT: W.O. 93-573, Results of Chemical Analysis

Project: PORT ORFORD  
Intended Use: Evaluate site  
Source of Material: Reference Chain of Custody Records  
Submitted by: CENPP-PE-HR  
Date Sampled: 8 Jun 93 Date Received: 10 Jun 93  
Method of Test or Specification: Reference Chain of Custody Records  
Reference: DD Form 448, MIPR No. E86-93-0076, dated 7 May 93

1. Enclosed are analytical results of three sediment samples collected from the above site. Included are report number K933305 from Columbia Analytical Services, (CAS), Inc., original Chain of Custody and sample Cooler Receipt form.

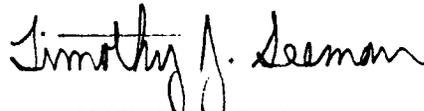
2. Project Laboratory Results: Up to 19 ppm of Acid Volatile Sulfide (AVS), and 4.3, 0.29, 38.7, 8.1, 3.36, 0.04, 32.8, and 24.2 ppm of arsenic cadmium, chromium, copper, lead, mercury, nickel and zinc, respectively, were found in the sediment samples. Up to nine polynuclear aromatic hydrocarbon (PAH) analytes were detected with a maximum concentration of 150 ppb. 26 ppb of 3- and 4-methylphenols were quantitated as 4-methyl phenol in one sample. No organochlorine pesticides/PCBs or silver were detected in any sample.

3. Evaluation of Project Laboratory's Data: The laboratory method blanks were free of targeted analytes, detection limits and holding times met method requirements. Two and six surrogates, similar to the analytes of interest, were used in the analysis of pesticides/PCBs and PAH/Phenols. All surrogate recoveries met either EPA advisory or method required quality control (QC) limits and are acceptable except for the following. One of two pesticide/PCB surrogates of the method blank were below method required QC limits. The data are accepted based on the remaining acceptable recovery (Reference EPA method 8080). The three acidic surrogates of the PAH/Phenol analysis were below method required QC limits in the laboratory control sample and method blank. Low surrogate recoveries of the above control samples do not directly influence the surrogate recoveries of the samples and these did not adversely affect the data. The matrix spike (MS), matrix spike duplicate (MSD) and laboratory control sample (LCS) recoveries and relative percent differences (RPD) met EPA or method required QC requirements and are acceptable with the following exception. The initial analysis of AVS on June 18, failed to meet the laboratory's method required QC limits due to low MS and LCS recoveries (47 percent). The batched reanalysis of MS, MSD and LCS recoveries were 50, 68 and 88 percent, respectively, with a RPD of 29, which still did not meet laboratory established recovery limits of 85-115 percent but were better than the initial analysis. The MS and MSD recoveries were below CAS QC limits and the RPD exceeded the EPA QC advisory limit of 20. Based on the low recoveries and high RPD in two sets, the AVS data should be considered low estimates.

CENPD-PE-GT-L (1110-1-8100c)  
SUBJECT: W.O. 93-573, Results of Chemical Analysis

4. If you have any questions or comments, please contact Dr. Ajmal M. Ilias at (503) 665-4166.

5. This completes all work requested for this project.



TIMOTHY J. SEEMAN  
Director

Enclosures

Copy Furnished: CENPD-PE-GT  
CEMRD-EP-EC  
CEMP-RT

July 12, 1993



Tim Seeman  
U. S. Army Corps of Engineers  
CENPD Materials Laboratory  
1491 NW Graham Avenue  
Troutdale, OR 97060-9503



Re: **Port Orchard/Project #93-573**

Dear Tim:

Enclosed are the results of the samples submitted to our laboratory on June 10, 1993. For your reference, these analyses have been assigned our service request number K933305.

Please note that two sets of data have been reported for the acid volatile sulfides (AVS) analysis. The initial analyses failed to meet QC criteria, and the second set of analyses were acceptable. The reported results for the second set of analyses were noticeably different from the first, however, and after discussion with Jim Britton, both sets of results have been included.

Also note that the acid surrogates for the EPA 8270 analyses failed to meet acceptance criteria in the case of the method blank and LCS samples. The associated samples were analyzed twice and passed the acceptance criteria; no further reanalysis was performed.

All analyses were performed consistent with our laboratory's quality assurance program. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the samples analyzed.

Please call if you have any questions. My extension is 208.

Respectfully submitted,

Columbia Analytical Services, Inc.

A handwritten signature in black ink, appearing to read "Kevin DeWhitt".

Kevin DeWhitt  
Quality Assurance Coordinator

KD/sam

Page 1 of 32

# COLUMBIA ANALYTICAL SERVICES, Inc.

## Acronyms

ASTM	American Society for Testing and Materials
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LUFT	Leaking Underground Fuel Tank
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected at or above the MRL
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Received: 06/10/93  
Date Analyzed: 06/14/93  
Work Order No.: K933305

Solids, Total  
EPA Method Modified 160.3  
Percent (%)

Sample Name	Lab Code	Result
PO-P-1	K3305-1	75.6
PO-P-2	K3305-2	78.8
PO-P-3	K3305-3	79.1

Approved by



Date

7-12

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COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U. S. Army Corps of Engineers Date Received: 06/10/93  
Project: Port Orchard/#93-573 Date Analyzed: 06/18/93  
Sample Matrix: Soil Work Order No.: K933305

Sulfide, Acid Volatile  
EPA Method Draft for AVS in Sediment, Aug. 1991  
mg/Kg (ppm)  
Dry Weight Basis

Sample Name	Lab Code	MRL	Result
PO-P-1	K3305-1	0.5	1.3
PO-P-2	K3305-2	0.5	19
PO-P-3	K3305-3	0.5	6.4
Method Blank	K3305-MB	0.5	ND

Approved by



Date

7-12

00001

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Received: 06/10/93  
Date Analyzed: 06/22/93  
Work Order No.: K933305

Sulfide, Acid Volatile  
EPA Method Draft for AVS in Sediment, Aug. 1991  
mg/Kg (ppm)  
Dry Weight Basis

Sample Name	Lab Code	MRL	Result
PO-P-1	K3305-1	0.5	ND
PO-P-2	K3305-2	0.5	5.7
PO-P-3	K3305-3	0.5	3.2
Method Blank	K3305-MB	0.5	ND

Approved by



Date 7-12

00005

**COLUMBIA ANALYTICAL SERVICES, INC.**

**Analytical Report**

**Client:** U.S. Army Corps of Engineers  
**Project:** Port Orford / #93-573  
**Matrix:** Soil

**Date Collected:** 6/8/93  
**Date Received:** 6/10/93  
**Work Order No.:** K933305

**Total Metals  
mg/kg (ppm)  
Dry Weight Basis**

Analyte	EPA Method	MRL	Sample Name:	PO-P-1	PO-P-2	PO-P-3
			Lab Code:	K330501	K330502	K330503
Arsenic	200.8	0.5		4.3	4.1	4.2
Cadmium	200.8	0.02		0.29	0.03	0.04
Chromium	200.8	0.2		38.5	33.6	38.7
Copper	200.8	0.1		7.2	7.1	8.1
Lead	200.8	0.02		3.27	3.11	3.36
Mercury	7471	0.02		0.04	ND	ND
Nickel	200.8	0.2		30.3	29.2	32.8
Silver	200.8	0.02		ND	ND	ND
Zinc	200.8	0.5		22.3	22.0	24.2

Solids, Total (%)      160.3 M      -      75.6      78.8      79.1

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

MET.S(1,2,3)03-13-92

Approved: 

Date: 7-12      Page No: 00000

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U.S. Army Corps of Engineers  
Project: Port Orford / #93-573  
Matrix: Soil

Work Order No.: K933305

Total Metals  
mg/kg (ppm)  
Dry Weight Basis

Sample Name: Method Blank  
Lab Code: K3305-MB

Analyte	EPA Method	MRL	
Arsenic	200.8	0.5	ND
Cadmium	200.8	0.02	ND
Chromium	200.8	0.2	ND
Copper	200.8	0.1	ND
Lead	200.8	0.02	ND
Mercury	7471	0.02	ND
Nickel	200.8	0.2	ND
Silver	200.8	0.02	ND
Zinc	200.8	0.5	ND

Approved: Kenn T. [Signature]

Date: 7-12 Page No.: 00007

**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

**Client:** U. S. Army Corps of Engineers  
**Project:** Port Orchard/#93-573  
**Sample Matrix:** Soil

**Date Received:** 06/10/93  
**Date Extracted:** 06/14/93  
**Work Order No.:** K933305

Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)  
 EPA Methods 3550/8080 (Low Level)  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name:	PO-P-1	PO-P-2	PO-P-3
Lab Code:	K3305-1	K3305-2	K3305-3
Date Analyzed:	06/29/93	06/29/93	06/29/93

Analyte	MRL			
Alpha-BHC	0.002	ND	ND	ND
Gamma-BHC (Lindane)	0.002	ND	ND	ND
Beta-BHC	0.006	ND	ND	ND
Heptachlor	0.002	ND	ND	ND
Delta-BHC	0.002	ND	ND	ND
Aldrin	0.002	ND	ND	ND
Heptachlor Epoxide	0.002	ND	ND	ND
Endosulfan I	0.002	ND	ND	ND
4,4'-DDE	0.002	ND	ND	ND
Dieldrin	0.002	ND	ND	ND
Endrin	0.002	ND	ND	ND
4,4'-DDD	0.002	ND	ND	ND
Endosulfan II	0.002	ND	ND	ND
4,4'-DDT	0.002	ND	ND	ND
Endrin Aldehyde	0.002	ND	ND	ND
Endosulfan Sulfate	0.002	ND	ND	ND
Methoxychlor	0.004	ND	ND	ND
Toxaphene	0.03	ND	ND	ND
Chlordane	0.01	ND	ND	ND
PCBs: Aroclor 1016	0.01	ND	ND	ND
Aroclor 1221	0.01	ND	ND	ND
Aroclor 1232	0.01	ND	ND	ND
Aroclor 1242	0.01	ND	ND	ND
Aroclor 1248	0.01	ND	ND	ND
Aroclor 1254	0.01	ND	ND	ND
Aroclor 1260	0.01	ND	ND	ND

Approved by *Kenn T. [Signature]* Date 7-12

00003

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Extracted: 06/14/93  
Work Order No.: K933305

Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)  
EPA Methods 3550/8080 (Low Level)  
mg/Kg (ppm)  
Dry Weight Basis

Sample Name:  
Lab Code:  
Date Analyzed:

Method Blank  
K3305-MB  
06/28/93

Analyte	MRL	
Alpha-BHC	0.002	ND
Gamma-BHC (Lindane)	0.002	ND
Beta-BHC	0.006	ND
Heptachlor	0.002	ND
Delta-BHC	0.002	ND
Aldrin	0.002	ND
Heptachlor Epoxide	0.002	ND
Endosulfan I	0.002	ND
4,4'-DDE	0.002	ND
Dieldrin	0.002	ND
Endrin	0.002	ND
4,4'-DDD	0.002	ND
Endosulfan II	0.002	ND
4,4'-DDT	0.002	ND
Endrin Aldehyde	0.002	ND
Endosulfan Sulfate	0.002	ND
Methoxychlor	0.004	ND
Toxaphene	0.03	ND
Chlordane	0.01	ND
PCBs: Aroclor 1016	0.01	ND
Aroclor 1221	0.01	ND
Aroclor 1232	0.01	ND
Aroclor 1242	0.01	ND
Aroclor 1248	0.01	ND
Aroclor 1254	0.01	ND
Aroclor 1260	0.01	ND

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

Approved by Kenn T. [Signature] Date 7-12

00009

**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

<b>Client:</b>	U. S. Army Corps of Engineers	<b>Date Received:</b>	06/10/93
<b>Project:</b>	Port Orchard/#93-573	<b>Date Extracted:</b>	06/14/93
<b>Sample Matrix:</b>	Soil	<b>Date Analyzed:</b>	07/02/93
		<b>Work Order No.:</b>	K933305

Polynuclear Aromatic Hydrocarbons  
 EPA Method 3540 in combination with GC/MS SIM Method  
 µg/Kg (ppb)  
 Dry Weight Basis

Sample Name:	PO-P-1	PO-P-2	PO-P-3
Lab Code:	K3305-1	K3305-2	K3305-3

Analyte	MRL			
Naphthalene	20	ND	ND	38
2-Methylnaphthalene	20	ND	ND	44
Acenaphthylene	20	ND	ND	ND
Dibenzofuran	20	ND	ND	22
Acenaphthene	20	ND	ND	ND
Fluorene	20	ND	ND	40
Phenanthrene	20	62	51	150
Anthracene	20	ND	ND	40
Fluoranthene	20	56	35	64
Pyrene	20	31	21	37
Benz(a)anthracene <sup>a</sup>	20	ND	ND	ND
Chrysene	20	21	ND	39
Benzo(b + k)fluoranthene <sup>♦</sup>	40	ND	ND	ND
Benzo(a)pyrene	20	ND	ND	ND
Indeno(1,2,3-cd)pyrene	20	ND	ND	ND
Dibenz(a,h)anthracene	20	ND	ND	ND
Benzo(g,h,i)perylene	20	ND	ND	ND

**SIM** Selected Ion Monitoring

<sup>♦</sup> These compounds coelute; therefore, the results are reported as the combined concentration.

<sup>a</sup> Result is from an analysis performed on July 7, 1993.

Approved by  Date 7-12

00010

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Extracted: 06/14/93  
Date Analyzed: 06/28/93  
Work Order No.: K933305

Polynuclear Aromatic Hydrocarbons  
EPA Method 3540 in combination with GC/MS SIM Method  
 $\mu\text{g/Kg}$  (ppb)  
Dry Weight Basis

Sample Name:  
Lab Code:

Method Blank  
K3305-MB

Analyte	MRL	
Naphthalene	20	ND
2-Methylnaphthalene	20	ND
Acenaphthylene	20	ND
Dibenzofuran	20	ND
Acenaphthene	20	ND
Fluorene	20	ND
Phenanthrene	20	ND
Anthracene	20	ND
Fluoranthene	20	ND
Pyrene	20	ND
Benz(a)anthracene	20	ND
Chrysene	20	ND
Benzo(b + k)fluoranthene ♦	40	ND
Benzo(a)pyrene	20	ND
Indeno(1,2,3-cd)pyrene	20	ND
Dibenz(a,h)anthracene	20	ND
Benzo(g,h,i)perylene	20	ND

**SIM** Selected Ion Monitoring

♦ These compounds coelute; therefore, the results are reported as the combined concentration.

Approved by



Date

7/12

00011

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U. S. Army Corps of Engineers Date Received: 06/10/93  
Project: Port Orchard/#93-573 Date Extracted: 06/14/93  
Sample Matrix: Soil Date Analyzed: 07/06/93  
Work Order No.: K933305

Phenols  
EPA Method 3540 in combination with GC/MS SIM Method  
 $\mu\text{g/Kg}$  (ppb)  
Dry Weight Basis

	Sample Name:	PO-P-1	PO-P-2	PPO-P-3
	Lab Code:	K3305-1	K3305-2	K3305-3
Analyte	MRL			
Phenol	20	ND	ND	ND
2-Methylphenol	20	ND	ND	ND
3- and 4-Methylphenol <sup>♦</sup>	20	ND	ND	26
2,4-Dimethylphenol	20	ND	ND	ND
Pentachlorophenol	50	ND	ND	ND

SIM Selected Ion Monitoring  
♦ Quantified as 4-methylphenol.

Approved by



Date

7-12

00012

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: U. W. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Extracted: 06/14/93  
Date Analyzed: 07/10/93  
Work Order No.: K933305

Phenols  
EPA Method 3540 in combination with GC/MS SIM Method  
 $\mu\text{g/Kg}$  (ppb)  
Dry Weight Basis

Sample Name:  
Lab Code:

Method Blank  
K3305-MB

Analyte	MRL	
Phenol	20	ND
2-Methylphenol	20	ND
3- and 4-Methylphenol ♦	20	ND
2,4-Dimethylphenol	20	ND
Pentachlorophenol	50	ND

**SIM** Selected Ion Monitoring

- ♦ These compounds coelute; therefore, the results are reported as the combined concentration, and quantified as 4-methylphenol.

Approved by



Date

7-12

00013

**APPENDIX A**  
**LABORATORY QC RESULTS**

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Received: 06/10/93  
Date Extracted: 06/18/93  
Date Analyzed: 06/18/93  
Work Order No.: K933305

Duplicate Summary  
Sulfide, Acid Volatile  
EPA Method Draft for AVS in Sediment, Aug. 1991  
mg/Kg (ppm)  
Dry Weight Basis

Sample Name	Lab Code	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference
PO-P-1	K3305-1	0.5	1.3	1.4	14	7

Approved by



Date

7-12

00014

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Received: 06/10/93  
Date Extracted: 06/18/93  
Date Analyzed: 06/18/93  
Work Order No.: K933305

Matrix Spike Summary  
Sulfide, Acid Volatile  
EPA Method Draft for AVS in Sediment, Aug. 1991  
mg/Kg (ppm)  
Dry Weight Basis

Sample Name	Lab Code	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery
PO-P-1	K3305-1	0.5	4.7	1.3	3.1	47

Approved by Kenn T. [Signature] Date 7-12

00015

COLUMBIA ANALYTICAL SERVICES, INC.

QA/OC Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
Sample Matrix: Soil

Date Received: 06/10/93  
Date Extracted: 06/22/93  
Date Analyzed: 06/22/93  
Work Order No.: K933305

Matrix Spike/Duplicate Matrix Spike Summary  
Sulfide, Acid Volatile  
EPA Method Draft for AVS in Sediment, Aug. 1991  
mg/Kg (ppm)  
Dry Weight Basis

Sample Name: PO-P-1  
Lab Code: K3305-1

Analyte	Spike Level		Sample Result	Spike Result		Percent Recovery		Relative Percent Difference
	MS	DMS		MS	DMS	MS	DMS	
Acid Volatile Sulfide	4.2	4.1	ND	2.1	2.8	50	68	29

Approved by



Date

7-12

00016

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
LCS Matrix: Water

Date Analyzed: 06/18/93  
Work Order No.: K933305

Laboratory Control Sample Summary  
Sulfide, Acid Volatile  
EPA Method Draft for AVS in Sediment, Aug. 1991  
mg/L (ppm)

Analyte	True Value	Result	Percent Recovery
Acid Volatile Sulfide	0.62	0.29	47

Approved by Kim Bennett Date 7-12

00017

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
LCS Matrix: Water

Date Analyzed: 06/22/93  
Work Order No.: K933305

Laboratory Control Sample Summary  
Sulfide, Acid Volatile  
EPA Method Draft for AVS in Sediment, Aug. 1991  
mg/L (ppm)

Analyte	True Value	Result	Percent Recovery
Acid Volatile Sulfide	0.56	0.49	88

Approved by



Date 7-12

00013

**COLUMBIA ANALYTICAL SERVICES, INC.**

**QA/QC Report**

**Client:** U.S. Army Corps of Engineers  
**Project:** Port Orford / #93-573  
**Matrix:** Soil

**Date Collected:** 6/8/93  
**Date Received:** 6/10/93  
**Work Order No.:** K933305

**Duplicate Summary  
 Total Metals  
 mg/kg (ppm)  
 Dry Weight Basis**

**Sample Name:** PO-P-1  
**Lab Code:** K330501

Analyte	EPA Method	MRL	Duplicate		Average	Relative Percent Difference
			Sample Result	Sample Result		
Arsenic	200.8	0.5	4.3	4.4	4.4	2
Cadmium	200.8	0.02	0.29	0.27	0.28	7
Chromium	200.8	0.2	38.5	34.7	36.6	10
Copper	200.8	0.1	7.2	7.1	7.2	1
Lead	200.8	0.02	3.27	3.12	3.20	5
Mercury	7471	0.02	0.04	ND	NC	NC
Nickel	200.8	0.2	30.3	29.3	29.8	3
Silver	200.8	0.02	ND	ND	ND	-
Zinc	200.8	0.5	22.3	22.2	22.2	<1

MRL Method Reporting Limit  
 NC Not Calculated  
 ND None Detected at or above the method reporting limit

METD.S/03-13-92

Approved: *Karin [Signature]*

Date: 7-12 Page No.: 00019

**COLUMBIA ANALYTICAL SERVICES, INC.**

**QA/QC Report**

**Client:** U.S. Army Corps of Engineers  
**Project:** Port Orford / #93-573  
**Matrix:** Soil

**Date Collected:** 6/8/93  
**Date Received:** 6/10/93  
**Work Order No.:** K933305

**Matrix Spike Summary**  
**Total Metals**  
**mg/kg (ppm)**  
**Dry Weight Basis**

**Sample Name:** PO-P-1  
**Lab Code:** K330501

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Criteria
Arsenic	0.5	26	4.3	25.9	83	75-125
Cadmium	0.02	6.6	0.29	6.52	94	75-125
Chromium	0.2	26	38.5	59.7	82	75-125
Copper	0.1	33	7.2	36.7	89	75-125
Lead	0.02	66	3.27	74.0	107	75-125
Mercury	0.02	0.47	0.04	0.49	96	75-125
Nickel	0.2	66	30.3	90.6	91	75-125
Silver	0.02	6.6	ND	5.91	90	75-125
Zinc	0.5	66	22.3	77.8	85	75-125

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

METMS.S/03-13-92

Approved: *Karin [Signature]*

Date: 7-12 Page No.:  
 00020

**COLUMBIA ANALYTICAL SERVICES, INC.**

QA/QC Report

**Client:** U. S. Army Corps of Engineers  
**Project:** Port Orchard/#93-573  
**Sample Matrix:** Soil

**Date Received:** 06/10/93  
**Date Extracted:** 06/14/93  
**Date Analyzed:** 06/28,29/93  
**Work Order No.:** K933305

**Surrogate Recovery Summary**  
**Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)**  
**EPA Methods 3550/8080**

Sample Name	Lab Code	Percent Recovery	
		Tetrachloro- <i>m</i> -xylene	Decachlorobiphenyl
PO-P-1	K3305-1	54	69
PO-P-2	K3305-2	55	64
PO-P-3	K3305-3	51	68
PO-P-3	K3305-3MS	63	73
PO-P-3	K3305-3DMS	51	67
Laboratory Control Sample	K3305-LCS	66	78
Method Blank	K3305-MB	*42	71
	CAS Acceptance Criteria	45-112	53-120

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

Approved by Kevin P. [Signature] Date 7-12

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
 Project: Port Orchard/#93-573  
 Sample Matrix: Soil

Date Received: 06/10/93  
 Date Extracted: 06/14/93  
 Date Analyzed: 06/29/93  
 Work Order No.: K933305

Matrix Spike/Duplicate Matrix Spike Summary  
 Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)  
 EPA Methods 3550/8080  
 mg/Kg (ppm)  
 Dry Weight Basis

Sample Name: PO-P-3  
 Lab Code: K3305-3

Analyte	Spike Level		Sample Result	Spike Result		Percent Recovery		CAS Acceptance Criteria	Relative Percent Difference
	MS	DMS		MS	DMS	MS	DMS		
	Gamma-BHC (Lindane)	0.013		0.013	ND	0.008	0.007		
Heptachlor	0.013	0.013	ND	0.009	0.008	69	62	38-147	11
Aldrin	0.013	0.013	ND	0.008	0.009	62	54	51-124	14
Dieldrin	0.013	0.013	ND	0.009	0.008	69	62	57-130	11
Endrin	0.013	0.013	ND	0.010	0.009	77	69	54-143	11
4,4'-DDT	0.013	0.013	ND	0.010	0.009	77	69	40-157	11

Approved by Kim [Signature] Date 7-12

00022

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
LCS Matrix: Soil

Date Extracted: 06/14/93  
Date Analyzed: 06/28/93  
Work Order No.: K933305

Laboratory Control Sample Summary  
Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs)  
EPA Methods 3550/8080  
mg/Kg (ppm)

Analyte	True Value	Result	Percent Recovery	CAS Percent Recovery Acceptance Criteria
Gamma-BHC (Lindane)	0.010	0.007	70	52-125
Heptachlor	0.010	0.007	70	38-147
Aldrin	0.010	0.007	70	51-124
Dieldrin	0.010	0.008	80	57-130
Endrin	0.010	0.008	80	54-143
4,4'-DDT	0.010	0.009	90	40-157

Approved by



Date 7-12

00023

**COLUMBIA ANALYTICAL SERVICES, INC.**

QA/QC Report

**Client:** U. S. Army Corps of Engineers  
**Project:** Port Orchard/#93-573  
**Sample Matrix:** Soil

**Date Received:** 06/10/93  
**Date Extracted:** 06/14/93  
**Date Analyzed:** 07/02,06/93  
**Work Order No.:** K933305

Surrogate Recovery Summary  
 Polynuclear Aromatic Hydrocarbons and Phenols  
 EPA Method 3540 in combination with GC/MS SIM Method

Sample Name	Lab Code	P e r c e n t R e c o v e r y						
		NAP	FLR	CRY	2FP	PHL	TBP	
PO-P-1	K3305-1	80	88	<sup>a</sup> 106	68	69	93	
PO-P-2	K3305-2	84	84	<sup>a</sup> 97	73	63	98	
PO-P-3	K3305-3	88	85	<sup>a</sup> 112	68	62	97	
PO-P-3	K3305-3MS	80	78	<sup>a</sup> 111	<sup>a</sup> 62	<sup>a</sup> 57	<sup>a</sup> 97	
PO-P-3	K3305-3DMS	85	87	<sup>a</sup> 144	<sup>a</sup> 67	<sup>a</sup> 74	<sup>a</sup> 111	
Laboratory Control Sample	K3305-LCS	<sup>b</sup> 67	<sup>b</sup> 78	<sup>b</sup> 85	<sup>c</sup> <5	<sup>c</sup> 10	<sup>c</sup> <5	
Method Blank	K3305-MB	<sup>b</sup> 80	<sup>b</sup> 84	<sup>b</sup> 99	<5	<5	<5	

**SIM** Selected Ion Monitoring  
**NAP** Naphthalene-D<sub>8</sub>  
**FLR** Fluorene-D<sub>10</sub>  
**CRY** Chrysene-D<sub>12</sub>  
**2FP** 2-Fluorophenol  
**PHL** Phenol-D<sub>6</sub>  
**TBP** 2,4,6-Tribromophenol

- a** Result is from an analysis performed on July 7, 1993.
- b** Result is from an analysis performed on June 28, 1993.
- c** Outside of acceptance criteria. See narrative.

Approved by Kevin Truitt Date 7-12

00024

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
 Project: Port Orchard/#93-573  
 Sample Matrix: Soil

Date Received: 06/10/93  
 Date Extracted: 06/14/93  
 Date Analyzed: 07/02,07/93  
 Work Order No.: K933305

Matrix Spike/Duplicate Matrix Spike Summary  
 Polynuclear Aromatic Hydrocarbons and Phenols  
 EPA Method 3540 in combination with GC/MS SIM Method  
 µg/Kg (ppb)  
 Dry Weight Basis

Sample Name: PO-P-3  
 Lab Code: K3305-3

Percent Recovery

Analyte	Spike Level		Sample Result	Spike Result		Percent Recovery		CAS Acceptance Criteria	Relative Percent Difference
	MS	DMS		MS	DMS	MS	DMS		
Acenaphthene	42	42	14J	52	59	90	107	40-130	17
Pyrene	42	42	37	110	120	NC	NC	40-130	NC
Benzo(a)pyrene	42	42	ND	43	51	102	121	40-130	17
Pentachlorophenol	42	42	ND	37	37	88	88	10-120	<1

- SIM Selected Ion Monitoring
- J Estimated concentration. The value is less than the method reporting limit, but greater than the method detection limit.
- NA Not Applicable because of the sample matrix. Accuracy of the spike recovery value is reduced, since the amount spiked was less than five times the background level.

Approved by Kenn DeWitt Date 7-12

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: U. S. Army Corps of Engineers  
Project: Port Orchard/#93-573  
LCS Matrix: Soil

Date Extracted: 06/14/93  
Date Analyzed: 06/28/93  
Work Order No.: K933305

Laboratory Control Sample Summary  
Polynuclear Aromatic Hydrocarbons and Phenols  
EPA Method 3540 in Combination with GC/MS SIM Method  
 $\mu\text{g/Kg}$  (ppb)  
Dry Weight Basis

Analyte	True Value	Result	Percent Recovery
Acenaphthene	33	23	70
Pyrene	33	31	94
Benzo(a)pyrene	33	27	82

Approved by



Date

7-12

00026

**APPENDIX B**  
**CHAIN OF CUSTODY INFORMATION**



Army Corp of Engineers  
Cooler Receipt Form

Project: Port Orford

Cooler received on 6/10 and opened on 6/10 by Ruth Allison

- 1 Were custody seals on outside of cooler?  YES  NO  
If yes, how many and where? 1 - Front  
Were signature and date correct?  YES  NO
- 2 Were custody papers taped to lid inside cooler?  YES  NO
- 3 Were custody papers properly filled out (ink, signed, etc.)?  YES  NO
- 4 Did you sign custody papers in the appropriate place?  YES  NO
- 5 Did you attach shipper's packing slip to this form?  YES  NO  
What kind of packing material was used? vermiculite
- 7 Was sufficient ice used (if appropriate)?  YES  NO
- 8 Were all bottles sealed in seperate plastic bags?  YES  NO
- 9 Did all bottles arrive in good condition (unbroken)?  YES  NO
- 10 Were all bottle labels complete (No., date, signed, analysis, pres., etc)?  YES  NO
- 11 Did all bottle labels and tags agree with custody papers?  YES  NO
- 12 Were correct bottles used for the tests indicated?  YES  NO
- 13 Were VOA vials checked for absence of air bubbles, and noted if so?  YES  NO
- 14 Was sufficient amount of sample sent in each bottle?  YES  NO
- 15 Temperature of cooler upon receipt \_\_\_\_\_

Explain any discrepancies \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**APPENDIX C**

**RAW DATA**

00030

