STATE OF OREGON

INTEROFFICE MEMO

TO: Gary Calaba

DATE: August 9, 1984

FROM: CHGray

RECEIVED
MAL RUSS
FEB 5 1985
WACKER SILTRONIC CORP.

SUBJECT: HW - Northwest Natural Gas
Preliminary Assessment
Multnomah County

The old Portland Gas & Coke Company produced oil and gas by gasification of oil with steam. The tar bottoms were disposed on-site. This operation started sometime in the 1880's and terminated in 1956 when they converted to importing liquified natural gas.

The tar bottoms are covered with at least 10 feet of soil cover. Exact locations of disposal are unknown. The site is next to the Willamette River. The shallow alluvial aquifer (approximately 10 feet deep) discharges to the Willamette River.

The Wacker Siltronics plant was built on top of part of the fill. During excavation for the plant site, oil sheen were encountered.

The presence of the tar bottoms due to their location and age pose a low threat to the environment. I do not feel any further investigation is warranted.

Please note letter from Northwest Natural Gas regarding their knowledge of the site. Their NPDES permit issued in 1974 has required oil and grease sampling from the stormwater pond. Up until 1981 it was weekly and was changed to monthly. They have consistently operated within those oil and grease effluent limitations.

/emc

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION

01 STATE	02 SITE NUMBER

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site)	02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER
NORTHWEST NATURAL GAS CO.	7900 N.W. ST. HELENS RD.

03 CITY	04 STATE	05 ZIP CODE	06 COUNTY	07 COUNTY CODE	08 CONG DIST
PORTLAND	OR	97203	MULTNOMAH		

09 COORDINATES LATITUDE	LONGITUDE
__ __ __.__	__ __ __.__

10 DIRECTIONS TO SITE (Starting from nearest public road)
NORTH ON N.W. ST. HELENS RD., TAKE DRIVEWAY ON RIGHT JUST BEFORE YOU GO UNDER ST. JOHNS BRIDGE. STAY TO RIGHT ON DRIVEWAY.

III. RESPONSIBLE PARTIES

01 OWNER (If known)	02 STREET (Business, mailing, residential)
WACKER SILTRONIC CORPORATION	7200 N.W. FRONT AVE.

03 CITY	04 STATE	05 ZIP CODE	06 TELEPHONE NUMBER
PORTLAND	OR	97203	(503) 243-2020

07 OPERATOR (If known and different from owner)	08 STREET (Business, mailing, residential)
NORTHWEST NATURAL GAS CO.	202 N.W. 2nd AVE.

09 CITY	10 STATE	11 ZIP CODE	12 TELEPHONE NUMBER
PORTLAND	OR.	97209	(503) 226-4211

13 TYPE OF OWNERSHIP (Check one)
☒ A. PRIVATE ☐ B. FEDERAL: _____ (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL
☐ F. OTHER: _____ (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)
☐ A. RCRA 3001 DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☐ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION
☒ YES DATE 6, 20, 84 (MONTH DAY YEAR)
☐ NO

BY (Check all that apply)
☐ A. EPA ☐ B. EPA CONTRACTOR ☒ C. STATE ☐ D. OTHER CONTRACTOR
☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: _____ (Specify)
CONTRACTOR NAME(S): _____

02 SITE STATUS (Check one)
☐ A. ACTIVE ☒ B. INACTIVE ☐ C. UNKNOWN

03 YEARS OF OPERATION
1880 (BEGINNING YEAR) | 1956 (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED
TAR BOTTOMS FROM GASIFICATION OF OIL WITH STEAM

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION
LOW POTENTIAL HAZARD TO THE ENVIRONMENT AND THE PUBLIC. LOCATION DOES NOT POSE THREAT TO MUNICIPAL WATER SOURCE OR PRIVATE SOURCES.

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)
☐ A. HIGH (Inspection required promptly) ☐ B. MEDIUM (Inspection required) ☐ C. LOW (Inspect on time available basis) ☒ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT	02 OF (Agency/Organization)	03 TELEPHONE NUMBER
WILLIAM GIBBS	NORTHWEST NATURAL GAS CO.	(503) 226-4211

04 PERSON RESPONSIBLE FOR ASSESSMENT	05 AGENCY	06 ORGANIZATION	07 TELEPHONE NUMBER	08 DATE
CHARLES GRAY	DEQ	STATE OF OR.	(503) 229-5288	7, 30, 84 (MONTH DAY YEAR)

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION

01 STATE	02 SITE NUMBER

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES *(Check all that apply)*

- ☐ A. SOLID
- ☐ B. POWDER, FINES
- ☐ C. SLUDGE
- ☐ D. OTHER _____ *(Specify)*
- ☐ E. SLURRY
- ☐ F. LIQUID
- ☐ G. GAS

02 WASTE QUANTITY AT SITE *(Measures of waste quantities must be independent)*

TONS _____

CUBIC YARDS _____

NO. OF DRUMS _____

03 WASTE CHARACTERISTICS *(Check all that apply)*

- ☐ A. TOXIC
- ☐ B. CORROSIVE
- ☐ C. RADIOACTIVE
- ☐ D. PERSISTENT
- ☐ E. SOLUBLE
- ☐ F. INFECTIOUS
- ☐ G. FLAMMABLE
- ☐ H. IGNITABLE
- ☐ I. HIGHLY VOLATILE
- ☐ J. EXPLOSIVE
- ☐ K. REACTIVE
- ☐ L. INCOMPATIBLE
- ☐ M. NOT APPLICABLE

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE			
OLW	OILY WASTE			
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES *(See Appendix for most frequently cited CAS Numbers)*

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION

V. FEEDSTOCKS *(See Appendix for CAS Numbers)*

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION *(Cite specific references, e.g., state files, sample analysis, reports)*

SITE VISIT; INTERVIEW WITH BILL GIBBS; DEQ FILES, NW NATURAL GAS FILES.

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 ☐ A. GROUNDWATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ B. SURFACE WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ C. CONTAMINATION OF AIR
03 POPULATION POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ D. FIRE/EXPLOSIVE CONDITIONS
03 POPULATION POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ E. DIRECT CONTACT
03 POPULATION POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ F. CONTAMINATION OF SOIL
03 AREA POTENTIALLY AFFECTED: _____ (Acres)
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ G. DRINKING WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ H. WORKER EXPOSURE/INJURY
03 WORKERS POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ I. POPULATION EXPOSURE/INJURY
03 POPULATION POTENTIALLY AFFECTED: _____
02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

HW 7.20

INVENTORY-POSSIBLE SOURCES OF HAZARDOUS WASTE

****

EPA NUMBER: _____ NPDES#: _____
SIC CODE BEG: _____ SIC CODE END: _____ BASIN CODE: _____
STATE: Oregon COUNTY: Multnomah CO CODE: _____

NAME: Northwest Natural Gas
OWNER: _____
ADDRESS: Wacker and Koppers property ZIP: _____
CONTACT: Duane Foley PHONE: 226-4211

LOCATION: Portland, Oregon (see map attached)
TOWNSHIP: 1N RANGE: 1E SECTION: 13
USGS MAP NAME: Linnton, Oregon

BUSINESS TYPE

Mfg oil gas from petroleum ended '50s. - Now storage facilities

WASTE TYPES

Tars, naphthalenes

DISPOSAL ACTIVITIES

On-site fill

PERIOD OF OPERATION: 1880's - 1950's

HISTORY OF SITE OR PLANT OPERATION

The site covered what is now Wacker and Koppers. The plant manufactured oil gas by the ~~cracking petroleum~~ in brick retorts. There was a benzene plant on the present Koppers area.

Heat obtained by burning oil in same retort
Ref. I.E.C. 21, 1041 (1929)

DETAILS OF WASTE CHARACTERISTICS, VOLUMES AND DISPOSAL OPERATION

Tar bottoms were disposed on-site including filling of Doane Lake. The more liquid material was ponded. It is believed (R. Gitschlag) that there may be 10 to 20 fe of tar over a good deal of the site that has been covered by about 10 feet of fill. A pipe draining the Wacker property (to river just west of RR bridge) shows an oil sheen.

SIC CODES

SCOEPA00012034

INVENTORY-POSSIBLE SOURCES OF HAZARDOUS WASTE

****

EPA NUMBER: _____

WASTE CHARACTERISTICS

IGNITABLE: _____ SOLID: Y
CORROSIVE: _____ RADIOACTIVE: _____ SEMI-SOLID: X
REACTIVE: _____ INFECTIOUS: _____ LIQUID: X
TOXIC: X OTHER: _____ GASEOUS: _____

TOTAL WASTE QUANTITIES

VERY LARGE AMOUNT: X COUNTED: _____
LARGE AMOUNT: _____ AMOUNT OF WASTE ESTIMATED: _____
SMALL AMOUNT: _____ REPORTED: _____
VERY SMALL AMOUNT: _____ TONS,YDS,BBL,ETC MEASURED: _____

WASTE DISPOSAL

REGULATORY CONTROLS: *None*
WASTE TRANSPORTED TO SITES #: _____
WASTE DISPOSED INTO SEWER SYSTEM: *None*
WASTE DISPOSED IN EFFLUENT: _____
WASTE DISPOSED OF ON SITE: *All*

ON SITE DISPOSAL

INCINERATION: _____ LAND SPREADING: _____
SURFACE STORAGE: X BURIAL: X
WELL INJECTION: _____ OTHER: _____

SITE CONDITIONS

GEOLOGIC SETTING
Fill over old lake bed

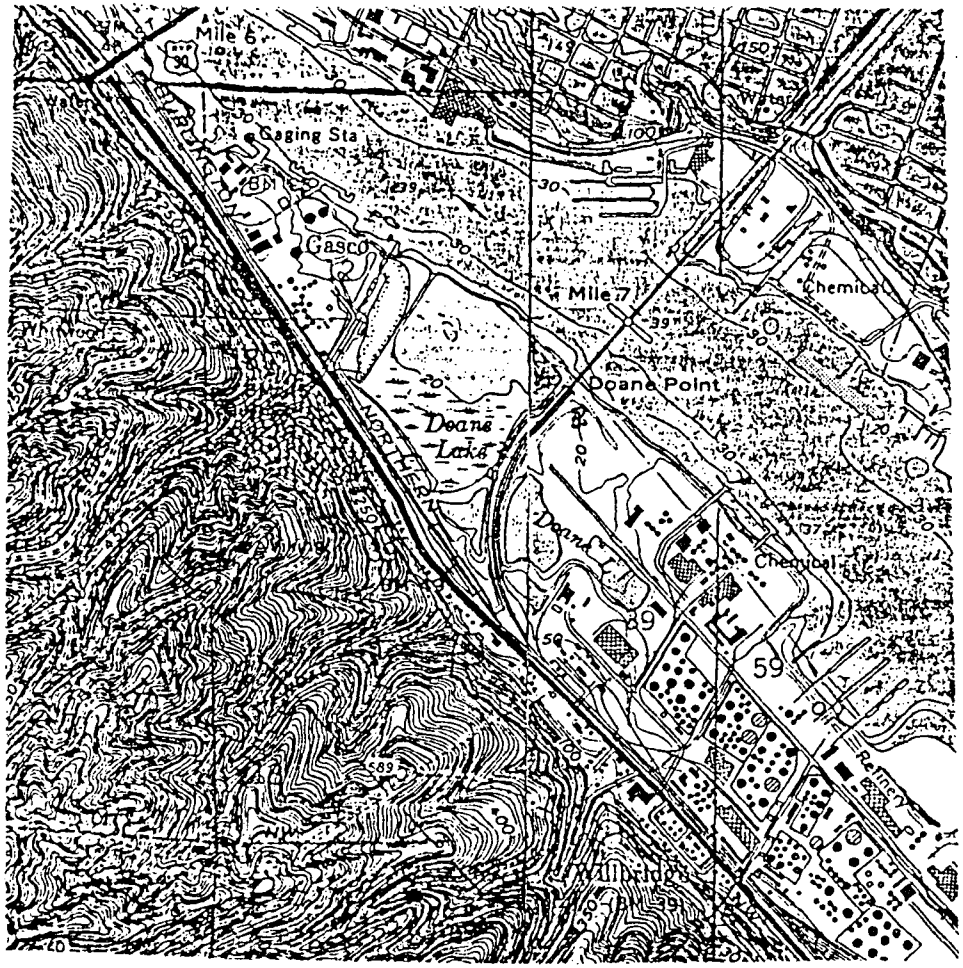
HYDROLOGIC CONDITIONS

DISTANCE OF LAKE OR MARINE WATER: _____
DISTANCE TO SURFACE STREAM: *Adjacent to Willamette River*
DEPTH TO GROUNDWATER: *5 to 10 feet*
DISTANCE TO WELLS OR SPRINGS: _____
DISTANCE TO NEAREST RESIDENCE: _____
USE OF SITE IF ABANDONED: *New plant site, empty lot*

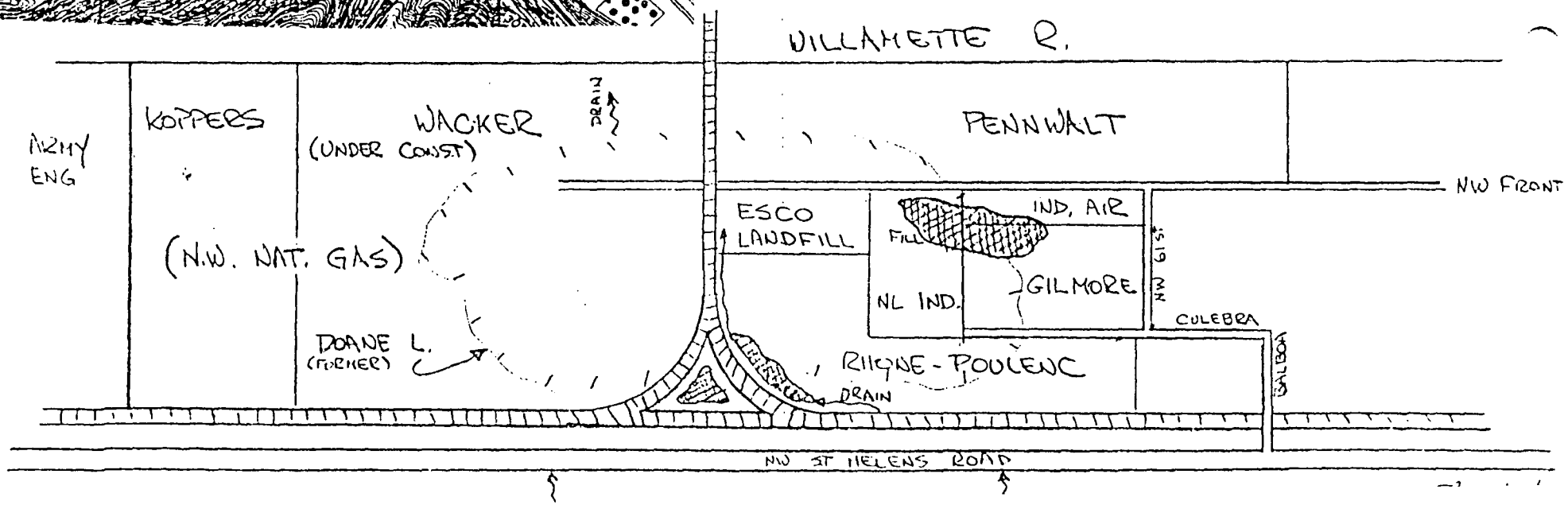
PHYSICAL CONTROLS AT SITE

SOURCES OF INFORMATION: *Dick Gitschlag, Rhone-Poulenc, plant mgr. site visit 8/17/79.*

COMPILER: *Fred Bromfeld* DATE: *August 20, 1979*



DOANE LAKE AREA



SCOEPA00012036

SUGGEST FOLLOW-UP

Doane Lake Area

1. It was originally thought that this area consisted of two lakebeds, Doane (east) and Giles (west), created from the old Doane Lake as a result of constructing the railroad bed in 1910. The recognition of Giles Lake as a separate entity, however, never came into common usage and it is not generally referred to on maps. As such, we shall refer to this area simply as Doane Lake.

   This will also avoid confusion with the Guilds Lake area about two miles to the S.E.

2. Almost the entire lake has been covered with 5 - 10 ft. of fill. The area, however, is a natural sump and the water table is only about 5 ft. below the surface. During a wet winter it may surface in some areas. The old Doane Lake fluctuated about 5 ft. in depth.

file WQ

cc: HW

NORTHWEST NATURAL GAS COMPANY

220 N.W. SECOND AVENUE PORTLAND, OREGON 97209

(503) 226-4211

Dept. of Environmental Quality
RECEIVED
AUG 8 1984
NORTHWEST REGION

RECEIVED
MAL RUSS
FEB 5 1985
WACKER SILTRONIC CORP.

August 2, 1984

Mr. Charles H. Gray
Asst. Regional Manager, NW Region
Department of Environmental Quality
522 S.W. 5th AVe.
Portland, OR 97201

Dear Mr. Gray:

I am writing in response to your recent inquiry concerning operations at the former Portland Gas & Coke Company plant near Linnton, and activities following the plant's shutdown in the late 1950's. A flow diagram of the process is enclosed.

Two accumulations of process residue remained when PG&C stopped manufacturing gas. A spent oxide pile with a volume of approximately 41,000 cubic yards was near the north end of the property: a tar pond estimated to contain some 30,000 cubic yards was located farther south (upstream).

We have some qualitative data on file for these materials, but little quantitative information on specific chemical compounds.

Most of the PG&C facilities were razed in the late 1960's, when construction of a liquefied natural gas (LNG) plant was begun. One portion of the existing small-tank farm was leased to Koppers: those tanks are still in use. Other, larger tanks near the riverbank were eventually reconditioned and are now leased to Pacific Northern Oil. Other tanks and metal structures were sold for scrap. Lampblack from Dorr thickeners was trucked offsite during demolition of the old gas plant. Its final disposition is not known.

In the early 1970's, all the remaining structures except the old Administration Building were demolished, and underground piping removed, in preparation for building a substitute natural gas (SNG) plant. That plant was never constructed, and the designated area is now used to store crushed rock.

As part of the general site cleanup associated with SNG preparations, the spent oxide pile was mainly hauled to the Scappoose landfill. The balance of

wlgdeq

that pile, with large amounts of overburden from the neighboring Rivergate Rock facility, was mixed with the ponded tar. After covering with additional overburden the property, was graded level.

With regard to your question on water quality, we have monitored effluent from our holding-pond discharge to the Willamette River since 1975. The initial permit, NPDES #1964-J, was in effect until February 11, 1981. At that time, it was superseded by the less stringent NPDES General Permit #0100-J. This second permit expires on December 31, 1985.

Please call if you have any questions or need additional information.

Sincerely,

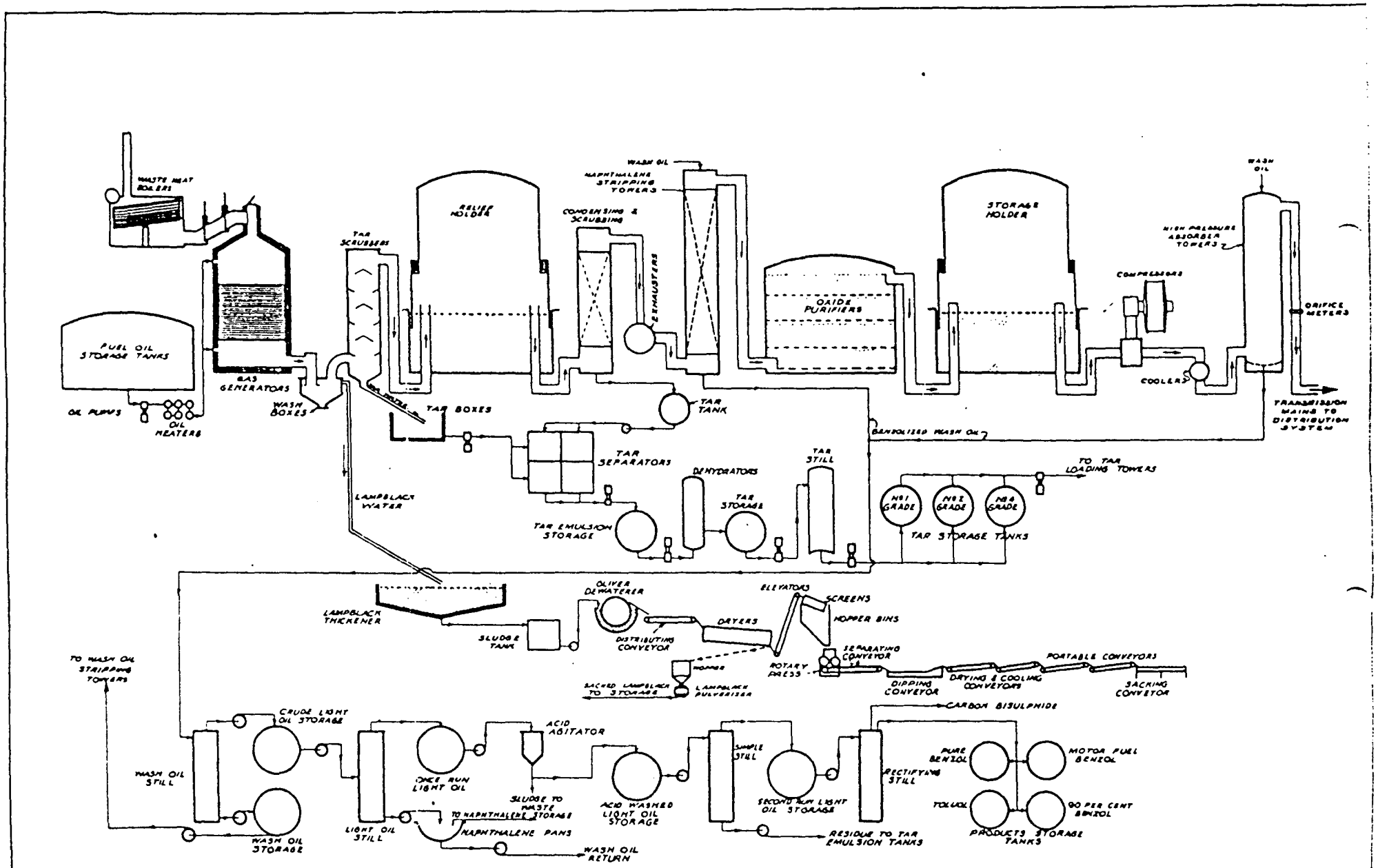
W. L. Gibbs

W. L. Gibbs, Manager
Engineering Department

WLG:lb
Encl.

cc: J. Van Bladeren
E. L. Bolin
D. L. Foley
R. W. Gullberg

wlgdeql



PORTLAND GAS & COKE COMPANY

GAS MANUFACTURING & BY PRODUCTS FLOW DIAGRAM

SCOEPA00012040

Gould Inc.,
10 Gould Center, Rolling Meadows, Illinois 60008
Telephone (312) 640-4000

GOULD
Electronics

July 2, 1985

CERTIFIED MAIL

RECEIVED
JUL 5 1985
MILLER, NASH, WIENER, HAGER & CARLSEN

John F. Neupert, Esq.
Miller, Nash, Wiener, Hager & Carlsen
111 S. W. Fifth Avenue
Portland, Oregon 97204-3699

Re: Wacker-Siltronic Corporation
Polysilicon Plant Site

Dear Mr. Neupert:

Pursuant to your letter of June 28, 1985, please be advised that Gould Inc. does not have any knowledge that it deposited or was responsible for deposits of certain hazardous substances on property now owned by your client, Wacker.

As you may know, Gould is presently working with the USEPA and Oregon DEQ with respect to an environmental study and evaluation of Gould's site at 5909 N. W. 61st Avenue, Portland. CH2M Hill prepared a Remedial Action Master Plan in connection with the Gould site and adjacent areas. To the best of my knowledge, CH2M Hill did not make any findings that Gould had disposed of any hazardous material on your client's property.

Gould purchased its site in Portland, Oregon from NL Industries on January 31, 1979. All operations at this site were discontinued approximately August, 1981. To the best of my knowledge, at no time from January 31, 1979 to the present did Gould dispose of any waste on your client's property. Under the asset purchase transaction with NL, Gould did not assume any liabilities for NL's operations at the Portland site prior to January 31, 1979.

If you are in possession of any facts which indicate that Gould placed hazardous material on your client's property, please furnish them to me. Until such facts are produced, Gould rejects Wacker's request to share in the cost of CH2M Hill's environmental study.

If you have any questions about this letter or wish to discuss this matter with me, please feel free to call me at (312) 640-4716.

Sincerely,

Michael C. Veysey

Michael C. Veysey
Business Section Legal Counsel

MCV/cak

STATE OF OREGON

INTEROFFICE MEMO

TO: Gary Calaba

DATE: August 9, 1984

FROM: CHGray

SUBJECT: HW - Northwest Natural Gas
Preliminary Assessment
Multnomah County

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/emc

81-125-1307

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
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☐ F. OTHER: _____ (Specify) ☐ G. UNKNOWN

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☒ YES DATE 6, 20, 84 (MONTH DAY YEAR)
☐ NO

BY (Check all that apply)
☐ A. EPA ☐ B. EPA CONTRACTOR ☒ C. STATE ☐ D. OTHER CONTRACTOR
☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: _____ (Specify)
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CHARLES GRAY	DEQ	STATE OF OR.	(503) 229-5288	7, 30, 84 (MONTH DAY YEAR)

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

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01 STATE	02 SITE NUMBER

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES *(Check all that apply)*

- ☐ A. SOLID
- ☐ B. POWDER, FINES
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- ☐ D. OTHER _____ *(Specify)*
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TONS _____

CUBIC YARDS _____

NO. OF DRUMS _____

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CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
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FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION *(Cite specific references, e.g., state files, sample analysis, reports)*

SITE VISIT; INTERVIEW WITH BILL GIBBS; DEQ FILES, NW NATURAL GAS FILES.

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 ☐ A. GROUNDWATER CONTAMINATION — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ B. SURFACE WATER CONTAMINATION — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ C. CONTAMINATION OF AIR — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ D. FIRE/EXPLOSIVE CONDITIONS — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ E. DIRECT CONTACT — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ F. CONTAMINATION OF SOIL — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 AREA POTENTIALLY AFFECTED: _____ (Acres) 04 NARRATIVE DESCRIPTION

01 ☐ G. DRINKING WATER CONTAMINATION — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ H. WORKER EXPOSURE/INJURY — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 WORKERS POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

01 ☐ I. POPULATION EXPOSURE/INJURY — 02 ☐ OBSERVED (DATE: _____) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

HW 7.20

INVENTORY-POSSIBLE SOURCES OF HAZARDOUS WASTE

****

EPA NUMBER: _____ NPDES#: _____
SIC CODE BEG: _____ SIC CODE END: _____ BASIN CODE: _____
STATE: Oregon COUNTY: Multnomah CO CODE: _____

NAME: Northwest Natural Gas
OWNER:
ADDRESS: Wacker and Koppers property ZIP:
CONTACT: Duane Foley PHONE: 226-4211

LOCATION: Portland, Oregon (see map attached)
TOWNSHIP: 1N RANGE: 1E SECTION: 13
USGS MAP NAME: Linnton, Oregon

BUSINESS TYPE

Mfg oil gas from petroleum ended '50s. Now storage facilities

WASTE TYPES

Tars, napthalenes

DISPOSAL ACTIVITIES

On-site fill

PERIOD OF OPERATION: 1880's - 1950's

HISTORY OF SITE OR PLANT OPERATION

The site covered what is now Wacker and Koppers. The plant manufactured oil gas by the ~~cracking petroleum~~ in brick retorts. There was a benzene plant on the present Koppers area.

Heat obtained by burning oil in same retort
Ref. I.E.C. 21, 104 (1929)

DETAILS OF WASTE CHARACTERISTICS, VOLUMES AND DISPOSAL OPERATION

Tar bottoms were disposed on-site including filling of Doane Lake. The more liquid material was ponded. It is believed (R. Gitschlag) that there may be 10 to 20 feet of tar over a good deal of the site that has been covered by about 10 feet of fill. A pipe draining the Wacker property (to river just west of RR bridge) shows an oil sheen.

SIC CODES

SCOEPA00012046

INVENTORY-POSSIBLE SOURCES OF HAZARDOUS WASTE

****

EPA NUMBER: _____

WASTE CHARACTERISTICS

IGNITABLE:				SOLID:	Y
CORROSIVE:		RADIOACTIVE:		SEMI-SOLID:	X
REACTIVE:		INFECTIOUS:		LIQUID:	X
TOXIC:	X	OTHER:		GASEOUS:	

TOTAL WASTE QUANTITIES

VERY LARGE AMOUNT:	X		COUNTED:	
LARGE AMOUNT:		AMOUNT OF WASTE	ESTIMATED:	
SMALL AMOUNT:			REPORTED:	
VERY SMALL AMOUNT:		TONS,YDS,BBL,ETC	MEASURED:	

WASTE DISPOSAL

REGULATORY CONTROLS: *None*

WASTE TRANSPORTED TO SITES #: _____

WASTE DISPOSED INTO SEWER SYSTEM: *None*

WASTE DISPOSED IN EFFLUENT: _____

WASTE DISPOSED OF ON SITE: *All*

ON SITE DISPOSAL

INCINERATION:		LAND SPREADING:	
SURFACE STORAGE:	X	BURIAL:	X
WELL INJECTION:		OTHER:	

SITE CONDITIONS

GEOLOGIC SETTING

Fill over old lake bed

HYDROLOGIC CONDITIONS

DISTANCE OF LAKE OR MARINE WATER: _____

DISTANCE TO SURFACE STREAM: *Adjacent to Willamette River*

DEPTH TO GROUNDWATER: *5 to 10 feet*

DISTANCE TO WELLS OR SPRINGS: _____

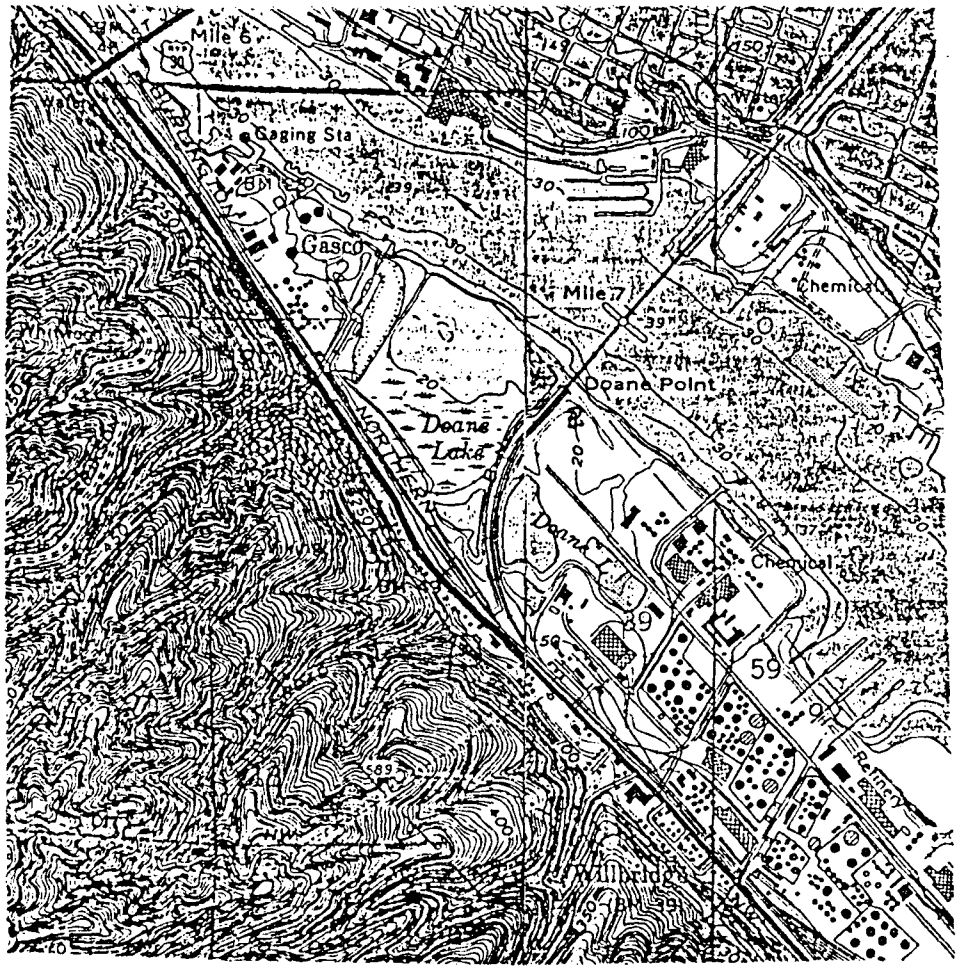
DISTANCE TO NEAREST RESIDENCE: _____

USE OF SITE IF ABANDONED: *New plant site, empty lot*

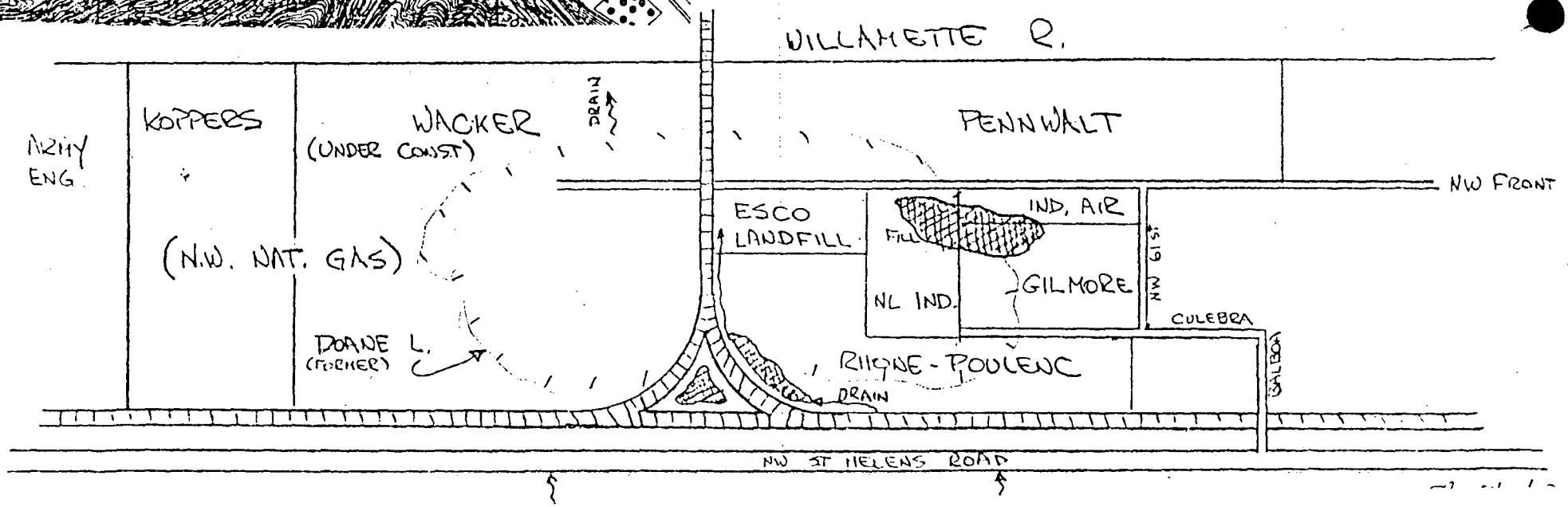
PHYSICAL CONTROLS AT SITE

SOURCES OF INFORMATION: *Dick Gitschlag, Rhone-Poulenc, plant mgr. site visit 8/17/79.*

COMPILER: *Fred Bromfeld* DATE: *August 20, 1979*



DOANE LAKE AREA



SCOEPA00012048

SUGGEST FOLLOW-UP

Doane Lake Area

1. It was originally thought that this area consisted of two lakebeds, Doane (east) and Giles (west), created from the old Doane Lake as a result of constructing the railroad bed in 1910. The recognition of Giles Lake as a separate entity, however, never came into common usage and it is not generally referred to on maps. As such, we shall refer to this area simply as Doane Lake.

   This will also avoid confusion with the Guilds Lake area about two miles to the S.E.

2. Almost the entire lake has been covered with 5 - 10 ft. of fill. The area, however, is a natural sump and the water table is only about 5 ft. below the surface. During a wet winter it may surface in some areas. The old Doane Lake fluctuated about 5 ft. in depth.

file WR

C: HW

NORTHWEST NATURAL GAS COMPANY

220 N.W. SECOND AVENUE PORTLAND, OREGON 97209

(503) 226-4211

Dept. of Environmental Quality
RECEIVED
AUG 8 1984
NORTHWEST REGION

August 2, 1984

Mr. Charles H. Gray
Asst. Regional Manager, NW Region
Department of Environmental Quality
522 S.W. 5th AVe.
Portland, OR 97201

Dear Mr. Gray:

I am writing in response to your recent inquiry concerning operations at the former Portland Gas & Coke Company plant near Linnton, and activities following the plant's shutdown in the late 1950's. A flow diagram of the process is enclosed.

Two accumulations of process residue remained when PG&C stopped manufacturing gas. A spent oxide pile with a volume of approximately 41,000 cubic yards was near the north end of the property: a tar pond estimated to contain some 30,000 cubic yards was located farther south (upstream).

We have some qualitative data on file for these materials, but little quantitative information on specific chemical compounds.

Most of the PG&C facilities were razed in the late 1960's, when construction of a liquefied natural gas (LNG) plant was begun. One portion of the existing small-tank farm was leased to Koppers: those tanks are still in use. Other, larger tanks near the riverbank were eventually reconditioned and are now leased to Pacific Northern Oil. Other tanks and metal structures were sold for scrap. Lampblack from Dorr thickeners was trucked offsite during demolition of the old gas plant. Its final disposition is not known.

In the early 1970's, all the remaining structures except the old Administration Building were demolished, and underground piping removed, in preparation for building a substitute natural gas (SNG) plant. That plant was never constructed, and the designated area is now used to store crushed rock.

As part of the general site cleanup associated with SNG preparations, the spent oxide pile was mainly hauled to the Scappoose landfill. The balance of

wlgdeq

that pile, with large amounts of overburden from the neighboring Rivergate Rock facility, was mixed with the ponded tar. After covering with additional overburden the property, was graded level.

With regard to your question on water quality, we have monitored effluent from our holding-pond discharge to the Willamette River since 1975. The initial permit, NPDES #1964-J, was in effect until February 11, 1981. At that time, it was superseded by the less stringent NPDES General Permit #0100-J. This second permit expires on December 31, 1985.

Please call if you have any questions or need additional information.

Sincerely,

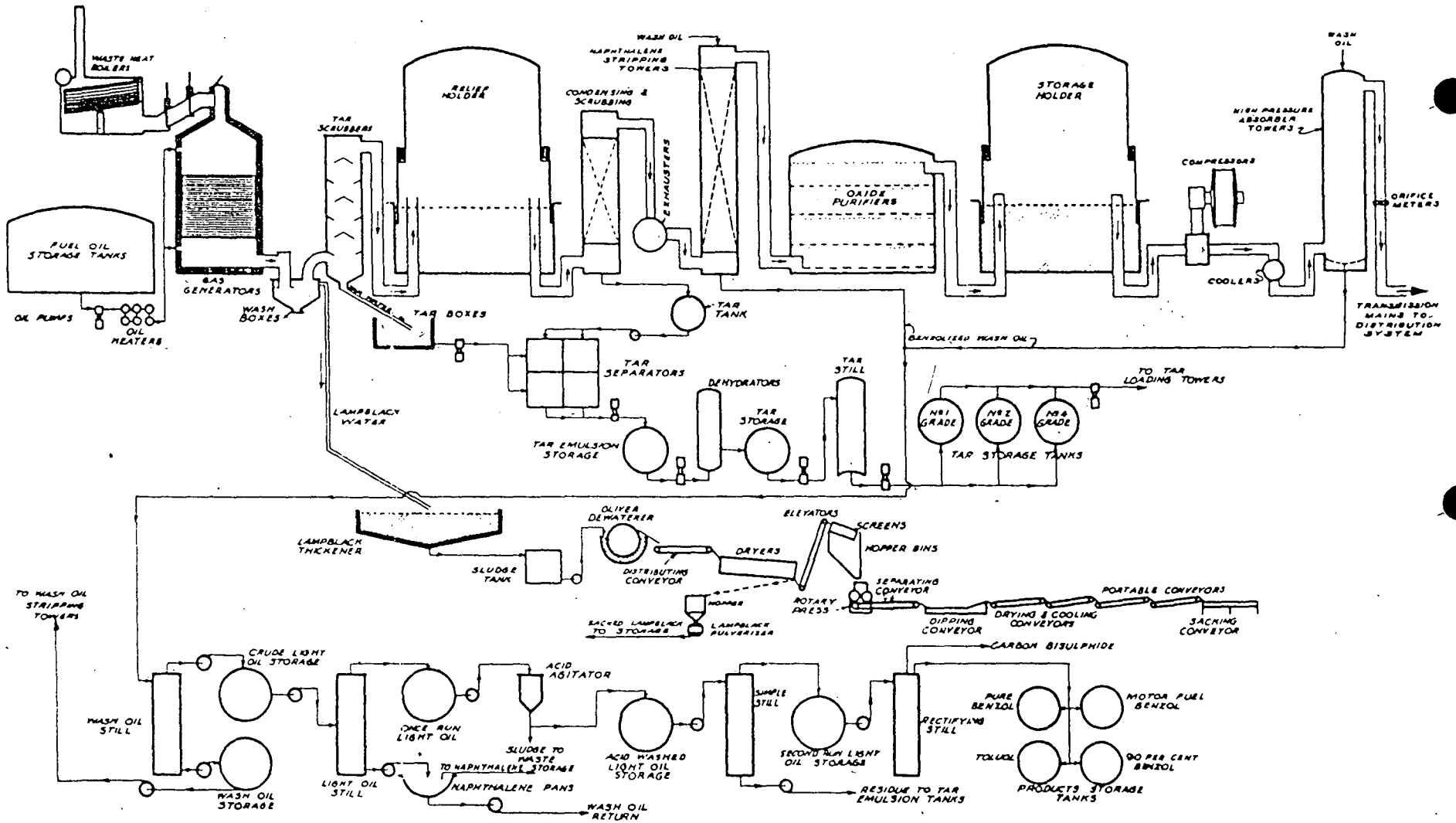
W. L. Gibbs

W. L. Gibbs, Manager
Engineering Department

WLG:lb
Encl.

cc: J. Van Bladeren
E. L. Bolin
D. L. Foley
R. W. Gullberg

wlgdeq1



PORTLAND GAS & COKE COMPANY

GAS MANUFACTURING & BY PRODUCTS FLOW DIAGRAM

SCOEPA00012052

OLYMPIC PIPE LINE COMPANY
2319 LIND AVE. S.W.
P.O. BOX 1800
RENTON, WASHINGTON 98057

RECEIVED
ENGINEERING
NOV 13 1990
John L. Pittman
Wacker Siltronic

November 7, 1990

Richard H. Wixom
Environmental Analyst
Regional Operations Division
Northwest Region
Department of Environmental Quality
811 S.W. 6th Avenue
Portland, Oregon 97204

110-Governing Agencies
Site Investigation:
Wacker Siltronics

Dear Mr. Wixom:

On the afternoon of October 17, 1990, Olympic Pipe Line Company received notification by facsimile correspondence (copy attached) from the Portland law firm of Miller, Nash, Wiener, Hager & Carlsen that their client, Wacker Siltronic Corporation, had reason to believe our pipeline was leaking subsurface on Wacker property located at 7200 N.W. Front Avenue in Portland, Oregon.

Ensuing telephone conversations with Mr. John L. Pittman, Director of Engineering for Wacker Siltronic, confirmed they had information gathered over a period of time from soil and groundwater studies conducted by their consulting firm, CH^2M Hill, which indicated high levels of benzene, toluene, ethylbenzene, and xylene (BTEX) in the groundwater near our pipeline. Mr. Pittman had notified the National Response Center of the suspect leak, also on October 17, 1990.

The presence of BTEX was discovered in samples CH^2M Hill had taken from approximately 25 feet subsurface and seemed to correlate to the pipeline corridor. These preliminary indications made Olympic's dedicated gasoline pipeline a likely suspect and this line was isolated immediately to prevent further possible contamination.

Our Supervisor of Operations and Maintenance began organizing crews and equipment for excavation of the area demonstrated most likely to be the problem source. This effort commenced the evening of October 17th and continued through to the morning of Friday the 19th, at which time the pipeline(s) were exposed and an area approximately 30' x 40' x 22' deep had been excavated.

Though materials removed may have indicated other possible contaminants (this area is filled with dredge spoils and

debris), Olympic found no evidence of hydrocarbons in any of the soils excavated. The pipeline and wrap (coating) was in excellent condition.

A preliminary pressure test was conducted on October 18th of this entire segment of pipe and indicated no integrity compromise. This information was shared between Olympic management personnel, Mr. Pittman, Jill Benson of CH2M Hill and yourself on site Friday AM, October 19, 1990. The decision was made to backfill the excavated area.

Olympic committed to further testing of soils and groundwater in the suspect area, but found no evidence which warranted remedial action or more extensive excavation.

We have conducted subsequent pressure checks on the entire gasoline line segment beginning October 31, 1990 and ending November 2, 1990 (charts enclosed). There is no indication from these tests that any leakage exists.

A detailed correlation of pressure loss v. temperature drop for the time periods referenced above has been prepared by Mr. Frank Hopf, Manager/Vice President of Olympic, a licensed P.E. (Texas #62118). We submit these results for your examination and records:

OLYMPIC PIPE LINE COMPANY
Portland, Oregon - Gasoline Lateral Proof Testing
October 18, 1990 - October 19, 1990
Relief Setting - 260 psi
Normal Op pressure - 80 psi

Time:
17:44 - Pressure lateral to 90 psi (at vacuum)
17:55 - Pressure holding at 89 psi
17:58 - Pressure stabilized at 87 psi
Commence further pressuring
18:03 - Pressure increased to 147 psi and holding
18:24 - Pressure increased to 270 psi
18:25 - Block in pressure. Line reading 266 psi
Air temperature (ambient) 52°F
Line temperature (indicated) 74.1°F
19:00 - Pressure - 254 psi / Temp 51°F (ambient)
10-19-90
05:00 - Pressure - 212 psi / Temp 48°F (ambient)

Review of pressure drop = 42 psi over 10 hour period.
Exposure - dry
1°F temp drop in fluid from 74.1°F to 73.1(±)°F

Ambient conditions possibly affected bulk line temperature. Probe mounted externally, insulated and buried. Wall (pipe) temperature will drop more rapidly than bulk line temperature.

CALCULATION METHODOLOGY

Pressure drop based on 1 (one) °F - bulk temperatue drop

$$\Delta P = \left(\frac{\Delta T}{\dfrac{\dfrac{\Delta V}{V} - \left[\left(\dfrac{D_L}{t} \right) \left(\dfrac{1.25 - \mu}{E} \right) + \dfrac{1}{B} \right]}{3\alpha - \gamma}} \right)$$

Where ΔV = Added volume in gallons during test = 0
V = Total volume in test section (gals.) = 101,556
D_L = Internal wall diameter = 13.438"
t = Wall thickness = .281"
μ = Poisson's Ratio (steel pipe) = 0.3
E = Bulk modulas - steel = 30,000,000 psi
B = Bulk modulas - gasoline at 58°F 220 psig
= 125,221 psig
T = 1°F
α = Coefficient of expansion for steel = 0.0000065/F°
γ = Coefficient of gaso at 58°F and 220 psi = 0.00068/F°

$$\Delta P = \left(\frac{1°F}{\dfrac{\dfrac{0}{101.556} \left[\left(\dfrac{13.438''}{.281''} \right) \left(\dfrac{1.25 - 0.3}{30{,}000{,}000PSI} \right) + \dfrac{1}{125{,}221PSIG} \right]}{3\left(.0000065/F°\right) - 0.00068/F°}} \right)$$

$$\Delta P = \left(\frac{1°F}{\dfrac{0 - \left(.000001514 + .000007958\right)/PSI}{\left(0.0000195 - 0.00068\right)/F°}} \right) = \frac{1°F}{\left(\dfrac{.000009472/PSI}{.0006605/°F} \right)}$$

P = 69.7 psi/°F 12-2-90 - F.H.

Olympic's present direction will be to pursue additional testing, as above specified as well as hydrostatic tests on

both the gasoline and fuel lines in the next few weeks, as coordinating allows.

It is our determination at this time however, that we cannot find a source material or cause for the evaluation that Olympic Pipe Line Company may have a leak on the Wacker property. We have committed to resolve this issue and approached the problem posed to us rapidly and conscientiously without question.

Olympic will be happy to share further information with all concerned. We also wish to express our appreciation to John Pittman for his complete cooperation and assistance. Should you have further questions, please feel free to call me at any time.

Very Truly Yours,

William Mulkey

W. A. Mulkey
Supervisor Regulatory and
Environmental Affairs

cc: John Pittman

Notified Coast Guard

MILLER, NASH, WIENER,
HAGER & CARLSEN
ATTORNEYS AND COUNSELORS AT LAW
3500 U.S. BANCORP TOWER
111 S.W. FIFTH AVENUE
PORTLAND, OREGON 97204-3699
TELEPHONE (503) 224-5858
TELEX 364462 KINGMAR PTL
FACSIMILE (503) 224-0155

HARVEY C. BARRAGAR

SEATTLE OFFICE:
4400 TWO UNION SQUARE
601 UNION STREET
SEATTLE, WASHINGTON 98101-2352
TELEPHONE (206) 622-8484
FACSIMILE (206) 622-7485

October 17, 1990

Mr. Frank Hopf
Olympic Pipeline Co.
Post Office Box 1800
Renton, Washington 98057

Sent to Fax (206) 271-5320

Dear Mr. Hopf:

This firm represents Wacker Siltronic Corporation. Our client's property at 7200 N.W. Front Avenue, Portland, Oregon, is crossed by a pipeline operated by your company.

This letter is to confirm my advice to your Operations Department ((206) 226-8880) that Wacker Siltronic Corporation has reason to believe that there is a leak in your pipeline on the Wacker Siltronic property.

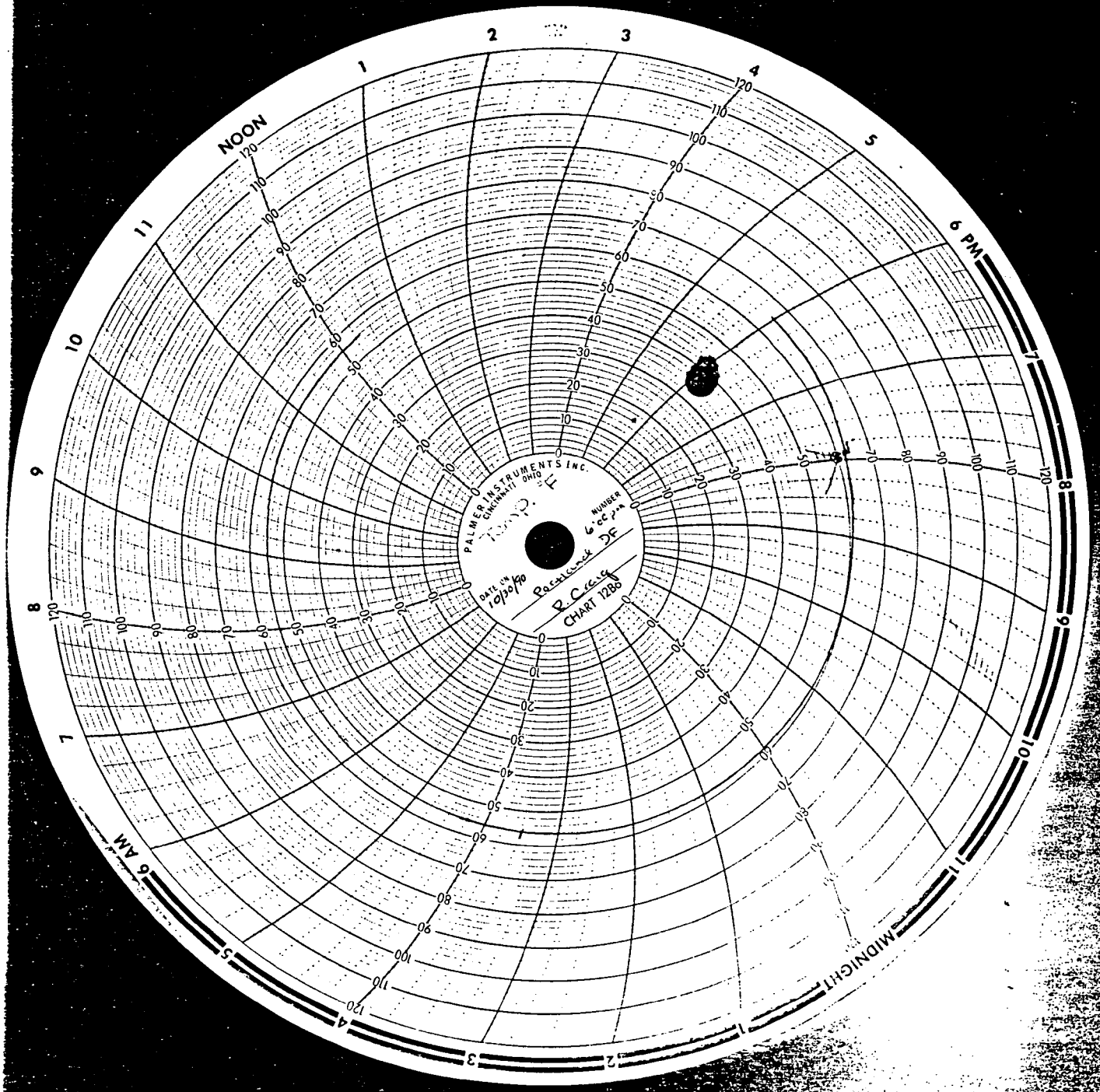
Further information can be obtained from John Pittman, Director of Engineering ((503) 243-2020). Wacker Siltronic is reporting the possible discharge to the National Response Center and to the Oregon Department of Environmental Quality.

Very truly yours,

Harvey C. Barragar

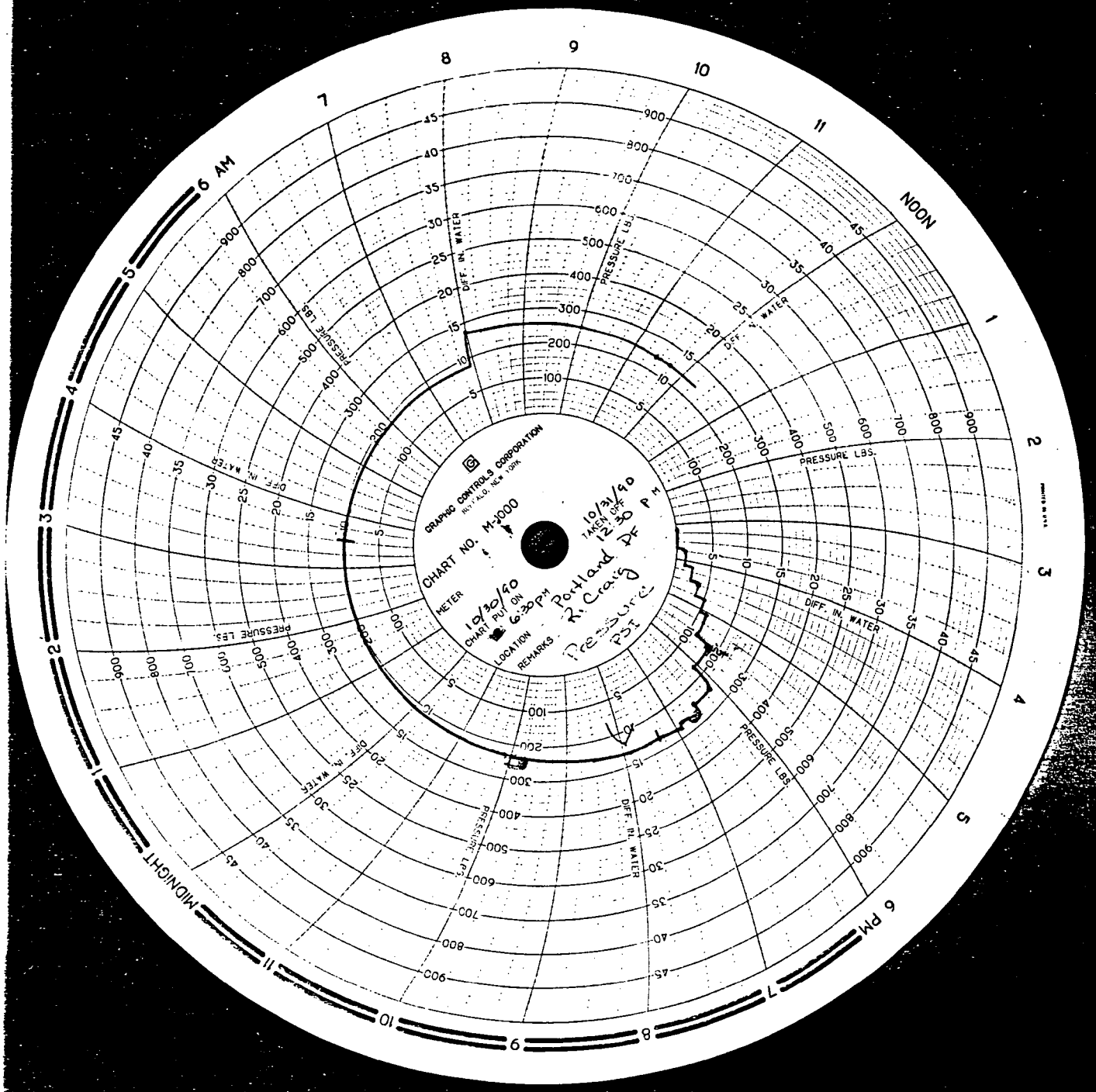
cc: Mr. John L. Pittman

PORTLAND DELIVERY
GASO LINE 10-31-90
TEMPERATURE 18 HOURS



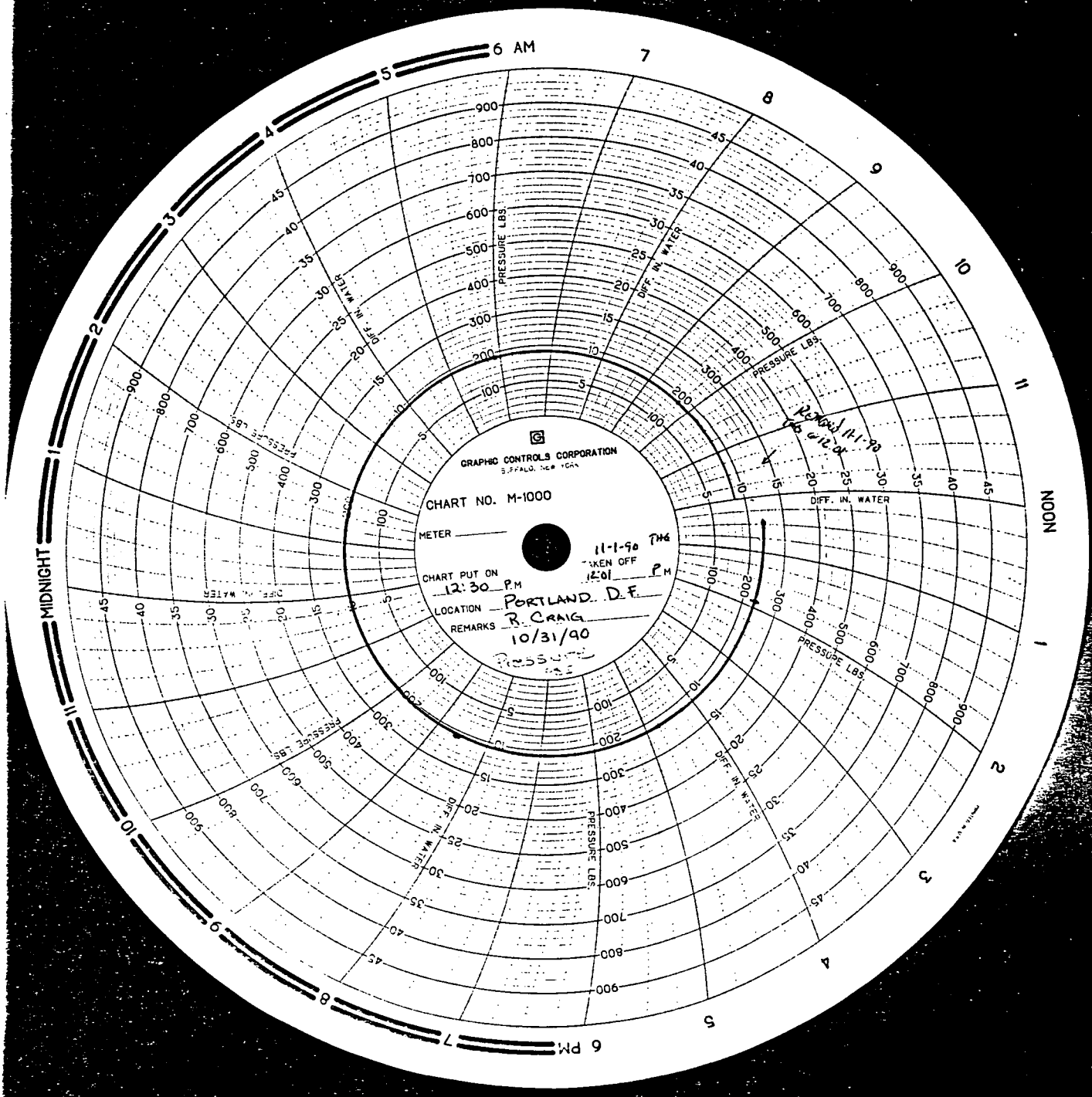
1-A

PORTLAND DELIVERY
GASO LINE 10-31-90
PRESSURE CHART 18 HOURS



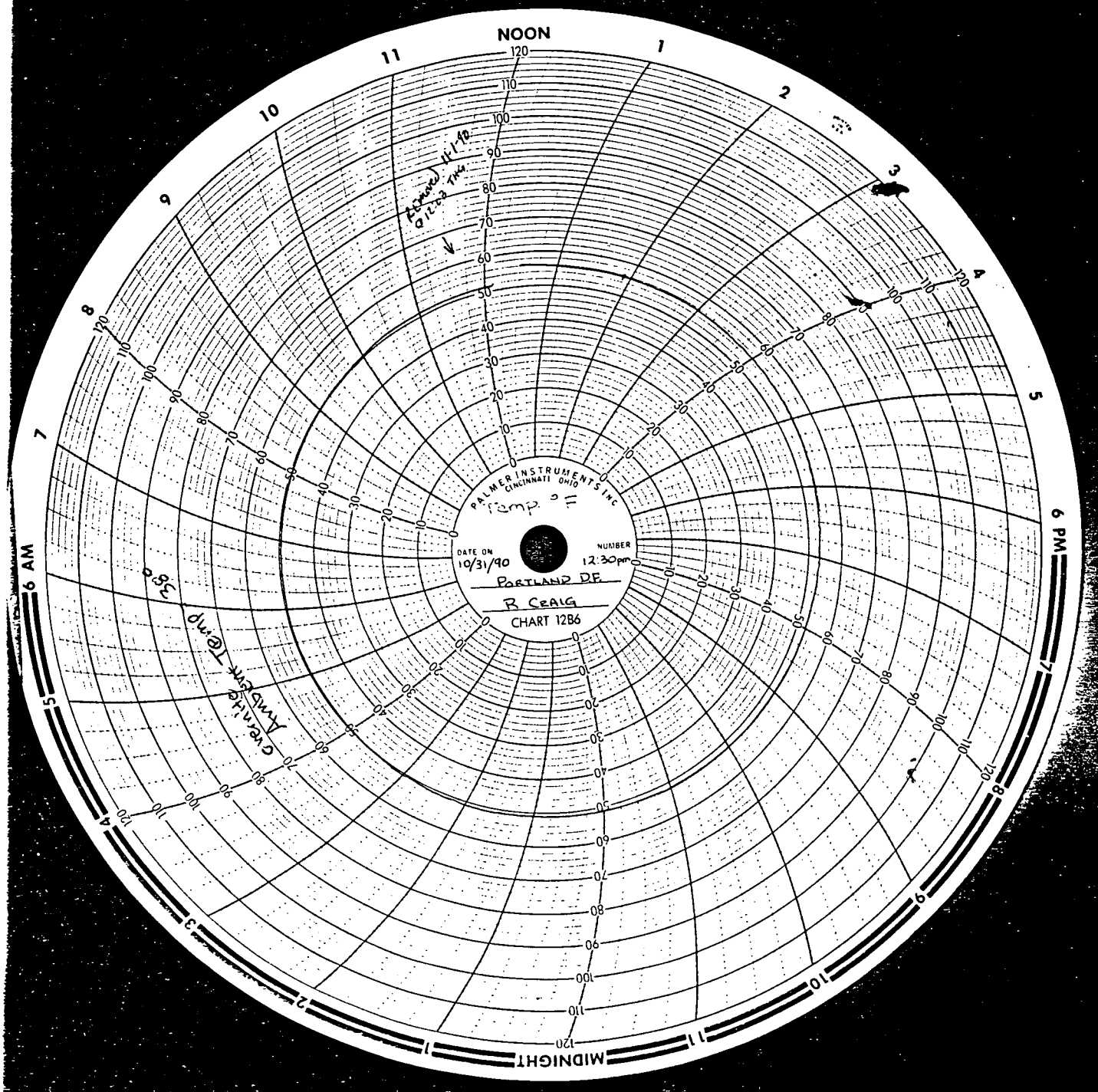
1B

PORTLAND DELIVERY GASO.
LINE 11-1-90
PRESSURE CHART 23 HRS.



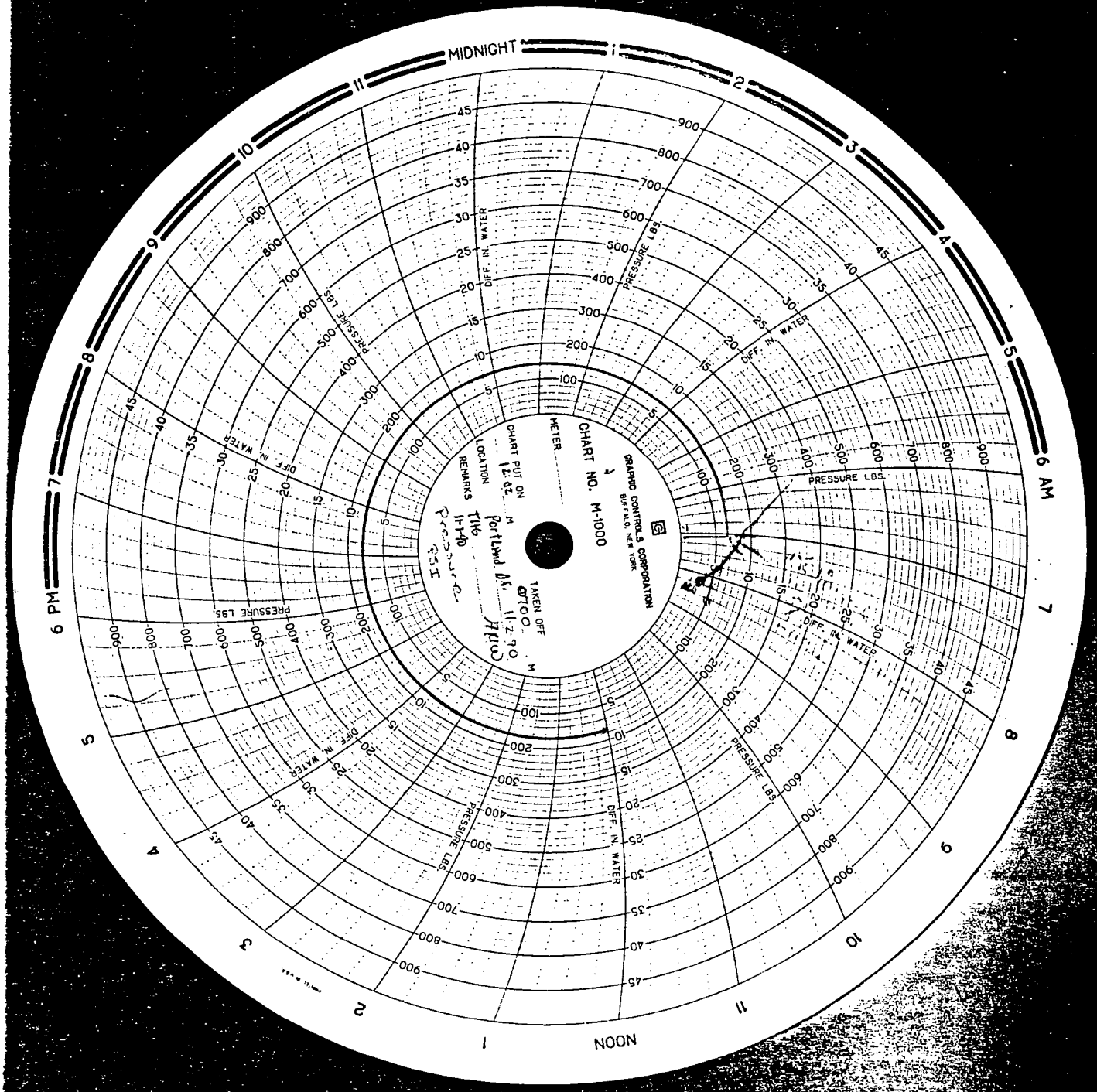
2A

PORTLAND DELIVERY GASO.
LINE 11-1-90
TEMPERATURE CHART 23HRS



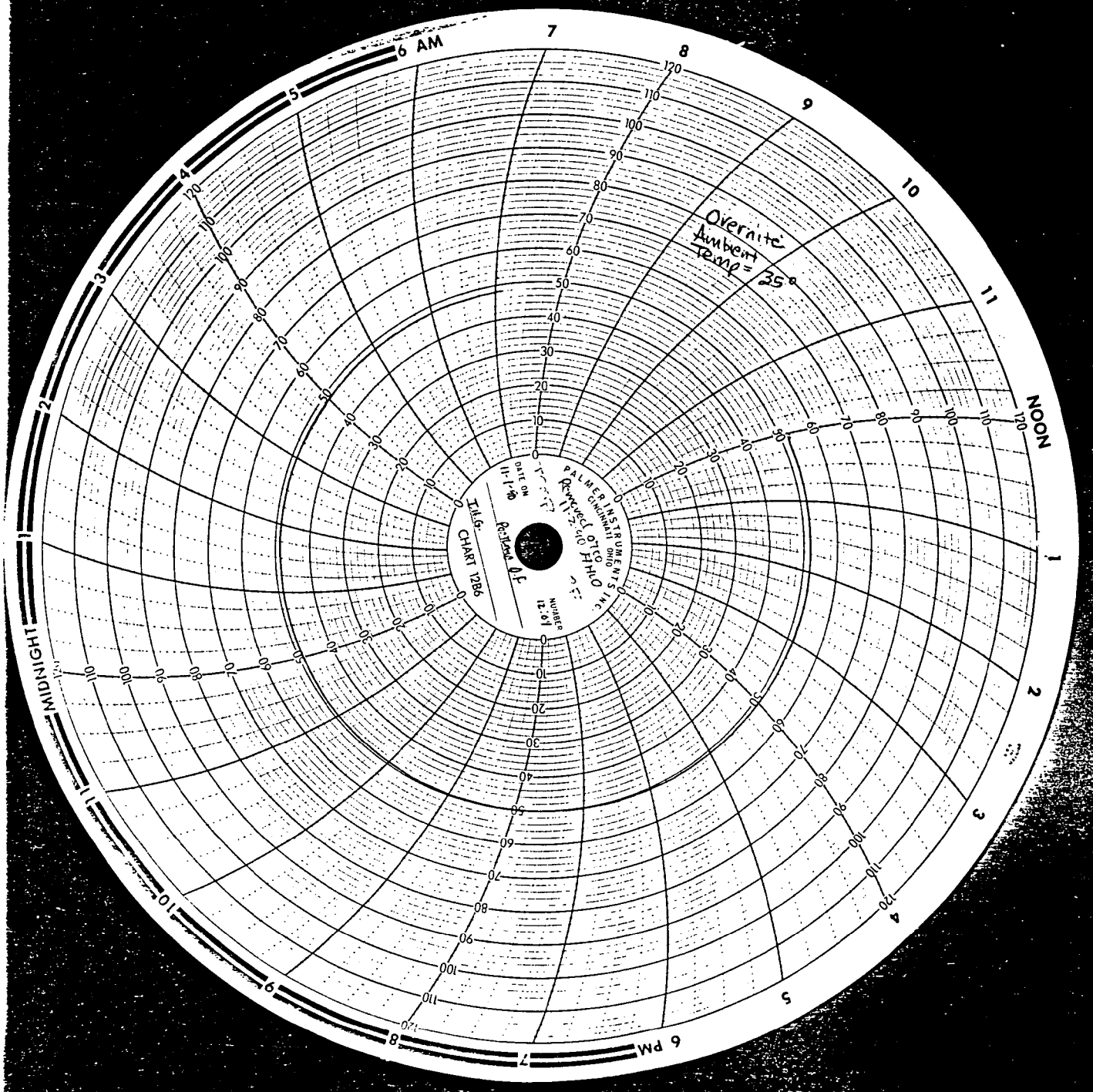
2B

PORTLAND DELIVERY GASO.
LINE 11-2-90
PRESSURE CHART 19 HRS.



3A

PORTLAND DELIVERY GASO.
LINE 11-2-90
TEMPERATURE 19 HOURS



3B

WACKER

FACSIMILE TRANSMITTAL SHEET

WACKER SILTRONIC CORPORATION
P.O. Box 83180
Portland, Oregon 97283-0180

7200 N.W. Front Avenue
Portland, Oregon 97210

PHONE: (503) 243-2020
FAX: (503) 226-0052
TELEX: 4970339

DATE: 3/11/91

FAX NO.: 1060/91

NUMBER OF PAGES (INCLUDING THIS PAGE) 4

TO: HARVEY BARREGAR

FROM: JOHN PITTMAN

MESSAGE/SPECIAL INSTRUCTIONS:

SEND TO FAX NO: 224-0155

Engineers
Planners
Economists
Scientists

Portland Office

March 8, 1991

PDX31790.A0

Mr. John Pittman
Wacker Siltronic Corporation
Portland, Oregon 97210-3676

Dear John:

This letter is a follow-up to our March 5, 1991, meeting with Olympic Pipeline (OPL), GeoEngineers, and you. As you know, OPL pressure tested both of their pipelines that transect the Wacker property on Friday, March 1, 1991. According to OPL, results of the pressure testing indicate that the gas line is not leaking and that the fuel line ruptured during the test. At this time, it is OPL's intent to replace both pipelines with two similar pipes, which are to be buried at a depth of about 4 to 6 feet below existing ground surface. OPL also plans to investigate the rupture in the fuel pipeline.

This letter presents our comments and recommendations pertaining to the proposed investigation. Addressed in the letter are our recommended approach to the investigation, a discussion of access concerns, comments pertaining to CH2M HILL's involvement in the investigative work, and a list of information that should be requested of OPL and GeoEngineers.

RECOMMENDED INVESTIGATIVE APPROACH

The pipeline investigation should focus on obtaining sufficient information to satisfy two questions:

1. Was a leak present in the pipeline prior to rupture of the pipe during the pressure testing?

2. Is there contamination present below Wacker property that is associated with a leak in either pipeline?

Because of access restrictions to the pipelines (namely the burial depth) and limited information about the location of the ruptured area, we realize that the investigation program needs to be approached in a phased manner. It is our recommendation that

Serving Oregon and Southwest Washington from two locations:
CH2M HILL **Portland Office** **2020 S.W. Fourth Avenue, 2nd Floor, Portland, OR 97201** **503.224.9190**
Corvallis Office 2300 N.W. Walnut Blvd, P.O. Box 428, Corvallis, OR 97339 503.752.4271

the initial investigation of the fuel pipeline be conducted with a panoramic video camera to allow for close inspection of the pipe by all interested parties. If the ruptured area(s) cannot be identified visually, several other investigative methods are available for use (such as an incremental packer testing setup or "smart pigs" that are capable of measuring wall thickness, etc). Upon review of this initial investigative data, a plan for further exploration should be developed which might include excavation of a portion of the pipeline and/or groundwater and soil sampling for visual inspection and chemical analysis.

ACCESS CONCERNS

Because of the depth of the pipelines (known to be up to 23 feet below existing ground surface), access is a concern. The issue of access affects not only the ability to readily excavate the pipe for visual inspection if it is desired, but also affects the ability to perform any necessary excavations. Should any inspection equipment become lodged in the line, excavation may be required to remove the equipment and allow for other means of pipeline inspection beyond the obstacle. Additionally, the new pipelines are to be installed along the same horizontal alignment as the original pipelines. Consequently, once the new lines are in place, excavation of the abandoned lines becomes increasingly difficult. Further, depending on the method of pipe inspection selected, the presence of the new lines may or may not interfere with the resulting data. Also, a deep excavation adjacent to the Fab 2 preload's vertical fabric reinforced soil wall may jeopardize the stability of the excavation and the surrounding area. Consequently, the Fab 2 preload construction schedule should be taken into consideration when evaluating the sequence of work. For these reasons, we recommend that the pipeline be investigated as soon as possible and before installation of the new pipelines.

CH2M HILL INVOLVEMENT

CH2M HILL understands OPL's interest in using their retained consultants to be the lead engineers on the investigative work and we hope to establish a cooperative working relationship with GeoEngineers. However, for CH2M HILL to best serve the needs of Wacker, perhaps a more formal approach to both CH2M HILL's and Wacker's input to, and review and approval of, OPL's investigative approach should be considered. For example, before testing the pipeline, the proposed testing method and specific type of equipment should be submitted to Wacker and CH2M HILL for review and approval. Also, we believe that our input to not only the investigative approach, but also the data evaluation, is required. Wacker and CH2M HILL should receive the results of the test data for review immediately after conducting any test.

REQUESTED INFORMATION

Review of the following information would be helpful in addressing the objectives of the investigation.

- All test data and information associated with both the November and recent pressure tests.
- Information and data for historical pressure testing of the pipelines, if any.
- Laboratory data sheets showing typical constituents and relative concentrations of the products transported through the pipelines (laboratory data sheets representative of several years of data are preferred).
- Available records pertaining to the historical pipeline uses. It would be beneficial to know the types and extent of records available. For example, have logs been kept for the life of the pipeline that show the type, quantity, date of shipment, and laboratory analysis for product transport through the pipeline?

If you have any questions before our meeting with OPL and GeoEngineers on March 14, please contact me or Mark Whitson at 224-9190.

Sincerely,

CH2M HILL

Jill K. Bensen P.E.

cc: Bill Cobb
Candee Hatch
Doug Kanis
Dave Watson
Mark Whitson

MILLER, NASH, WIENER, HAGER & CARLSEN
ATTORNEYS AND COUNSELORS AT LAW
3500 U. S. BANCORP TOWER
111 S.W. FIFTH AVENUE
PORTLAND, OREGON 97204-3699
TELEPHONE (503) 224-5858
TELEX 364462 KINGMAR PTL
FAX (503) 224-0155

FACSIMILE TRANSMISSION

To: Mr. John Pittman

Company: Wacker Siltronic Corp.

FAX Number: 226-0052

Telephone Number:

From: Mr. Harvey Baragar

Total pages being sent (including this page): 3

Date: 3/21/91 Client # 70150

Time: Matter # 6001

If you do not receive all pages or if there is any question, please call (503) 224-5858, ext. ____.

OUR FAX NUMBER IS (503) 224-0155.

COMMENTS:

MILLER, NASH, WIENER,
HAGER & CARLSEN
ATTORNEYS AND COUNSELORS AT LAW
3500 U.S. BANCORP TOWER
111 S.W. FIFTH AVENUE
PORTLAND, OREGON 97204-3699
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SEATTLE OFFICE:
4400 TWO UNION SQUARE
601 UNION STREET
SEATTLE, WASHINGTON 98101-2352
TELEPHONE (206) 622-8484
FACSIMILE (206) 622-7485

HARVEY C. BARRAGAR

March 18, 1991

Mr. Frank Hopf
Olympic Pipeline Co.
Post Office Box 1800
2319 Lind S.W.
Renton, Washington 98055

Certified-Return
Receipt Requested

Dear Mr. Hopf:

Reference is made to our letter of October 17, 1990 regarding your company's pipeline across the Wacker Siltronic Corporation property.

As you may know, a portion of the Olympic Pipeline fuel oil line across our client's property did not withstand a pressure test. Wacker Siltronic Corporation and its engineering firm CH2M/Hill believe there is convincing evidence that there has been a leak on its property and that remediation is appropriate. The engineers are compiling information supporting their view, a copy of which will be provided to a representative of Olympic Pipeline Co. as soon as it is available.

John Pittman, Director of Engineering of Wacker Siltronic Corporation, understood from statements made by a representative of your company on March 5, 1991 that a section of the pipeline would be replaced and that appropriate remediation would be undertaken. At a meeting on March 15, Mr. Pittman was informed that the section of pipe will be replaced and that Olympic Pipeline Co. will take no further action. Furthermore, Olympic Pipeline was unwilling to share any information in its possession regarding the alleged leak.

Representatives of Olympic Pipeline Co. have been advised that Wacker Siltronic Corporation is beginning an expansion in the area of the pipeline. Remediation efforts could be substantially more expensive after this expansion is underway. We have been asked to advise you that Wacker Siltronic Corporation will look to Olympic Pipeline Co. for

MILLER, NASH, WIENER,
HAGER & CARLSEN

reimbursement of any costs related to remediation of environmental damaged caused by leaks in your company's pipeline. In the event that our client's expansion project is delayed as a result of governmental action related to the leaking pipeline, Wacker Siltronic will also look to Olympic Pipeline Co. for any damages resulting from such delay.

Wacker Siltronic Corporation is extremely disappointed at the uncooperative stance of Olympic Pipeline Co.

Very truly yours,

cc: Mr. John Pittman

OLYMPIC PIPE LINE COMPANY

2319 LIND AVE. S.W.
PO BOX 1800
RENTON, WASHINGTON 98057

03448/53139

June 11, 1991

Mr. John Pittman
Director of Engineering
Wacker Siltronics Corporation
P.O. Box 83180
Portland, OR 97283-0180

HAND DELIVERED

Re: Requested Documents

Dear John:

Per our agreement, attached for your information are the following documents:

- HYDROSTATIC TESTING PORTLAND DELIVERY LINES, MAY, 1991 prepared for Olympic Pipeline Company by MARMAC, Cypress, California.
- June 11, 1991 letter to Geo Engineers, Inc. from Analytical Technologies, Inc. containing the analyses for the diesel and turbine fuel products transported through Olympic's fuel line.

As you will note in Section 4 of the Marmac report, the report concludes that the fuel line segment from the distribution facility (DF) to the Texaco terminal failed the pressure test. This is the segment of the line which transverses the Wacker Siltronics property. Be advised that we have contacted MARMAC and are obtaining an addendum to this report which provides greater specificity of the events leading up to the failure of the line and will state, that in MARMAC's opinion, the fuel line did not fail prior to applying the 780 PSI pressure to the line. We will be forwarding a copy of this document, which we have yet to receive, to you on or before Friday, June 14, 1991.

If you have any further questions regarding the documents which we are providing, please feel free to contact me.

Very truly yours,

William A. Mulkey

WAM/tlc
41\cl\olympic\pittma-l.001
Encl.

Analytical Technologies, Inc.
560 Naches Avenue, S.W., Suite 101, Renton, WA 98055, (206) 228-8335

ATI I.D. # 9106-025

June 11, 1991

GeoEngineers, Inc.
10170 SW Nimbus Ave
Suite H1
Portland, OR 97223

Attention : George Saunders

Project Number : 894-008-P69

Project Name : Olympic Pipe Line

On June 4, 1991, Analytical Technologies, Inc., received 2 product samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data were issued on June 7, 1991.

Enclosed is the amended page to the report previously issued. Please replace the original page with this update. We apologize for any inconvenience this may have caused.

Bob Olsiewski

Bob A. Olsiewski
Project Manager

Frederick W. Grothkopp
Technical Manager

FWG/hal/cn

AnalyticalTechnologies,Inc. 560 Naches Avenue, S.W., Suite 101, Renton, WA 98055. (206) 228-8335

ATI I.D. # 9106-025

June 7, 1991

GeoEngineers, Inc.
10170 SW Nimbus Ave
Suite H1
Portland, OR 97223

Attention : George Saunders

Project Number : 894-008-P69

Project Name : Olympic Pipe Line

On June 4, 1991, Analytical Technologies, Inc., received 2 product samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Bob A. Olsiewski
Project Manager

Frederick W. Grothkopp
Technical Manager

FWG/hal/cn

AnalyticalTechnologies,Inc.

ATI I.D. # 9106-025

SAMPLE CROSS REFERENCE SHEET

CLIENT : GEOENGINEERS, INC.
PROJECT # : 894-008-P69
PROJECT NAME : OLYMPIC PIPE LINE

ATI #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
9106-025-1	DIESEL	05/31/91	PRODUCT
9106-025-2	TURBINE FUEL	06/02/91	PRODUCT

----- TOTALS -----

MATRIX	# SAMPLES
PRODUCT	2

ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of the report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

Analytical Technologies, Inc.

ATI I.D. # 9106-025

ANALYTICAL SCHEDULE

CLIENT : GEOENGINEERS, INC.
PROJECT # : 894-008-P69
PROJECT NAME : OLYMPIC PIPE LINE

ANALYSIS	TECHNIQUE	REFERENCE	LAB
BETX	GC/PID	EPA 8020	R
FUEL HYDROCARBONS	GC/FID	EPA 8015 MODIFIED	R

R = ATI - Renton
SD = ATI - San Diego
T = ATI - Tempe
PNR = ATI - Pensacola
FC = ATI - Fort Collins
SUB = Subcontract

AnalyticalTechnologies,Inc.

ATI I.D. # 9106-025

VOLATILE ORGANIC COMPOUNDS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: N/A
PROJECT #	: 894-008-P69	DATE RECEIVED	: N/A
PROJECT NAME	: OLYMPIC PIPE LINE	DATE EXTRACTED	: N/A
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 06/05/91
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8020 (BETX)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BENZENE	<0.5
ETHYLBENZENE	<0.5
TOLUENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

BROMOFLUOROBENZENE	93

AnalyticalTechnologies,Inc.

ATI I.D. # 9106-025-1

VOLATILE ORGANIC COMPOUNDS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 05/31/91
PROJECT #	: 894-008-P69	DATE RECEIVED	: 06/04/91
PROJECT NAME	: OLYMPIC PIPE LINE	DATE EXTRACTED	: N/A
CLIENT I.D.	: DIESEL	DATE ANALYZED	: 06/06/91
SAMPLE MATRIX	: PRODUCT	UNITS	: ug/L
EPA METHOD	: 8020 (BETX)	DILUTION FACTOR	: 100,000

COMPOUNDS	RESULTS
BENZENE	130,000
ETHYLBENZENE	510,000
TOLUENE	830,000
TOTAL XYLENES	3,000,000

SURROGATE PERCENT RECOVERIES

BROMOFLUOROBENZENE	115

AnalyticalTechnologies,inc.

ATI I.D. # 9106-025-2

VOLATILE ORGANIC COMPOUNDS
DATA SUMMARY

CLIENT	: GEOENGINEERS, INC.	DATE SAMPLED	: 06/02/91
PROJECT #	: 894-008-P69	DATE RECEIVED	: 06/04/91
PROJECT NAME	: OLYMPIC PIPE LINE	DATE EXTRACTED	: N/A
CLIENT I.D.	: TURBINE FUEL	DATE ANALYZED	: 06/06/91
SAMPLE MATRIX	: PRODUCT	UNITS	: ug/L
EPA METHOD	: 8020 (BETX)	DILUTION FACTOR	: 100,000

COMPOUNDS	RESULTS
BENZENE	430,000
ETHYLBENZENE	1,500,000
TOLUENE	2,800,000
TOTAL XYLENES	8,200,000

SURROGATE PERCENT RECOVERIES

BROMOFLUOROBENZENE	*

* - Out of limits due to matrix interference.

AnalyticalTechnologies,Inc.

ATI I.D. # 9106-025

VOLATILE ORGANIC COMPOUNDS
QUALITY CONTROL DATA

CLIENT : GEOENGINEERS, INC.
PROJECT # : 894-008-P69
PROJECT NAME : OLYMPIC PIPE LINE
EPA METHOD : 8020 (BETX)
SAMPLE MATRIX : WATER

SAMPLE I.D. # : 9106-036-2
DATE EXTRACTED : N/A
DATE ANALYZED : 06/05/91
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	23.3	20.0	42.1	94	39.9	83	5
TOLUENE	1.11	20.0	19.2	90	19.7	93	3
TOTAL XYLENES	2.75	40.0	39.1	91	39.9	93	2

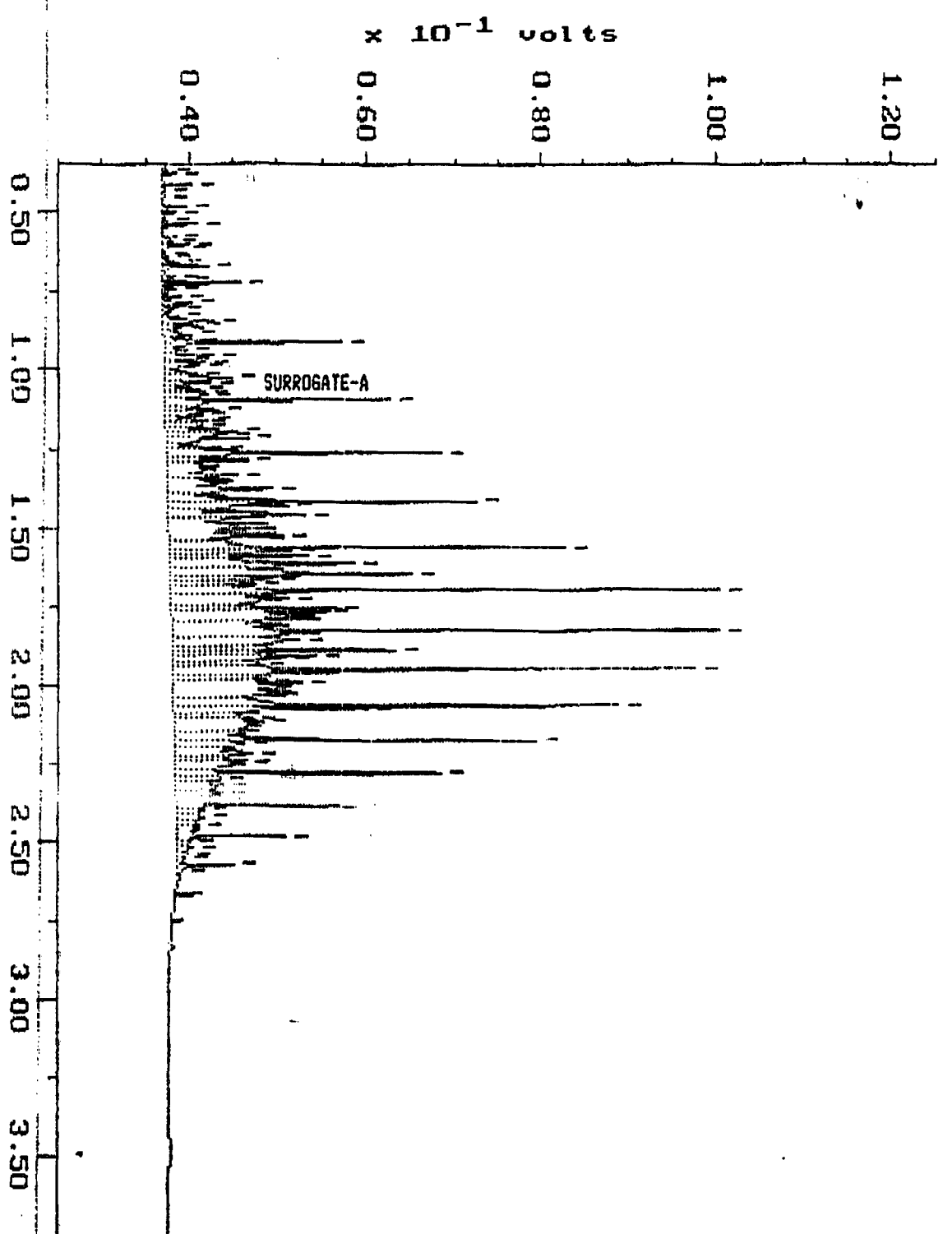
$$\%Recovery = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$RPD\ (\text{Relative \% Difference}) = \frac{|(\text{Spike Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

Sample: 9106-025-1 DIL
Acquired: 05-JUN-91 5:49
Dilution: 1 : 2000.000

Channel: BERT
Method: L:\BRO2\MAXDATA\BERT\FUEL0604
Inj Vol: 1.00

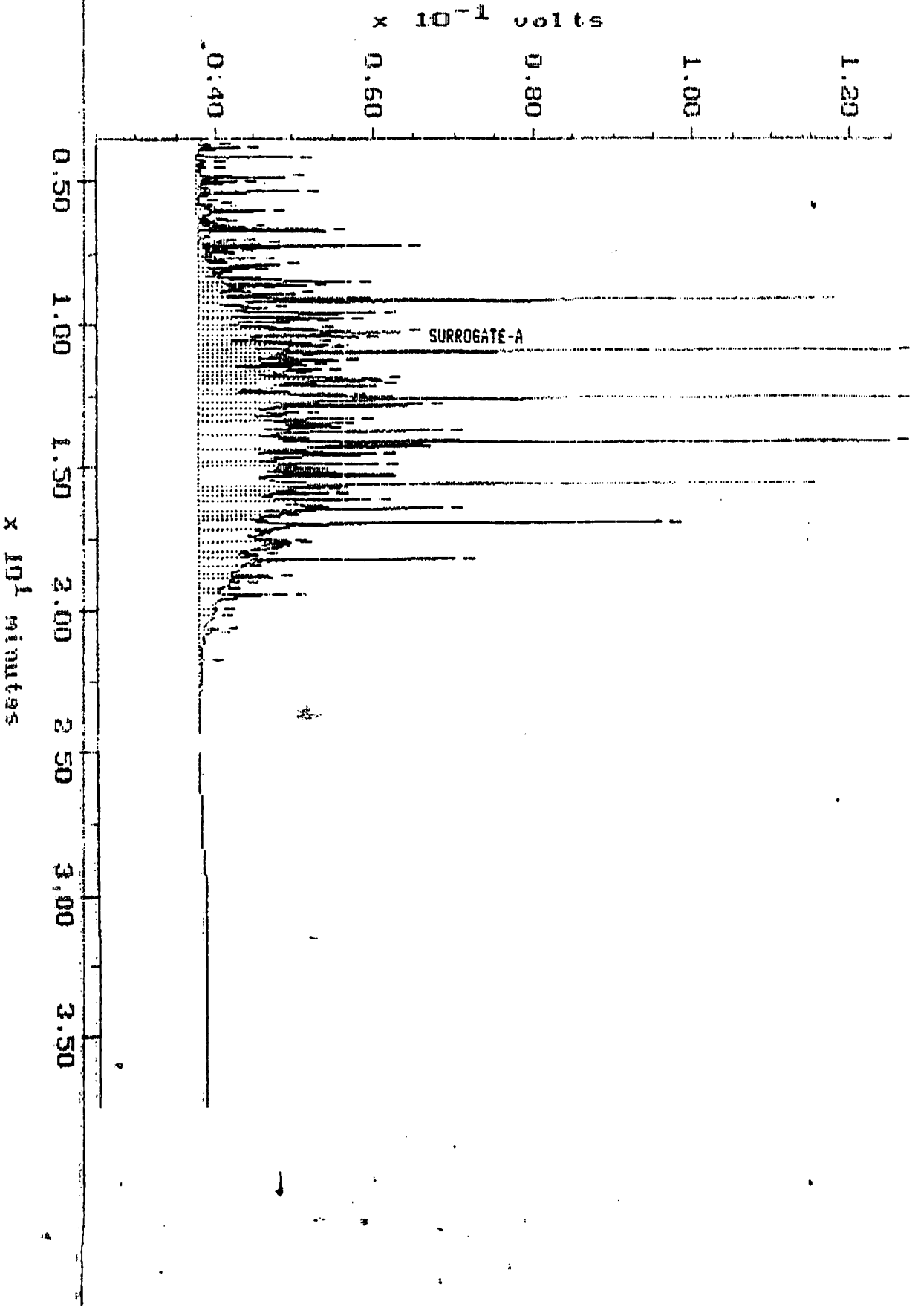
Filename: 0604BE22
Operator: PEA



Sample: 9106-025-2 DIL
Acquired: 05-JUN-91 7:20
Dilution: 1 : 2000.000

Channel: BERT
Method: L:\BROZ\MAXDATA\BERT\FUEL0604
Inj Vol: 1.00

Filename: 0604BE24
Operator: PEA



AnalyticalTechnologies, Inc.
560 Naches Avenue SW, Suite 101 Renton, WA 98055 (206)228-8335

DATE 06/03/91 PAGE 1 OF 1

Chain of Custody

LABORATORY NUMBER: 9106-025

PROJECT MANAGER: George Saunders
COMPANY: GeoEngineers, Inc.
ADDRESS: 10110 SW Nimbus Ave., Suite H1
Portland, OR 97223
PHONE: 503-624-9274 SAMPLED BY: George Saunders

SAMPLE DISPOSAL INSTRUCTIONS
☒ ATI Disposal @ $5.00 each (See special instructions) ☐ Return

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	8010 Halogenated Volatiles	8020 Aromatic Volatiles	BETX ONLY (8020)	8240 GCMS Volatiles	8270 GCMS BNA	8310 HPLC PNA	8080 Pesticides & PCB's	PCB's ONLY	8140 Phosphate Pesticides	8150 Herbicides	WDOE PAH/HH (WAC 173)	418.1 (TPH)	413.2 Grease & Oil	8015 (Modified)	TOC 9060	TOX 9020	% Moisture	EP TOX Metals (8) EP EXT	Priority Pollutant Metals (13)	TCLP ONLY: 8080 Pesticide (4)	8240 ZH-EXT	8270	8150 Herbicides (2)	Metals (8)			NUMBER OF CONTAINERS
Diesel	05/31/91	1410	liquid	-1		X	X											X													4
Turbine fuel	06/02/91	2140	liquid	-2		X	X											X													4

PROJECT INFORMATION
PROJECT NUMBER: 891-008-P69
PROJECT NAME: Olympic Pipe Line
PURCHASE ORDER NUMBER: 891-008-P69
ONGOING PROJECT? YES ☒ NO ☐

SAMPLE RECEIPT
TOTAL NUMBER OF CONTAINERS: 8
COC SEALS/INTACT? Y/N/NA: Y
RECEIVED GOOD COND./COLD: Y
RECEIVED VIA: Courier

PRIOR AUTHORIZATION IS REQUIRED FOR RUSH PROJECTS
TAT: (NORMAL) ☐ 2WKS (RUSH) ☐ 24HR ☐ 48 HRS ☐ 72 HRS ☒ 1 WK
GREATER THAN 24 HR. NOTICE? YES ☒ NO ☐ (LAB USE ONLY)

SPECIAL INSTRUCTIONS: ATTEN: Bob Olsewski.
1) Analyze Containers 1/4, store the remaining Containers
2) EPA 8020 analysis - 10 ug/l (ppb) detection limits.
3) EPA 8015 analysis - Will use chromatograms for standards for future analysis.

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: Time: George Saunders 9:00	Signature: Time:	Signature: Time:
Printed Name: Date: George Saunders 6/3/91	Printed Name: Date:	Printed Name: Date:
Company: GeoEngineers	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: (LAB) 3.**
Signature: Time: 930	Signature: Time:	Signature: Time:
Printed Name: Date: V. Pennick 6/4/91	Printed Name: Date:	Printed Name: Date:
Company: ATI	Company:	Analytical Technologies, Inc.

ATI Labs: San Diego (619)458-9141 • Phoenix (602)438-1530 • Seattle (206)228-8335 • Pensacola (904)474-1001 DISTRIBUTION: White, Canary - ATI • Pink - ORIGINATOR

Nº 4718

SCOEPA00012082

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4.0	TEST RESULTS	4

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B	ARCO Gas
C	D.F. to Texaco Gas
D	Shell Gas
E	UNOCAL Gas
F	Chevron Gas
G	ARCO Fuel
H	Junction to Texaco Fuel
I	D.F. to Junction Fuel
J	Shell Fuel
K	UNOCAL Fuel
L	Chevron Fuel
M	New Gas Line Across Wacker Property
N	New Aboveground Manifold Piping

HYDROSTATIC TESTING

PORTLAND DELIVERY LINES

Olympic Pipe Line Company
P.O. Box 1800
2319 Lind Avenue S.W.
Renton, Washington 98057

May, 1991

Prepared by:

MARMAC
6415 Katella Avenue
Cypress, CA 90630-5207

MARMAC Project #1940

HYDROSTATIC TESTING
PORTLAND DELIVERY LINES
OLYMPIC PIPE LINE COMPANY

1.0 INTRODUCTION

MARMAC was contracted by Shell Oil Company's General Engineering from their Houston, Texas office to provide engineering services for the testing of all of the pipelines that originate at the Portland Delivery Facility (DF). The Mobil lines from the DF were not tested because they were idle and under nitrogen pressure. The Time Oil lines from the DF and the McCall Oil lines from the Junction were also not tested because Olympic does not own them.

1.1 System Description

The Olympic pipeline originates at the refineries in northern Washington. As the line travels south, it makes deliveries at various locations. The main line terminates at the Portland DF. There it splits into parallel systems for gasoline and fuel oils. At the Portland DF, deliveries are made to ARCO, Mobil, Time and to the Portland Junction. At the Junction, connections are made to Shell, UNOCAL, Chevron, McCall and Texaco. The piping allows a continuous displacement and test from the DF to Texaco.

1.2 Scope of Work

MARMAC was to plan and organize the work with a special attention as to how to safely displace all of the product out of the lines and minimize downtime. MARMAC worked very closely with Olympic operating and scheduling personnel who in turn had close contact with the shippers and the terminals.

During the initial planning for this work, it was decided by Olympic to modify the manifold piping at the junction to take all of the valves aboveground and include a spool piece for a future meter run to be used for line integrity. The cathodic protection flanges at Texaco was also relocated to aboveground.

A draft plan was developed on how the testing would be accomplished that was first reviewed with the Olympic personnel and then presented to the terminal operators to elicit their help and comments. After this meeting, the plan was finalized and the work proceeded.

SCOEPA00012086

2.0 PREPARATION FOR TESTING PROCEDURE

A copy of the step-by-step procedure that was developed for this project follows in this section. This procedure outlines the necessary steps that must be taken to prepare the line for filling with water to be used for the hydrotest.

As part of the procedure, a detailed schedule was developed that includes every major step for the entire project. This was matched with the proposed shipping schedule to determine any conflicts and also determine milestones of when the lines needed to be back in service.

Foam or poly pigs were used to displace the product and test water from the pipeline. It is recommended that where a pig must pass through a check valve that a pig with a minimum length of 49 inches be used.

Due to the high cost of disposing of the test water that may have picked up some hydrocarbon content as a result of the testing activity, nine (9) Baker tanks were manifolded at the DF to allow the storage of the water between tests. As it turned out, all of the water was disposed of at the Texaco terminal at no cost to the project.

SCOEPA00012088

TEST OLYMPIC PIPE LINE GASOLINE LINE TO ARCO

Day 1

1. ARCO gas delivery complete.

2. 3-4 hour shutdown:

   * Drain gasoline from DF manifold.
   * Blind gasoline manifold between mainline and ARCO.
   * Remove portion of manifold at ARCO.
   * Return mainline to service.

3. Install barrel with pig in it on ARCO line, V-804.

4. Nitrogen Unit "A" set up at DF.

Day 2

1. Displace gasoline into ARCO with N2. Stop pig short of valve at ARCO.

2. Install drip pan under spool piece at ARCO.

3. Remove spool with pig at ARCO, and install blind flange at ARCO.

4. Remove barrel at DF. Remove V-804 and mating check valve and CKV-AG1 and reinstall barrel.

5. Fill line with water by putting pig in barrel and pushing it to ARCO with water. Let water level out.

6. Move nitrogen Unit "A" from DF and set up at ARCO.

Days 3 & 4

1. Conduct hydrotest.

2. After test, push test water to DF with pig and N2.

13. Move nitrogen Unit "A" from ARCO and set up at DF.

Days 5 & 6

1. Remove blind flange at ARCO and hook up piping. Remove barrel at DF and install manifold section and valves V-804 and mating check valve and CKV-AG1.

Day 7

1. Fill ARCO lateral with gasoline from ARCO terminal. Ready to flow gasoline to ARCO.

DJ/jd:1940
(testline.rpt)

TEST OLYMPIC PIPE LINE GASOLINE LINE FROM DF TO TEXACO

Day 5

1. Drain gasoline manifold at DF.

2. Remove section of gasoline mainline branch manifold at DF and blind flange manifold flanges and Mobil branch.

3. Remove V-868 and mated check valve.

   Install barrel on exposed flange.

5. Push gasoline toward Texaco from DF with pig and nitrogen.

6. Stop pig short of Texaco terminal and pump out section of line between pig and Texaco.

6. Install barrel at Texaco for future displacements.

Day 6

1. Reinstall mainline branch manifold at DF and blind flange mainline outlet.

2. At junction remove manifold and valve V-878 and mated check valve.

3. Install temporary spool piece in junction.

Day 7

1. Fill line from DF to Texaco with water behind pig and allow pressure and temperature to level out.

Days 8 & 9

1. Conduct hydrostatic test.

2. Move nitrogen Unit "A" to the Texaco end.

Day 10

1. After test, push test water from Texaco to DF with pig and nitrogen.

Days 11, 12 & 13

1. When change is made from gas to fuel, drain the gasoline manifold.

2. Remove the temporary spool at mainline branch and reinstall mainline branch spool and valve V-868 and mated check valve.

3. Remove temporary line at the junction and install the pre-tested manifold and valves.

Day 14

1. Fill line from Texaco to V-878 and mated check valve with gasoline from Texaco.

2. When change is made from fuel to gas, fill the manifold at the DF with gasoline and fill the mainline from the DF to V-878 with gasoline.

DJ/jd:1940
(df-tex.rpt)

TEST OLYMPIC PIPE LINE SHELL GASOLINE LATERAL

Day 6

1. Bleed down lateral.

2. Install barrel on Shell valve V-877.

3. Remove spool piece at tie-in and install blind flange on both Shell valve and exposed flange with temporary piping for displacement.

4. Set up the nitrogen Unit "A" at the Junction facility.

Day 7

1. Push the gasoline into the Shell with a pig and nitrogen.

2. Remove valve V-877 and mating check valve.

3. Remove pig at tie-in and reinstall barrel on exposed flange at the junction.

4. Fill the lateral with water behind a pig from the junction to the terminal. Allow the temperature and pressure to level out.

Days 8 & 9

1. Conduct hydrostatic test.

2. Push water into junction with nitrogen into a Baker tank set-up at the Junction.

Days 10, 11, 12 & 13

1. Hook up new junction manifold piping and reinstall V-877 and mating check valve.

2. Remove blind flanges at terminal and install spool piece.

3. Fill line with product from Shell facility.

DJ/jd:1940(shelllat.rpt)

TEST OLYMPIC PIPE LINE UNOCAL GASOLINE LATERAL

Day 6

1. Bleed down lateral.

2. Install barrel on Unocal valve V-882.

3. Remove spool piece at tie-in and install blind flange on both Unocal valves and exposed flange with temporary piping for displacement.

4. Set up the nitrogen Unit "A" at the Junction facility.

Day 7

1. Push the gasoline into the Unocal with a pig and nitrogen.

2. Remove valve V-882 and mating check valve.

3. Remove pig at tie-in and reinstall barrel on exposed flange at the junction.

4. Fill the lateral with water behind a pig from the junction to the terminal. Allow the temperature and pressure to level out.

Days 8 & 9

1. Conduct hydrostatic test.

2. Push water into junction with nitrogen into a Baker tank set-up at the Junction.

Days 10, 11, 12 & 13

1. Hook up new junction manifold piping and reinstall V-882 and mating check valve.

2. Remove blind flanges at terminal and install spool piece.

3. Fill line with product from Unocal facility.

DJ/ac:1940(unoclat.rpt)

TEST OLYMPIC PIPE LINE CHEVRON GASOLINE LATERAL

Day 6

1. Bleed down lateral.

2. Install barrel on Chevron valve V-879.

3. Remove spool piece at tie-in and install blind flange on both Chevron valve and exposed flange with temporary piping for displacement.

4. Set up the nitrogen Unit "A" at the Junction facility.

Day 7

1. Push the gasoline into the Chevron with a pig and nitrogen.

2. Remove valve V-879 and mating check valve.

3. Remove pig at tie-in and reinstall barrel on exposed flange at the junction.

4. Fill the lateral with water behind a pig from the junction to the terminal. Allow the temperature and pressure to level out.

Days 8 & 9

1. Conduct hydrostatic test.

2. Push water into junction with nitrogen into a Baker tank set-up at the Junction.

Days 10, 11, 12 & 13

1. Hook up new junction manifold piping and reinstall V-879 and mating check valve.

2. Remove blind flanges at terminal and install spool piece.

3. Fill line with product from Chevron facility.

DJ/jd:1940(chevrlat.rpt)

TEST OLYMPIC PIPE LINE FUEL LINE TO ARCO

Day 19

1. ARCO fuel delivery complete.

2. 3-4 hour shutdown:

   * Drain fuel from DF manifold.
   * Blind fuel manifold between mainline and ARCO.
   * Remove portion of manifold at ARCO.
   * Return mainline to service.

3. Install barrel on ARCO line, V-803.

4. Nitrogen (N2) unit set up at DF.

Day 20

1. Displace fuel into ARCO with N2. Stop pig short of valve.

2. Install drip pan under spool piece at ARCO.

3. Remove spool with pig at ARCO and install blind flange at ARCO.

4. Remove barrel at DF. Remove V-803 and mating check valve and reinstall barrel.

5. Fill line with water by putting pig in barrel and pushing it to ARCO with water. Let water pressure and temperature level out.

6. Move and set up N2 unit at ARCO.

Days 21 & 22

1. Conduct hydrotest.

2. After test, push test water to DF with pig and N2.

3. Move and set up N2 unit at DF.

Days 23 & 24

1. Remove blind flange at ARCO and hook up piping. Remove barrel at DF and install manifold section and valve V-803 and mating check valve.

Day 25

1. Fill ARCO lateral with fuel from both ARCO terminal and DF. Ready to flow fuel to ARCO.

CEP/jd:1940
(fuelline.rpt)

TEST OLYMPIC PIPE LINE FUEL LINE FROM DF TO TEXACO

Day 25

1. Drain fuel manifold at DF.

2. Remove section of fuel mainline branch manifold at DF and blind flange manifold flanges and Mobil branch.

3. Remove V-870 and mated check valve.

4. Install barrel on exposed flange.

5. Push fuel toward Texaco from DF with pig and nitrogen.

6. Stop pig short of Texaco terminal and pump out section of line between pig and Texaco.

6. Install barrel at Texaco for future displacements.

Day 26

1. Reinstall mainline branch manifold at DF and blind flange mainline outlet.

2. At junction remove manifold and valve V-876 and mated check valve.

3. Install temporary spool piece in junction.

Day 27

1. Fill line from DF to Texaco with water behind pig and allow pressure and temperature to level out.

Days 28 & 29

1. Conduct hydrostatic test.

2. Move nitrogen Unit "A" to the Texaco end.

Day 30

1. After test, push test water from Texaco to DF with pig and nitrogen.

Days 31, 32 & 33

1. When change is made from gas to fuel, drain the gasoline manifold.

2. Remove the temporary spool at mainline branch and reinstall mainline branch spool and valve V-870 and mated check valve.

3. Remove temporary line at the junction and install the pre-tested manifold and valves.

Day 34

1. Fill line from Texaco to V-876 and mated check valve with fuel from Texaco.

2. When change is made from gasoline to fuel, fill the manifold at the DF with fuel and fill the mainline from the DF to V-876 with fuel.

DJ/ac:1940
(fuel-tex.rpt)

TEST OLYMPIC PIPE LINE SHELL FUEL LATERAL

Day 26

1. Bleed down lateral.

2. Install barrel on Shell valve V-875.

3. Remove spool piece at tie-in and install blind flange on both Shell valve and exposed flange with temporary piping for displacement.

4. Set up the nitrogen Unit "A" at the Junction facility.

Day 27

1. Push the gasoline into the Shell with a pig and nitrogen.

2. Remove valve V-875 and mating check valve.

3. Remove pig at tie-in and reinstall barrel on exposed flange at the junction.

4. Fill the lateral with water behind a pig from the junction to the terminal. Allow the temperature and pressure to level out.

Days 28 & 29

1. Conduct hydrostatic test.

2. Push water into junction with nitrogen into a Baker tank set-up at the Junction.

Days 30, 31, 32 & 33

1. Hook up new junction manifold piping and reinstall V-875 and mating check valve.

2. Remove blind flanges at terminal and install spool piece.

3. Fill line with product from Shell facility.

DJ/jd:1940(shellfue.rpt)

TEST OLYMPIC PIPE LINE CHEVRON FUEL LATERAL

Day 26

1. Bleed down lateral.

2. Install barrel on Chevron valve V-880.

3. Remove spool piece at tie-in and install blind flange on both Chevron valve and exposed flange with temporary piping for displacement.

4. Set up the nitrogen Unit "A" at the Junction facility.

Day 27

1. Push the gasoline into the Chevron with a pig and nitrogen.

2. Remove valve V-880 and mating check valve.

3. Remove pig at tie-in and reinstall barrel on exposed flange at the junction.

4. Fill the lateral with water behind a pig from the junction to the terminal. Allow the temperature and pressure to level out.

Days 28 & 29

1. Conduct hydrostatic test.

2. Push water into junction with nitrogen into a Baker tank set-up at the Junction.

Days 30, 31, 32 & 33

1. Hook up new junction manifold piping and reinstall V-880 and mating check valve.

2. Remove blind flanges at terminal and install spool piece.

3. Fill line with product from Chevron facility.

DJ/jd:1940(chev-fue.rpt)

TEST OLYMPIC PIPE LINE UNOCAL FUEL LATERAL

Day 26

1. Bleed down lateral.

2. Install barrel on Unocal valve V-881.

3. Remove spool piece at tie-in and install blind flange on both Unocal valve and exposed flange with temporary piping for displacement.

4. Set up the nitrogen Unit "A" at the Junction facility.

Day 27

1. Push the gasoline into the Unocal with a pig and nitrogen.

2. Remove valve V-881 and mating check valve.

3. Remove pig at tie-in and reinstall barrel on exposed flange at the junction.

4. Fill the lateral with water behind a pig from the junction to the terminal. Allow the temperature and pressure to level out.

Days 28 & 29

1. Conduct hydrostatic test.

2. Push water into junction with nitrogen into a Baker tank set-up at the Junction.

Days 30, 31, 32 & 33

1. Hook up new junction manifold piping and reinstall V-881 and mating check valve.

2. Remove blind flanges at terminal and install spool piece.

3. Fill line with product from Unocal facility.

DJ/jd:1940(unoc-fue.rpt)

3.0 HYDROSTATIC TEST PROCEDURE

The procedure that follows in this section was developed as a guideline to take into account all possible contingencies. As such, it was not always followed exactly. Every test was carried out under the direct supervision of the MARMAC project engineer or his designated representative or the Shell Chief Inspector.

The minimum test pressure in all sections was to be 725 psig.

SCOEPA00012104

HYDROSTATIC TEST PROCEDURE
OLYMPIC PIPE LINE PORTLAND DELIVERY LINES

1. Introduction

This test procedure describes the requirements for hydrostatic testing of pipelines in compliance with the United States Department of Transportation (DOT) Code of Federal Regulations, Title 49 Part 195, Subpart E, entitled Hydrostatic Testing.

A set-up procedure has been prepared that describes the necessary activities in a step-by-step manner that must be performed prior to and immediately after this test procedure. This set-up procedure is a supplement to this test procedure.

2. Contractor's Responsibilities and Line Filling

The owner of the pipeline will be responsible for all permits required by federal, state and local agencies for procurement of water, water quality and for the discharge of water used in the hydrostatic testing operation.

The contractor shall receive the water from a location designated by the company and add a dye (supplied by Company) before pumping into the pipeline.

3. Test Pressure

This pipe will be tested for 8 hours at a minimum of 725 psig for all piping.

4. Length of Test Sections and Test Medium

A. The test sections are described in the set-up procedure.

B. Water will be used as the test medium.

5. Test Equipment Required

A. Centrifugal pump to fill segment of line with water.

B. Reciprocating pump to apply test pressure to section of line under test. Pump must be suitable for pumping at maximum test pressure and equipped so flow rate can be varied from 0-100 GPM.

SCOEPA00012105

C. Calibrated barrel to measure water injected or withdrawn from the section of line under test.

D. One pressure recorder and chart for each section (0-150% of test pressure psi range with 15 psi increments).

E. One temperature recorder with remote sensing bulb and chart for each section (5° F increments).

F. Pressure gauges (0-150% of test pressure) as needed.

G. Deadweight testers and test thermometers to calibrate the test instruments.

H. Test manifold.

6. Location and Calibration of Test Instruments

A. The pressure gauges and pressure recorders shall be calibrated and their accuracy certified prior to, at the midpoint, and immediately following the test.

The temperature recorders shall be calibrated and their accuracy certified prior to the test.

B. An 8 hour pressure recorder shall be located at the beginning of the test segment and shall be manifolded to the test segment to include a pressure gauge and deadweight tester. The manifold should be capable of isolating all of the instruments from the pipeline and from each other.

C. The temperature recorder shall be located so that it will not be affected by the following:

1. Ambient temperature changes.
2. Changes in injection fluid temperature because of close proximity to the injection pump.

The temperature bulb shall be secured directly to the bare pipe with a suitable heat transfer compound and then backfilled and tamped to ground level at least 8 hours prior to hydrostatic test so that pipeline temperature will stabilize. (As an alternative, to backfilling, the bulb shall be wrapped with multiple layers of insulation and protected from water intrusion).

7. Instructions for Conducting the Tests

SCOEPA00012106

A. Install necessary connections to line for discharge of reciprocating pump and pressure indication.

B. Fill section to be tested with testing liquid by running a pipeline scraper ahead of the liquid as it is pumped into the pipeline. If the temperature of the test fluid differs from pipeline temperature, the test fluid temperature must be allowed to stabilize in the segment before the test can begin. All necessary precautions must be taken to insure no air remains in the test segment.

A centrifugal pump capable of 1500 bph at 250 feet of head will be set at the proposed fill locations. The minimum fill rate will be 750 bph at 300 feet of head and the maximum fill rate will be 2000 bph.

Once the pig is received in the incoming manifold, the section will be packed to maximum capacity of fill pumps.

C. After the segment of pipe that is to be tested has been filled with the testing fluid, close the main valves, open the bypass lines, and use the reciprocating pump to apply the test pressure on the pipe.

D. The pressure on the segment of pipe being tested shall be raised to 95% of test pressure and allowed to stabilize. Next, raise the pressure to the test pressure and hold for 15 minutes. The vents shall be opened to check for any air. If none is detected, the valves shall be closed and the test begun.

E. Maintain the test pressure on the segment of line under test for a minimum of 8 hours. While under test, the test pressure should be constantly monitored. If the temperature of the pipe doesn't change as a result of varying ambient conditions, this test pressure should remain constant. This will indicate the pipe to be sound and subsequent calculations are not necessary. However, should the temperature of the line vary, quantities of water will need to be added or withdrawn from the pipeline to maintain test pressure. These quantities will then be used in calculations to account for pressure changes. In lieu of this, calculations shall be made to determine if the pressure change is tracking with the temperature change.

Unexplainable pressure losses would indicate leakage in the test section. If temperatures increase, care must be taken that the test pressure is not exceeded.

F. If no leaks are detected during this 8 hour test at 125 percent of the design pressure, testing is complete.

SCOEPA00012107

8. Proposed Dewatering Procedures

After completion of all the above, nitrogen will be connected to the pipeline and dewatering will commence. A pig will be utilized to dewater the pipeline. The direction of dewater in relation to the direction of fill will be determined by the Inspector. At all times during dewatering operations, the discharge pressure will be monitored and the discharge valve will be throttled to ensure a full column of water exists in the pipeline at all times.

9. Test Records

A. A record must be made of each hydrostatic test and that record retained as long as the pipeline is in service.

B. The record shall include:

1. Recording gauge charts.
2. Dead weight tester data.
3. Reasons for any failure during test.
4. Calculations to support a valid test.
5. Hourly recording chart of chart pressure and temperature, deadweight and gauged pressure, and ambient air temperature.

C. Each recording chart shall list:

1. Carrier's name.
2. Name and signature of person responsible for test.
3. Minimum test pressure.
4. Test medium.
5. Description of facility test.
6. Explanation of pressure or temperature discontinuities that appear on any chart.

10. Calculations

Once the testing period has elapsed and should the temperature have changed from its original value, calculations must be made to determine if volume changes are the result of temperature variations or whether they are the result of leakage.

CEP/ac:1940
(hyd-test)

SCOEPA00012108

4.0 TEST RESULTS

The tests all proceeded as planned and were successful except for one segment. The problem occurred during the testing of the fuel oil leg from the DF to Texaco. The pipe failed under test. By segmenting the line, it was determined that the leak was under the Wacker property. Due to the very large amount of cover over the line across the Wacker property (in excess of 25 feet), it was decided to not look for the leak and repair it but just replace the line. It was decided to also replace the gasoline line at the same time. The new portion of the gasoline line was tested before tie-in. The fuel oil line was tested after tie-in from the DF to the Junction. The portion of the line from the Junction to Texaco was previously tested successfully.

CEP/jd:1940
(hydro.spc)

SCOEPA00012110

A

NORTHWEST METAL FAB. & PIPE
6720 S.W. FROG POND LANE
WILSONVILLE, OR 97070

SCALER SALES
Authorized
ASHCROFT WHOLESALER

CUSTOMER ORDER #_____

CERTIFICATION

CERTIFICATION IS HEREBY ISSUED THAT: FOXBORO 40MR 0-1500#
SN-9182861C,91A2861-B,91A286A-1 GAUGE(S) WERE TESTED FOR ACCURACY AND
2210901
CALIBRATED ON AN ASHCROFT TESTER CHECKED BELOW THAT IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS:

( ) TQ-150/14620 MANSFIELD & GREEN
( ) 901B HELSE DIGITAL GAUGE
( ) MERCURY MANOMETER
( ) 7781 ASHCROFT DIGIGAUGE
( ) 1305 ASHCROFT DEAD WEIGHT TESTER

BASED ON THE AFORMENTIONED TEST, THIS ORDER FOR THE ABOVE GAUGE(S) IS CERTIFIED TO BE 1/2 % OF ENTIRE SCALE.

CERTIFIED THE 1 DAY OF FEBRUARY 19 91.

SCALER SALES COMPANY
BY Kevin Nolan

KEVIN NOLAN

VARIATIONS:

P.O. Box 17127
1927 N. Argyle
Portland, Oregon 97217
(503) 289 8871
FAX (503) 286 0690

AUTOMATION SERVICE

CALIBRATION CERTIFICATE

Test Equipment Division
2360 Chaffee Drive
St. Louis, MO 63146 USA
(314) 993-5224

Out-of-state
call toll free
1-800-325-4808

Fax
(314) 993-3868

Telex
6841034

CUSTOMER NORTHWEST METAL FAB. & PIPE

PURCHASE ORDER NO. 979

ITEM FOXBORO 40MR-RFM2F/PB-AA/TA-1A

SERIAL NO. 91A2861-B

REFERENCE CALIBRATION 808A/JP241698A-7

CALIBRATION RANGE 0-500°F (RED PEN)

DEVIATIONS IN:

X °F ____ °C ____ MILLIVOLTS ____ PSI ____ % SPAN

STANDARD	EQUIPMENT	DEVIATION
80	80	0
125	125	0
250	249	-1.0
375	374	-1.0
500	500	0

THIS IS TO CERTIFY THAT THE ABOVE DATA APPLIES TO THE MATERIALS AND/OR PARTS FURNISHED ON THE SUBJECT PURCHASE ORDER, AND IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS THROUGH FOLLOWING REPORT(S).

BY [signature]
QUALITY CONTROL

DATE 1/22/91

Quality test equipment since 1956.

SCOEPA00012114

AUTOMATION SERVICE

Test Equipment Division
2360 Chaffee Drive
St. Louis, MO 63146 USA
(314) 993-5224

Out-of-state
call toll free
1-800-325-4608

Fax
(314) 993-3968

Telex
6841034

CUSTOMER Northwest Metal Fab.

PURCHASE ORDER # 979

ITEM Fx. 40MR-BFM2/P13-AA/TA-1A

SERIAL # 91A2861-B

REFERENCE CALIBRATION T-100/8366

CALIBRATION RANGE 0-3000 psig. (Green Pen)

DEVIATIONS IN:

____ °F ____ °C ____ MILLIVOLTS ✓ PSI ____ %SPAN

STANDARD	EQUIPMENT	DEVIATION
0	0	0
750	750	0
1500	1500	0
2250	2250	0
3000	3000	0

THIS IS TO CERTIFY THAT THE ABOVE DATA APPLIES TOTHE MATERIALS AND/OR PARTS FURNISHED ON THE SUBJECT PURCHASE ORDER, AND IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS THROUGH FOLLOWING REPORT(S).

BY B B Feldman

DATE 21 Jan. 91

Quality test equipment
since 1956

AUTOMATION SERVICE

CALIBRATION CERTIFICATE

Test Equipment Division
2390 Chaffee Drive
St. Louis, MO 63146 USA
(314) 993-5224

Out-of-state
call toll free
1-800-325-1608

Fax
(314) 993-3868

Telex
6841034

CUSTOMER NORTHWEST METAL FAB & PIPE

PURCHASE ORDER NO. 979

ITEM FOXBORO 40MR-RFM2F/PB-AA/TA-1A

SERIAL NO. 91A2861C

REFERENCE CALIBRATION 808A/JP241698A-7

CALIBRATION RANGE 0-500°F (RED PEN)

DEVIATIONS IN:

X °F ____ °C ____ MILLIVOLTS ____ PSI ____ % SPAN

STANDARD	EQUIPMENT	DEVIATION
80	80	~~0~~
125	124	-1.0
250	249	-1.0
375	374	-1.0
500	500	~~0~~

THIS IS TO CERTIFY THAT THE ABOVE DATA APPLIES TO THE MATERIALS AND/OR PARTS FURNISHED ON THE SUBJECT PURCHASE ORDER, AND IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS THROUGH FOLLOWING REPORT(S).

BY [signature]
QUALITY CONTROL

DATE 1/23/91

AUTOMATION SERVICE

Test Equipment Division
2290 Chaffee Drive
St. Louis, MO 63146 USA
(314) 993-5224

Out-of-state
call toll free
1-800-325-4809

Fax
(314) 993-3868

Telex
6841034

CUSTOMER Northwest Metal Fab.

PURCHASE ORDER # 979

ITEM Ex. 40MR-RFM12F/PB-1A/TA-1A

SERIAL # 91A2361-C

REFERENCE CALIBRATION

T100/8366

CALIBRATION RANGE

0-2000 psig

DEVIATIONS IN:

____ °F ____ °C ____ MILLIVOLTS ✓ PSI ____ %SPAN

STANDARD	EQUIPMENT	DEVIATION
0	0	0
500	500	0
1000	1000	0
1500	1500	0
2000	2000	0

THIS IS TO CERTIFY THAT THE ABOVE DATA APPLIES TOTHE MATERIALS AND/OR PARTS FURNISHED ON THE SUBJECT PURCHASE ORDER, AND IS TRACEABLE TO THE NATIONAL BUREAU OF STANDARS THROUGH FOLLOWING REPORT(S).

BY BBZeldman

DATE 22 Jan. 91

REFINERY SUPPLY COMPANY, INC.

"Serving the Oil and Gas Industry Since 1923"

NORTHWEST METAL FAB & PIPE
18805 S.W. 108TH AVE
SHERWOOD, OREGON 97140

PO# 015

C E R T I F I C A T I O N

WE GUARANTEE THE ACCURACY OF THIS INSTRUMENT

35265-001 SERIAL # 5980 CODE 25

TO BE WITHIN 1/10TH OF 1% OF THE RATED PRESSURE.

THE REFINERY SUPPLY COMPANY

Dan J Abell

DAN ABELL

1-8-91

DATE

6901 E. 12th Street • Tulsa, Oklahoma 74112 • (918) 836-4681

REFINERY SUPPLY COMPANY, INC.

"Serving the Oil and Gas Industry Since 1923"

NORTHWEST METAL FAB & PIPE
18805 S.W. 108TH AVE
SHERWOOD, OREGON 97140

PO# 015

C E R T I F I C A T I O N

WE GUARANTEE THE ACCURACY OF THIS INSTRUMENT

35265-001 SERIAL # 5982 CODE 24

TO BE WITHIN 1/10TH OF 1% OF THE RATED PRESSURE.

THE REFINERY SUPPLY COMPANY

Dan Abell

DAN ABELL

1-8-91

DATE

6901 E. 12th Street • Tulsa, Oklahoma 74112 • (918) 836-4681

B

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPE LINE	ARCO GAS LEG	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	-1+59	20+67	PORTLAND D.F.

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1965	14.0"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
42,000	0.250"		300	300

DATE TEST PERFORMED: 2-6-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	RECEIVED FROM HYDRANT TO PUMP SUCTION
TEST BY	CONTRACTOR: NORTHWEST METAL FAB / ENGINEER: MARMAC
TEST PRESSURE - MINIMUM: 727 psig	727 psig
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	Pressure Pump, Deadweight tester, Dual Pen Chart Recorder, Pressure gauges
AVERAGE TEMPERATURE OF TESTING MEDIUM	59.5
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	AT TEST SITE
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED AT HIGH POINT
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 2/6/91 16:30 ☐ AM ☑ PM COMPLETED: 2/7/91 00:30 ☑ AM ☐ PM
ARE PRESSURES CONTINUOUS? If not, explain. YES	
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	TRANSFER LINE FROM PORTLAND D.F. TO ARCO TERMINAL

GENERAL COMMENTS

TEST PROCEEDED SMOOTHLY. PRESSURE dropped AS evening progressed AS temperature dropped. CALCULATIONS MADE TO VERIFY GOOD TEST. (COPY ATTACHED).

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E Potter

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

HYDROTEST CALCULATIONS

DATE	FEB-06-91
LINE:	ARCO GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.25	INCHES
LENGTH	0.42	MILES
TEST PRESSURE	731	PSIG
WATER TEMP		
BEGIN	62	DEG F
END	62	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	55.2	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	16489.59	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	16544.77	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	0.999857	
Vtp': CORRECT. VOL	16544.77	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-06-91
LINE:	ARCO GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.25	INCHES
LENGTH	0.42	MILES
TEST PRESSURE	727	PSIG
WATER TEMP		
BEGIN	57	DEG F
END	57	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	60.2	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	16489.59	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	16549.83	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000200	
Vtp': CORRECT. VOL	16549.83	GALLONS

8/6/91

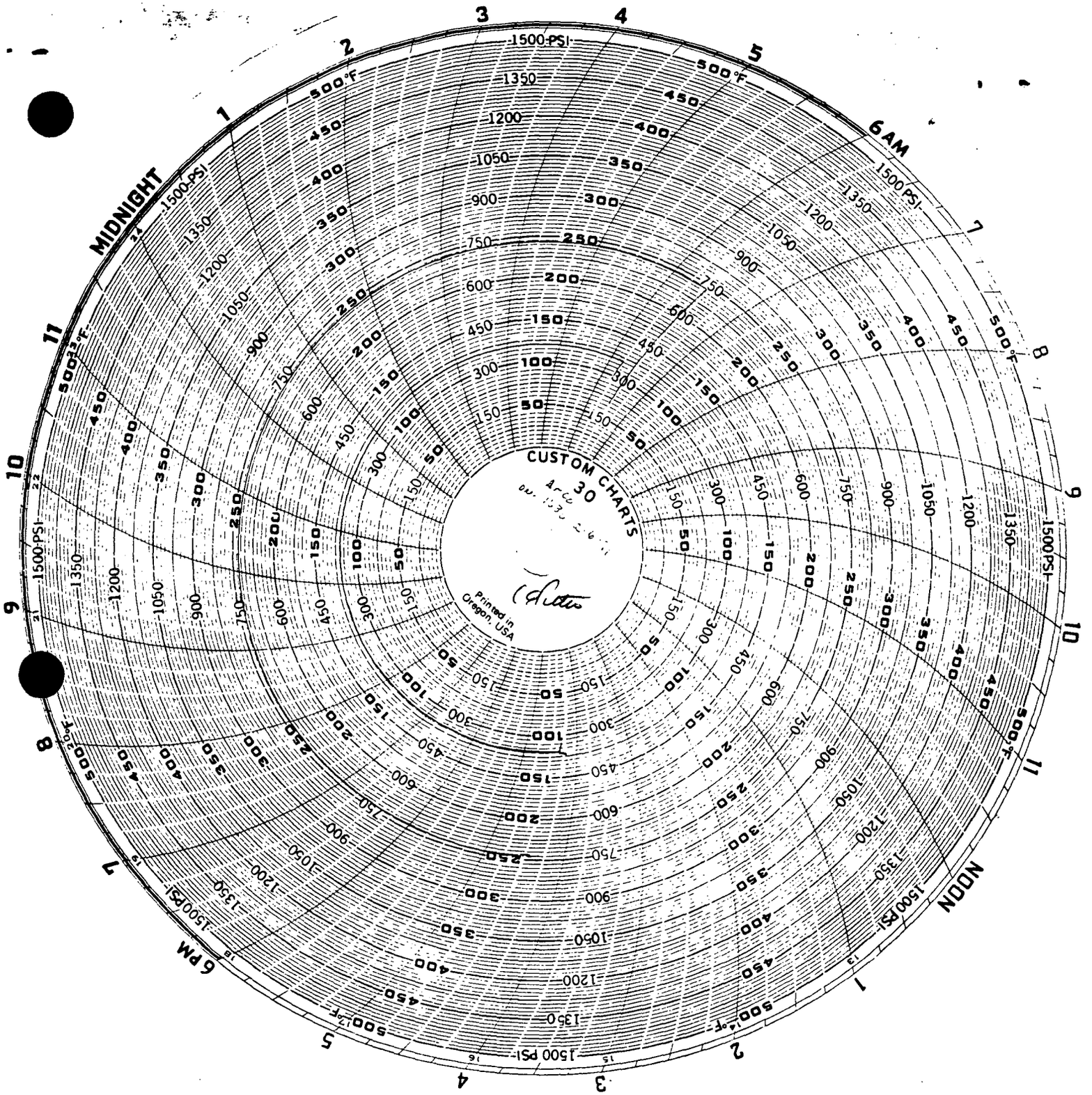
Time	D.W. Tester	Pressure Recorder	Gauge	Temp
1630	731	735	730	62
1700	731	735	730	60
17:30	731	735	730	58
18:00	731	735	730	58
18:30	731	735	730	58
19:00	731	735	730	57
19:30	731	735	730	57
20:00	731	735	730	57
20:30	731	735	730	57
21:00	731	735	730	56.5
21:50	731	735	728	58
22:00	731	735	727	58
22:50	730	734	722	58
23:00	728	732	721	59
23:50	727	732	721	58
24:00	727	732	721	57
0:50	727	732	721	57

TEST Results
12:30 AM 2-7-9
NWM:

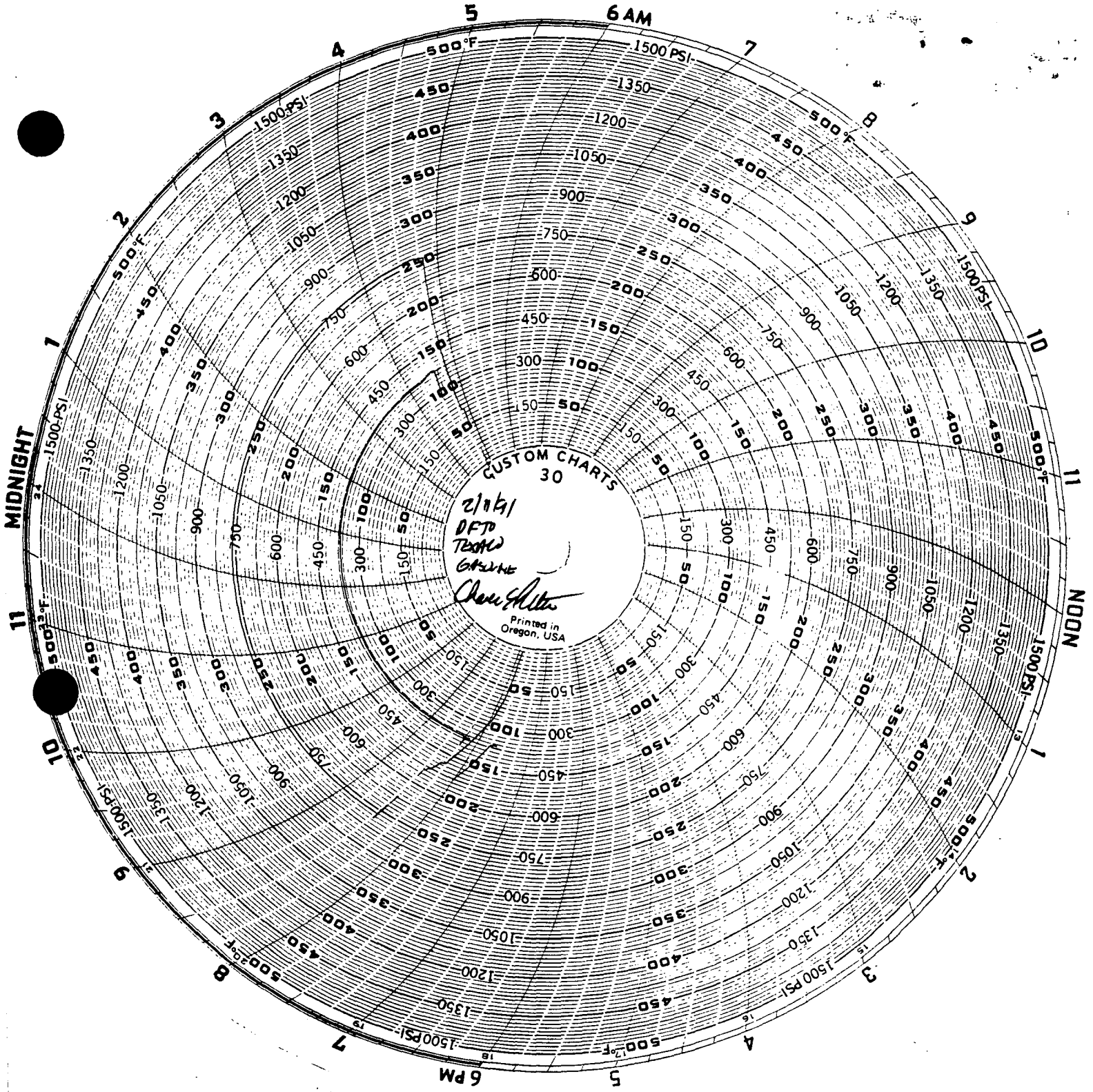
— Test is on ARCO Log [illegible] LF

Comments; It appears to be good test with [illegible] Gas Problems. No weeps at test [illegible] Equipment Evening [illegible] with no out of [illegible] Equipment

SCOEPA00012125


CUSTOM CHARTS
30
Printed in Oregon, USA
MIDNIGHT
6 AM
NOON
6 PM
1500 PSI
500 °F

C



SCOEPA00012128

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	D.F. TO TEXACO GAS	WCO

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	0+00	211+20	PORTLAND D.F.

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1965	14.00"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
42,000	0.250"		300	300

DATE TEST PERFORMED
2-11-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	FROM HYDRANT BY D.F.
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM: 762	PRESSURES INCREASED TO 764
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, DUAL PEN CHART RECORDER DEADWEIGHT TESTER, PRESSURE GAUGES
AVERAGE TEMPERATURE OF TESTING MEDIUM	61.5
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	762 AT D.F.
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, Δel does not exceed 100 FT.
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 8:30 ☒ AM ☐ PM COMPLETED: 16:30 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	OLYMPIC LINE FROM DF to TEXACO TERMINAL

GENERAL COMMENTS

TEST PROCEEDED WITHOUT ANY PROBLEMS. PRESSURE INCREASED DURING DAY AS TEMPERATURES INCREASED. CALCULATIONS WERE MADE AND ARE ATTACHED

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: [signature]

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

2/11/91

D-F TEXAS

14" 750# [illegible]

TEMPERATURE [illegible] GAUGES

		DW	CHART	TEMP	GAUGE
START	0:30	762	760	122	760
	11:00	762	760	122	760
	[illegible]	762	760	122	760
	10:00	762	760	122	760
	10:30	762	760	122	760
	11:00	762	760	122	760
	[illegible]	762	760	122	760
	12:00	762	760	122	760
	12:30	762	760	122	760
	13:00	762	760	122	760
	13:30	763	760	123	761
	14:00	763	760	123	761
	14:30	764	760	124	762
	15:00	764	760	124	762
	15:30	764	760	124	762
	16:00	764	760	124	762
END	16:30	764	760	124	762

Charles E. [illegible]
2/11/91

DEADWEIGHT TESTER 3265-001 S/N 5982

CHART FOXBORO 40MR 0-1500#
S/N 918261A-1

HYDROTEST CALCULATIONS

DATE	FEB-11-91
LINE:	D.F. to TEXACO GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.25	INCHES
LENGTH	4	MILES
TEST PRESSURE	762	PSIG
WATER TEMP		
BEGIN	61	DEG F
END	61	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	560.2	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	157043.7	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	157603.9	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	0.999933	
Vtp': CORRECT. VOL	157603.9	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-11-91
LINE:	D.F. to TEXACO GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.25	INCHES
LENGTH	4	MILES
TEST PRESSURE	762	PSIG
WATER TEMP		
BEGIN	61.5	DEG F
END	61.5	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	554.6	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	157043.7	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	157598.3	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	0.999896	
Vtp': CORRECT. VOL	157598.3	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-11-91
LINE:	D.F. to TEXACO GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.25	INCHES
LENGTH	4	MILES
TEST PRESSURE	764	PSIG
WATER TEMP		
BEGIN	62	DEG F
END	62	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	550.3	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	157043.7	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	157594.0	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	0.999857	
Vtp': CORRECT. VOL	157594.0	GALLONS

D

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.15
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	SHELL GAS LINE	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
			JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1965	14.00"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
42,000	0250"		300	300

DATE TEST PERFORMED

DATA CHECK LIST	REMARKS
TEST MEDIUM WATER	OBTAINED FROM HYDRANT ON SHELL PIER
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM	805 PSIG
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, DUAL PEN CHART RECORDER DEADWEIGHT TESTER, PRESSURE GAUGES
AVERAGE TEMPERATURE OF TESTING MEDIUM	52°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	805 PSIG
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, Δel does not exceed 100 ft
TEST DURATION (including time started and completed)	DURATION 8 HOURS STARTED 1400 ☐ AM ☒ PM COMPLETED 2200 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	LINE FROM OLYMPIC JUNCTION TO SHELL MANIFOLD

GENERAL COMMENTS

INITIAL TEST FAILED DUE TO EXCESSIVE AIR THAT WAS IN LINE. LINE WAS DRAINED AND REFILLED WITH PIG. TEST WAS THEN SUCCESSFUL. DRAWINGS SHOW THAT LINE SHOULD HAVE DRAINED TO JUNCTION AND FILLED WITH WATER FROM THE JUNCTION TO DISPLACE AIR AT SHELL MANIFOLD. SINCE IT DIDN'T IT SUGGESTS A DIP IN THE LINE CONTRARY TO THE DRAWINGS

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E. Peters

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FC 115

14" SHELL SOUTH LINE

START 2-15-91 @ DW 805 @ 1355

END 2-16-91 @ 0730

TIME	DEAD WEIGHT	LB'S ON CHART	LB'S ON GAUGE	OUT SIDE AIR TEMP
1400	805	790	798	54°
1430	805	790	798	54°
1500	805	795	798	56°
1530	806	795	798	54°
1600	807	795	799	56°
1630	807	796	799	56°
1700	808	797	799	54°
1730	810	797	800	52°
1800	810	802	800	52°
1900	811	802	800	52°
1930	811	802	800	50°
2000	811	802	800	50°
2030	811	802	800	50°
2100	812	802	800	50°
2130	812	802	800	50°
2200	812	802	800	50°

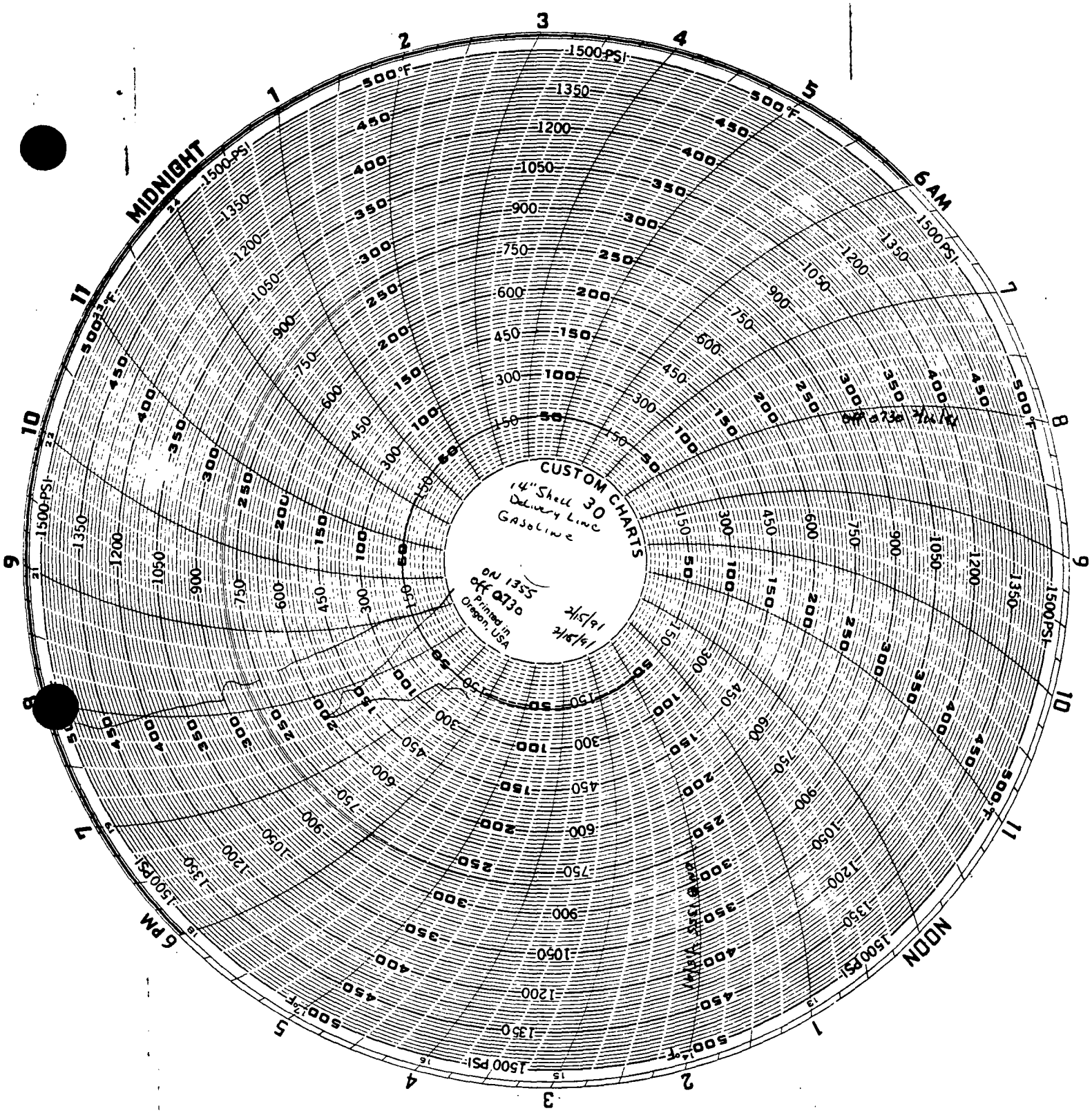
FOXBORO RECORDER

MODEL 40MR-RFM2F/PB-AA/TA-1A

SERIAL 91A2861-1

DEAD WEIGHT

CRS# 35265-1 S/N 5982



SCOEPA00012139

FOXBORO
MODEL # 40MR-RFM2F/PB-AA/TA-1A
SERIAL # 91A2861-1

DEAD WEIGHT
CRS # 35265-1
S/N # 5982
Virgil U. Acree

SCOEPA00012140

E

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	25467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPE LINE	UNOCAL GAS LINE	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	0+00	11+13.8	PORTLAND JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1973	12.75	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
35000	0.312		300	300

DATE TEST PERFORMED: 2-12-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	RECEIVED FROM HYDRANT ON SHELL PIER
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM: 738	INITIAL PRESSURE WAS 740 PSIG
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, DEADWEIGHT TESTER, DUALPEN CHART RECORDER PRESSURE GAUGES
AVERAGE TEMPERATURE OF TESTING MEDIUM	50.25°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	AT TEST SITE
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, ELEV. NOT MORE THAN 100 FT
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 2/12/91 3:30 ☐ AM ☒ PM COMPLETED: 2/12/91 11:30 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	Delivery line from OLYMPIC PIPE LINE to UNOCAL

GENERAL COMMENTS

TEST PROCEEDED SMOOTHLY, DID NOT RECORD OUTSIDE AIR TEMPERATURE, BUT IT DID DROP ACCORDING TO RADIO NEWS AND NEWSPAPER.

CALCULATIONS MADE TO CORRELATE TEMPERATURE AND PRESSURE DROPS

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles Potter

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
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RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

HYDROTEST CALCULATIONS

DATE	FEB-12-91
LINE:	UNOCAL GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.322	INCHES
LENGTH	0.2109	MILES
TEST PRESSURE	738	PSIG
WATER TEMP		
BEGIN	48	DEG F
END	48	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	24.5	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	6658.416	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	6682.962	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000580	
Vtp': CORRECT. VOL	6682.962	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-12-91
LINE:	UNOCAL GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.322	INCHES
LENGTH	0.2109	MILES
TEST PRESSURE	740	PSIG
WATER TEMP		
BEGIN	52.5	DEG F
END	52.5	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	23.7	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	6658.416	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	6682.126	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000430	
Vtp': CORRECT. VOL	6682.126	GALLONS

CERTIFICATION OF PIPE LINE HYDROSTATIC PRESSURE TEST

PRESSURE RECORDER CALIBRATION

UNICAL

CALIBRATION BEFORE TEST		COMPARISON DURING TEST		+em P COMPARISON AFTER TEST	
PRESSURE RECORDER	DEADWEIGHT TESTER	PRESSURE RECORDER	DEADWEIGHT TESTER	PRESSURE RECORDER	DEADWEIGHT TESTER
	3:30 PM	720	740	57	
	4:30 PM	720	740	54	
	5:30 PM	720	740	53	525 INITIAL POINT USE average
	6:30	720	737	50	
	7.30	720	738	48	
	8.30	720	738	48	
	9.30	720	738	48	
	10.30	720	738	48	
	11.30	720	738	48	

CALIBRATED BY _____

CHECKED BY [illegible]

CHECKED BY _____

DEADWEIGHT TESTER MAKE & SERIAL NUMBER Charles Peter

INJECTION AND WITHDRAWAL DATA

PWBS RELOCATED TO BENEKTO PIPE AT 6:30 PM

FLUID INJECTION, GAL.	TIME	FLUID WITHDRAWN, GAL.	TIME

TOTAL INJECTION _____ GAL.

TOTAL WITHDRAWAL _____ GAL.

NET CHANGE IN VOLUME OF THE TEST SECTION ± _____ GAL.

DATA TAKEN BY _____ TITLE _____

CERTIFIED BY _____ TITLE _____

0-113(4-78)

CERTIFICATION OF PIPE LINE HYDROSTATIC PRESSURE TEST

CARRIER NAME _____

TESTING COMPANY NAME _____

PRESSURE TEST No. _____ DATE _____

THIS IS TO CERTIFY THAT THE PIPE LINE OR PIPE LINE SECTION DESCRIBED BELOW WAS HYDROSTATICALLY PRESSURE TESTED IN ACCORDANCE WITH THE FOLLOWING PROCEDURE:

PIPE LINE _____ FROM _____ TO _____

DESCRIPTION OF FACILITY TESTED _____

SECTION LENGTH _____ PIPE DIAMETER _____ WALL THICKNESS _____ GRADE _____

LOCATION OF TEST PRESSURE RECORDER CONNECTION _____

LOCATION OF TEMPERATURE RECORDER BULB _____

INITIAL PRESSURE AT POINT OF TEST _____ PSIG TIME _____ AM PM

INITIAL TEMPERATURE OF TEST SECTION _____ °F ELEVATION AT POINT OF TEST _____ MSL

INITIAL PRESSURE AT LOWEST ELEVATION POINT IN SECTION _____ PSIG;

ELEVATION _____ MSL; MP. _____. THE PRESSURE WAS ☐ MEASURED ☐ CALCULATED

INITIAL PRESSURE AT HIGHEST ELEVATION POINT IN SECTION _____ PSIG;

ELEVATION _____ MSL; MP. _____. THE PRESSURE WAS ☐ MEASURED ☐ CALCULATED

FINAL PRESSURE AT POINT OF TEST _____ PSIG TIME _____ AM PM

FINAL TEMPERATURE OF TEST SECTION _____ °F

TOTAL FLUID INJECTED _____ GAL. TOTAL FLUID WITHDRAWN _____ GAL.

NET CHANGE IN VOLUME OF THE TEST SECTION ± _____ GAL.

LENGTH OF TEST _____ HRS. _____ MIN.; TESTING FLUID _____, SPEC. GVTY. _____ TEMP. _____ °F

INITIAL PRESSURE _____ % OF SMYS AT THE TEST SITE _____ % AT HIGH POINT _____ % AT LOW POINT

MINIMUM TEST PRESSURE DURING A SELECTED 24-HOUR PERIOD (TEST PRESSURE) _____ PSIG

MAXIMUM ALLOWABLE OPERATING PRESSURE _____ PSIG. BASED ON _____ % SMYS

OR _____

WERE THERE ANY LEAKS? ☐ YES ☐ NO; IF YES, EXPLAIN _____

WAS EVERY COMPONENT THAT WILL BE SUBJECTED TO THE SYSTEM WORKING PRESSURE HYDROSTATICALLY TESTED? ☐ YES ☐ NO; IF NO, EXPLAIN _____

PRESSURE RECORDER MAKE AND SERIAL NO. _____

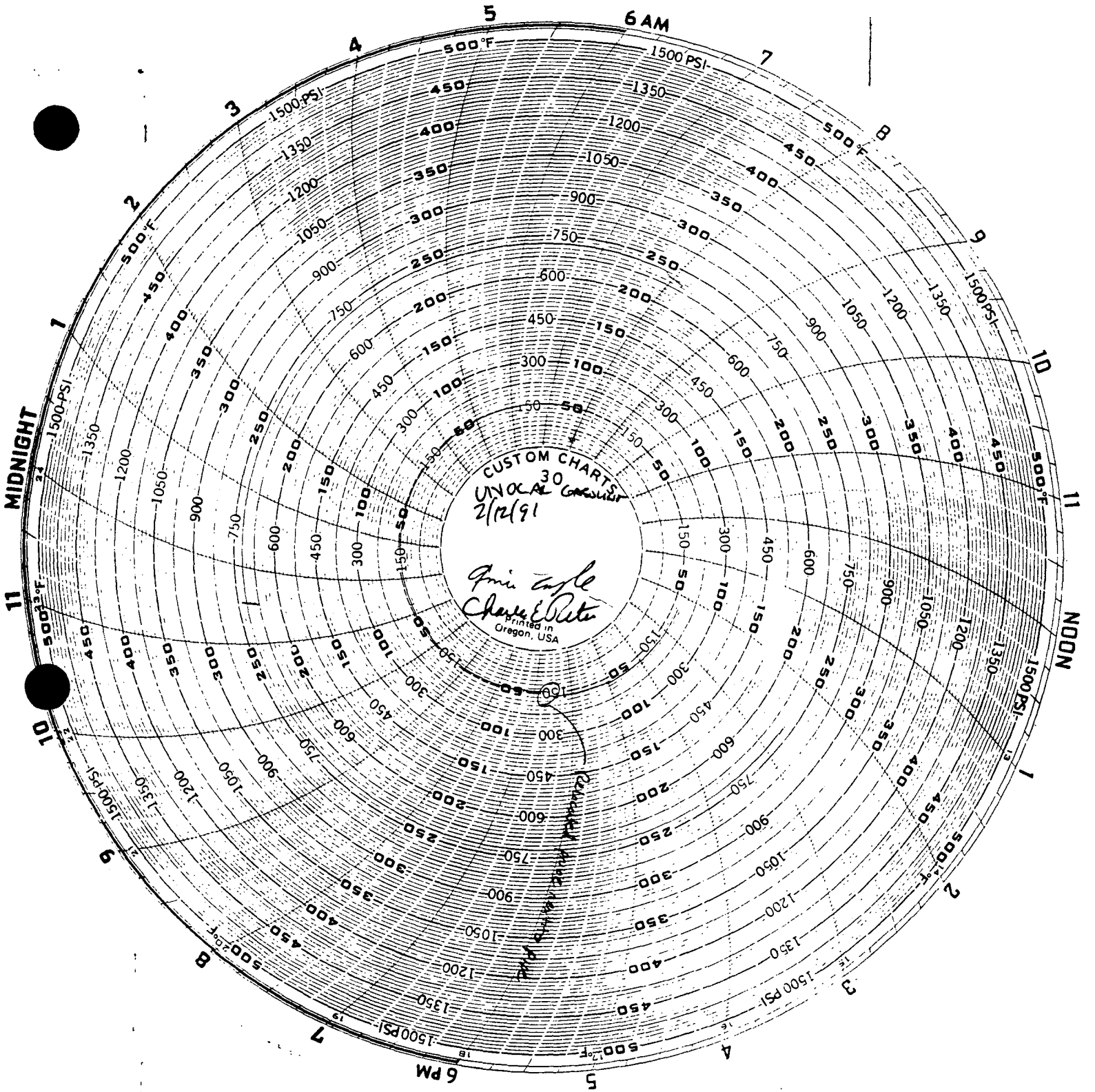
TEMPERATURE RECORDER MAKE AND SERIAL NO. _____

REMARKS: _____

CONDUCTED BY _____ TITLE _____

CERTIFIED BY _____ TITLE _____

WITNESSED BY _____ TITLE _____



SCOEPA00012148

UNOCAL
S/N 91A 2861-B

F

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPE LINE	CHEVRON GAS LEG	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	0+00	4+49	PORTLAND JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1973	12.75"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
35,000	0.312		300	300

DATE TEST PERFORMED: 2-12-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	RECEIVED FROM HYDRANT AT SHELL PIER
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM: 726 PSIG	INITIAL PRESSURE WAS 735, FINAL WAS 726
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, DEADWEIGHT TESTER, DUAL PEN CHART RECORDER, PRESSURE GAUGES
AVERAGE TEMPERATURE OF TESTING MEDIUM	54.5°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	AT TEST SITE
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, NOT OVER 100 FT DEL.
TEST DURATION (including time started and completed)	DURATION: 3 HOURS STARTED: 2/12/91 3:30 ☐ AM ☒ PM COMPLETED: 2/12/91 11:30 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	DELIVERY LINE FROM OLYMPIC P/L TO CHEVRON

GENERAL COMMENTS

TEST PROCEEDED SMOOTHLY. TEST GOT STARTED WITH NO PROBLEMS

DID NOT RECORD OUTSIDE AIR TEMPERATURE. CALCULATIONS MADE (COPY

ATTACHED) TO CORRELATED PRESSURE DROP WITH TEMPERATURE DROP.

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E. Peters

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

CHEVRON GAS LINE 2/12/91

TIME	DW	CHART	CHART TEMP
15:30	735	720	60
16:30	730	718	60
17:30	730	714	60
18:30	730	713	60
19:30	730	713	54
20:30	726	713	54
21:30	725	713	54
22:30	725	713	54
23:30	726	713	54

NOTE: DROP IN TEMPERATURE AT 19:30 RESULTED FROM RELOCATING TEMPERATURE PROBE NEXT TO PIPE. SINCE OUTSIDE AIR TEMP. DEFINITELY DROPPED ASSUMED A STARTING TEMPERATURE OF 55°F

Charles E Pelton

NOTE: TEMPERATURE ON UNOCAL CHART WAS ON AT SAME TIME (LINE WAS PARALLEL) AND SHOWED A DROP THROUGH INITIAL TIME FRAME BEFORE RELOCATING THE PROBE.

CERTIFICATION OF PIPE LINE HYDROSTATIC PRESSURE TEST

PRESSURE RECORDER CALIBRATION

CALIBRATION BEFORE TEST		COMPARISON DURING TEST		COMPARISON AFTER TEST	
PRESSURE RECORDER	DEADWEIGHT TESTER	PRESSURE RECORDER	DEADWEIGHT TESTER	PRESSURE RECORDER	DEADWEIGHT TESTER
	3:30 PM	710	[illegible]	[illegible]	
		716	[illegible]		
		718	720		
		713	[illegible]		
	[illegible]	[illegible]	720	54	
	[illegible]	713	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	54	
	10:30	713	725	54	
	[illegible]	3	[illegible]	54	

CALIBRATED BY _____

CHECKED BY _____

CHECKED BY _____

DEADWEIGHT TESTER MAKE & SERIAL NUMBER _____

INJECTION AND WITHDRAWAL DATA

FLUID INJECTION, GAL.	TIME	FLUID WITHDRAWN, GAL.	TIME

TOTAL INJECTION _____ GAL.

TOTAL WITHDRAWAL _____ GAL.

NET CHANGE IN VOLUME OF THE TEST SECTION ± _____ GAL.

DATA TAKEN BY _____ TITLE _____

CERTIFIED BY _____ TITLE _____

0-113(4-75)

CERTIFICATION OF PIPE LINE HYDROSTATIC PRESSURE TEST

CARRIER NAME _____

TESTING COMPANY NAME _____

PRESSURE TEST No. _____ DATE _____

THIS IS TO CERTIFY THAT THE PIPE LINE OR PIPE LINE SECTION DESCRIBED BELOW WAS HYDROSTATICALLY PRESSURE TESTED IN ACCORDANCE WITH THE FOLLOWING PROCEDURE:

PIPE LINE _____ FROM _____ TO _____

DESCRIPTION OF FACILITY TESTED _____

SECTION LENGTH _____ PIPE DIAMETER _____ WALL THICKNESS _____ GRADE _____

LOCATION OF TEST PRESSURE RECORDER CONNECTION _____

LOCATION OF TEMPERATURE RECORDER BULB _____

INITIAL PRESSURE AT POINT OF TEST _____ PSIG TIME _____ AM PM

INITIAL TEMPERATURE OF TEST SECTION _____ °F ELEVATION AT POINT OF TEST _____ MSL

INITIAL PRESSURE AT LOWEST ELEVATION POINT IN SECTION _____ PSIG;

ELEVATION _____ MSL; MP. _____. THE PRESSURE WAS ☐ MEASURED ☐ CALCULATED

INITIAL PRESSURE AT HIGHEST ELEVATION POINT IN SECTION _____ PSIG;

ELEVATION _____ MSL; MP. _____. THE PRESSURE WAS ☐ MEASURED ☐ CALCULATED

FINAL PRESSURE AT POINT OF TEST _____ PSIG TIME _____ AM PM

FINAL TEMPERATURE OF TEST SECTION _____ °F

TOTAL FLUID INJECTED _____ GAL. TOTAL FLUID WITHDRAWN _____ GAL.

NET CHANGE IN VOLUME OF THE TEST SECTION ± _____ GAL.

LENGTH OF TEST _____ HRS. _____ MIN.; TESTING FLUID _____, SPEC. GVTY. _____ TEMP. _____ °F

INITIAL PRESSURE _____ % OF SMYS AT THE TEST SITE _____ % AT HIGH POINT _____ % AT LOW POINT

MINIMUM TEST PRESSURE DURING A SELECTED 24-HOUR PERIOD (TEST PRESSURE) _____ PSIG

MAXIMUM ALLOWABLE OPERATING PRESSURE _____ PSIG. BASED ON _____ % SMYS

OR _____

WERE THERE ANY LEAKS? ☐ YES ☐ NO; IF YES, EXPLAIN _____

_____

WAS EVERY COMPONENT THAT WILL BE SUBJECTED TO THE SYSTEM WORKING PRESSURE HYDROSTATICALLY TESTED? ☐ YES ☐ NO; IF NO, EXPLAIN _____

_____

PRESSURE RECORDER MAKE AND SERIAL NO. _____

TEMPERATURE RECORDER MAKE AND SERIAL NO. _____

REMARKS: _____

_____

_____

_____

CONDUCTED BY _____ TITLE _____

CERTIFIED BY _____ TITLE _____

WITNESSED BY _____ TITLE _____

HYDROTEST CALCULATIONS

DATE	FEB-12-91	
LINE:	CHEVRON GAS	
BY:	C. PETERSEN	

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.322	INCHES
LENGTH	0.08504	MILES
TEST PRESSURE	735	PSIG
WATER TEMP		
BEGIN	55	DEG F
END	55	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	9.2	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	2684.835	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	2694.044	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000312	
Vtp': CORRECT. VOL	2694.044	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-12-91
LINE:	CHEVRON GAS
BY:	C. PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.322	INCHES
LENGTH	0.08504	MILES
TEST PRESSURE	726	PSIG
WATER TEMP		
BEGIN	54	DEG F
END	54	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

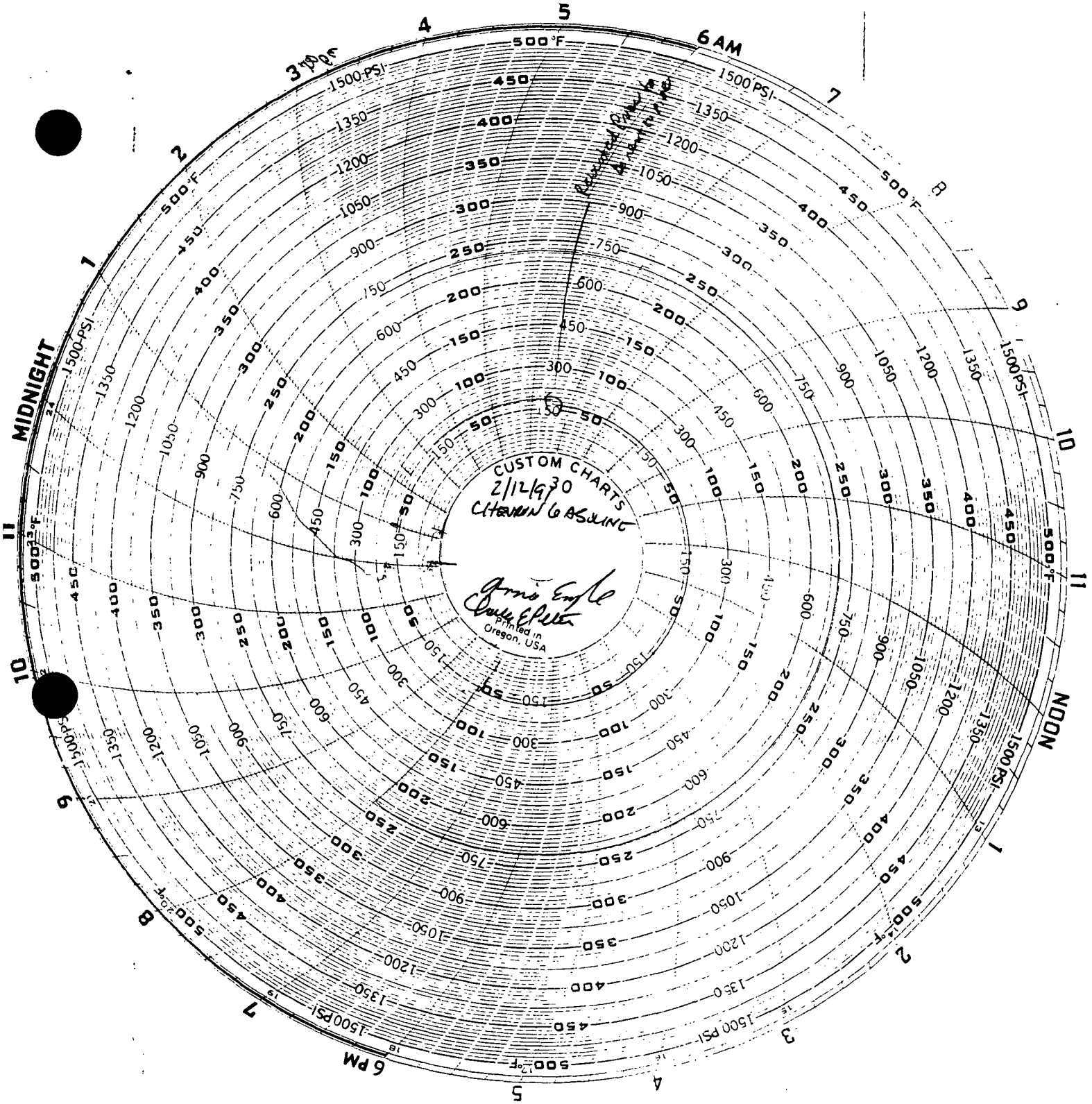
WATER ADDED TO TEST:	9.2	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	2684.835	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	2694.066	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000362	
Vtp': CORRECT. VOL	2694.066	GALLONS


CUSTOM CHARTS
2/12/97
CHEVRON GASOLINE
Printed in Oregon, USA
MIDNIGHT
NOON
6 AM
6 PM
500°F
1500 PSI

SIV
91A2961_C

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PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE		LOCATION CODE	DIVISION
OLYMPIC PIPELINE		ARCO FUEL	WCD
SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	-1+59	20+67	Delivery Facility

LINE HISTORY

DATE CONSTRUCTED	O.D.		TYPE (Seamless, ERW, etc.)	
1965	14.0"		ERW	
SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
42000	0.250"		300	300

DATE TEST PERFORMED
2-20-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	OBTAINED FROM HYDRANT AT D.F.
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAL
TEST PRESSURE - MINIMUM: 787 psig	THIS WAS INITIAL PRESSURE
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	Pressure Pump, Dual Pen Chart Recorder Deadweight tester, Pressure Gauge
AVERAGE TEMPERATURE OF TESTING MEDIUM	51.5°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	787 psig at
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT REQUIRED. Del does not exceed 100 ft
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 11:10 ☒ AM ☐ PM COMPLETED: 19:10 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	Delivery line from D.F. to ARCO Terminal

GENERAL COMMENTS

Pressure steadily increased even though temperature decreased

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E Peter

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

14" D.F TO ARCO FUEL

START: 1110 @ 2-20-91
END: 0710 @ 2-21-91

TIME	DEAD WEIGHT	LB'S ON CHART	TEMP ON CHART	LB'S ON GAUGE	OUT SIDE AIR TEMP
1110	787	780	54	790	60
1140	788	780	54	790	69
1210	791	781	54	790	65
1240	792	782	55	790	60
1310	793	782	54	790	65
1340	794	782	53	790	62
1410	794	784	54	790	65
1440	795	785	54	792	60
1510	796	787	52	792	57
1540	797	790	52	797	58
1610	797	793	51	799	55
1640	798	793	50	799	53
1710	798	793	50	799	51
1740	798	794	50	799	50
1810	798	794	50	799	48
1840	799	795	49	800	48
1910	799	795	49	800	46
2-21-91 @ 0710	805	797	50	800	42

NOTE: VERY SLIGHT DRIP AROUND 2" VENT VALVE STEM.

FOXBORO: 40MR-RFM2F/PB-AA/TA-1A
SER# 91A2861-1
DEAD WEIGHT: CRS 35265-1
S/N 5982

HYDROTEST CALCULATIONS

DATE	FEB-20-91
LINE:	ARCO FUEL
BY:	V. CROSE

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.25	INCHES
LENGTH	0.42	MILES
TEST PRESSURE	787	PSIG
WATER TEMP		
BEGIN	54	DEG F
END	54	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	67.5	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	16489.59	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	16557.06	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000362	
Vtp': CORRECT. VOL	16557.06	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-20-91
LINE:	ARCO FUEL
BY:	V. CROSE

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.25	INCHES
LENGTH	0.42	MILES
TEST PRESSURE	799	PSIG
WATER TEMP		
BEGIN	49	DEG F
END	49	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

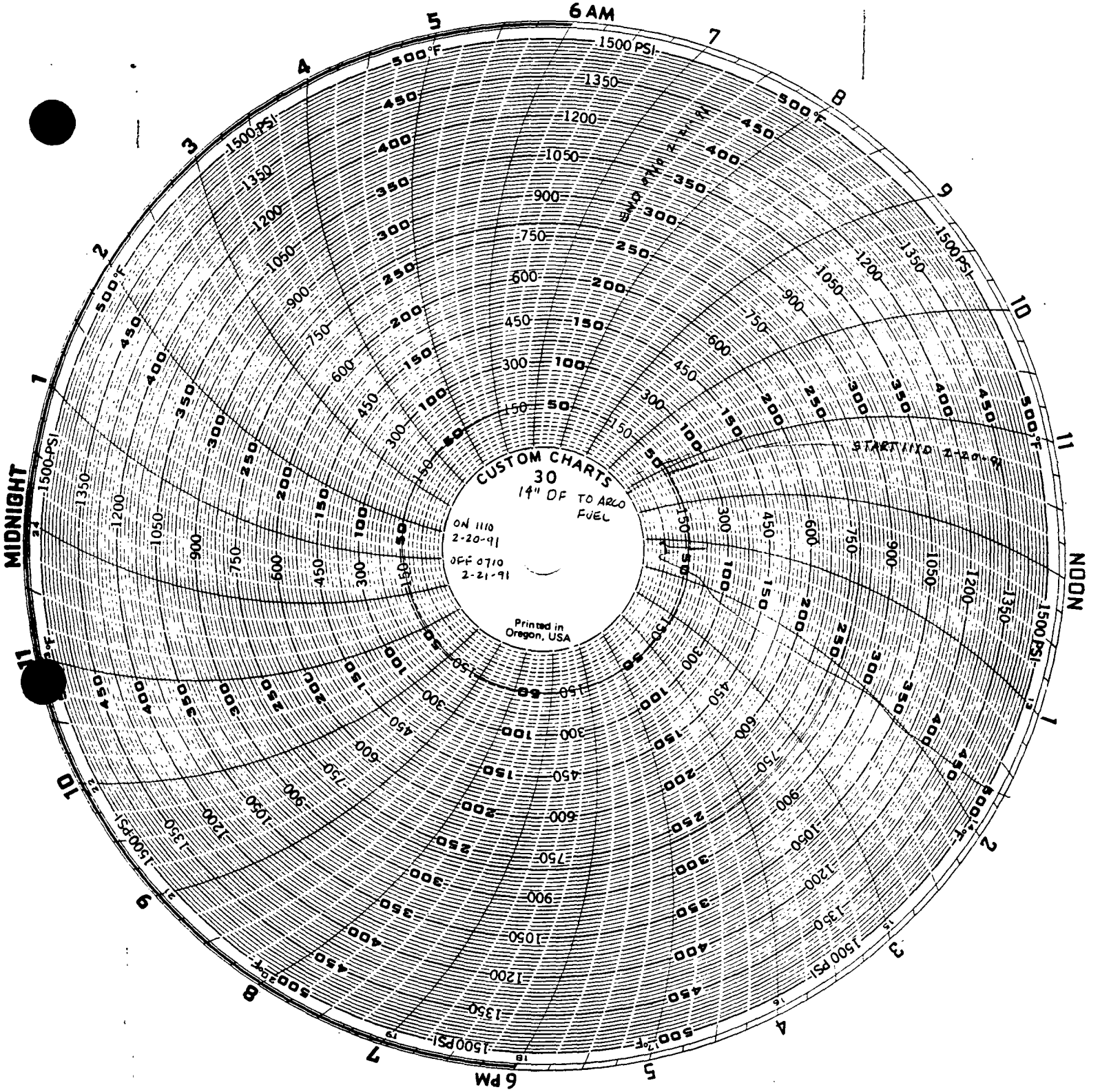
WATER ADDED TO TEST:	71.3	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	16489.59	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	16560.88	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000554	
Vtp': CORRECT. VOL	16560.88	GALLONS



SCOEPA00012166

FOXBORO
40MR-RFM2-F/PB-AA/TA-1A
SER# 91A2861-1

DEAD WEIGHT TESTER
CRS 35265-1
SN 5982

Virgil V. Crow

H

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	JCT TO TEXACO FUEL	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	130+71	311+28	JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1965	14.0"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
42000	0.250"		300	300

DATE TEST PERFORMED
3-1-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	USED ON PREVIOUS TEST
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARNAC
TEST PRESSURE - MINIMUM: 900 psig	PRESSURE WAS CONSTANT THROUGHOUT THE TEST
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, TWO PEN CHART RECORDER DEADWEIGHT TESTER, PRESSURE GAUGE
AVERAGE TEMPERATURE OF TESTING MEDIUM	50.5°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	900 psig at Test Site
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, Δel does not exceed 100 ft.
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 13:45 ☐ AM ☐ PM COMPLETED: 21:45 ☐ AM ☐ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	Delivery line from JCT to Texaco terminal

GENERAL COMMENTS

Pressure on deadweight tester and start and ending pressure on the chart remained constant

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E Peter

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

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H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

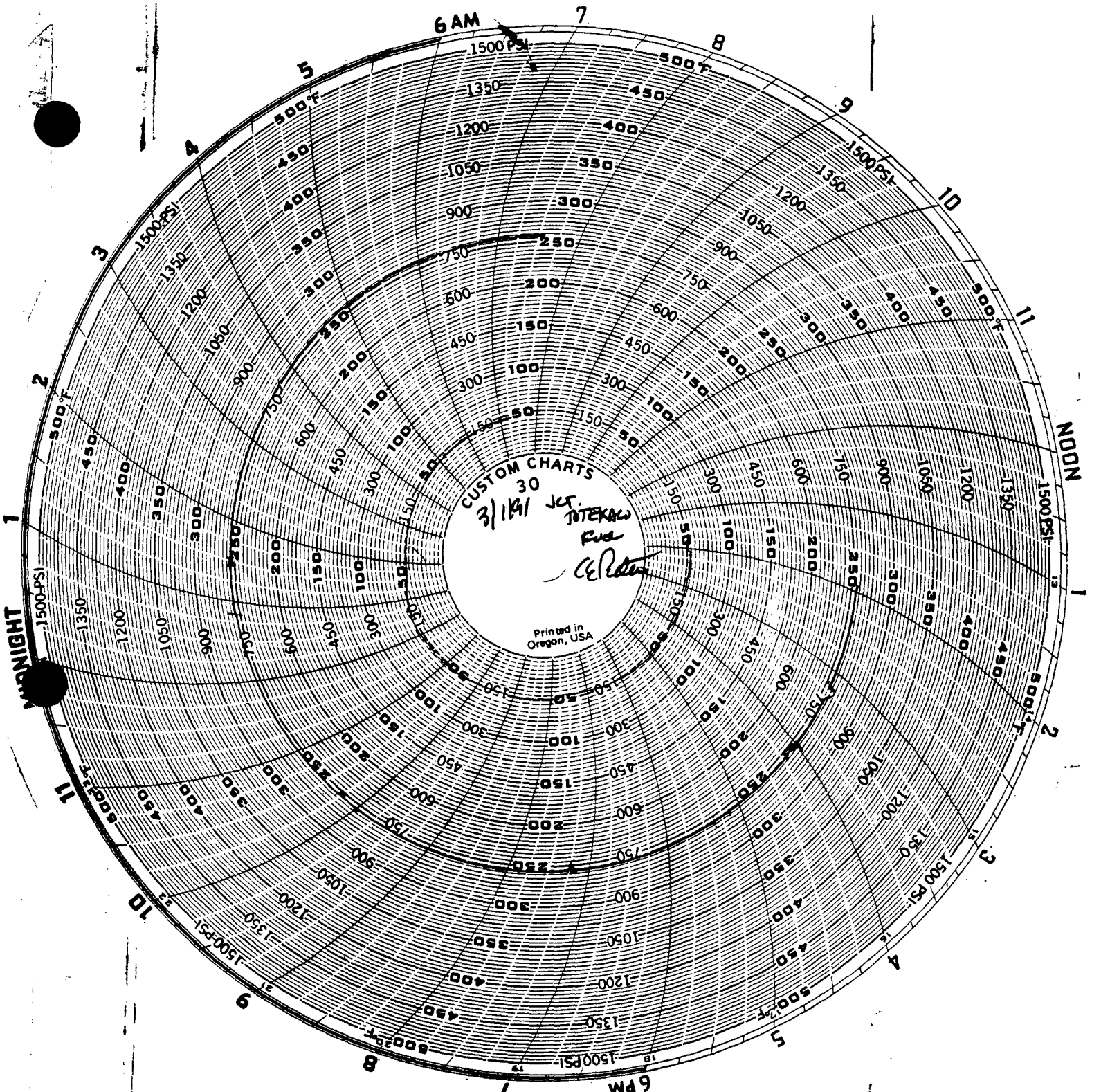
D. Records of failures during test and the reason for the failures.

FG2313015

11 TERRAL GAS 3/1/91

TIME 1 00 pm	DW	CHART	GAUGE	OFF CHART T	OUTDOOR T
13:45	~~799~~	765	797	52	54°F
14:45	~~799~~	765	797	52	50°F
15:45	~~798~~	767	795	52	46
16:45	ew	767	795	51	44
17:45	ew	766	795	51	41
18:45	ew	766	795	50	40
19:45	ew	765	795	48	40
20:45	ew	765	795	48	40
21:45	ew	765	795	49	40
~~22:45~~					

THE REFINERY SUPPLY Co
TULSA OK.
Ord 35265-1
S/N 5980



SCOEPA00012172

Foxboro
SU 91A 2961-B

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.15
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	FUEL OIL DISTRICT	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	0+00	130+525	DF

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1965/1991	14 inch	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
42,000/35,000	0.250"/0.375		300	300

DATE TEST PERFORMED: 4/25/91

DATA CHECK LIST	REMARKS
TEST MEDIUM	WATER
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM	775 psig
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, DUAL PEN CHART RECORDER, DEADWEIGHT TESTER, PRESSURE GAUGE
AVERAGE TEMPERATURE OF TESTING MEDIUM	55°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	775 psig
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, DOES NOT EXCEED 100 ft.
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 9:00 ☒ AM ☐ PM COMPLETED: noon ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	FUEL OIL DISTRIBUTION LINE FROM DF TO JUNCTION

GENERAL COMMENTS

TEST INCLUDED PORTION OF LINE THAT WAS REPLACED ACROSS THE WACKER PROPERTY FROM STATION 76+13 to 95+88

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E Preston

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

4/25/91

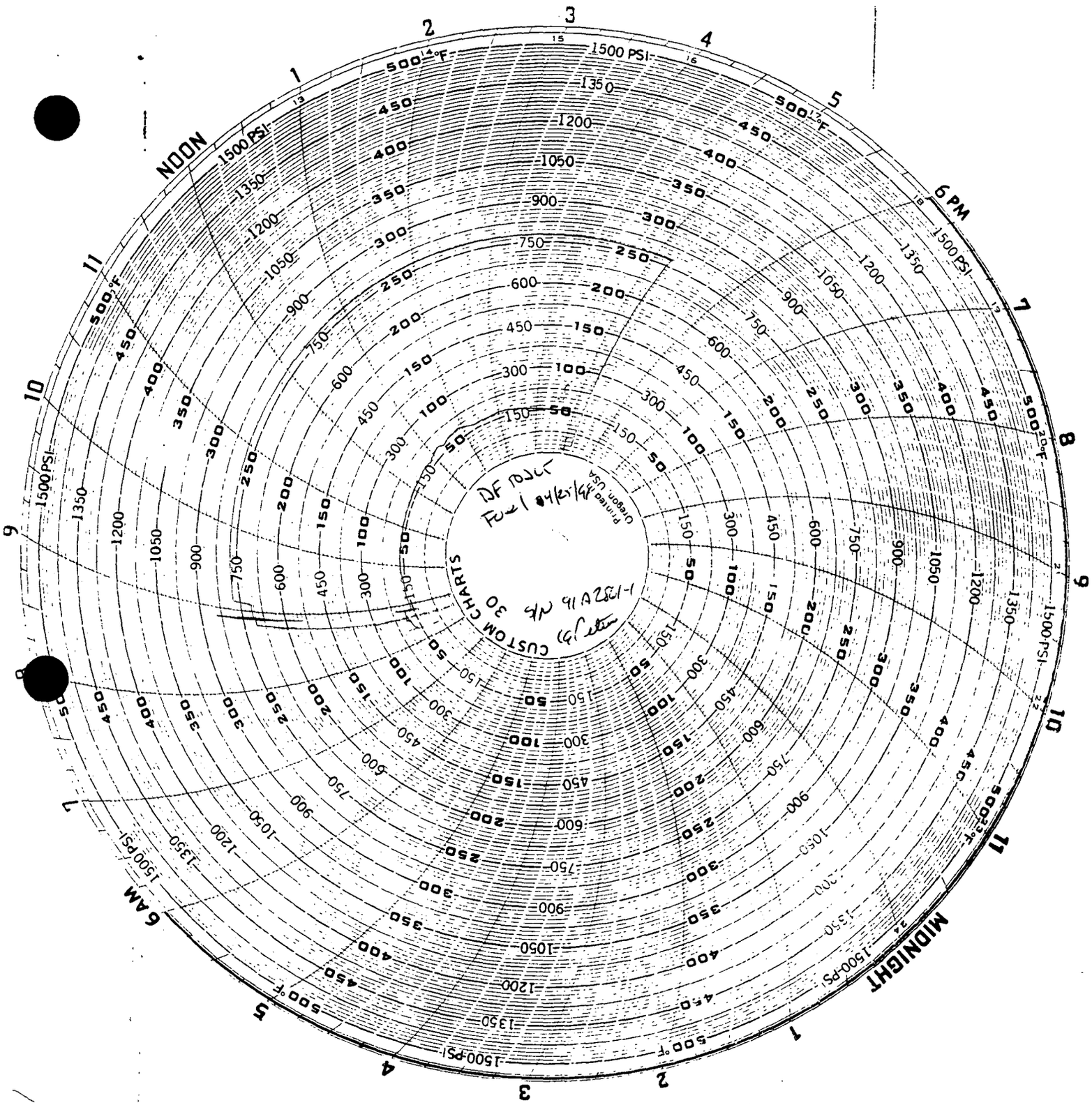
FUEL OIL LINE

DF TO JUNCTION

CHART Foxboro S/N 91A 2861-1
Deadweight : Refinery Supply S/N 5982

	DW	GAUGE	CHART	CHART TF	AIR TF	
9:03	775	775	775	55	60	SUNN
10:00	775	775	775	55	57	CLOUDY
11:00	775	775	775	55	60	SUNNY
12:00	775	775	775	54	58	CLOUDY
13:00	775	775	778	55	60	SUN
14:00	775	775	780	60	59	SUN
15:00	775	777	780	55	59	SUN
[illegible]	775	775	778	55	54	CLOUD
[illegible]	775	775	775	52	54	CLOUD RAINY

Charles Fuller


NOON
6 PM
MIDNIGHT
6 AM
1500 PSI
500°F
CUSTOM CHARTS
Printed in Oregon, USA
DF Rosie
Fuel 04/27/68
1-1282A 91 N/S 30

J

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	SHELL FUEL	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
			JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1965	14.0"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
42,000	0.250"		300	300

DATE TEST PERFORMED: 2/28/91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	FROM HYDRANT AT SHELL PIER
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM: 766 PSIG	THIS WAS INITIAL PRESSURE
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, DUAL PEN CHART RECORDER DEADWEIGHT TESTER, PRESSURE GAUGE
AVERAGE TEMPERATURE OF TESTING MEDIUM	56.5°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	766 PSIG at test point
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, Δel does not exceed 100ft
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 9:45 ☒ AM ☐ PM COMPLETED: 16:45 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	Delivery line from Jct to SHELL MANIFOLD

GENERAL COMMENTS

TEST PROCEEDED WITH NO DIFFICULTIES WITH INCREASING PRESSURE

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: [signature]

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

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INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

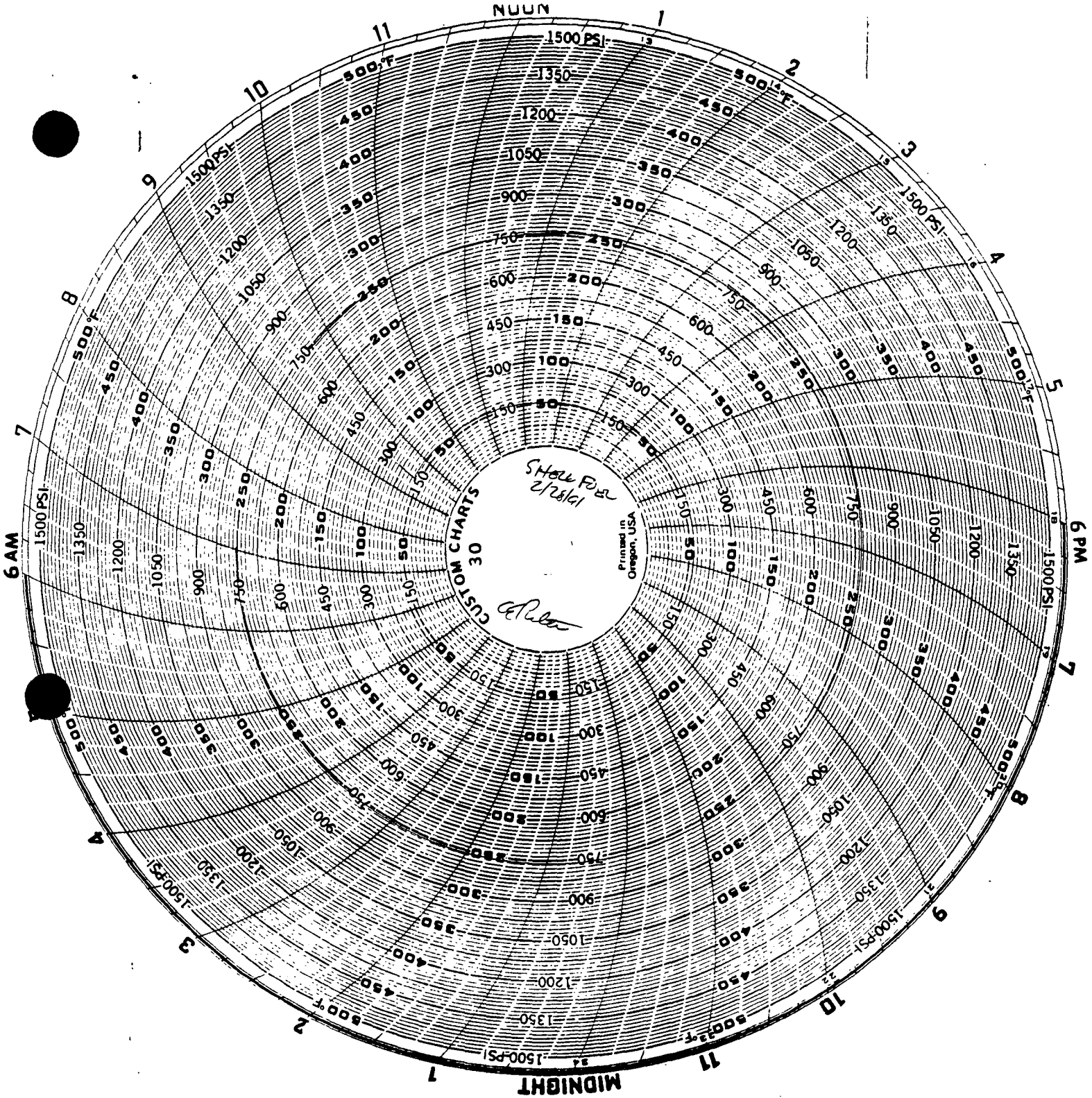
D. Records of failures during test and the reason for the failures.

FG2313015

SHELL FUEL 2/28/91

TIME	DW TEST	PSIG CHART	TEMP CHART	PSIG GAUGE	AIR TEMP
0945	766	743	57	765	50
1045	768	750	55	768	58
1145	774	753	54	770	66
1430	786	767	50	797	65
1600	791	780	50	792	61
1645	791	780	55	792	59

C Elliott



SCOEPA00012183

K

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.15
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	UNOCAL FUEL	WCD

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	0+00	11+13.8	JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1973	12.75"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
			300	300

DATE TEST PERFORMED: 2-27-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	REUSED FROM PREVIOUS test
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM: 772 psig	
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	Pressure pump, Dual pen chart recorder Deadweight tester, pressure gauge
AVERAGE TEMPERATURE OF TESTING MEDIUM	52.5°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	773 psig
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT REQUIRED, Del does not exceed 100 ft
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 15:10 ☐ AM ☒ PM COMPLETED: 23:00 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	Delivery line from JCT TO UNOCAL TERMINAL

GENERAL COMMENTS

CALCULATIONS WERE MADE TO CORRELATE DATA. PRESSURES DROPPED WHILE TEMPERATURE ON CHART INCREASED BUT OUTSIDE AIR TEMP DECREASED. TEMPERATURES AVERAGED BETWEEN AIR AND GROUND. THESE CALCULATIONS PLUS THE APPROXIMATE 1 CUP OF liquid that leaked out of the deadweight tester indicates a good test.

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E Peters

ATTACHMENTS REQUIRED FOR EACH TEST
1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

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D. Records of failures during test and the reason for the failures.

FG2313015

HYDROTEST CALCULATIONS

DATE	FEB-27-91
LINE:	UNOCAL FUEL
BY:	C.PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.312	INCHES
LENGTH	0.211	MILES
TEST PRESSURE	781	PSIG
WATER TEMP		
BEGIN	48	DEG F
END	48	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	26.1	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	6683.603	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	6709.672	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000580	
Vtp': CORRECT. VOL	6709.672	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-27-91
LINE:	UNOCAL FUEL
BY:	C.PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.312	INCHES
LENGTH	0.211	MILES
TEST PRESSURE	773	PSIG
WATER TEMP		
BEGIN	57	DEG F
END	57	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	23.5	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	6683.603	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	6707.113	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000200	
Vtp': CORRECT. VOL	6707.113	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-27-91
LINE:	UNOCAL FUEL
BY:	C.PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.312	INCHES
LENGTH	0.211	MILES
TEST PRESSURE	781	PSIG
WATER TEMP		
BEGIN	54.13	DEG F
END	54.13	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	24.7	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	6683.603	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	6708.317	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000356	
Vtp': CORRECT. VOL	6708.317	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-27-91
LINE:	UNOCAL FUEL
BY:	C.PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.312	INCHES
LENGTH	0.211	MILES
TEST PRESSURE	773	PSIG
WATER TEMP		
BEGIN	52.5	DEG F
END	52.5	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	24.9	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	6683.603	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	6708.545	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000430	
Vtp': CORRECT. VOL	6708.545	GALLONS

12" UNION OIL (FUEL)

START: 2-27-91 @ 1510
END: 2-28-91 @ 0700

TIME	DEAD WEIGHT	LB'S ON CHART	TEMP ON CHART		GAUGE PSIG	AIR TEMP
1510	780.8	775	48	52.5 54.13	771	67
1540	781	775	48		771	66
1610	781	775	48		771	66
1640	781	775	50		770	61
1710	776.7	770	55		768	56
1830		765	55		765	51
1930	779	765	56		761	50
2000	774	764	55		760	49
2030	777	765	56		760	48
2130	777	765	56		760	46
2200	775	764	56		760	46
2230	772	764	56	52.5	760	44
2300	773	765	57	51.5	760	44
0700	774	754	57		755	36

1) AT APPROX. 1730 WE HAD LOST ABOUT 3/4 OF A CUP OF WATER THROUGH THE SHAFT OF THE DEAD WEIGHT TESTER
2) AT APPROX 2130 WE HAD LOST ABOUT 2 TBS OF WATER AROUND VALVE ON DEAD WEIGHT TESTER. @ 0700 HAD LOST A TOTAL OF ABOUT 3 TBS.

(OVER)

FOX BORO: 40MR-RFM2F/PB-AA/TA-1A

DEAD WEIGHT TESTER: CRS 35265-1

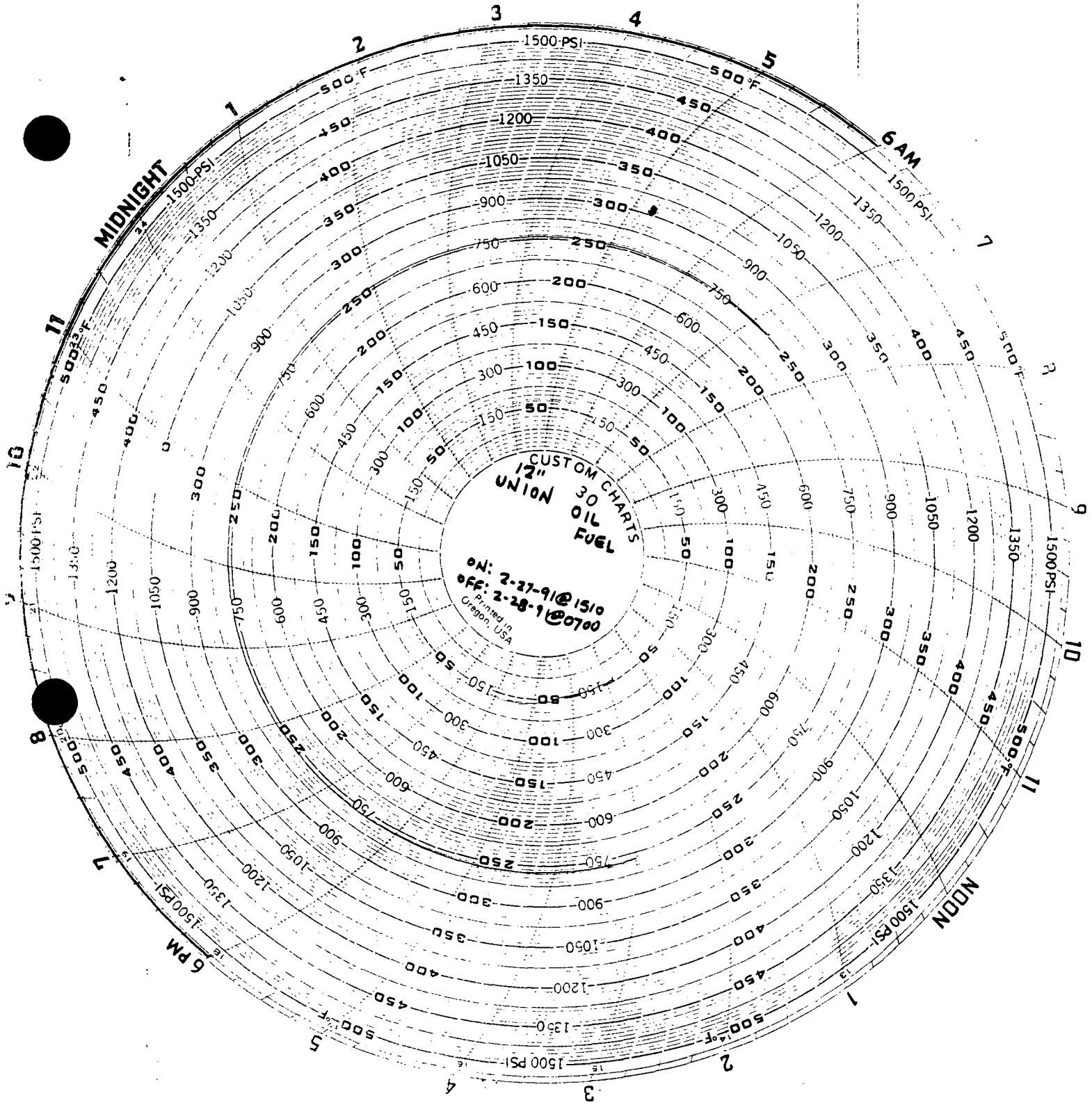
S/N 5980

UNOCAL FUEL

TIME	DW		CHART PSIG	CHART TEMP	GAUGE PSIG	OUTSIDE TEMP
1510	775.8		775	48	~~07~~ 771	67
1540	776		775	~~50~~ 48	771	66
1610	776	+5	775	48	771	66
1640	776		775	50	770	61
1710	771.7		770	55	768	56
1830			765	55	765	51
1930	779		765	56	761	50
2000	774		764	55	760	49
2030	777		765	56	760	43
2130	777		765	56	760	46
2200	775		764	56	760	46
2230	772		764	56	760	44
2300	773		765	57	760	44
0700	774		754	57	755	36

* AT APPROX 1730 LOST 3/4 OF A CUP OF WATER THROUGH SHAFT OF P.W. TESTER

AT APPROX 2130 LOST 2 TBLS OF WATER AROUND VALVE ON P.W TESTER TOTAL OF 3 TBLS


CUSTOM CHARTS
12"
UNION
30
OIL
FUEL
ON: 2-27-91@1510
OFF: 2-28-91@0700
Printed in Oregon, USA
MIDNIGHT
6 AM
NOON
6 PM
1500 PSI
1350
1200
1050
900
750
600
450
300
150
500°F
450
400
350
300
250
200
150
100
50

FOXBORO: 40MR-RFM2F/PB-AA/TA-1A
SER 91A2861-C
DEAD WEIGHT TESTER
CRS 35265-1
S/N 5980
Virgil V. Crane
2-28-91

L

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	CHEVRON FUEL	WCP

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	0+00	4+49	PORTLAND JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1973	12.75"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
35,000	0.312"		300	300

DATE TEST PERFORMED: 2-28-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	REUSED FROM PREVIOUS TEST ON GASOLINE LINE
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM: 766 PSIG	INITIAL PRESSURE WAS 786 PSIG
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	Pressure Pump, Dual Pen Chart Recorder DEADWEIGHT TESTER, PRESSURE GAUGES
AVERAGE TEMPERATURE OF TESTING MEDIUM	52.5
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	766 PSIG at test site at JUNCTION
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	NOT RECORDED, ΔEL DOES NOT EXCEED 100 FT.
TEST DURATION (including time started and completed)	DURATION: 8 HOURS STARTED: 9:45 ☒ AM ☐ PM COMPLETED: 18:20 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	DELIVERY LINE FROM OLIMPIC MAINLINE TO CHEVRON

GENERAL COMMENTS

THERE WAS A LEAK IN DEADWEIGHT TESTER THAT LOST APPROXIMATELY .25 gallon until DW TESTER WAS CHANGED AT 17:10 PRESSURE WAS STEADIER. IT ALSO LEAKED APPROXIMATELY .025 gallons due to leaking connection. CALCULATIONS MADE TO CONFIRM GOOD TEST

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles Peter

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

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Copy: Division

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III. Data Check List

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B. Tested By - name of company performing test.

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D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

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H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

HYDROTEST CALCULATIONS

DATE	FEB-28-91
LINE:	CHEVRON FUEL
BY:	C. PETERSEN

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.322	INCHES
LENGTH	0.08504	MILES
TEST PRESSURE	766	PSIG
WATER TEMP		
BEGIN	50	DEG F
END	50	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	10.1	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	2684.835	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	2694.921	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000523	
Vtp': CORRECT. VOL	2694.921	GALLONS

HYDROTEST CALCULATIONS

DATE	FEB-28-91	
LINE:	CHEVRON FUEL	
BY:	C. PETERSEN	

INPUT

PIPE SIZE	12.75	INCHES
WALL THK.	0.322	INCHES
LENGTH	0.08504	MILES
TEST PRESSURE	786	PSIG
WATER TEMP		
BEGIN	55	DEG F
END	55	DEG F
RESTRAINT	1	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	9.8	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	0.000	GALLONS

CALCS

CALC TYPE:	RESTRAINED	
STD COND. VOL:	2684.835	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	2694.630	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000312	
Vtp': CORRECT. VOL	2694.630	GALLONS

CHEV FUEL 2/28-3/1/91

TIME		DW TEST	PSIG CHART	TEMP CHART	PSIG GAUGE	AIR TEMP
0945		300	730	55	730	50
1045		799	779	54	790	58
1145	Leak in D.W. Shaft	796	776	55	789	62
1430	Leak in DW Shaft	788	767	55	790	65
1600	Leak in DW Shaft	786	765	53	784	61
16:45	Leak in DW Shaft	782	763	52	780	59
CHANGED		DW TEST				
17:10		785	757	52	780	57
17:50		783	755	51	780	55
18:20		782	754	50	779	54
0650		765	742	50	760	49

NEW DEADWEIGHT CHECKED APPROX 30 oz of Liquid

New Deadweight 35265

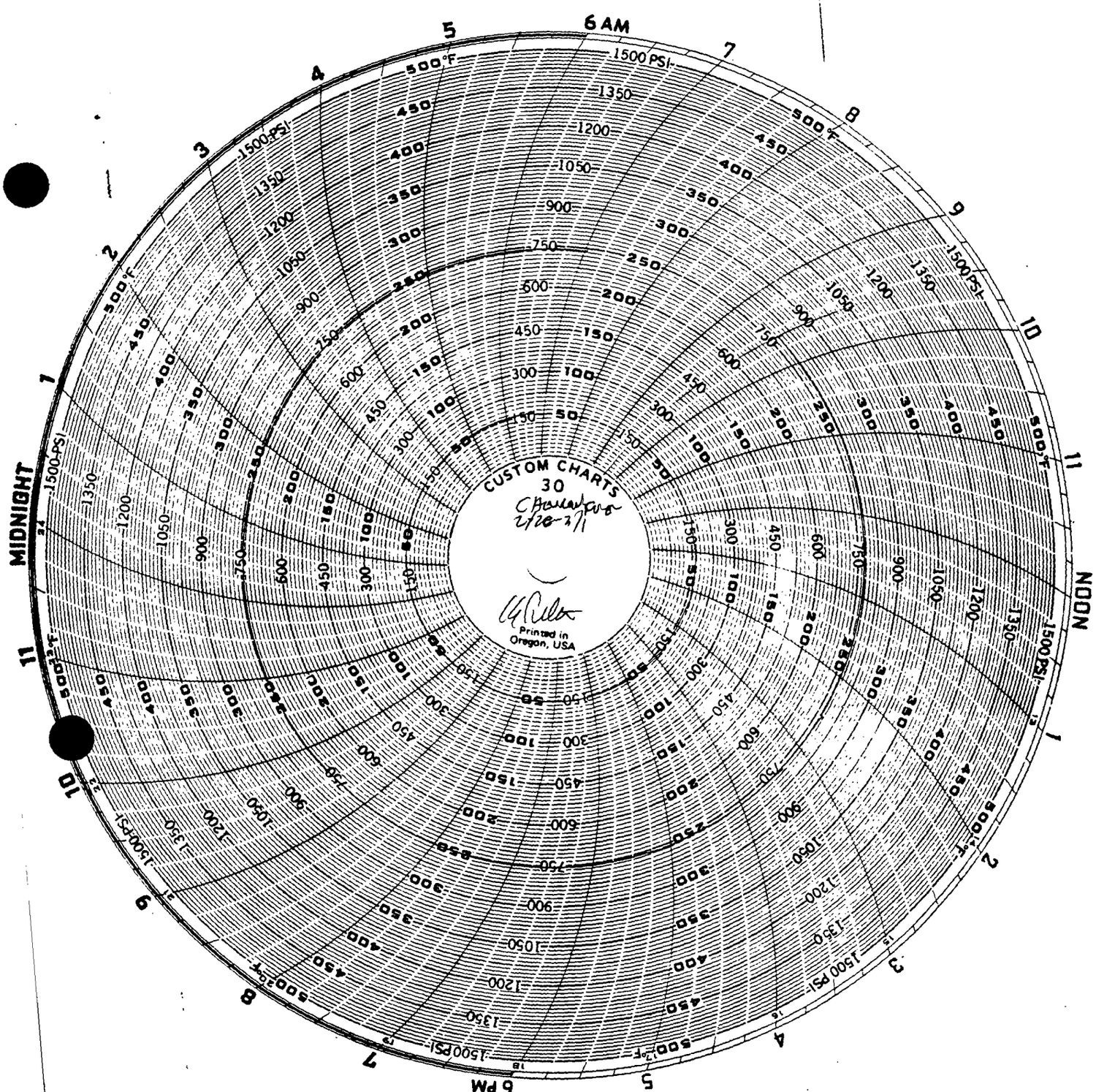
S/N 5950

Pressure supplied

CHART FOXBORO 5 Hour

S/N 91A2861-C

CHART FOXBORO 91A2861-B



SCOEPA00012202

M

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.115
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	New Gasoline line crosses Wacker property	WCO

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	76+12.6	95+57.5	95+57.5

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1991	14.00 INCH	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
35,000	0.375 INCH		300	300

DATE TEST PERFORMED: 4/2/91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	OBTAINED FROM HYDRANT AT TEST SITE
TEST BY	CONTRACTOR - NORTHWEST MUTAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM	785 psig
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	Pressure pump, Dual pen CHART RECORDER DEADWEIGHT TESTER, PRESSURE GAUGE
AVERAGE TEMPERATURE OF TESTING MEDIUM	47°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	783 psig at - MIDN
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	785 psig
TEST DURATION (including time started and completed)	DURATION: 8 HOURS
	STARTED: 0930 ☒ AM ☐ PM
	COMPLETED: 1630 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	BURIED LINE REF. [illegible]

GENERAL COMMENTS

Actual pipe length is 59 feet short when compared to the stationing. ORIGINAL LINE WENT VERY DEEP. New line is only buried with four foot of cover.

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E. Pelter

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

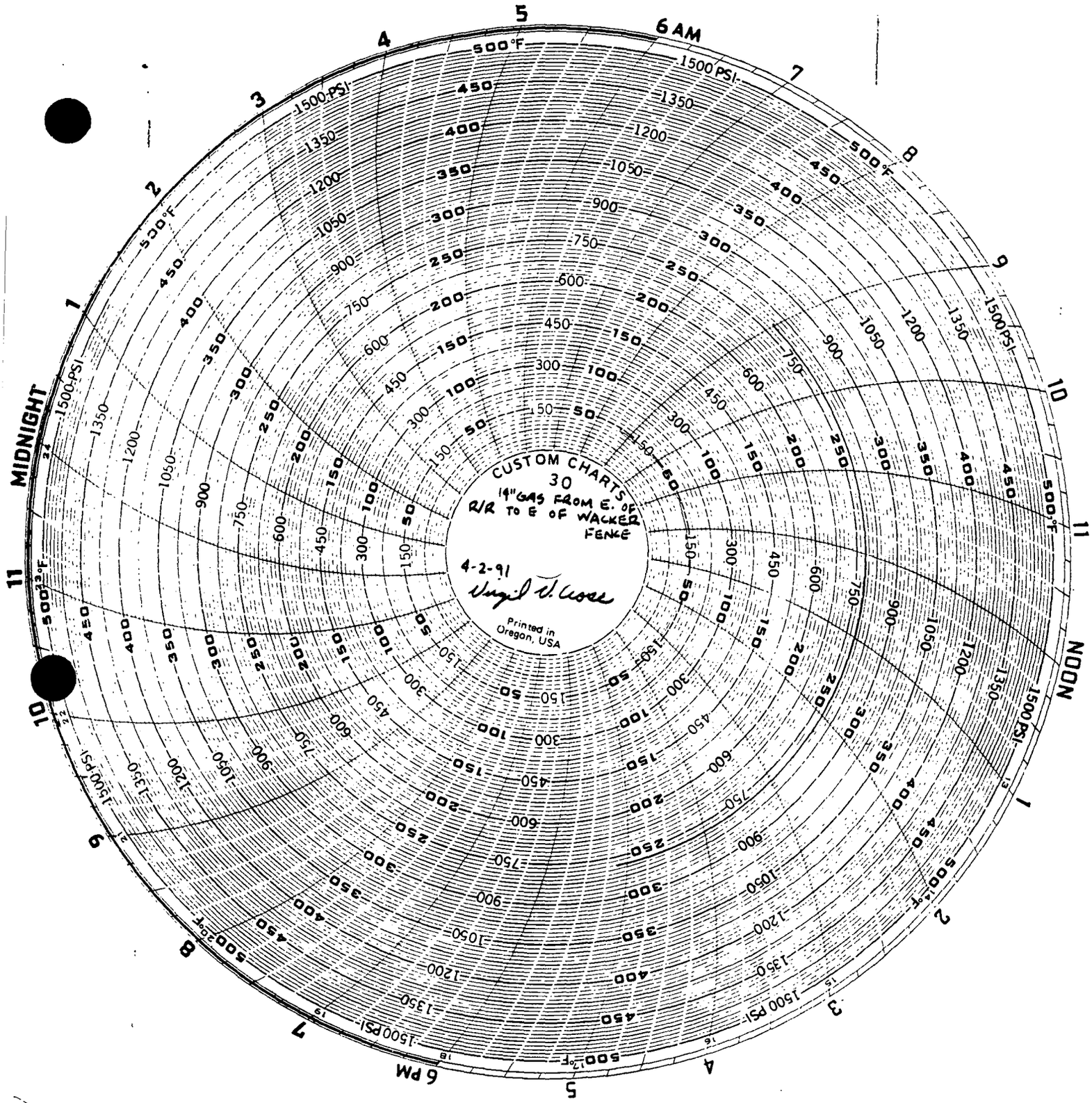
14" GAS LINE FROM EAST SIDE OF RAILROAD TRACKS TO EAST SIDE OF WACKER'S WASTE WATER TREATMENT PLANTS FENCE.

TIME	DEAD WEIGHT	LB'S ON CHART	TEMP ON CHART	LB'S ON GAUGE	OUTSIDE AIR TEMP
0830	785	782	46	775	53
0930	785	782	48	775	53
1030	785	782	50	775	60
1130	785	783	48	775	70
1230	788	784	48	775	54
1330	788	783	48	775	50
1430	787	780	48	775	54
1530	788	780	46	775	58
1630	788	780	45	775	51

FOXBORO RECORDER
40MR-RFM2F/PB-AA/TA-1A
SER # 91A2861-B

DEAD WEIGHT TESTER
CRS 35265-1
S/N 5982

START: 4-2-91 @ 0830
END: 4-2-91 @ 1630


CUSTOM CHARTS
30
14" GAS FROM E. OF
R/R TO E OF WALKER
FENCE
4-2-91
Virgil V. Cross
Printed in
Oregon, USA
MIDNIGHT
NOON
6 AM
6 PM
500°F
1500 PSI

FOXBORO RECORDER
40MR-RFM7F/PB-AA/TA-1A
SER # 91A2861-B

DEAD WEIGHT TESTER
CRS 35265-1
S/N 5982

N

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.16
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	NEW FUEL MANIFOLD & McCall GAS	WCO

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	NA	NA	JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1991	14"/12"	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
35000	0.375 / 0.312		300	300

DATE TEST PERFORMED: 2-17-91

DATA CHECK LIST	REMARKS
TEST MEDIUM: WATER	OBTAINED FROM HYDRANT AT SHELL PIER
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER MARMAC
TEST PRESSURE - MINIMUM	1093 psig
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, QUALPAN CHART RECORDER DEADWEIGHT TESTER, PRESSURE GAUGE
AVERAGE TEMPERATURE OF TESTING MEDIUM	50°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	1093 psig
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	N/A
TEST DURATION (including time started and completed)	DURATION: 4 HOURS STARTED: 12:30 ☐ AM ☒ PM COMPLETED: 16:30 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	New aboveground piping, for Chevron fuel and McCall Gas
GENERAL COMMENTS	
SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST	Charles E Peter

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

FUEL MANIFOLD & McCALL GAS

START 2-17-91 @ DW 1093 @ 12^{30}
END 2-17-91 @ DW 1107 @ 16^{30}

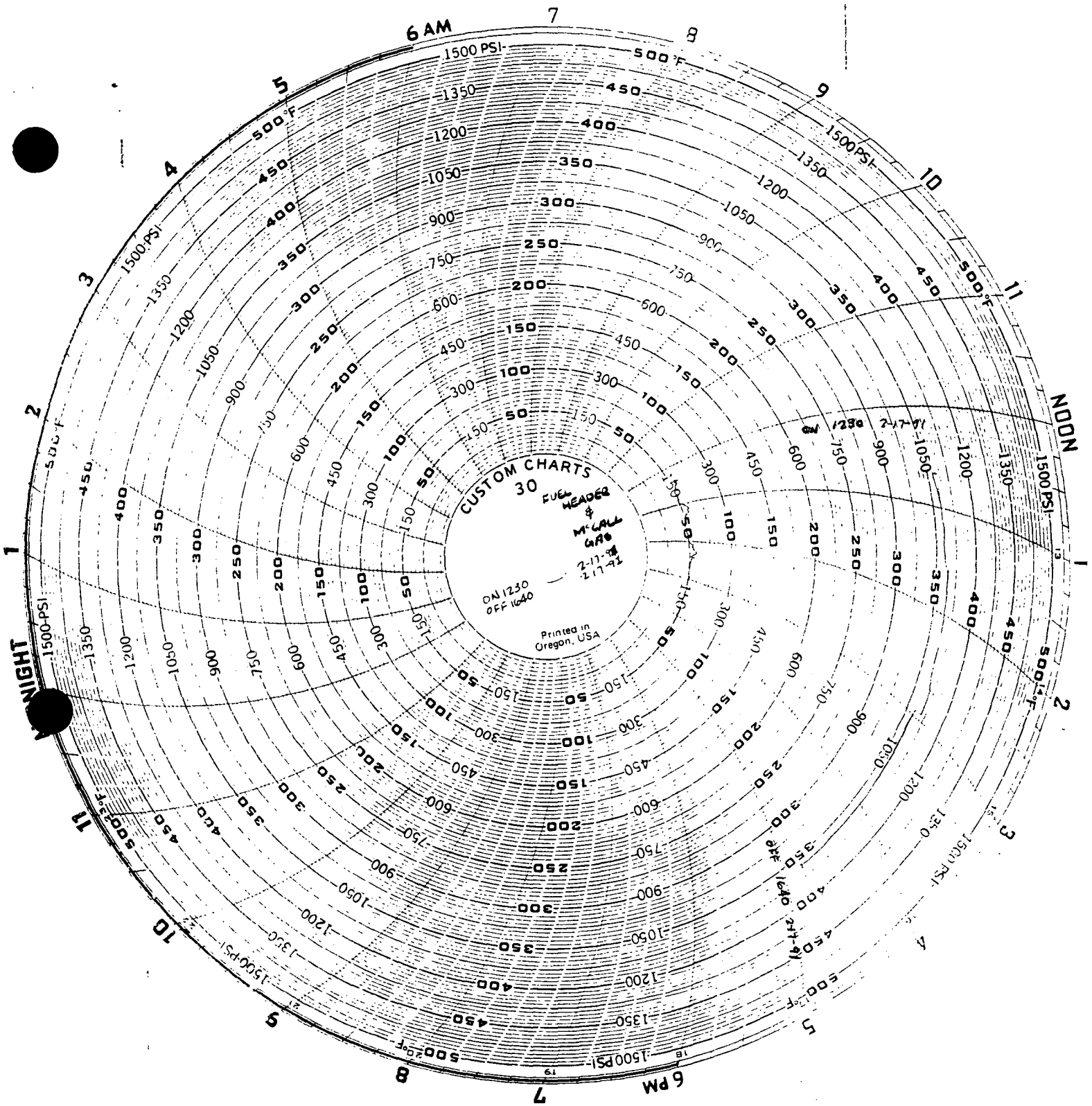
TIME	DEAD WEIGHT	LB'S ON CHART	LB'S ON GAUGE	OUT SIDE AIR TEMP
12^{30}	1093	1077	1099	63°
1300	1104	1080	1110	54°
1330	1115	1085	1111	60°
1400	1117	1095	1115	52°
1430	1130	1102	1125	52°
BLEED OFF [illegible]# → 14~~45~~ (1445)	1100	1083	1100	51°
1500	1100	1078	1100	51°
1530	1100	1080	1100	51°
1600	1102	1081	1100	50°
1630	1107	1085	1100	49°

[illegible] gal

FOXBORO
40MR-RFM2F/PB-AA/TA-A
SER # 91A2861-B

DEAD WEIGHT
CRS 35265-1
S/N 5980

NOTE: A VERY SLIGHT LEAK @ THREADED VALVE USED FOR FILL ONLY.



SCOEPA00012213

FOXBORO
40MR-RFM2F/PB-AA/TA-1A
SERIAL 91A2861-B

DEAD WEIGHT TESTER
CRS 35265-1
S/N 5980

Dwight J. Cuse

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.15
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	NEW GAS MANIFOLD	WLO

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
			JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1991	14/12	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
35000	.375/.365		300	300

DATE TEST PERFORMED
2-10-91

DATA CHECK LIST	REMARKS
TEST MEDIUM WATER	FROM HYDRANT
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM	952 psig
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	Pressure recorder, dual pen chart recorder DEADWEIGHT TESTER, PRESSURE GAUGE
AVERAGE TEMPERATURE OF TESTING MEDIUM	45°F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	952 psig ABOVEGROUND PIPING IN FAB YARD
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	N/A
TEST DURATION (including time started and completed)	DURATION ▶ 4 HOURS STARTED ▶ 9:00 ☒ AM ☐ PM COMPLETED ▶ 13:00 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	NEW PIPING FOR ABOVEGROUND MANIFOLD
GENERAL COMMENTS	
SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST ▶	Charles E. Pelton

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

HYDROTEST CALCULATIONS

DATE	FEB-10-91	
LINE:	NEW MANF.PIPING	
BY:	C.PETERSEN	

INPUT

PIPE SIZE	14	INCHES
WALL THK.	0.0375	INCHES
LENGTH	0.067	MILES
TEST PRESSURE	955	PSIG
WATER TEMP		
BEGIN	46	DEG F
END	50	DEG F
RESTRAINT	0	ENTER ZERO (0) FOR UNRESTRAINED ONE (1) FOR RESTRAINED

RESULT

WATER ADDED TO TEST:	51.6	GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:	-0.258	GALLONS

CALCS

CALC TYPE:	UNRESTRAINED	
STD COND. VOL:	2798.712	GALLONS
Fwp:	********	
Fpp:	********	
Fpt:	********	
Fwt:	********	
Fpwt:	********	
Vtp: CORRECT. VOL	2850.311	GALLONS

@END OF TEST

Fpp':	********	
Fpt':	********	
Fwt':	********	
Fpwt':	1.000510	
Vtp': CORRECT. VOL	2850.053	GALLONS

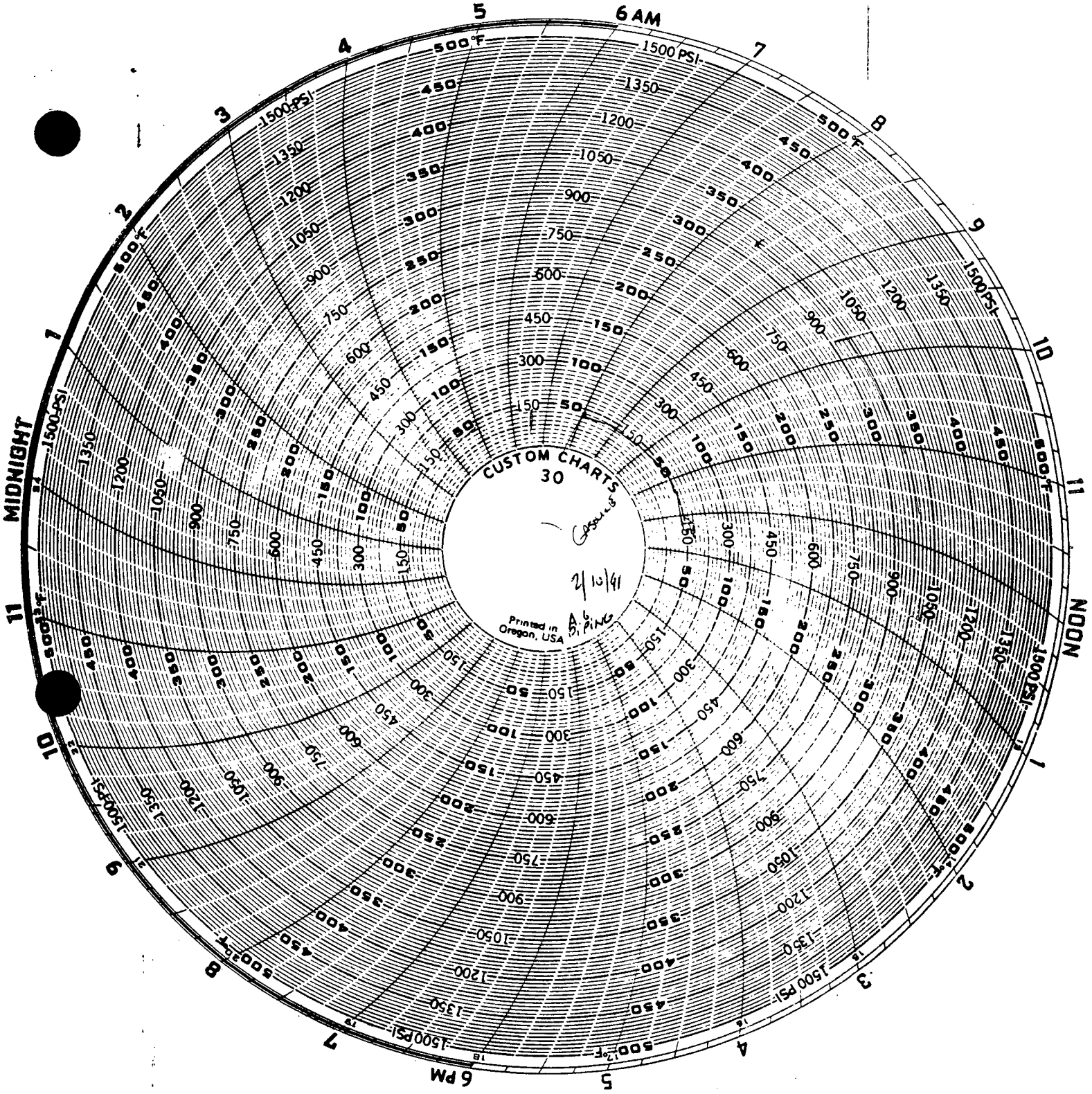
```
                    HYDROTEST CALCULATIONS
DATE                FEB-10-91
LINE:               NEW MANF.PIPING
BY:                 C.PETERSEN

INPUT
PIPE SIZE                14  INCHES
WALL THK.            0.0375  INCHES
LENGTH                0.067  MILES
TEST PRESSURE           996  PSIG
WATER TEMP
   BEGIN                 46  DEG F
   END                   49  DEG F
RESTRAINT                 0  ENTER ZERO (0) FOR UNRESTRAINED
                                          ONE (1) FOR RESTRAINED
RESULT
WATER ADDED TO TEST:    53.7  GALLONS (BASED ON 60 DEG INITIAL TEMP)
WATER ADDED @ TEST:   -0.175  GALLONS

CALCS
CALC TYPE:          UNRESTRAINED
STD COND. VOL:      2798.712  GALLONS
Fwp:                ********
Fpp:                ********
Fpt:                ********
Fwt:                ********
Fpwt:               ********
Vtp: CORRECT. VOL   2852.460  GALLONS

@END OF TEST
Fpp':               ********
Fpt':               ********
Fwt':               ********
Fpwt':              1.000539
Vtp': CORRECT. VOL  2852.285  GALLONS
```

HYDROTEST ABN & CLEANING PIPING 2/14/91

	D.W.	GAUGE	CHART	TEMP.
START 9:00 AM	955	949 955	960	45°F
10:00	952	952	964	45
11:00	972	971	990	50
12:00	985	985	1005	51
END 1:00 PM	996	997	1023	49

Bleed out ~~gal~~ 11 gal at and to get to 950 again

CC Pitts


CUSTOM CHARTS
30
Printed in Oregon, USA
6 AM
NOON
6 PM
MIDNIGHT
1500 PSI
500°F
2/10/91

PL-318 (REV. 11-82)

HYDROSTATIC TEST CERTIFICATION DATA

LINES FALLING WITHIN D.O.T. LIQUID AND GAS PIPELINE REGULATIONS

SHELL PIPE LINE CORPORATION

Instructions for Completion on Reverse side

JOB NO.	35467.1E
ES NO.	90-150

PIPELINE	LOCATION CODE	DIVISION
OLYMPIC PIPELINE	NEW MANIFOLD PIPING	WCO

SECTION TESTED	FROM STATION SURVEY	TO STATION SURVEY	TEST SITE LOCATION
	N/A	N/A	JUNCTION

LINE HISTORY

DATE CONSTRUCTED	O.D.	TYPE (Seamless, ERW, etc.)
1991	14/12	ERW

SPEC. MIN. YIELD	WALL	ANSI RATING	VALVES	FLANGES
35,000	0.375/0.312		300	300

DATE TEST PERFORMED

DATA CHECK LIST	REMARKS
TEST MEDIUM WATER	OBTAINED FROM HYDRANT ON SHELL PIER
TEST BY	CONTRACTOR - NORTHWEST METAL FAB ENGINEER - MARMAC
TEST PRESSURE - MINIMUM	1060 PSIG
LIST PRINCIPAL TEST EQUIPMENT (Pump, Tester, Recorder, etc.)	PRESSURE PUMP, DUAL PEN CHART RECORDER DEADWEIGHT TESTER
AVERAGE TEMPERATURE OF TESTING MEDIUM	55.5 °F
PRESSURE AT LOWEST ELEVATION POINT IN THE SECTION, INCLUDING ELEVATION AND LOCATION.	1060 PSIG
PRESSURE AT HIGHEST ELEVATION POINT IN THE TEST SECTION, INCLUDING ELEVATION AND LOCATION.	N/A ABOVEGROUND PIPING
TEST DURATION (including time started and completed)	DURATION: 4 HOURS STARTED: 0900 ☒ AM ☐ PM COMPLETED: 1300 ☐ AM ☒ PM
ARE PRESSURES CONTINUOUS? If not, explain.	YES
DESCRIPTION OF FACILITY TESTED. (Hwy-xing, River, Pump Sta., Buried Line, etc.)	New aboveground piping for SHELL, McCallard UNION FUEL oil lines
GENERAL COMMENTS	

SIGNATURE OF OPERATOR'S EMPLOYEE RESPONSIBLE FOR TEST: Charles E Pulles

ATTACHMENTS REQUIRED FOR EACH TEST

1. Dead Weight Tester Data.
2. Recording Gauge Charts.
3. *Elevation Profile of Line Indicating Test Site (Required if Elevation Difference Greater than 100').*

DISTRIBUTION:

HEAD OFFICE PROJECT: Original: Engineering - Products - General Engineering
Copy: Division

DIVISION PROJECT: Original: Division
Copies: Local Procedures

RETENTION: As Long As Facility Tested In Use.

INSTRUCTIONS FOR FILLING OUT HYDROSTATIC TEST DATA FORM

I. Test Section Location - The line section being tested should be adequately described by survey alignment sheets which indicate section, township, range block no. and names of facilities. For existing pipelines, the description should be the same as that shown on the "Pipeline Facilities Information List".

II. Line History - Data on the pipeline should be filled out as best possible starting at field level and being added to at Division or Engineering Department level.

III. Data Check List

A. Test Medium - medium used such as water, crude oil, etc.

B. Tested By - name of company performing test.

C. Test Pressure - minimum pressure used in test. For liquid line, if pressure is lowered after initial four hours, both initial and final minimum test pressures shall be shown.

D. Principal Test Equipment and Comments - a list of the principal test equipment, i.e., pump, recorder, etc.

E. Average Temperature of Test Medium - average testing fluid temperature should be recorded at both ends of test section to facilitate pressure calculations based on a temperature differential.

F. Pressure at Lowest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the lowest elevation point in the section tested should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

G. Pressure at Highest Elevation Point in Test Section - where elevation differences exceed 100 feet, the pressure at the highest elevation point in the test section should be recorded along with the elevation and the location of that point. The location should be made from established geodetic surveys on alignment sheets.

H. Test Duration - must record test pressure continuously for the entire test; a minimum of 4 hours for liquid piping exposed to view and a minimum of 8 hours for other liquid piping and for gas lines. Starting and completion times and the time of any pressure reduction on liquid lines are to be recorded.

I. Are Test Pressures Continuous - if the test pressures fluctuate, explain briefly the cause, whether it be faulty equipment, gauges, or line failure.

J. Description of Facility Tested - pipeline section, a highway crossing, river crossing, pump station manifold, pipe pre-tested for future use, etc.

K. Signature of Operator's Employee Responsible for Test.

IV. Attachments Required for Each Test

A. Dead Weight Tester Data - dead weight tester data forms should be filled out for each gauge calibrated.

B. Recording Gauge Charts - attach actual charts as recorded, showing pipeline description and signature of operator's responsible person.

C. Elevation Profile of Line Indicating Test Site - attach an elevation profile and include the exact position of test sites used (if elevation difference > 100').

D. Records of failures during test and the reason for the failures.

FG2313015

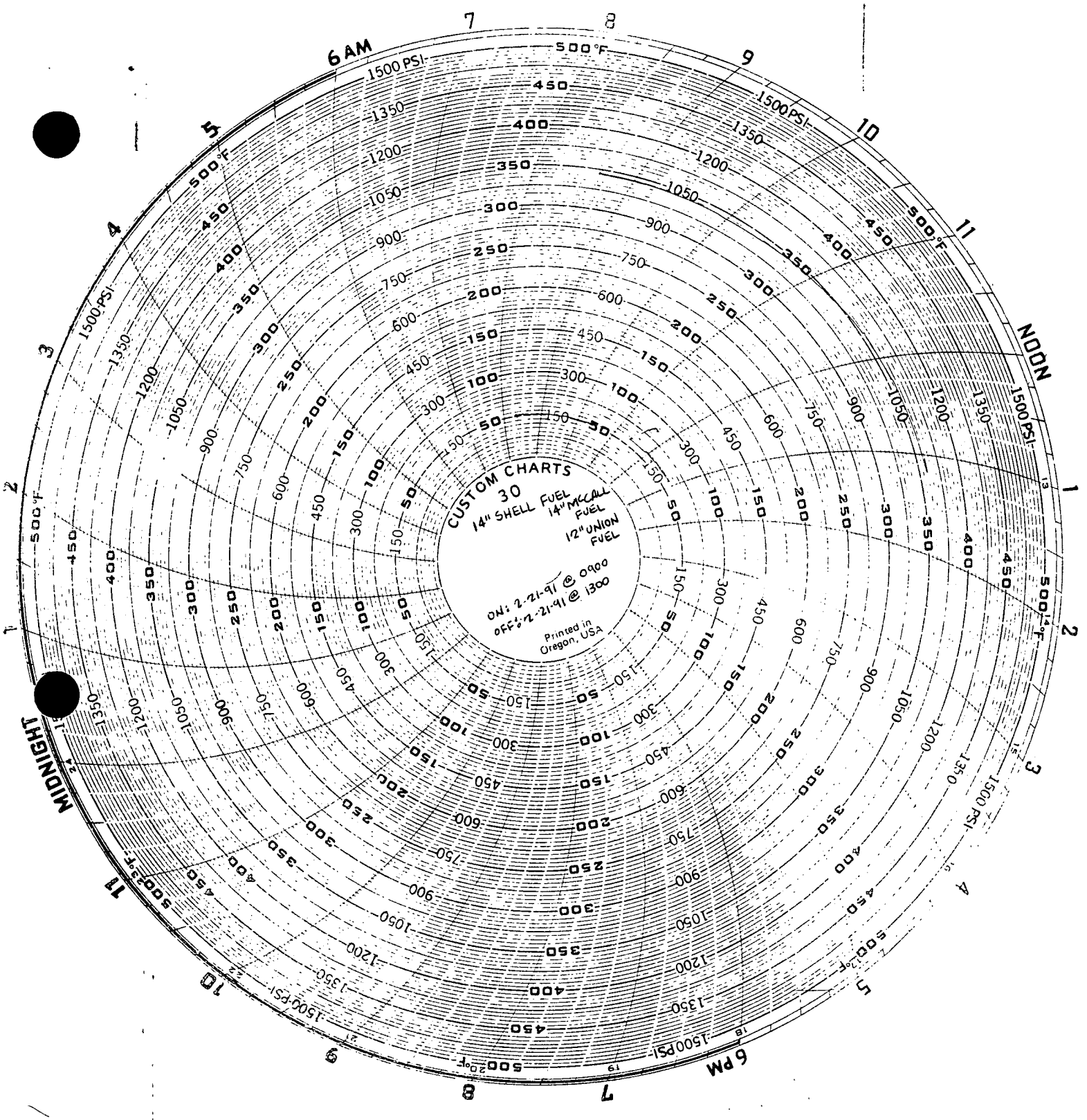
14" SHELL FUEL, 14" McCALL & 12" UNION

START: 2-21-91 @ 0900
END: 2-21-91 @ 1300

TIME	DEAD WEIGHT	LB'S ON CHART	TEMP ON CHART	LB'S ON GAUGE	OUT SIDE AIR TEMP
0900	1060	1035	51	1051	42°
0930	1060	1035	51	1051	42°
1000	1061	1034	50	1050	53°
1030	1065	1035	50	1051	57°
1100	1075	1050	52	1065	59°
1130	1090	1057	58	1085	56°
1200	1100	1065	58	1090	55°
1230	1102	1079	60	1090	55°
1300	1106	1079	60	1100	56°

FOXBORO RECORDER
40MR-RFM2F/PB-AA/TA-1A
SN 91A2861-C

DEAD WEIGHT TESTER
CRS 35265-1
S/N 5980


CUSTOM CHARTS
30
14" SHELL FUEL
14" McCALL FUEL
12" UNION FUEL
ON: 2-21-91 @ 0900
OFF: 2-21-91 @ 1300
Printed in Oregon, USA
6 AM
NOON
6 PM
MIDNIGHT
500°F
1500 PSI

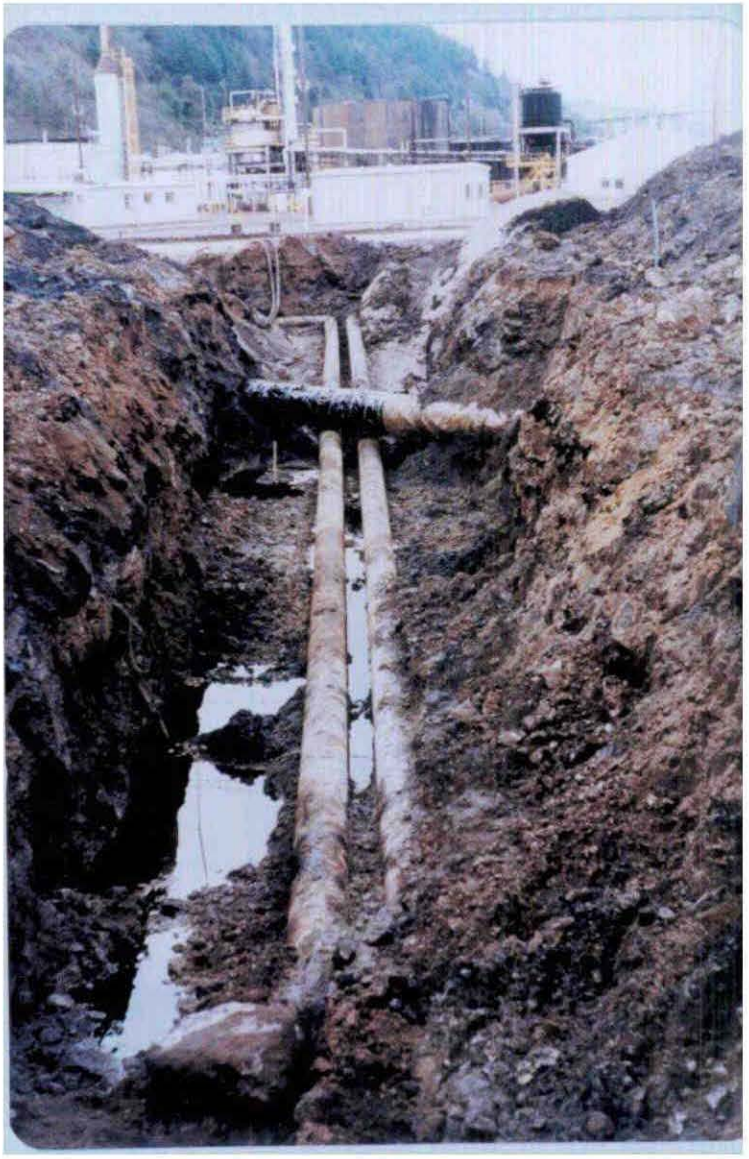
FOXBORO
40MR-RFM2F/PB-AA/TA-1A
SERIAL # 91A286HC

DEAD WEIGHT TESTER
CRS 35265-1
S/N 5980

Virgil V. Cross

PHOTOS

Olympic
Pipeline
1979



Olympic Pipeline
3-16-79

C-9609-R3-26A

Olympic Pipeline Oil
Pumping into Clarifier
3-16-79

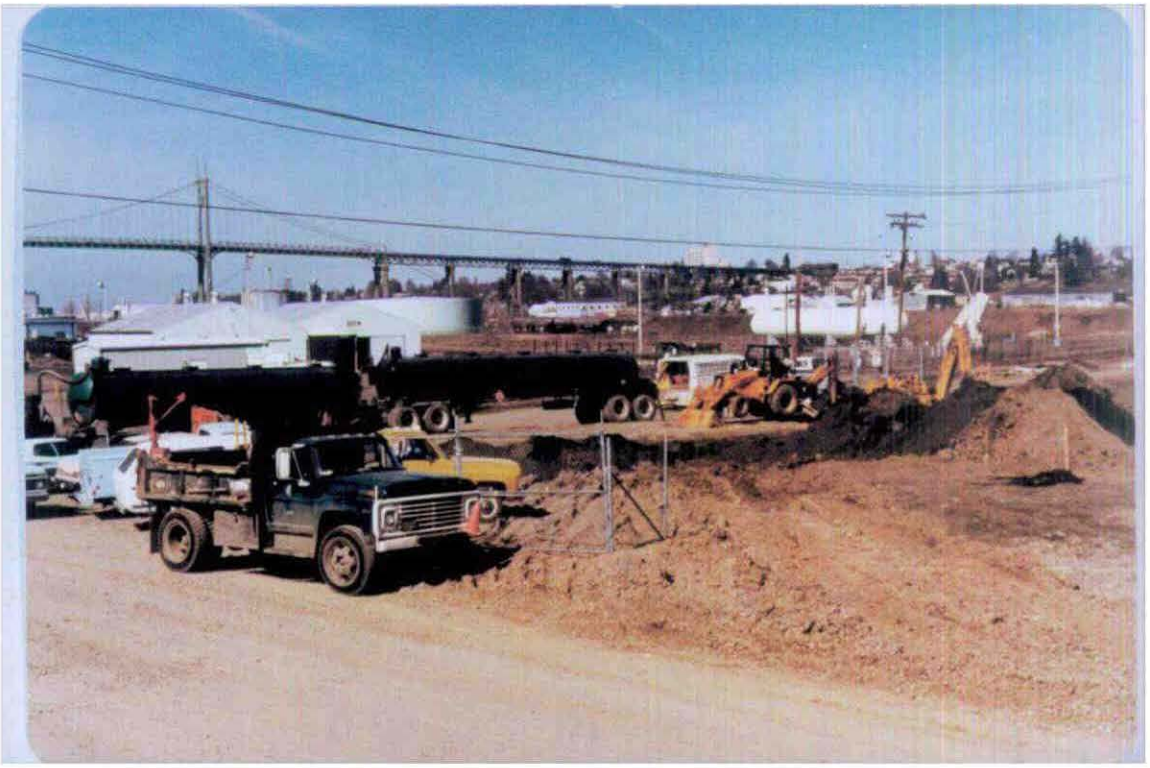
C-9609-R3-28A

Oil Problem & WWT
Parcel. Aerial.
3-19-79

C-9609- R3-24A

Aerial. Oil Problem &
WWT Parcel
3-19-79

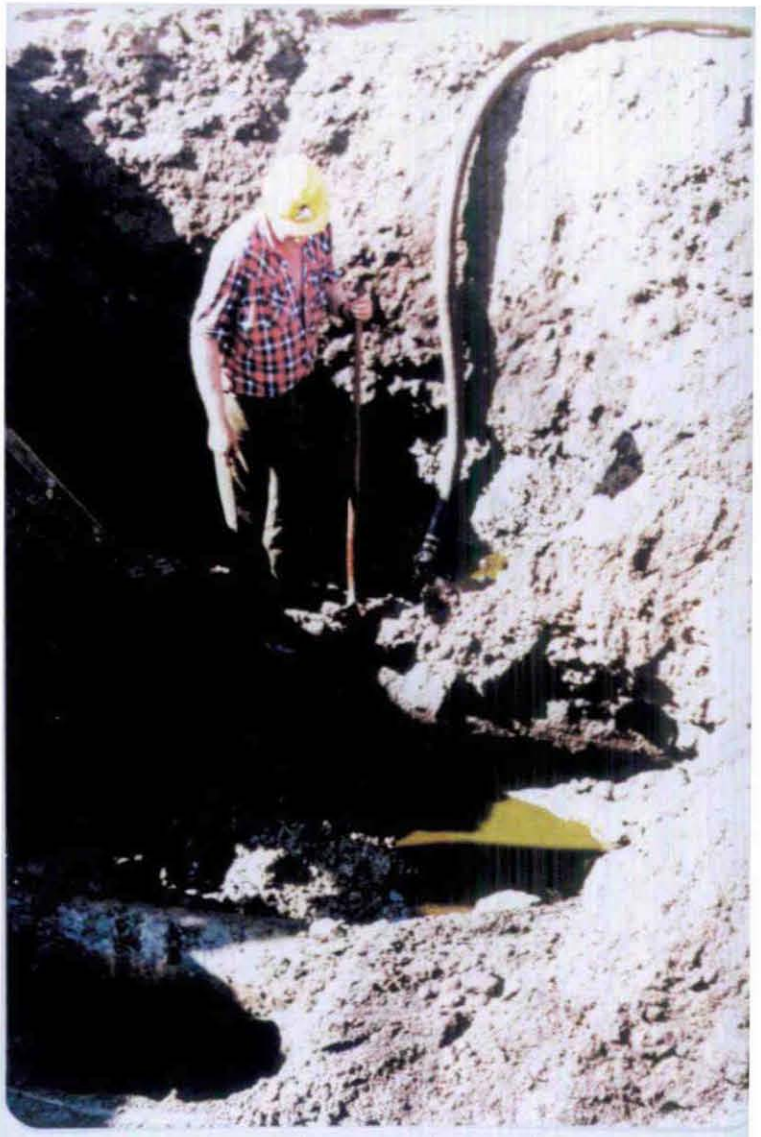
C-9609, R3-22A



Oil Contamination
Problem

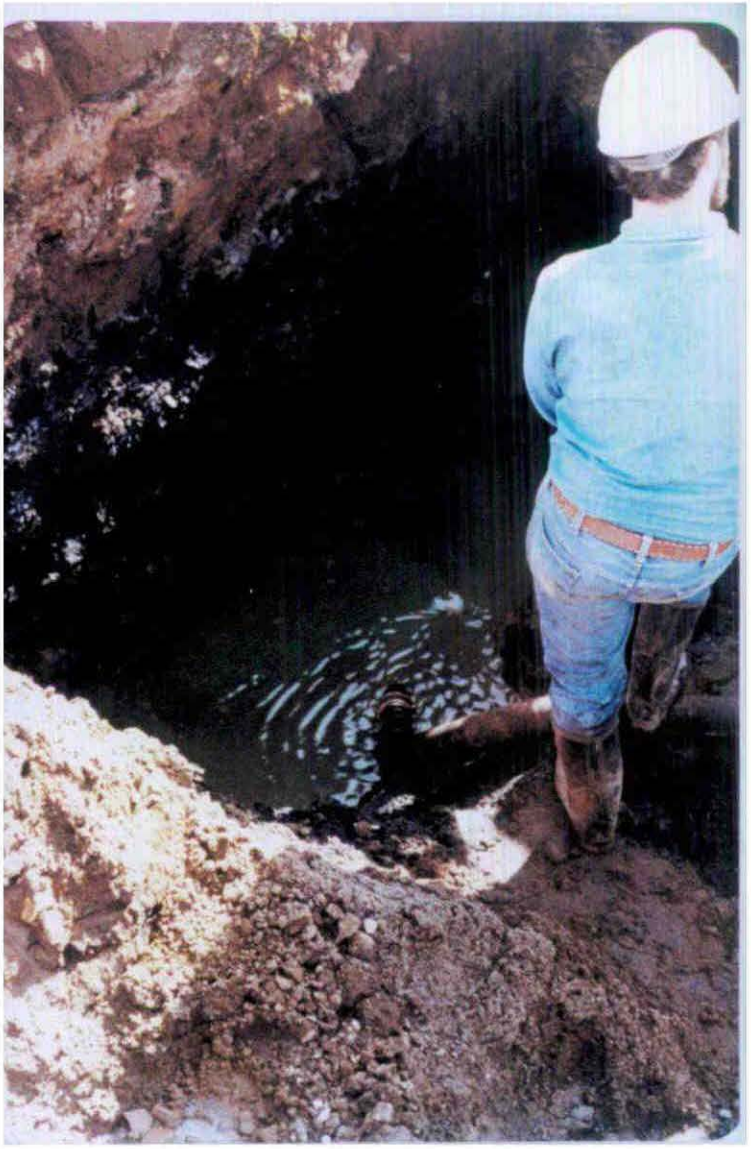
3-22-79

C.9609 - R3-20A



Oil Contamination
Problem 3-22-79

C-9609 - R3-15A



Oil Contamination
Problem 3-22-79

C-9609- R3-13A

Oil Contamination
Problem 3-22-79

C.9609. R3-17A

Olympic Pipeline
3-23-79

C-9609 — R4-18A

Olympic Pipeline
3-23-79

C-9609- R4.20A

Olympic Pipeline
3-23-79

C-9609. R4-16A

Olympic Pipeline
3-23-79

C-9609 - R4-14A

oil in clarifier
Re-excavation
4-9-79

C-9608 - R4-10A

Clarifier
Re-excavation
4-9-79

C.9609 - R4-12A

Oil in clarifier
re-excavation
4-9-79

C-9609 - R4-8A

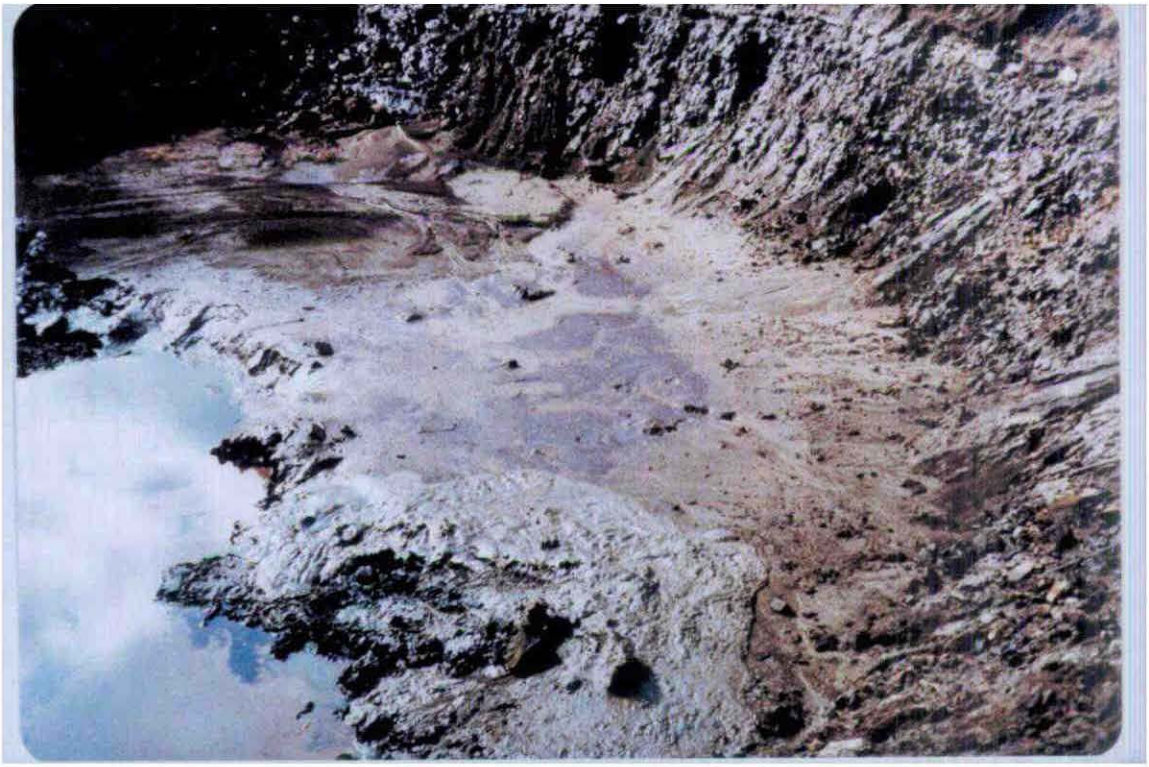
Clarifier Re-
excavation
4-9-79

C-9609 - R4-6A

Clarifier re-excavation

4-9-79

C-9609 - R3-36A



Clarifier Re-excavation 4-9-79

C.9609 - RJ-34A

settling pond for
Olympic Pipeline
4-9-79

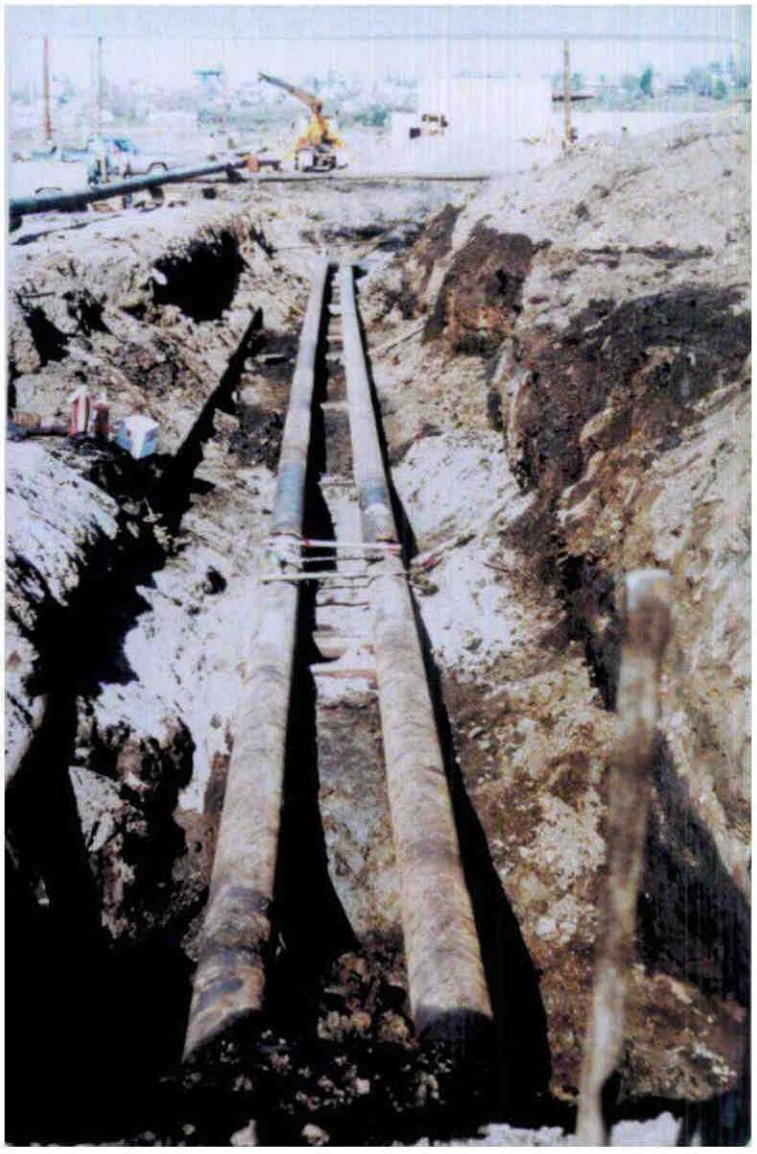
C-9608 - R4-2A

Excavated Debris from
Olympic Pipelines
4-9-79

C-9609- R3-32A

settling pond for
Olympic Pipeline.
4-9-79

C-9609. R4-4A

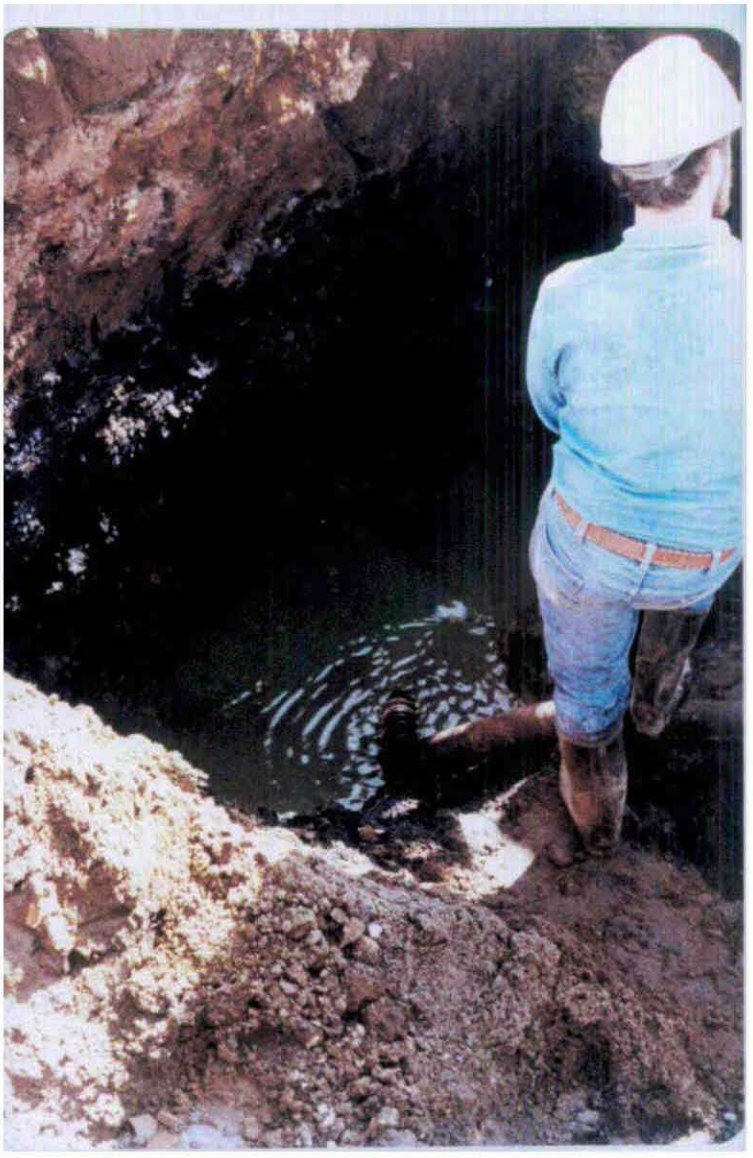


Olympic Pipeline Fire
Replacement 4-9-79

C-9609-R3-30A

3 sets of
Olympic Pipeline
Photos
1979

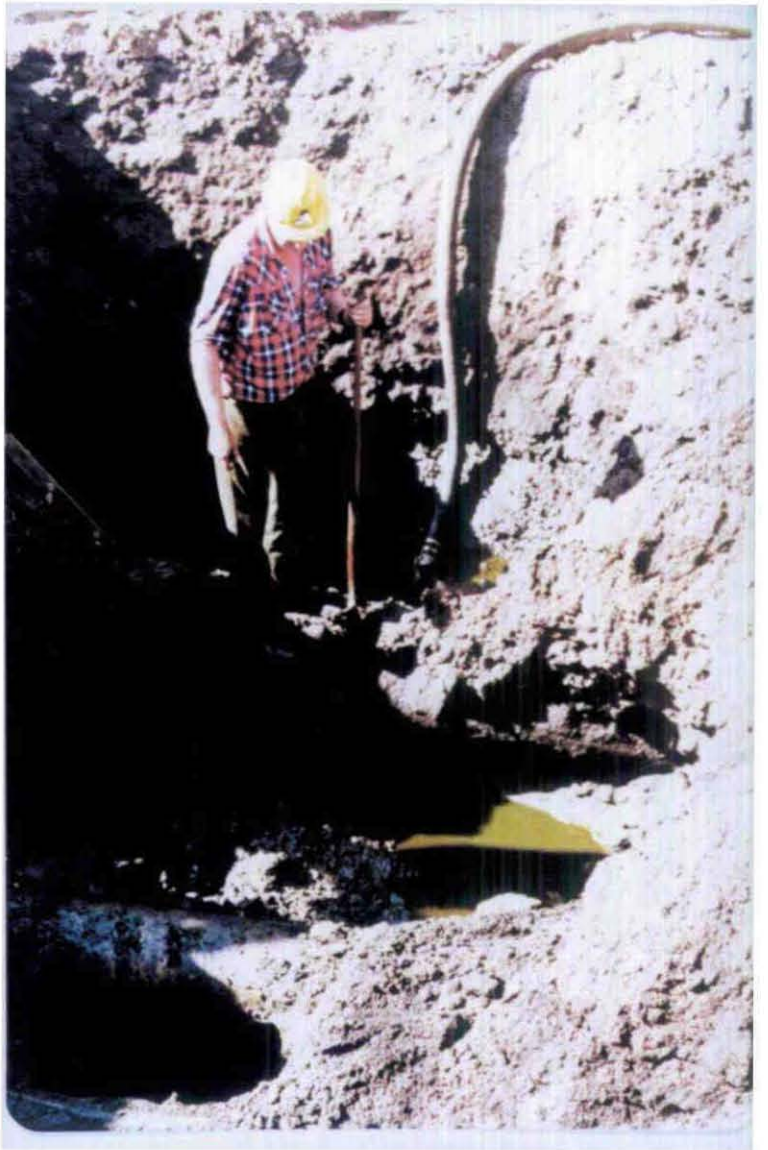
SCOEPA00012273



Oil Contamination problem.

March 22, 1979

C-9609 - R3-13A



Oil Contamination problem.

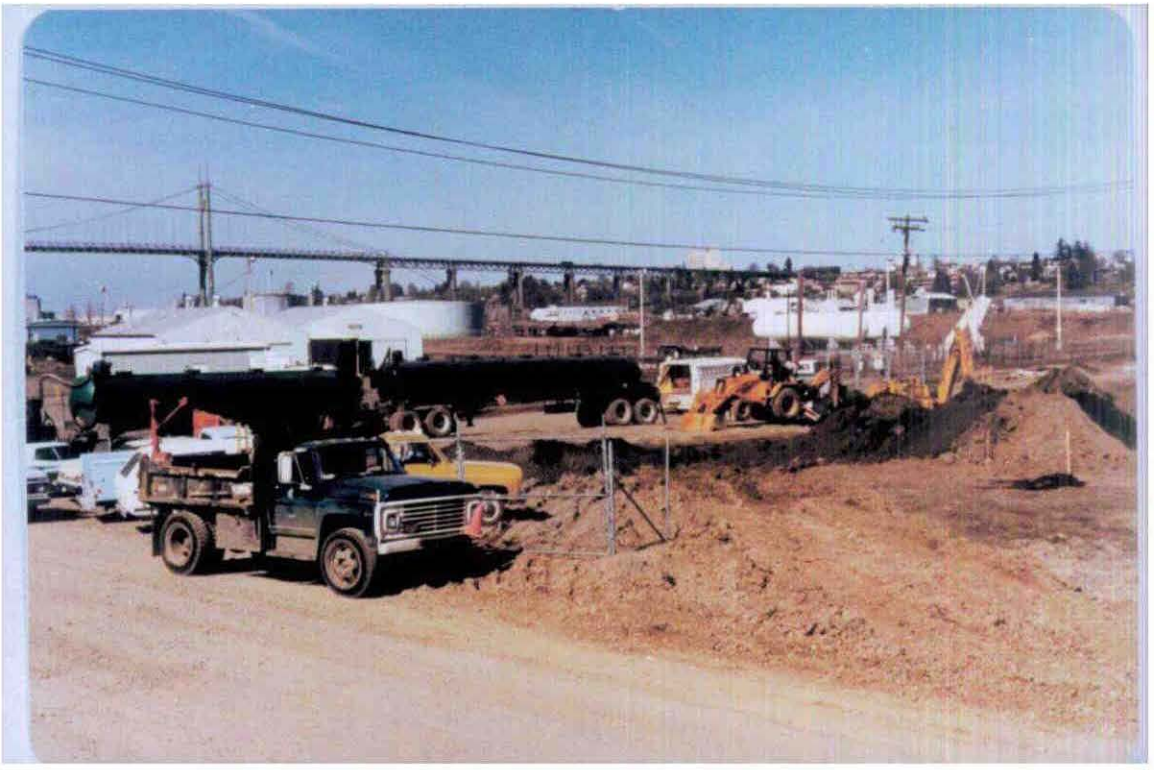
March 22, 1979

C-9609- R3-15A

Oil Contamination problem.

March 22, 1979

C.9609 R3-17A



Oil Contamination problem.

March 22, 1979

C.9609. R3-20A

Aerial photo of oil problem &
WWT Parea
April 19, 1979

C-9609- R3-22A

Aerial photo of oil problem &
WWT Parea

April 19, 1979

C.9609. R3-24A

Olympic Pipeline

March 16, 1979

C-9609 - R3-26A

C.9609 · R3.28A

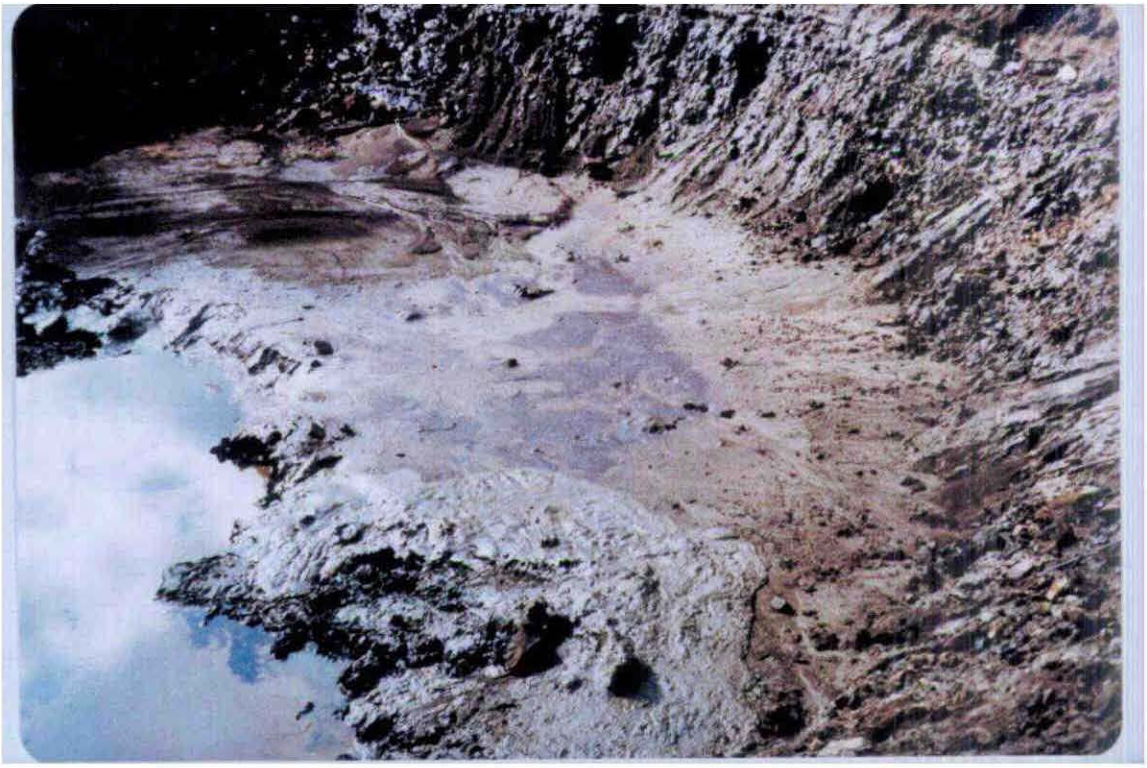
Olympic Pipeline oil pumping
into clarifier
March 16, 1979

Olympic Pipeline fine
replacement
April 9, 1979

C-9609 – RJ-30A

Excavated debris from Olympic
Pipelines
April 9, 1979

C-9609 - RJ-32A



Clarifier re-excavation
April 9, 1979

C-9609 - R3.34A

Clarifier re-excavation
April 9, 1979

C-9609- R3-36A

Settling pond for Olympic
Pipeline
April 9, 1979

C-9609 - R4.2A

Settling pond for Olympic
Pipeline
April 9, 1979

C-9609 - R4-4A

Clarifier re-excavation
April 9, 1979

C-9605 - R4-6A

Oil in clarifier re-excavation
April 9, 1979

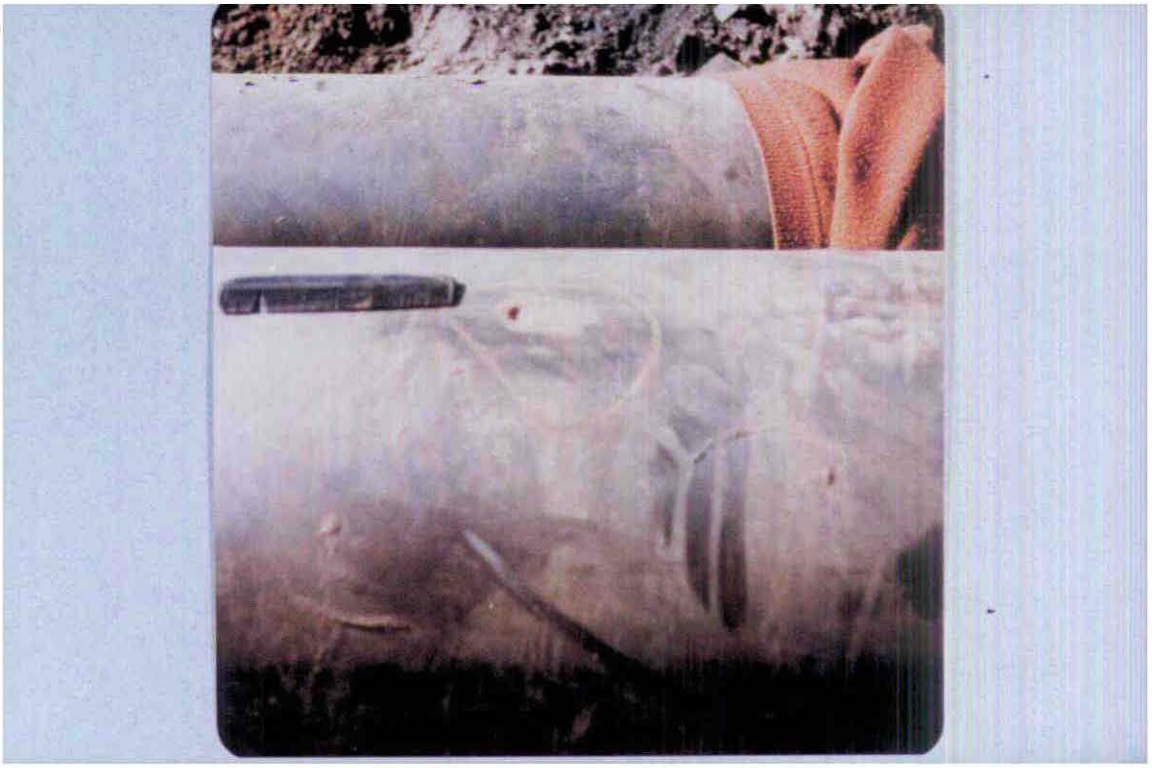
C-9609- R4-8A

Oil in clarifier re-excavation
April 9, 1979

C-9609 - R4-10A

Clarifier re-excavation
April 9, 1979

C-9609 - R4-12A



Olympic Pipeline
March 23, 1979

C-8609 - R4-14A

Olympic Pipeline
March 23, 1979

C-9609 - R4-1CA

Olympic Pipeline
March 23, 1979

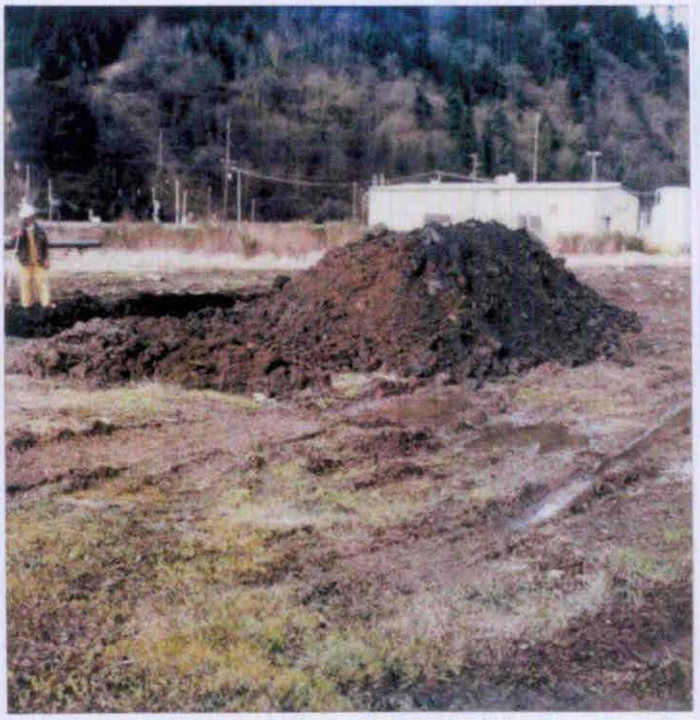
C-9609 - R4-18A

Olympic Pipeline
March 23, 1979

C-7609 - R4·20A

Olympic
Pipeline

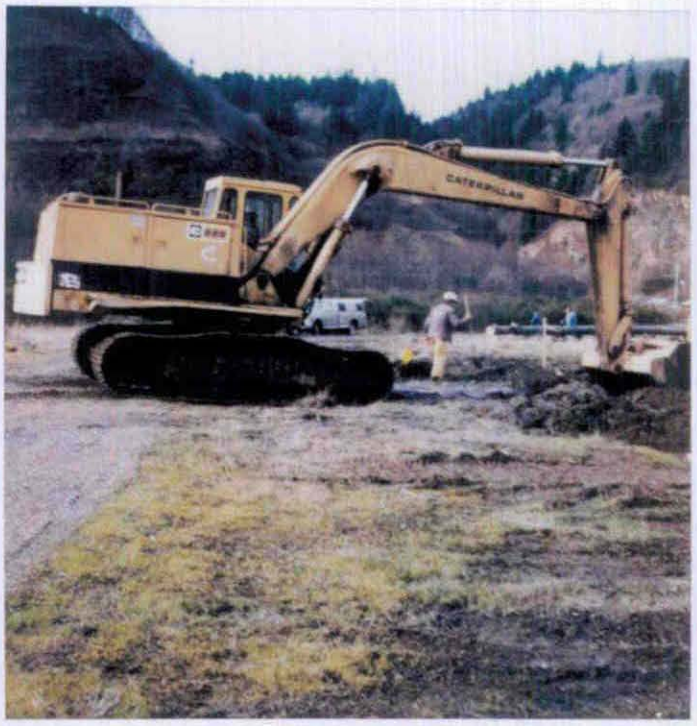
1991



#1

3-11-91

C-9609-R1-2A



#2

3-11-91

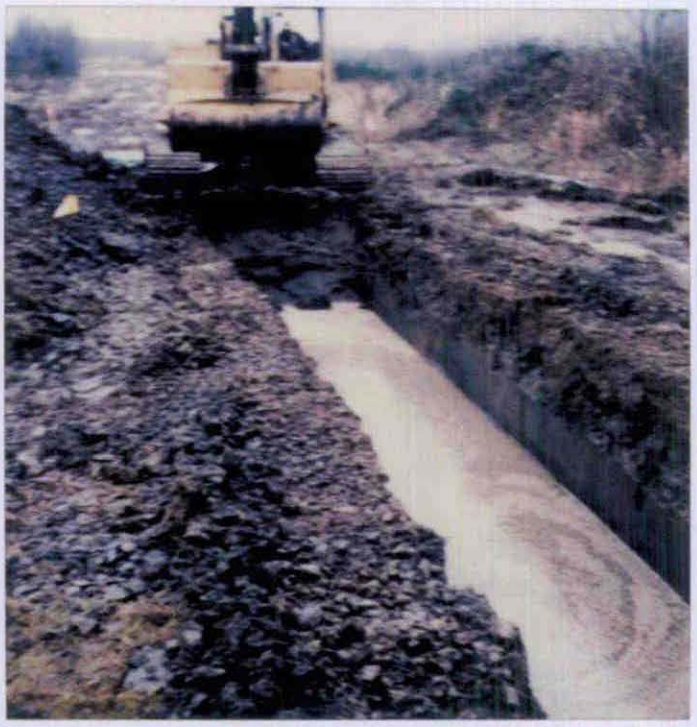
C. 9609 - R1-4A

#3

West

3-11-91 over

C-9609-R1-BA



#4

3-11-91

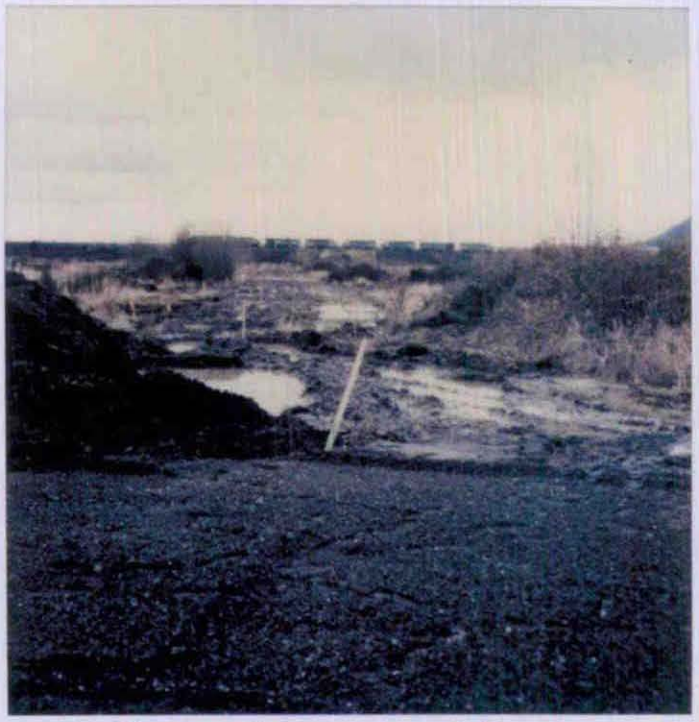
C-9609-R1-8A

#5

west
↑

3-12-91

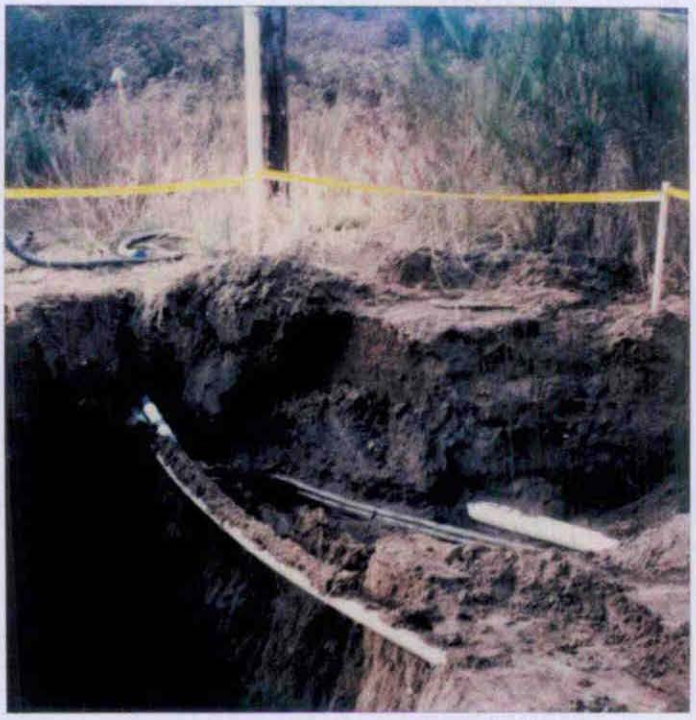
C-9609 - R1-10A



#6 Pipe Buried 7½ feet
off to south from center
of old pipe
3-12-91

C-9609 - R1-12A

3-15-91



#7

C-9609 - RI-13A

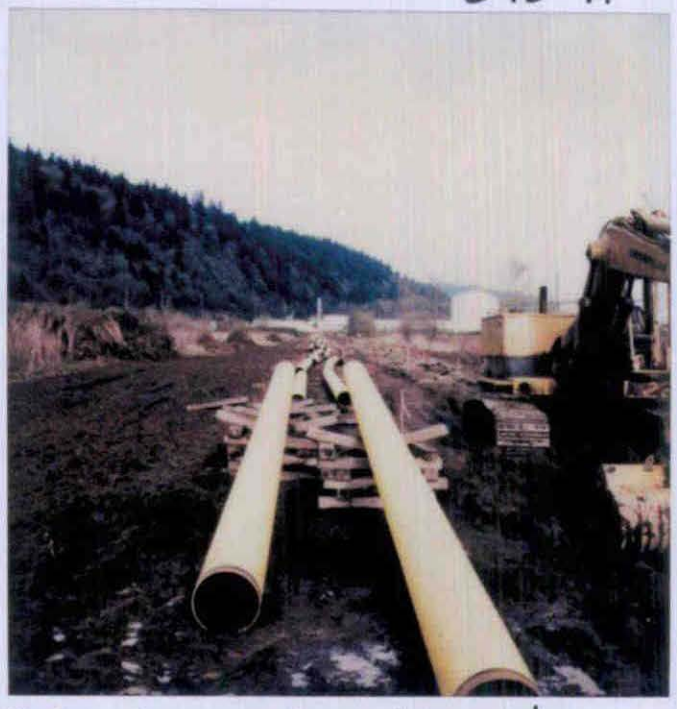
3-15-91

Facing Railroad tracks
Alt. Power + Some other conduit
EAST ↖

#8

C-9608 - R1-15A

3-15-91



Pipe line going toward
WWTP
#9

↑
W

C.9609 - R1-18A

3-15-91

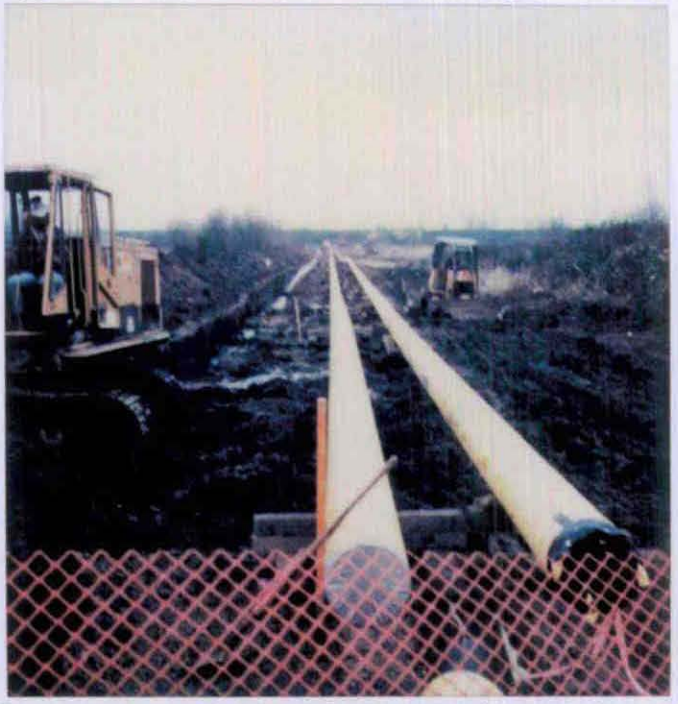
24" water main

↑ E

#10 over

C-9609- RI-19A

#11 3-18-91

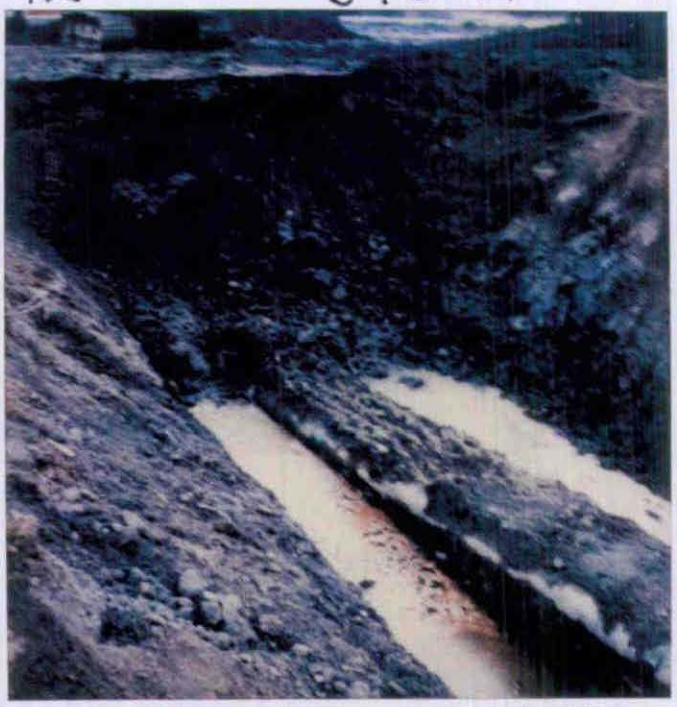


Pipe All welded + xrayed ready to be rolled into ditch

↑ E

C-9609 - R1-22A

#12 3-18-91



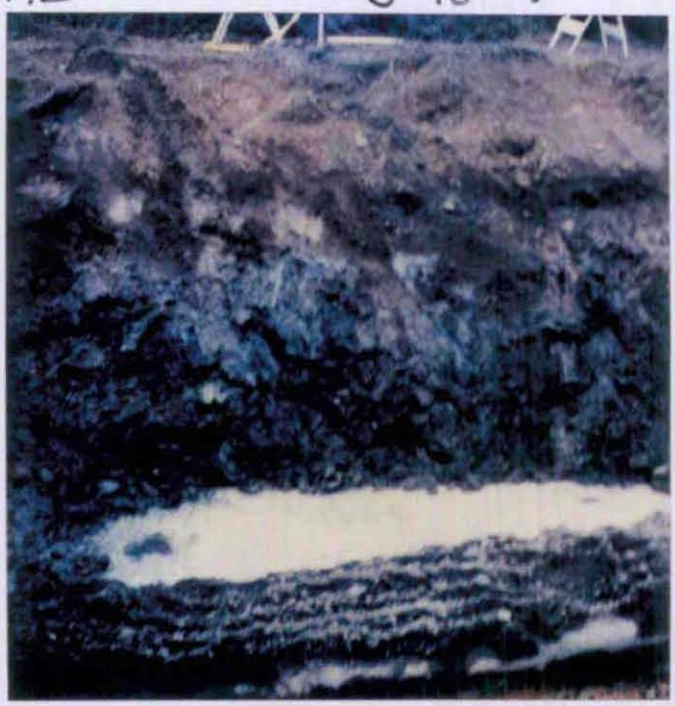
Old Pipe Line Down About
10 to 12 feet

↖ E

over

C-9609-R1-23A

#13 3-18-91



Shows side of trench by WWTP

N ↑

C.9609 - R1.25A

#14 3-18-91

old Pipe caped + pressur tested to 1100 psi ? Pipe goes back in front of WWTP - ✓ OK

C-9609 - R1.28A

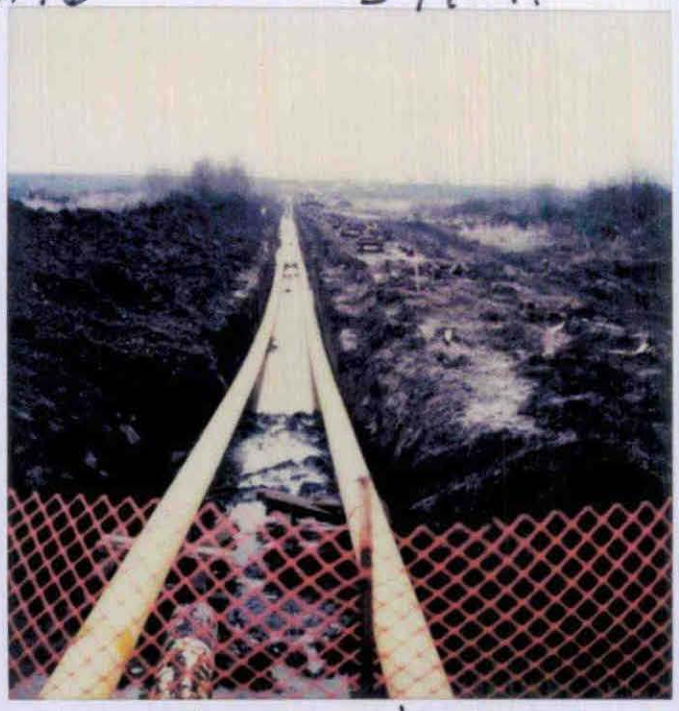
#15 3-19-91

Putting in new pipe to the old

W ↑

C-9609 - R1-30A

#16 3-19-91

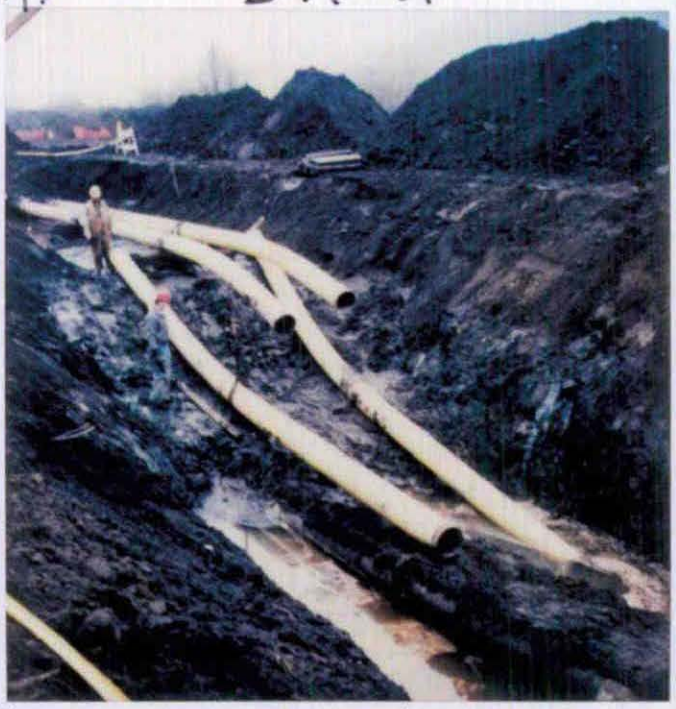


New Pipe rolled into Ditch

E ↑

C-9609 - R1-32A

#17 3-19-91



Pipe being droped down to meet old Pipe E

C-9609 – R1-33A

#18 3-22-91

New Lines meet old
Line by WWTP E
About 10 to 12 feet 1
Deep

C-9609-R1-36A

#19 3-22-91

About 20" Pipe Put under
Rail Road tracks
white Line caped

W ↑

C-2609 - R2-1A

#20 3-22-91

C-5604-R2-3A

#21 3-22-91

two 24" water mains
+ one PVC line capped
off

C-9609 - R2-6A

#22 3-22-91

24" water mains
one on left is capped
off

W
↑

C-9609- R2-7A

#23 3-22-91

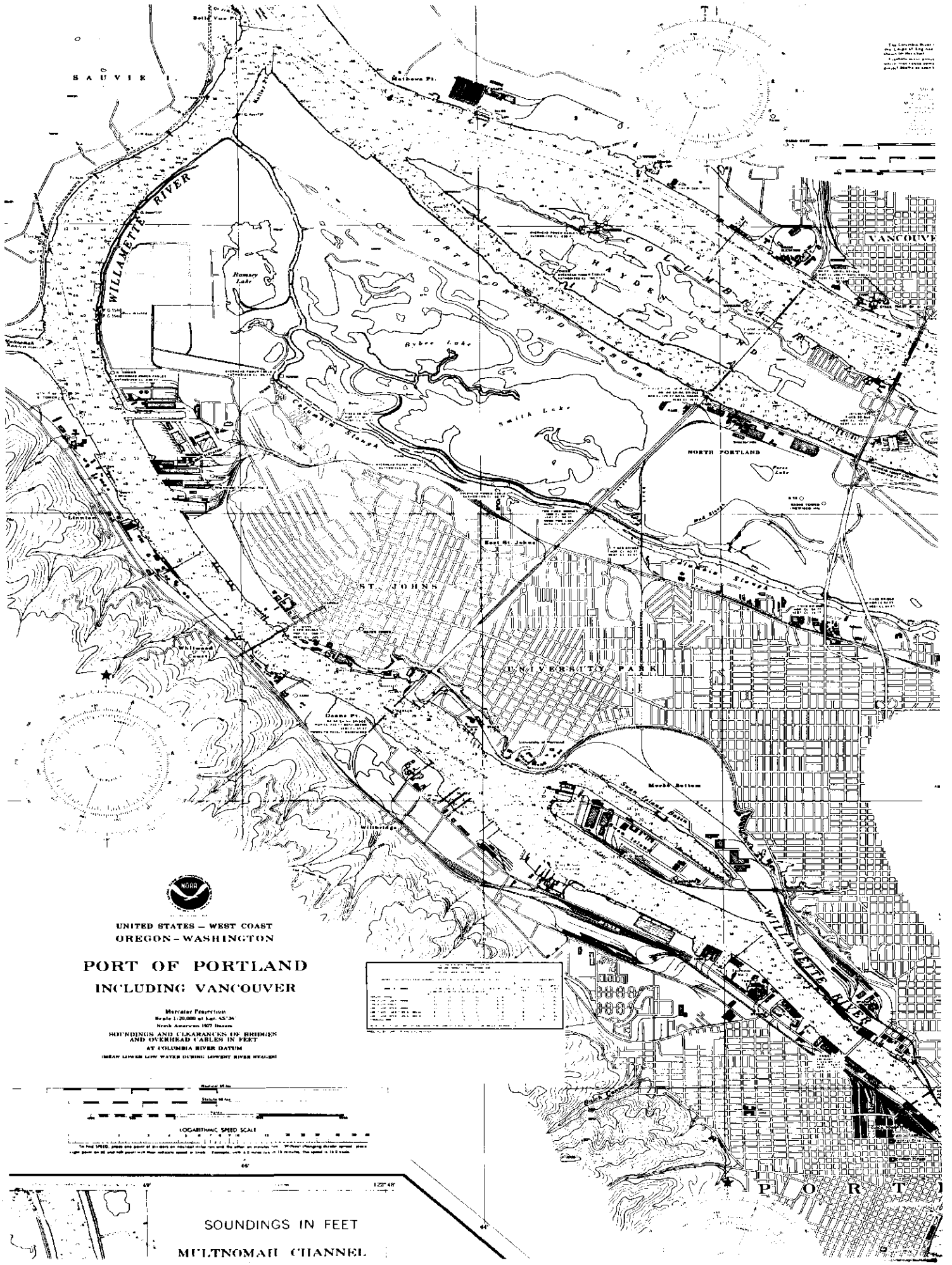
New Pipe Line to go under white PVC Pipe And under City water main

C-9609 - R2-9A

#24 3-26-91

New Pipe under tracks with Pipe Locators

C-9609- R2-11A



SCOEPA00012367

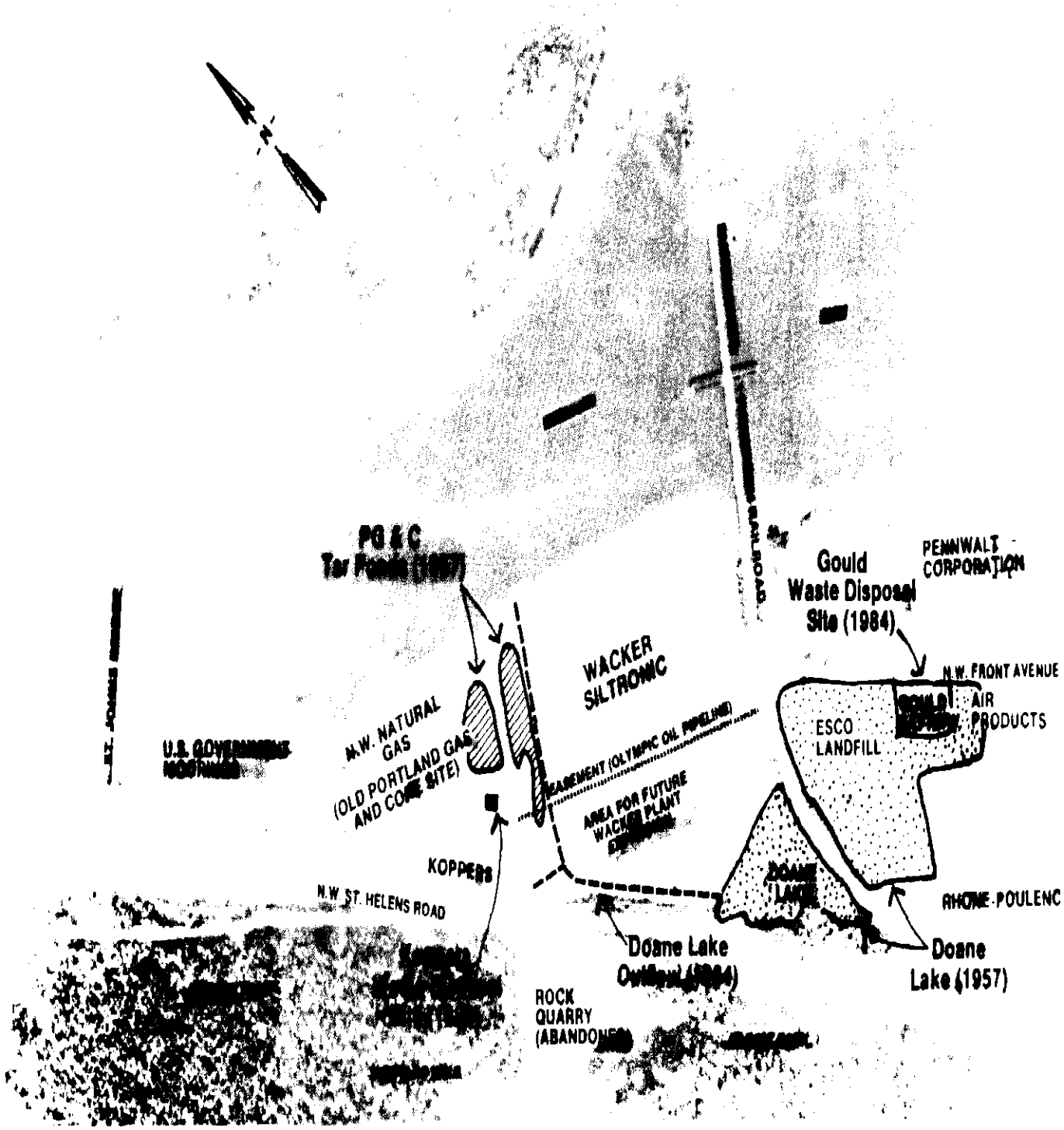


Figure 2 WACKER SILTRONIC PLANT HISTORIC WASTE MANAGEMENT AREAS

SCALE 1" = 940 FEET (1 cm 110 m)

ACKROYD Photography Inc
23281 - 19
Copy

SCOEPA00012370

Photo 2. 1913

Portland Gas and Coke beings operation.

(Notice US Moorings north of PG&C and vacant land to the south.)

23281-3
Copy

MARVIN B. DURNING A PROFESSIONAL SERVICE CORPORATION LAW OFFICES
1411 FOURTH AVENUE BUILDING, SUITE 1522, SEATTLE, WASHINGTON 98101-2212 TELEPHONE (206) 223-9616 TELECOPY (206) 223-9617

GERARDO A. CARLO, OF COUNSEL
ADMITTED IN PUERTO RICO
AND DISTRICT OF COLUMBIA

MARVIN B. DURNING, OF COUNSEL
CARLO & DUBOS
SAN JUAN, PUERTO RICO

Attached photos are from this report:

Wacker Siltronic Corporation

NL/Gould Superfund Site; Doane Lake Study

Liability for Remedial Action Costs Under Oregon Law

January 31, 1989

(Revised)

1913

Portland Development Commission
Site History Sample 3 x 5 Photos

2. 1913

Portland Development Commission
Site History Sample 3 x 5 Photos

16. 1984

18. 1984

Photo 18. 1984

Color photo looking southeast from St. John's Bridge.

ACKROYD Photography Inc.
C-9609-1
Copy

Data Validation and Data Quality Assessment Report

Focused Remedial Investigation
Quarterly Groundwater Monitoring
Wacker Siltronic Corporation Property
Portland, Oregon
Project Number: 5237

Prepared for:

Hahn and Associates, Inc.
434 NW 6th Avenue
Suite 203
Portland, Oregon 97209

Prepared by:

Kathy J. Gunderson
981 State Street
Raymond, Washington 98577

September 23, 2002

Approved for Release: Kathy J. Gunderson
Kathy J. Gunderson
Owner, Validation Chemist

Data Validation and Data Quality Assessment Report

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September 23, 2002

Approved for Release: Kathy J. Gunderson
Kathy J. Gunderson
Owner, Validation Chemist

1.0 Introduction

This report presents the EPA Level III validation of the sample analyses listed in Table 1. With the exception of several amenable cyanide analyses, the samples were analyzed by Environmental Services Laboratory, Incorporated, located in Portland, Oregon. The amenable cyanide analyses of the first two reports were preformed by Columbia Inspection, Incorporated, located in Portland, Oregon. The validation was performed in accordance with the procedures established in the *Contract Laboratory Program National Functional Guidelines for Inorganic and Organic Data Review* (Functional Guidelines) (USEPA 1994 and 1999). Data quality objectives (DQOs), project detection limits, and quality control (QC) sample frequencies are from the *Focused Remedial Instigation Sampling and Analysis Plan (SAP) Wacker Siltronic Corporation Property* (Hahn and Associates 2001). The criteria used to qualify data are from the SAP, Functional Guidelines. the analytical methods, or the professional judgment of the validation chemist.

The following laboratory deliverables were reviewed during the validation process:

- Chain-of-custody (COC) documentation to assess holding times and verify report completeness
- Laboratory QC sample results, including method blanks, surrogate spikes, laboratory control samples (LCSs), matrix spike/matrix spike duplicates (MS/MSDs), and laboratory duplicates
- Field QC samples for field blank contamination and field duplicate precision

In addition, the DQOs of precision, accuracy, representativeness, comparability, and completeness were evaluated against the criteria set forth in the SAP.

The qualified data are summarized in Table 3 at the end of this report. Laboratory communications are presented in Appendix A. Data qualifier flags have been added to the sample results in the laboratory reports. The Hahn and Associates Spreadsheets have been modified to reflect the data changes and qualifiers prescribed in this report.

SCOEPA00012381

Table 1
Sample Data Reviewed

Sample ID	PAH	VOA	SVOA	Total Metals	Dissolved Metals	Cyanide
5237-011008-101		X				
5237-011008-102	X	X	X	X		X
5237-011008-103	X	X	X	X		X
5237-011008-104	X	X	X	X		X
5237-011008-105	X	X	X	X		X
5237-011009-106		X				
5237-011009-107	X	X	X	X		X
5237-011212-100		X				
5237-011212-101	X	X	X	X	X	X
5237-011212-102	X	X	X	X		X
5237-011212-103	X	X	X	X		X
5237-011212-104	X	X	X	X		X
5237-011213-105	X	X	X	X		X
5237-011213-106		X				
5237-020402-100		X				
5237-020402-101	X	X	X	X	X	X
5237-020402-102	X	X		X		X
5237-020403-103		X				
5237-020403-104	X	X	X	X		X
5237-020403-105	X	X	X	X	X	X
5237-020403-106	X	X		X		X
5237-020710-100		X				
5237-020710-101	X	X	X	X	X	X
5237-020710-102	X	X		X		X
5237-020710-103	X	X	X	X		X
5237-020710-104	X	X	X	X	X	X
5237-020710-105	X	X		X		X

PAH: Polycyclic aromatic hydrocarbons by Method 8270 selective ion monitoring (SIM) (USEPA 1996)
VOA: Volatile organic analyses by Method 8260B (USEPA 1996)
SVOA: Semivolatile organic analyses by Method 8270C (USEPA 1996)
Total Metals: Total antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, silver, titanium, vanadium, and zinc by Method 6010B (USEPA 1996)
Dissolved Metals: Dissolved antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, selenium, silver, titanium, vanadium, and zinc by Method 6010B (USEPA 1996)
Cyanide: Total cyanide by Method 9010B (USEPA 1996) & amenable cyanide by Method 4500-CN G (APHA 1998)

2.0 Data Validation Results

2.1 Custody, Preservation, and Completeness – Acceptable with Discussion

The samples were received intact and, except as noted below, were properly preserved. Custody was maintained as required from sample collection to laboratory receipt. With one exception, the reports are complete and contain results for all samples and tests requested on the COC forms.

The temperature of samples upon receipt at the laboratory was not documented on the COCs or elsewhere in the reports. Environmental Services Laboratory provided the sample receipt temperatures for each sample delivery group (SDG).

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The temperature of the majority of the samples was above the recommended temperature range of 2 to 6 °C at the time of laboratory receipt. The temperature range of the samples was 7 to 11 °C. Data qualifiers are not recommended.

Total and dissolved barium and magnesium results were reported for the metals analyses even though they are not listed in the SAP as target analytes.

The total iron result of sample 5237-020710-105 was incorrectly reported. The laboratory resubmitted a corrected results sheet.

Amenable cyanide analysis was performed on sample 5237-020710-102. It was not requested on the COC.

Sample 5237-011008-103 was not analyzed for amenable cyanide as requested on the COC. Completeness of the data set is not compromised because the total cyanide result is undetected making the amenable cyanide result undetected as well.

QC results were not reported with the amenable cyanide analyses performed by Columbia Inspection. Method blank and LCS results were resubmitted via facsimile.

2.2 Polycyclic Aromatic Hydrocarbon Analyses

2.2.1 Holding Times – Acceptable

The samples were extracted and analyzed within the required holding times.

2.2.2 Continuing Calibration – Acceptable

Continuing calibration verifications were reported and all percent recovery values met the Functional Guidelines criteria of 75 to 125%.

2.2.3 Blank Analyses – Acceptable

2.2.3.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the reporting limits.

2.2.3.2 Field Blanks

Samples 5237-011008-103, 5237-011212-102, 5237-020402-102, and 5237-020710-102 were identified as equipment blanks. Target analytes were not detected above the reporting limits.

2.2.4 Surrogate Analyses – Acceptable with Discussion

Surrogate compounds were reported for all samples, blanks, and QC samples as required. Except as noted below, all surrogate recovery values are within the laboratory's control limits.

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The nitrobenzene-d_5 surrogate recovery value for sample 5237-020403-104 is above the SAP criteria at 129%. Data qualifiers are not required because Functional Guidelines allows one surrogate (out of three) to exceed criteria without qualification.

The nitrobenzene-d_5 surrogate recovery value for the sample duplicate associated with SDGs 0110096 and 0110107 is below the SAP criteria at zero percent. Data qualifiers are not required because a non-project sample was analyzed as the duplicate.

2.2.5 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Qualifications

Except as noted below, MS/MSD analyses were performed at the required frequency and all percent recovery and relative percent difference (RPD) values are within the laboratory's control limits.

The laboratory analyzed sample duplicates and matrix spikes to satisfy the MS/MSD requirement of the method.

The RPD values for acenaphthene, fluorene, naphthalene, and phenanthrene in the duplicate analysis of sample 5237-011213-105 are above the laboratory control limits at 25.0%, 25.2%, 22.8%, and 21.5%, respectively. The results have been qualified as estimated (J).

The RPD values for anthracene, fluoranthene, fluorene, and phenanthrene in the duplicate analysis of sample 5237-020710-101 are above the laboratory control limits at 27.5%, 20.7%, 22.5%, and 30.8%, respectively. Data qualifiers are not required for anthracene because the results are less than five times the reporting limit. The fluoranthene, fluorene, and phenanthrene results have been qualified as estimated (J).

Several SDGs have percent recovery and RPD values outside the laboratory's control limits. Data qualifiers are not required because non-project samples were analyzed as the duplicate or matrix spike.

Sample ID	Analyte	Qualification	Quality Control Exceedance
5237-011213-105	Acenaphthene Fluorene Naphthalene Phenanthrene	J	Duplicate RPD above laboratory control limits and results greater than 5 times the reporting limit
5237-020710-101	Fluoranthene Fluorene Phenanthrene	J	Duplicate RPD above laboratory control limits and results greater than 5 times the reporting limit

2.2.6 Laboratory Control Sample Analyses – Acceptable

One LCS/LCSD pair was reported with each analytical batch. All percent recovery and RPD values are within the laboratory's control limits.

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2.2.7 Laboratory Reporting Limits – Acceptable

The updated target reporting limits for PAHs in water were met.

2.2.8 Field Duplicates – Acceptable with Discussion

Four field duplicate pairs were identified on the COC forms. The SAP criterion for field duplicate precision of water samples is RPD values less than 50. The RPD values of benzo(a)pyrene, benzo(b)fluoranthene, and benzo(g,h,i)perylene in field duplicate pair 5237-020710-104/105 are above the SAP criterion at 54, 53, and 58, respectively. Data qualification is not recommended because the sample values are less than 5 times the reporting limit. Field duplicate RPD values are listed in Table 2.

2.2.9 Overall Assessment of Data Useability

The useability of the data is based on the EPA guidance documents listed above. Upon consideration of the information presented here, the data are acceptable except where flagged with data qualifiers that modify the usefulness of the individual values.

2.3 Semivolatile Organic Compound Analyses

2.3.1 Holding Times – Acceptable

The samples were extracted and analyzed within the required holding times.

2.3.2 Continuing Calibration – Acceptable with Discussion

Calibration verifications were analyzed at the required frequency. Except as noted below, all percent recovery values met the Functional Guidelines criteria of 75 to 125%.

The 2,4,6-tribromophenol recovery in the calibration verification associated with SDG 0110107 is below criteria at 70.9%. Data qualifiers are not required because 2,4,6-tribromophenol is a surrogate compound.

2.3.3 Blank Analyses – Acceptable

2.3.3.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the reporting limits.

2.3.3.2 Field Blanks

Two equipment blanks, samples 5237-011008-103 and 5237-011212-102, were analyzed for semivolatile organic compounds. Target analytes were not detected above the reporting limits in either field blank.

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2.3.4 Surrogate Analyses – Acceptable with Qualifications

Surrogate compounds were added to all samples, blanks, and QC samples as required. Except as noted below, all surrogate recovery values are within the laboratory's control limits.

The phenol-d_5 surrogate recovery value for sample 5237-020403-104 is below the laboratory's control limits at 9.7%. The acid results of sample 5237-020403-104 have been qualified as estimated (J) or estimated detection limit (UJ) because the recovery is less than 10%.

The 2-fluorobiphenyl surrogate recovery value for matrix spike analysis sample 5237-011212-104 is below the laboratory's control limits at 20.8%. Data qualifiers are not required for QC samples.

The 2-fluorobiphenyl surrogate recovery value for sample 5237-020710-101 is below the laboratory's control limits at 33.4%. Data qualifiers are not required because Functional Guidelines allows one surrogate per fraction (acid or base/neutral) to exceed criteria without qualification.

Sample ID	Analyte	Qualification	Quality Control Exceedance
5237-020403-104	Acid fraction analytes	J positive results UJ detection limits	Surrogate recovery below 10%

2.3.5 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Qualifications

Except as noted below, MS/MSD analyses were performed at the required frequency and all percent recovery and RPD values are within the laboratory's control limits.

The laboratory reported sample duplicate and matrix spike analyses to satisfy the MS/MSD requirement of the method. Data qualifiers are not required.

The 1,2,4-trichlorobenzene recovery value in the spiked analysis of sample 5237-011212-104 is below the laboratory's control limits at 43.6%. The undetected 1,2,4-trichlorobenzene result of sample 5237-011212-104 has been qualified as estimated detection limit (UJ).

The acenaphthene recovery value in the spiked analysis of sample 5237-020710-104 is below the laboratory's control limits at zero percent (the laboratory reported the value as a negative number). The acenaphthene result of sample 5237-02071-104 has been qualified as estimated (J).

Sample ID	Analyte	Qualification	Quality Control Exceedance
5237-020710-104	Acenaphthene	J	MS recovery below laboratory control limits
5237-011212-104	1,2,4-Trichlorobenzene	UJ	MS recovery below laboratory control limits

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2.3.6 Laboratory Control Sample Analyses – Acceptable with Discussion

One LCS/LCSD pair was reported with each extraction batch. Except as noted below, all percent recovery and RPD values are within the laboratory's control limits.

The 2,4-dinitrotoluene recovery value in the LCSD associated with SDG 0110107 is below the laboratory's control limits at 36.9%. Data qualifiers are not required because the LCS recovery is acceptable.

The RPD value of pyrene in the LCS/LCSD associated with SDG 0110096 is above the laboratory's control limits at 27.5. Data qualifiers are not required because pyrene was reported from the SIM analysis for this SDG.

2.3.7 Laboratory Reporting Limits – Acceptable with Discussion

The SAP target reporting levels were met for non-PAH analytes.

For SDGs 0112130, 0112149, 0204039, 0204039, 0204078, and 0207076 the laboratory reported PAH analytes, even though these analytes were also reported for the SIM analyses.

2.3.8 Field Duplicates – Acceptable

Two field duplicate pairs were analyzed for semivolatile organics. The field duplicate criterion for precision of water samples is RPD values less than 50. As shown in Table 2, all field duplicate RPD values are acceptable.

2.3.9 Overall Assessment of Data Useability

The useability of the data is based on the guidance documents listed above. Upon consideration of the information presented here, the data are acceptable, except where qualifiers that modify the usefulness of the individual values.

2.4 Volatile Organic Compound Analyses

2.4.1 Holding Times – Acceptable

The samples were analyzed within the required holding times.

2.4.2 Continuing Calibration – Acceptable

Continuing calibrations were analyzed at the required frequency. All percent recovery values met the Functional Guidelines criteria of 75 and 125%.

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2.4.3 Blank Analyses – Acceptable with Discussion

2.4.3.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the reporting limits.

2.4.3.2 Field Blanks

Seven trip blanks and four equipment blanks were collected with the samples. Except as noted below, target analytes were not detected above the reporting limits in any field blank.

Acetone was detected in equipment blank samples 5237-011008-103 and 5237-011212-102 at 149 and 54.7 µg/L, respectively. Data qualifiers are not required because acetone was not detected in the associated samples.

2.4.4 Surrogate Analyses – Acceptable with Discussion

Surrogate compounds were reported for all samples, blanks, and QC samples as required. Except as noted below, all percent recovery values are within the laboratory's control limits.

The dibromofluoromethane surrogate recovery values for samples 5237-020402-100 and 5237-020402-101 are above the laboratory's control limits at 119.4 and 118.4%, respectively. Data qualifiers are not required because the other two surrogate recovery values are acceptable.

2.4.5 Matrix Spike/Matrix Spike Duplicate Analyses – Acceptable with Discussion

MS/MSDs were analyzed at the required frequency. Except as noted below, all percent recovery and RPD values are within the laboratory's control limits.

The RPD value of 1,2,4-trimethylbenzene in the duplicate analysis associated with SDG 011107 is above the laboratory control limits at 24.7. The methyltert-butylether RPD value for the duplicate analysis associated with SDG 0204039 is below the laboratory's control limits at 36.5. Data qualifiers are not required because a non-project sample was analyzed as the MS/MSD and the acceptable laboratory control sample demonstrates the analytical system is in-control.

2.4.6 Laboratory Control Sample Analyses – Acceptable

Laboratory control samples were analyzed as required and all percent recovery values are within the laboratory's control limits.

2.4.7 Laboratory Reporting Limits – Acceptable with Discussion

The SAP target reporting levels were met, with one exception. The laboratory's reporting limit for benzene is 1.00 µg/L, which is higher than the SAP target reporting limit of 0.5 µg/L.

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2.4.8 Field Duplicates – Acceptable

Four samples were identified as field duplicates as shown in Table 2. The field duplicate criterion for precision of water samples is RPD values less than 50. All field duplicate RPD values are acceptable.

2.4.9 Overall Assessment of Data Useability

The useability of the data is based on the guidance documents listed above. Upon consideration of the information presented here, the data are acceptable.

2.5 Metals and Cyanide Analyses

2.5.1 Holding Times – Acceptable with Qualifications

All samples were analyzed within the required holding times, with the following exceptions.

The amenable cyanide analyses of the samples collected 10-8-01 and the total and amenable cyanide analyses of the samples collected 10-9-01, and the amenable cyanide analysis of sample 5237-011212-104 were preformed past the 14-day holding time. The results have been qualified as estimated (J) or estimated detection limit (UJ).

Sample ID	Analyte	Qualification	Quality Control Exceedance
5237-011008-102 5237-011008-104 5237-011008-105 5237-011009-107 5237-011212-104	Amenable cyanide	J positive results UJ detection limits	Analysis hold time exceeded
5237-011009-107	Total cyanide	J positive results UJ detection limits	Analysis hold time exceeded

2.5.2 Calibration Verifications – Acceptable

Calibration verifications were analyzed at the required frequency. All Functional Guidelines criteria were met.

2.5.3 Blank Analyses – Acceptable with Qualifications

2.5.3.1 Method Blanks

Method blanks were analyzed at the required frequency and target analytes were not detected above the reporting limits.

2.5.3.2 Field Blanks

Four equipment blanks were collected with the samples. Target analytes were not detected in the field blanks, except as noted below.

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Total iron and magnesium were detected in equipment blank 5237-011008-103, total iron was detected in equipment blank 5237-011212-102, total copper, iron, manganese, and zinc were detected in equipment blank 5237-020402-102, and total zinc was detected in equipment blank 5237-020710-102. Functional Guidelines prescribes three qualifications schemes for blank contamination, (1) associated sample concentrations greater than the action level (5 times the blank) are not qualified, (2) associated sample concentrations less than the action level and greater than the reporting limit are qualified as undetected (U) at the reported value, and (3) associated sample concentrations less than the action level and less than the reporting limit are qualified as undetected (U) at the reporting limit. The associated samples were qualified as shown in the following table.

Sample ID	Analyte	Qualification	Quality Control Exceedance
5237-020710-103 5237-020710-104	Total zinc	U at reported value	Result is greater than the reporting limit and less than 5 times the field blank level

2.5.4 Duplicate Sample Analyses – Acceptable with Discussion

Except as noted below, sample duplicate analyses were reported at the required frequency and all RPD values are within the Functional Guidelines criterion of less than 20% when the concentrations are greater than five times the reporting limit.

Columbia Inspection did not report duplicate results for the amenable cyanide analyses. Data qualifiers are not recommended.

Several RPD values are above the Functional Guidelines criterion, however, data qualifiers are not required because non-project samples were analyzed as the duplicates.

The sample duplicate results for SDG 0110107 were reported as dissolved, even though dissolved results were not requested. The dissolved titanium RPD value for the duplicate analysis of sample 5237-011009-107 is above the criteria at 200%. Data qualifiers are not required because the precision of the total titanium MS and MSD results is acceptable.

2.5.5 Matrix Spike Analyses – Acceptable with Discussion

Except as noted below, matrix spike analyses were reported at the required frequency and all recovery values are within Functional Guidelines criteria of 75 to 125%.

Columbia Inspection did not report matrix spike results for the amenable cyanide analyses. Data qualifiers are not required because the acceptable LCS demonstrates the analytical system is in control.

Several metals percent recovery values are outside Functional Guidelines criteria. Data qualifiers are not required because non-project samples were analyzed as the matrix spikes.

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The dissolved sodium, calcium, and iron recovery values in the MS analysis and the dissolved calcium recovery value in the MSD analysis of sample 5237-020710-101 are below Functional Guidelines criteria (values range from 62.2 to 71.5%). Data qualifiers are not required for sodium and iron because the MSD recovery values are acceptable. Data qualifiers are not required for calcium because Functional Guidelines does not require qualifications when the native sample concentration is greater than four times the amount spiked.

The total iron recovery values in the MS and MSD analyses of sample 5237-011009-107 are above Functional Guidelines criteria at 140% each. Data qualifiers are not required because the native sample concentration overwhelms the amount spiked by a factor of 23.

The dissolved iron, magnesium, and manganese recovery values in the MS and MSD analyses of sample 5237-020402-101 are below Functional Guidelines criteria (values range from 48.0 to 70.0%). Data qualifiers are not required because the native sample concentration is greater than four times the amount spiked.

2.5.6 Laboratory Control Sample Analyses – Acceptable

Laboratory control samples were analyzed at the required frequency. All percent recovery values are within Functional Guidelines criteria.

2.5.7 Laboratory Reporting Limits – Acceptable with Discussion

The SAP target reporting levels were met for all analytes except chromium. The laboratory reporting limit for chromium is 5 µg/L, which is higher than the SAP target reporting limit of 1.5 µg/L.

2.5.8 Field Duplicates – Acceptable with Qualifications

Four field duplicates were analyzed for metals as shown in Table 2. The criterion used to evaluate field duplicate precision is RPD values less than or equal to 50. Sample results associated with RPD values above this criterion were qualified as estimated (J) as shown in the following table.

Sample ID	Analyte	Qualification	Quality Control Exceedance
5237-011212-103 5237-011212-104	Total cyanide	J	Field duplicate RPD greater than 50
5237-020403-105 5237-020403-106	Amenable cyanide Total titanium	J	Field duplicate RPD greater than 50

2.5.9 Overall Assessment of Data Useability

The case narrative states that the amenable cyanide analysis of sample 5237-020710-101 produced a negative result. The amenable result is gained by subtracting the non-amenable result from the total result. Since it is unknown whether the interference is with the total or non-

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amenable analysis, both the total and amenable cyanide results of sample 5237-020710-101 have been qualified as estimated or estimated detection limit.

Sample ID	Analyte	Qualification	Quality Control Exceedance
5237-020710-101	Total cyanide Amenable cyanide	J UJ	Negative amenable cyanide result

The useability of the data is based on the guidance documents listed above. Upon consideration of the information presented here, the data are acceptable except where flagged with data qualifiers that modify the usefulness of the individual values.

3.0 Assessment of Data Quality Objectives

3.1 Precision

Precision is a measure of the mutual agreement among individual measurements of the same property, under prescribed similar conditions. Precision is determined through analysis of MS/MSDs, sample duplicates, LCS/LCSDs, and field duplicate samples. Duplicate samples are evaluated for precision in terms of relative percent difference. Relative percent difference is defined as the difference between the duplicate results divided by the mean and expressed as a percent.

The precision of the semivolatile organics data is acceptable. The MS/MSD, duplicate, LCS/LCSD, and field duplicate RPD values are within criteria.

The precision of the PAH data set is acceptable, with the following exceptions. The acenaphthene, fluoranthene, naphthalene, and phenanthrene results of sample 5237-011213-105 and the fluoranthene, fluorene, and phenanthrene results of sample 5237-020710-101 may be imprecise as shown by the high RPD values of the duplicate analyses. The high RPD values of benzo(a)pyrene, benzo(b)fluoranthene, and benzo(g,h,i)perylene in field duplicate pair 5237-020710-104/105 do not affect the precision of the data set because the results are less than five times the reporting limit. The LCS/LCSD RPD values are within criteria.

The precision of the volatile organic data set is acceptable. The high RPD values of several duplicate analyses do not affected the precision of the data set because non-project samples were analyzed as the duplicates. The precision of the field duplicate is acceptable.

The precision of the metals and cyanide data sets is acceptable, with the following exceptions. The total cyanide results of field duplicate pair 5237-011210-103/104 and the amenable cyanide and total titanium results of field duplicate pair 5237-010403-105/106 may be imprecise as shown by the high RPD values. Laboratory duplicate precision is acceptable.

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3.2 Accuracy

Accuracy is the degree of agreement between a measurement and the accepted reference or true value. The level of accuracy is determined by examination of surrogates, matrix spikes, matrix spike duplicates, laboratory control samples, method blanks, and field blanks. The surrogate, matrix spike, matrix spike duplicate, and laboratory control sample recovery values were compared to the criteria set forth in Functional Guidelines or the analytical method. Method and field blanks are analyzed to identify compounds that could be introduced during the sampling, laboratory extraction, or analysis phase (i.e., laboratory contaminates) and lead to inaccurate results.

The accuracy of the polycyclic aromatic hydrocarbon data set is good. One sample has surrogate recovery values above criteria; however, the accuracy of the results is not compromised because a pattern of high recovery was not observed. All matrix spikes, matrix spike duplicates, laboratory control samples, method blanks, and field blanks are acceptable.

The accuracy of the semivolatile organics data set is acceptable, with the following exceptions. The accuracy of the acid fraction analyte results of sample 5237-020403-104 maybe biased low as shown by the very low (less than 10%) recovery of one acid fraction surrogate. The low surrogate recovery of 2-fluorobiphenyl in sample 5237-020710-101 does not affect the accuracy of the results because a pattern of low recovery was not observed. The low recovery of 2,4-dinitrotoluene in one LCSD does not affect the data because the LCS recovery is acceptable. The method blanks and field blanks are free of contamination.

The accuracy of the volatile organics data set is acceptable. Two samples have surrogate recovery values above criteria, however, the accuracy of the results is not compromised because a pattern of high recovery was not observed. Two field blanks contained acetone at levels above the reporting limit. The acetone contamination does not impact the data because acetone was not detected in the associated samples. The LCS and method blank analyses are acceptable.

The accuracy of the metals and cyanide data sets is acceptable. The recovery of several MS/MSDs are outside Functional Guidelines criteria. The accuracy of the data is not affected because either a pattern of bias was not observed or the native sample concentration overwhelmed the amount spiked. The field blanks contained reportable levels of target analytes. The impact of the field blank contamination has been minimized by the proper use of data qualifiers as prescribed by Functional Guidelines. Qualifying contaminates in the associated samples as undetected when their concentration is less than five times the blank concentration minimizes the possibility of false positive results. The laboratory control samples and method blanks are acceptable.

3.3 Representativeness

Representativeness is the extent to which the data reflect the actual contaminate levels present in the samples. Representativeness is assessed through method and field blanks, and proper preservation and handling. Method and field blank analyses allow for the detection of artifacts

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that may be reported as false positive results. Proper sample preservation and handling ensure that sample results reflect the actual sample concentrations.

The data are assumed to be representative, with the exception of results from analyses that were performed past the holding time. Since the results of tests performed past the holding time may not be representative, they were qualified as estimated. The method blank and field blank contamination does not impact the representativeness of the data because the procedures in Functional Guidelines were followed to minimize the impact of the contamination. The remaining data are representative since the samples were analyzed within the required holding time, and the samples were properly preserved and handled (the receipt temperature deviations are negligible).

3.4 Comparability

Comparability is a measure of how easily the data set can be compared and combined with other data sets. The data are assumed to be comparable since standard EPA methods were used to analyze the samples, the method QC criteria generally were met, and routine detection limits were reported.

3.5 Completeness

Completeness is expressed as the ratio of valid results to the amount of data expected to be obtained under normal conditions. Completeness is determined by assessing the number of samples for which valid results were obtained versus the number of samples that were submitted to the laboratory for analysis. Valid results are results that are determined to be usable during the data validation review process.

The completeness of this data set is 100%. The completeness is 100% even though one sample was not analyzed for amenable cyanide. The missing amenable cyanide result does not compromise completeness because the total cyanide result is undetected. All remaining samples were analyzed as requested and the results were determined to be valid.

4.0 Definition of Data Qualifiers

4.1 Inorganic Data Qualifiers

The following data validation qualifiers were used in the review of this data set. These qualifiers are taken from Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA 1994).

U The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

J The associated value is an estimated quantity.

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UJ The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

R The data are unusable. (Note: Analyte may or may not be present.)

4.2 Organic Data Qualifiers

The following data validation qualifiers were used in the review of this data set. These qualifiers are taken from Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA 1999).

U The analyte was analyzed for but not detected above the reported sample quantitation limit.

J The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".

NJ The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

R The sample results are rejected due to serious deficiencies in the ability to analyze the samples and meet quality control criteria. The presence or absence of the analyte cannot be verified.

5.0 References

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Table 2
Field Duplicate Precision

Sample ID	Duplicate ID	Analyte	Sample Value	Duplicate Value	RPD
5237-011212-103	5237-011212-104	Acenaphthene (8270 SIM)	12.9	12.6	2.4
		Acenaphthylene (8270 SIM)	0.240	0.230	4.3
		Anthracene (8270 SIM)	2.97	2.94	1.0
		Benzo(a)anthracene (8270 SIM)	0.320	0.230	33
		Benzo(a)pyrene (8270 SIM)	0.140	< 0.100	NC
		Benzo(b)fluoranthene (8270 SIM)	0.100	<0.100	NC
		Benzo(g,h,i)perylene (8270 SIM)	0.100	<0.100	NC
		Benzo(k)fluoranthene (8270 SIM)	0.100	<0.100	NC
		Chrysene (8270 SIM)	0.410	0.290	34
		Fluoranthene (8270 SIM)	4.72	4.46	5.7
		Fluorene (8270 SIM)	4.77	5.13	7.3
		Naphthalene (8270 SIM)	10.5	10.8	2.8
		Phenanthrene (8270 SIM)	22.8	21.8	4.5
		Pyrene (8270 SIM)	5.07	4.49	12
		Acenaphthene (8270C)	7.54	7.59	0.7
		Anthracene (8270C)	2.53	2.50	1.2
		Fluoranthene (8270C)	3.11	3.04	2.3
		Fluorene (8270C)	3.53	3.59	1.7
		Naphthalene (8270C)	5.01	6.19	21
		Phenanthrene (8270C)	15.8	15.5	1.9
		Pyrene (8270C)	3.69	3.42	7.8
		Benzene	26.8	27.0	0.7
		cis-1,2-dichloroethene	409	398	2.7
		Naphthalene	13.9	12.4	11
		o-xylene	2.66	2.57	3.4
		Toluene	1.27	1.32	3.9
		trans-1,2-dichloroethene	2.20	2.15	2.3
		Trichloroethene	3.53	3.39	4.1
		Vinyl chloride	332	306	8.2
		1,1-dichloroethene	<1.00	1.03	NC
		Total cyanide	0.725	0.066	167
		Amenable cyanide	0.263	<0.0200	NC
		Total Barium	0.123	0.119	3.3
		Total Iron	48.1	47.2	1.9
		Total Magnesium	54.7	54.2	0.9
		Total Manganese	1.83	1.83	0
		Total Nickel	0.0056	0.0055	1.8
		Total Titanium	0.169	0.132	24
		Total Vanadium	0.0084	0.0066	24
		Total Zinc	0.0104	0.0094	10

SCOEPA00012397

Table 2 – Continued

Sample ID	Duplicate ID	Analyte	Sample Value	Duplicate Value	RPD
5237-020710-104	5237-020710-105	Acenaphthene	129	132	2.3
		Acenaphthylene	1.65	1.48	11
		Anthracene	8.42	8.63	2.5
		Benzo(a)anthracene	0.530	0.680	25
		Benzo(a)pyrene	0.150	0.260	54
		Benzo(b)fluoranthene	0.110	0.190	53
		Benzo(g,h,i)perylene	0.110	0.200	58
		Benzo(k)fluoranthene	0.120	0.170	34
		Chrysene	0.530	0.670	23
		Fluoranthene	7.70	8.15	5.7
		Fluorene	34.4	36.2	5.1
		Naphthalene	77.4	77.6	0.3
		Phenanthrene	72.0	80.4	11
		Pyrene	8.16	7.37	10
		Indeno(1,2,3-cd)pyrene	<0.100	0.130	NC
		1,2,4-Trimethylbenzene	31.2	30.8	1.3
		1,3,5-Trimethylbenzene	8.28	8.39	1.3
		4-isopropyltoluene	1.33	1.47	10
		Benzene	65.9	68.1	3.3
		Ethyl benzene	31.6	30.4	3.9
		Isopropylbenzene	4.46	4.26	4.6
		m,p-xylene	19.9	18.8	5.7
		n-propylbenzene	1.19	1.27	6.5
		Naphthalene	135	145	7.1
		o-xylene	33.2	31.0	6.8
		Toluene	1.24	1.29	4.0
		Total cyanide	0.724	0.726	0.3
		Total Arsenic	0.0152	0.0173	13
		Total Barium	0.117	0.116	0.9
		Total Iron	80.6	80.3	0.4
		Total Magnesium	21.4	24.2	12
		Total Manganese	4.89	4.89	0
		Total Titanium	0.0286	0.0171	50
		Total Vanadium	0.0053	<0.0050	NC

SCOEPA00012398

Table 2 – Continued

Sample ID	Duplicate ID	Analyte	Sample Value	Duplicate Value	RPD
5237-020403-105	5237-020403-106	Acenaphthene	91.6	84.0	8.7
		Acenaphthylene	1.01	1.39	32
		Anthracene	6.43	7.14	10
		Benzo(a)anthracene	0.310	0.320	3.2
		Chrysene	0.420	0.440	4.6
		Fluoranthene	7.18	8.20	13
		Fluorene	18.4	19.5	5.8
		Naphthalene	110	101	8.5
		Phenanthrene	34.1	33.8	0.9
		Pyrene	5.16	6.38	21
		1,2,4-Trimethylbenzene	9.56	7.78	21
		1,3,5-Trimethylbenzene	2.49	2.16	14
		Benzene	89.1	87.4	1.9
		Ethyl benzene	19.5	18.0	8.0
		Isopropylbenzene	2.38	2.12	12
		m,p-xylene	8.58	7.90	8.2
		Naphthalene	327	216	41
		o-xylene	11.9	10.6	12
		Toluene	2.07	2.14	3.3
		Total cyanide	0.416	0.615	39
		Amenable cyanide	0.064	0.183	96
		Total Arsenic	0.018	0.0174	3.4
		Total Barium	0.115	0.114	0.9
		Total Iron	90.9	89.6	1.4
		Total Magnesium	21.8	21.5	1.4
		Total Manganese	4.88	4.85	0.6
		Total Titanium	0.022	0.013	51
		Total Zinc	0.0243	<0.0050	NC

SCOEPA00012399

Table 2 – Continued

Sample ID	Duplicate ID	Analyte	Sample Value	Duplicate Value	RPD
5237-011008-104	5237-011008-105	Acenaphthene	18.5	18.9	2.1
		Acenaphthylene	0.38	0.380	0
		Anthracene	4.20	4.10	2.4
		Benzo(a)anthracene	0.250	0.200	22
		Chrysene	0.290	0.240	19
		Fluoranthene	5.80	5.50	5.3
		Fluorene	7.90	7.90	0
		Naphthalene	27.7	22.5	0.9
		Phenanthrene	31.8	29.8	6.5
		Pyrene	6.40	6.30	1.6
		Benzene	14.7	21.4	37
		cis-1,2-dichloroethene	251	345	32
		Naphthalene	38.9	49.9	25
		Vinyl chloride	92.4	129	33
		Toluene	<1.00	2.02	NC
		2-methylnaphthalene (8270C)	6.74	7.17	6.2
		Total cyanide	0.468	0.456	2.6
		Total Barium	0.153	0.142	7.5
		Total copper	0.0055	0.0037	39
		Total Iron	49.6	47.0	5.4
		Total Manganese	2.85	2.84	0.4
		Total Titanium	0.564	0.448	23
		Total vanadium	0.0233	0.0173	30
		Total Zinc	0.0307	0.0236	26

RPD Relative percent difference
NC Not calculable
< Analyte not detected above the associated reporting limit
Metals and cyanide results are in mg/L
Volatile organics, semivolatile organics, and PAH values are in µg/L

SCOEPA00012400

Table 3
Summary of Qualified Data

Sample ID	Analyte	Qualifier	Reason for Qualification
5237-011213-105	Acenaphthene Fluorene Naphthalene Phenanthrene	J	Duplicate RPD above laboratory control limits and results greater than 5 times the reporting limit
5237-020710-101	Fluoranthene Fluorene Phenanthrene	J	Duplicate RPD above laboratory control limits and results greater than 5 times the reporting limit
5237-020403-104	2,3,4,6-Tetrachlorophenol 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol 2,4-Dichlorophenol 2,4-Dimethylphenol 2,4-Dinitrophenol 2,6-Dichlorophenol 2-Chlorophenol 2-Methylphenol 2-Nitrophenol 3&4-Methylphenol 4,6-Dinitro-2-methylphenol 4-Chloro-3-methylphenol 4-Nitrophenol Pentachlorophenol Phenol	UJ	Surrogate recovery below 10%
5237-020710-104	Acenaphthene	J	MS recovery below laboratory control limits
5237-011212-104	1,2,4-Trichlorobenzene	UJ	MS recovery below laboratory control limits
5237-011008-102 5237-011008-104 5237-011008-105 5237-011009-107 5237-011212-104	Amenable cyanide	UJ	Analysis hold time exceeded
5237-011009-107	Total cyanide	UJ	Analysis hold time exceeded
5237-020710-103 5237-020710-104	Total zinc	U at reported value	Result is greater than the reporting limit and less than 5 times the field blank level
5237-011212-103 5237-011212-104	Total cyanide	J	Field duplicate RPD greater than 50
5237-020403-105 5237-020403-106	Amenable cyanide	J	Field duplicate RPD greater than 50
5237-020403-105 5237-020403-106	Total titanium	J	Field duplicate RPD greater than 50
5237-020710-101	Total cyanide Amenable cyanide	J UJ	Negative amenable cyanide result

SCOEPA00012401

Appendix A

Laboratory Communications

(7 pages)

SCOEPA00012402

Environmental Services Laboratory

Date: *18-Sep-02*

CLIENT:	Hahn and Associates	**Client Sample ID:**	105
Lab Order:	0207076	**Tag Number:**	
Project:	5237/Wacker Siltronics	**Collection Date:**	7/10/02
Lab ID:	0207076-06A	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS		**EPA 6010B**		**(3005A)**		Analyst: mal
Antimony	ND	0		mg/L	1	7/16/02
Arsenic	0.017	0		mg/L	1	7/16/02
Barium	0.12	0		mg/L	1	7/16/02
Cadmium	ND	0		mg/L	1	7/16/02
Chromium	ND	0		mg/L	1	7/16/02
Cobalt	ND	0		mg/L	1	7/16/02
Copper	ND	0		mg/L	1	7/16/02
Iron	80	0		mg/L	1	7/16/02
Lead	ND	0		mg/L	1	7/16/02
Magnesium	24	0		mg/L	1	7/16/02
Manganese	4.9	0		mg/L	1	7/16/02
Nickel	ND	0		mg/L	1	7/16/02
Selenium	ND	0		mg/L	1	7/16/02
Silver	0.0014	0		mg/L	1	7/16/02
Titanium	0.017	0		mg/L	1	7/16/02
Vanadium	0.0045	0		mg/L	1	7/16/02
Zinc	ND	0		mg/L	1	7/16/02
PAH BY SIM, AQUEOUS		**8270-SIM**		**(3510C)**		Analyst: mrs
Acenaphthene	130	0.10		µg/L	1	7/12/02
Acenaphthylene	1.5	0.10		µg/L	1	7/12/02
Anthracene	8.6	0.10		µg/L	1	7/12/02
Benz(a)anthracene	0.68	0.10		µg/L	1	7/12/02
Benzo(a)pyrene	0.28	0.10		µg/L	1	7/12/02
Benzo(b)fluoranthene	0.19	0.10		µg/L	1	7/12/02
Benzo(g,h,i)perylene	0.20	0.10		µg/L	1	7/12/02
Benzo(k)fluoranthene	0.17	0.10		µg/L	1	7/12/02
Chrysene	0.67	0.10		µg/L	1	7/12/02
Dibenz(a,h)anthracene	ND	0.10		µg/L	1	7/12/02
Fluoranthene	8.2	0.10		µg/L	1	7/12/02
Fluorene	36	0.10		µg/L	1	7/12/02
Indeno(1,2,3-cd)pyrene	0.13	0.10		µg/L	1	7/12/02
Naphthalene	78	0.10		µg/L	1	7/12/02
Phenanthrene	80	0.10		µg/L	1	7/12/02
Pyrene	7.4	0.10		µg/L	1	7/12/02
Surr: 2-Fluorobiphenyl	72.5	43-116		%REC	1	7/12/02
Surr: 4-Terphenyl-d14	65.0	33-141		%REC	1	7/12/02
Surr: Nitrobenzene-d5	82.5	35-114		%REC	1	7/12/02
VOLATILES BY GC/MS		**EPA 8260B**				Analyst: jlw
1,1,1,2-Tetrachloroethane	ND	1.0		µg/L	1	7/11/02

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

003/004

SCOEPA00012403

Environmental Services Laboratory

Date: *18-Sep-02*

CLIENT:	Hahn and Associates	**Client Sample ID:**	104
Lab Order:	0207076	**Tag Number:**	
Project:	5237/Wacker Siltronics	**Collection Date:**	7/10/02
Lab ID:	0207076-05A	**Matrix:**	AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
ICP METALS		**EPA 6010B**		**(3005A)**		**Analyst: mal**
Antimony	ND	0.0050		mg/L	1	7/16/02
Arsenic	0.015	0.0050		mg/L	1	7/16/02
Barium	0.12	0.0050		mg/L	1	7/16/02
Cadmium	ND	0.0020		mg/L	1	7/16/02
Chromium	ND	0.0050		mg/L	1	7/16/02
Cobalt	ND	0.0050		mg/L	1	7/16/02
Copper	ND	0.0050		mg/L	1	7/16/02
Iron	81	0.010		mg/L	1	7/16/02
Lead	ND	0.0050		mg/L	1	7/16/02
Magnesium	24	0.050		mg/L	1	7/16/02
Manganese	4.9	0.0050		mg/L	1	7/16/02
Nickel	ND	0.0050		mg/L	1	7/16/02
Selenium	ND	0.0050		mg/L	1	7/16/02
Silver	ND	0.0050		mg/L	1	7/16/02
Titanium	0.029	0.010		mg/L	1	7/16/02
Vanadium	0.0053	0.0050		mg/L	1	7/16/02
Zinc	0.0053	0.0050		mg/L	1	7/16/02
BNA SEMI-VOL ORGANICS, AQUEOUS		**EPA 8270C**		**(3510C)**		**Analyst: mrs**
1,2,4,5-Tetrachlorobenzene	ND	2.0		µg/L	1	7/17/02
1,2,4-Trichlorobenzene	ND	2.0		µg/L	1	7/17/02
1,2-Dichlorobenzene	ND	2.0		µg/L	1	7/17/02
1,2-Diphenylhydrazine	ND	2.0		µg/L	1	7/17/02
1,3-Dichlorobenzene	ND	2.0		µg/L	1	7/17/02
1,4-Dichlorobenzene	ND	2.0		µg/L	1	7/17/02
2,3,4,6-Tetrachlorophenol	ND	2.0		µg/L	1	7/17/02
2,4,5-Trichlorophenol	ND	2.0		µg/L	1	7/17/02
2,4,6-Trichlorophenol	ND	2.0		µg/L	1	7/17/02
2,4-Dichlorophenol	ND	2.0		µg/L	1	7/17/02
2,4-Dimethylphenol	ND	2.0		µg/L	1	7/17/02
2,4-Dinitrophenol	ND	10		µg/L	1	7/17/02
2,4-Dinitrotoluene	ND	2.0		µg/L	1	7/17/02
2,6-Dichlorophenol	ND	2.0		µg/L	1	7/17/02
2,6-Dinitrotoluene	ND	2.0		µg/L	1	7/17/02
2-Chloronaphthalene	ND	2.0		µg/L	1	7/17/02
2-Chlorophenol	ND	2.0		µg/L	1	7/17/02
2-Methylnaphthalene	42	2.0		µg/L	1	7/17/02
2-Methylphenol	ND	2.0		µg/L	1	7/17/02
2-Nitroaniline	ND	2.0		µg/L	1	7/17/02
2-Nitrophenol	ND	2.0		µg/L	1	7/17/02
3&4-Methylphenol	ND	4.0		µg/L	1	7/17/02

Qualifiers:

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

B - Analyte detected in the associated Method Blank

* - Value exceeds Maximum Contaminant Level

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

E - Value above quantitation range

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SCOEPA00012404

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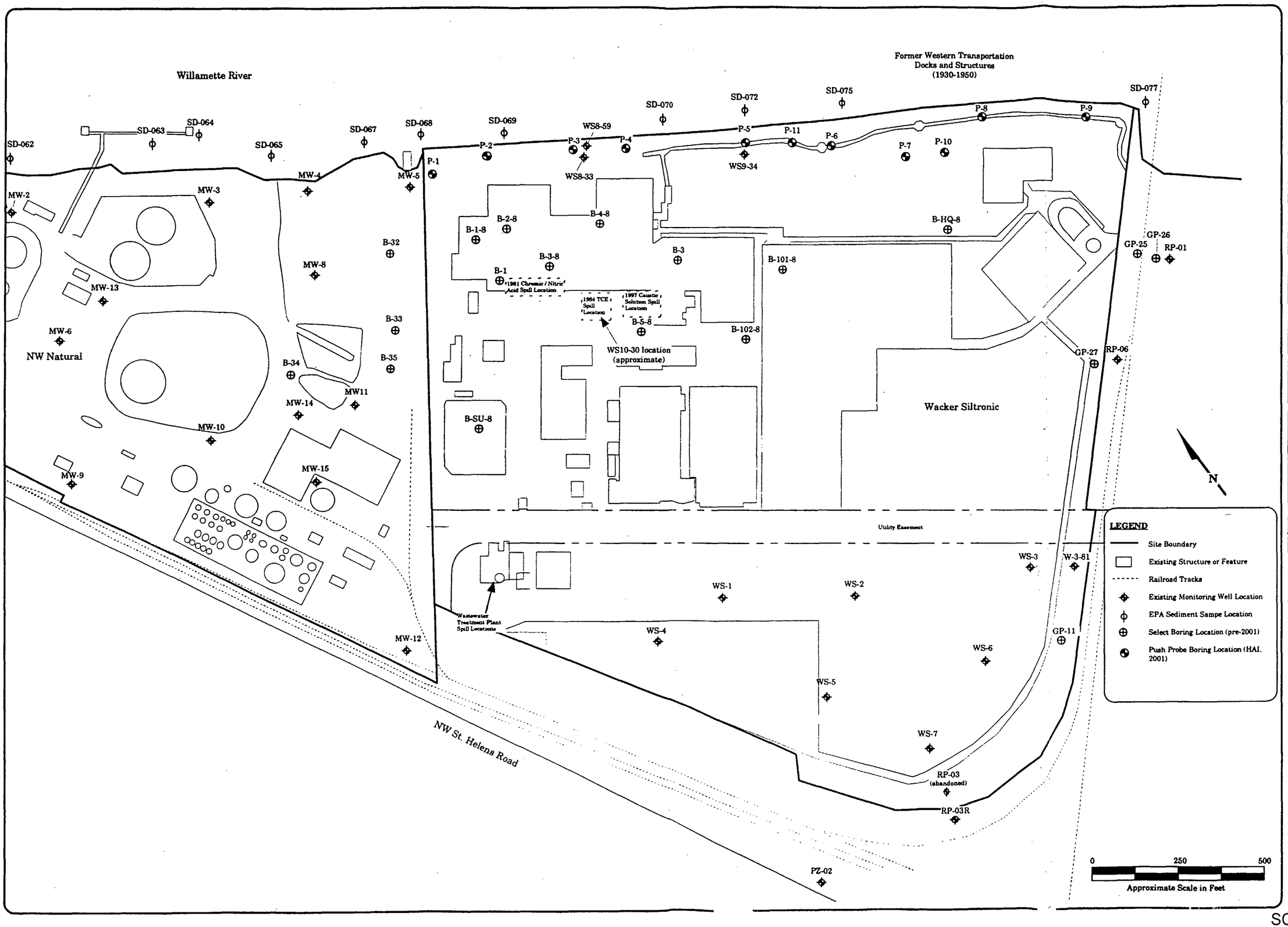

Figure 1

Monitoring Well and Push Probe Location Map

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN & ASSOCIATES, INC.
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

May 2002

Project No. 5237

TABLE 1
Summary of Validated Analytical Results for Groundwater Samples: Monitoring Wells
Detected Volatile Organic Compounds by EPA Method 8260

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

Well Number	HAI Sample Number	Sample Date	Screen Interval (feet bgs)	Analytical Results – ug/l (ppb) VOCs by EPA Method 8260												
				Aromatic VOCs (AVOCs)					Halogenated VOCs (HVOCs)							
				Benzene	Ethylbenzene	Toluene	Xylenes	Naphthalene	1,1-DCE	cis-1,2-DCE	trans-1,2-DCE	TCE	Vinyl Chloride	Other VOCs	Total AVOCs	Total HVOCs
WS-8-33	5237-011009-107	9-Oct-01	23-33	**107.**	27.9	ND> 10.	ND> 20.	**841.**	ND> 10.	ND> 10.	ND> 10.	ND> 10.	ND> 12.	1,2,4-TMB = 18.8	994.7	ND
	5237-011213-105	13-Dec-01		68.	29.6	ND> 5.	23.2	455.	ND> 5.	ND> 5.	ND> 5.	ND> 5.	ND> 6.	1,2,4-TMB = 23.1	598.9	ND
	5237-020403-105	3-Apr-02		89.1	19.5	2.07	20.48	327.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	1,2,4-TMB = 9.56; 1,3.5-TMB=2.49; IPB=2.38	472.6	ND
	5237-020403-106 (dup)	3-Apr-02		87.4	18.	2.14	18.5	216.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	1,2,4-TMB = 7.78; 1,3.5-TMB=2.16; IPB=2.12	354.1	ND
	5237-020710-104	10-Jul-02		65.9	31.6	1.24	53.1	135.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	1,2,4-TMB = 31.2; 1,3.5-TMB=8.28; IPB=4.46; 4-IPT=1.33; nPB=1.19	286.8	ND
	5237-020710-105 (dup)	10-Jul-02		68.1	30.4	1.29	49.8	145.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	1,2,4-TMB = 30.8; 1,3.5-TMB=8.39; IPB=4.26; 4-IPT=1.47; nPB=1.27	294.6	ND
WS-8-59	5237-011008-104	8-Oct-01	49-59	14.7	ND> 1.	ND> 1.	ND> 2.	38.9	ND> 1.	251.	ND> 1.	ND> 1.	92.4	ND	53.6	343.4
	5237-011008-105 (dup)	8-Oct-01		21.4	ND> 1.	2.02	ND> 2.	49.9	ND> 1.	345.	ND> 1.	ND> 1.	129.	ND	73.3	474.
	5237-011212-103	12-Dec-01		26.8	ND> 1.	1.27	2.66	13.9	ND> 1.5	409.	2.2	3.53	332.	ND	44.6	746.7
	5237-011212-104 (dup)	12-Dec-01		27.	ND> 1.	1.32	2.57	12.4	1.03	398.	2.15	3.39	306.	ND	43.3	710.6
	5237-020403-104	3-Apr-02		13.	ND> 1.	ND> 1.	1.11	ND> 2.	ND> 1.	99.6	ND> 1.	ND> 1.	136.	ND	14.1	235.6
	5237-0207103	10-Jul-02		20.8	ND> 1.	1.17	2.29	ND> 2.	ND> 1.	117.	ND> 1.	1.19	160.	ND	24.3	278.2
WS-9-34	5237-011008-102	8-Oct-01	24-34	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 5.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-011212-101	12-Dec-01		ND> 1.	ND> 1.	ND> 1.	ND> 2.	2.04	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	2.	ND
	5237-020402-101	2-Apr-02		ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-020710-101	10-Jul-02		ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
Quality Control Samples																
Trip Blanks	5237-011008-101	8-Oct-01	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 5.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-011212-100	12-Dec-01	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-011213-106	13-Dec-01	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-011009-106	9-Oct-01	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-020402-100	2-Apr-02	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-020403-103	3-Apr-02	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-020710-100	10-Jul-02	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
Water EB	5237-011008-103	8-Oct-01	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 5.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	acetone = 149.0	ND	ND
	5237-011212-102	12-Dec-01	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	acetone = 54.7	ND	ND
	5237-020402-102	2-Apr-02	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
	5237-020710-102	10-Jul-02	NA	ND> 1.	ND> 1.	ND> 1.	ND> 2.	ND> 2.	ND> 1.	ND> 1.	ND> 1.	ND> 1.	ND> 1.2	ND	ND	ND
Ambient Water Quality Criteria (AWQC) for Surface Water [1]				71. [2]	29,000. [3]	200,000. [3]	#	620. [3]	#	11,600. [3]	140,000. [3]	81. [3]	525. [3]	#	#	#

Note:
# = not established
AVOCs = aromatic volatile organic compounds
bgs = below ground surface
DCB = dichlorobenzene
DCE = dichloroethene
EB = equipment blank
EPA = U.S. Environmental Protection Agency
HVOCs = halogenated volatile organic compounds
IPB = isopropylbenzene
ND = not detected above detection limit indicated
nPB = n-propylbenzene
ppb = parts per billion
TCE = trichloroethene
TMB = trimethylbenzene
ug/l = micrograms/liter
VOCs = volatile organic compounds

1 = Reference Level indicated is the lowest guidance value provided in the Ambient Water Quality Criteria (EPA 822-Z-99-001) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health Protection)
2 = Reference Level based on Human Fish Consumption Criteria of AWQC
3 = Reference Level based on Lowest Observable Health Effect Level for Freshwater, as provided within NOAA Screening Quick Reference Tables, updated September 1999
Bold = Detected above lowest identified AWQC
(Data Validation and Data Quality Assessment Report, Kathy J. Gunderson, September 23, 2002)

TABLE 2
Summary of Validated Analytical Results for Groundwater Samples: Monitoring Wells
Polynuclear Aromatic Hydrocarbons by EPA Method 8270 SIM

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

PAHs by EPA Method 8270 (SIM)				Analytical Results ug/l (ppb)																
				Carcinogenic PAHs							Non-carcinogenic PAHs									
Well Number	HAI Sample Number[1]	Sample Date	Screen Interval (feet bgs)	Benzo (a) anthracene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Benzo (a) pyrene	Chrysene	Dibenzo (a,h) anthracene	Indeno (1,2,3-cd) pyrene	Acenaphthene	Acenaphthylene	Anthracene	Benzo (g,h,i) perylene	Fluoranthene	Fluorene	Naphthalene	Phenanthrene	Pyrene	Total PAHs
WS-8-33	5237-011009-107	9-Oct-01	23-33	**0.55**	**0.19**	ND> 0.1	**0.27**	**0.6**	ND> 0.1	**0.11**	98.7	1.17	8.42	0.15	7.83	32.5	485.	85.	7.65	728.1
	5237-011213-105	13-Dec-01		**0.25**	**0.1**	ND> 0.1	**0.27**	**0.3**	ND> 0.1	**0.11**	105. J	2.35	11.9	ND> 0.1	7.35	31.9 J	287. J	70.5 J	7.15	524.2
	5237-020403-105	3-Apr-02		**0.31**	ND> 0.1	ND> 0.1	ND> 0.1	**0.42**	ND> 0.1	ND> 0.1	91.6	1.01	6.43	ND> 0.1	7.18	18.4	110.	34.1	5.16	274.6
	5237-020403-106 (dup)	3-Apr-02		**0.32**	ND> 0.1	ND> 0.1	ND> 0.1	**0.44**	ND> 0.1	ND> 0.1	84.	1.39	7.14	ND> 0.1	8.2	19.5	101.	33.8	6.38	262.2
	5237-020710-104	10-Jul-02		**0.53**	**0.11**	**0.12**	**0.15**	**0.53**	ND> 0.1	ND> 0.1	129.	1.65	8.42	0.11	7.7	34.4	77.4	72.	8.16	340.3
	5237-020710-105 (dup)	10-Jul-02		**0.68**	**0.19**	**0.17**	**0.26**	**0.67**	ND> 0.1	**0.13**	132.	1.48	8.63	0.2	8.15	36.2	77.6	80.4	7.37	354.1
WS-8-59	5237-011008-104	8-Oct-01	49-59	**0.25**	ND> 0.1	ND> 0.1	ND> 0.1	**0.29**	ND> 0.1	ND> 0.1	18.5	0.38	4.2	ND> 0.1	5.8	7.9	22.7	31.8	6.4	98.2
	5237-011008-105 (dup)	8-Oct-01		**0.2**	ND> 0.1	ND> 0.1	ND> 0.1	**0.24**	ND> 0.1	ND> 0.1	18.9	0.39	4.1	ND> 0.1	5.5	7.9	22.5	29.8	6.3	95.8
	5237-011212-103	12-Dec-01		**0.32**	**0.1**	**0.1**	**0.14**	**0.41**	ND> 0.1	ND> 0.1	12.9	0.24	2.97	0.1	4.72	4.77	10.5	22.8	5.07	65.1
	5237-011212-104 (dup)	12-Dec-01		**0.23**	ND> 0.1	ND> 0.1	ND> 0.1	**0.29**	ND> 0.1	ND> 0.1	12.6	0.23	2.94	ND> 0.1	4.46	5.13	10.8	21.8	4.49	63.
	5237-020403-104	3-Apr-02		**0.16**	ND> 0.1	ND> 0.1	ND> 0.1	**0.24**	ND> 0.1	ND> 0.1	5.03	ND> 0.1	1.91	ND> 0.1	3.5	2.34	1.13	9.9	2.57	26.8
	5237-020710-103	10-Jul-02		**0.17**	ND> 0.1	ND> 0.1	ND> 0.1	**0.23**	ND> 0.1	ND> 0.1	4.53	ND> 0.1	1.31	ND> 0.1	3.15	1.92	0.63	3.45	3.49	18.9
WS-9-34	5237-011008-102	8-Oct-01	24-34	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	2.07	0.15	ND> 0.1	ND> 0.1	0.36	0.18	0.45	ND> 0.1	0.38	3.6
	5237-011212-101	12-Dec-01		**0.11**	**0.1**	**0.1**	**0.15**	**0.17**	ND> 0.1	**0.12**	17.8	0.33	0.33	0.17	1.91	6.43	0.4	2.45	1.74	32.3
	5237-020402-101	2-Apr-02		ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	17.5	0.19	0.44	ND> 0.1	1.59	1.8	ND> 0.1	4.81	ND> 0.1	26.3
	5237-020710-101	10-Jul-02		ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	11.1	0.17	0.22	ND> 0.1	0.91 J	2.09 J	0.13	2.06 J	1.13	17.8
Quality Control Samples																				
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020402-100	2-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020403-103	3-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020710-100	10-Jul-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water EB	5237-011008-103	8-Oct-01	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
	5237-011212-102	12-Dec-01	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
	5237-020402-102	2-Apr-02	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
	5237-020710-102	10-Jul-02	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
Ambient Water Quality Criteria (AWQC) for Surface Water[1]				0.049 [3]	0.049 [3]	0.049 [3]	0.049 [3]	0.049 [3]	0.049 [3]	0.049 [3]	2,700. [2]	#	110,000. [3]	#	370. [3]	14,000. [3]	620. [4]	#	11,000. [3]	#

Note:
# = not established
bgs = below ground surface
EB = equipment blanks
EPA = U.S. Environmental Protection Agency
ND = not detected above detection limit indicated
PAHs = polynuclear aromatic hydrocarbons
ppb = parts per billion
ug/l = micrograms per liter

1 = Reference Level indicated is the lowest guidance value provided in the Ambient Water Quality Criteria (EPA 822-Z-99-001) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health Protection)
2 = Reference Level based on Aquatic Fresh Chronic Criteria of AWQC
3 = Reference Level based on Human Fish Consumption Criteria of AWQC
4 = Reference Level based on Lowest Observable Health Effect Level for Freshwater, as provided within NOAA Screening Quick Reference Tables, updated September 1999
Bold = Detected above lowest identified AWQC
(Data Validation and Data Quality Assessment Report, Kathy J. Gunderson, September 23, 2002)

TABLE 3
Summary of Validated Analytical Results for Groundwater Samples: Monitoring Wells
Detected Semi-Volatile Organic Compounds by EPA Method 8270C

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

SVOCs by EPA Method 8270				Analytical Results ug/l (ppb)			
Well Number	HAI Sample Number	Sample Date	Screen Interval (feet bgs)	Carbazole	Dibenzofuran	2-Methylnaphthalene	PAHs
WS-8-33	5237-011009-107	9-Oct-01	23-33	14.7	4.26	59.2	See Table 4
	5237-011213-105	13-Dec-01		45.2	3.97	65.8	See Table 4
	5237-020403-105	3-Apr-02		11.5	2.12	5.48	See Table 4
	5237-020403-106 (dup)	3-Apr-02		-	-	-	See Table 4
	5237-020710-104	10-Jul-02		18.3	3.05	41.9	See Table 4
	5237-020710-105 (dup)	10-Jul-02		-	-	-	See Table 4
WS-8-59	5237-011008-104	8-Oct-01	49-59	ND> 4.	ND> 2.	6.74	See Table 4
	5237-011008-105 (dup)	8-Oct-01		ND> 4.	ND> 2.	7.17	See Table 4
	5237-011212-103	12-Dec-01		ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-011212-104 (dup)	12-Dec-01		ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-020403-104	3-Apr-02		ND> 8.	ND> 4.	ND> 4.	See Table 4
	5237-020710-103	10-Jul-02		ND> 4.	ND> 2.	ND> 2.	See Table 4
WS-9-34	5237-011008-102	8-Oct-01	24-34	ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-011212-101	12-Dec-01		ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-020402-101	2-Apr-02		ND> 8.	ND> 4.	ND> 4.	See Table 4
	5237-020710-101	10-Jul-02		ND> 4.	ND> 2.	ND> 2.	See Table 4
Quality Control Samples							
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-
	5237-020710-100	10-Jul-02	NA	-	-		-
Water EB	5237-011008-103	8-Oct-01	NA	ND> 4.	ND> 2.	ND> 2.	See Table 2
	5237-011212-102	12-Dec-01	NA	ND> 4.	ND> 2.	ND> 2.	See Table 2
	5237-020402-102	2-Apr-02	NA	-	-	-	See Table 2
	5237-020710-102	10-Jul-02	NA	-	-	-	See Table 2
Ambient Water Quality Criteria (AWQC) for Surface Water [1]				#	#	#	#

Note:
bgs = below ground surface
EB = equipment blanks
EPA = U.S. Environmental Protection Agency
ND = Not detected above detection limit indicated
PAHs = polynuclear aromatic hydrocarbons
ppb = parts per billion
ug/l = micrograms/liter
= not established

1 = Ambient Water Quality Criteria (EPA 822-Z-99-001)
(Data Validation and Data Quality Assessment Report, Kathy J. Gunderson, September 23, 2002)

TABLE 4
Summary of Validated Analytical Results for Groundwater Samples: Monitoring Wells
Metals and Cyanide
Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

Well Number	HAI Sample Number	Sample Date	Screen Interval (feet bgs)	Analytical Results – mg/l (ppm)																	
				Total Metals by EPA Methods 6010, 200.7 and/or 7000 Series																EPA 9010 B	EPA 9010 B
				Magnesium	Magnesium, Diss	Manganese	Manganese, Diss	Nickel	Nickel, Diss	Selenium	Selenium, Diss	Silver	Silver, Diss	Titanium	Titanium, Diss	Vanadium	Vanadium, Diss	Zinc	Zinc, Diss	Total Cyanide	Amenable Cyanide
WS-8-33	5237-011009-107	9-Oct-01	23-33	27.2	-	5.07	-	0.0039	-	ND> 0.005	-	ND> 0.0019	-	0.766	-	0.0397	-	0.0496	-	ND> 0.02 UJ	ND> 0.02 UJ
	5237-011213-105	13-Dec-01		30.	-	5.57	-	ND> 0.005	-	0.0063	-	ND> 0.005	-	0.0762	-	0.0059	-	0.0147	-	0.854	ND> 0.02
	5237-020403-105	3-Apr-02		21.8	19.9	4.88	4.51	ND> 0.005	ND> 0.005	ND> 0.005	0.0084	ND> 0.005	ND> 0.005	0.022 J	ND> 0.01	ND> 0.005	ND> 0.005	0.0243	ND> 0.015	0.416	0.064 J
	5237-020403-106 (dup)	3-Apr-02		21.5	-	4.85	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.013 J	-	ND> 0.005	-	ND> 0.005	-	0.615	0.183 J
	5237-020710-104	10-Jul-02		24.1	24.3	4.89	5.02	ND> 0.005	ND>.00556	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	0.0286	ND> 0.0111	0.0063	ND> 0.0056	ND> 0.0053 U	ND> 0.0056	0.724	ND> 0.08
	5237-020710-105 (dup)	10-Jul-02		24.2	-	4.89	4.89	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.0171	-	ND> 0.005	-	ND> 0.005	-	0.728	ND> 0.08
WS-8-59	5237-011008-104	8-Oct-01	49-59	ND> 0.05	-	2.85	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	0.564	-	0.0233	-	0.0307	-	0.468	ND> 0.02 UJ
	5237-011008-105 (dup)	8-Oct-01		ND> 0.05	-	2.84	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	0.448	-	0.0173	-	0.0236	-	0.456	ND> 0.02 UJ
	5237-011212-103	12-Dec-01		54.7	-	1.83	-	0.0056	-	ND> 0.005	-	ND> 0.005	-	0.169	-	0.0084	-	0.0104	-	0.725 J	0.263
	5237-011212-104 (dup)	12-Dec-01		54.2	-	1.83	-	0.0055	-	ND> 0.005	-	ND> 0.005	-	0.132	-	0.0066	-	0.0094	-	0.066 J	ND> 0.02 UJ
	5237-020403-104	3-Apr-02		39.9	-	3.33	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.0694	-	ND> 0.005	-	0.0086	-	1.42	ND> 0.4
	5237-020710-103	10-Jul-02		46.4	-	2.19	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.108	-	0.0063	-	ND> 0.0055 U	-	0.459	ND> 0.04
WS-9-34	5237-011008-102	8-Oct-01	24-34	53.3	-	4.31	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	0.0055	-	ND> 0.001	-	0.0055	-	0.14	ND> 0.02 UJ
	5237-011212-101	12-Dec-01		60.2	15.6	7.1	2.24	0.0369	0.006	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.005	0.217	ND> 0.001	0.0548	ND> 0.005	0.376	0.0155	0.074	ND> 0.02
	5237-020402-101	2-Apr-02		45.5	22.7	4.35	2.59	0.0229	0.0087	ND> 0.005	0.0054	ND> 0.005	ND> 0.005	0.254	ND> 0.01	0.0482	ND> 0.005	0.197	ND> 0.015	0.11	ND> 0.04
	5237-020710-101	10-Jul-02		57.1	36.4	6.66	4.73	0.0365	0.0064	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	0.27	ND> 0.0111	0.043	ND> 0.0056	0.224	0.0153	0.074 J	ND> 0.04 UJ
Quality Control Samples																					
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020402-100	2-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020403-103	3-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020710-100	10-Jul-02	NA																		
Water Eq. Blanks	5237-011212-102	8-Oct-01	NA	0.05	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.01	-	ND> 0.005	-	ND> 0.01	-	ND> 0.02	ND> 0.02
	5237-011008-103	12-Dec-01	NA	0.0775	-	ND> 0.005	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	ND> 0.001	-	ND> 0.005	-	ND> 0.005	-	ND> 0.02	ND> 0.02
	5237-020402-102	2-Apr-02	NA	ND> 0.05	-	0.0059	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.01	-	ND> 0.005	-	0.0359	-	ND> 0.04	-
	5237-020710-102	10-Jul-02	NA	ND> 0.05		ND> 0.005		ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.01	-	ND> 0.005		0.0079		ND> 0.04	ND> 0.04
Ambient Water Quality Criteria (AWQC) for Surface Water [1]				#	#	#	#	0.052 [2]		0.005 [2]		0.003 [2]		#	#	#	#	0.12 [2]		0.005 [2]	

Note:
# = not established
bgs = below ground surface
Diss = dissolved
EB = equipment blank
EPA = U.S. Environmental Protection Agency
mg/l = milligrams/liter
ND = not detected above detection limit indicated
ppm = parts per million

1 = Reference Level indicated is the lowest guidance value provided in the Ambient Water Quality Criteria (EPA 822-Z-99-001) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health Protection)
2 = Reference Level based on Aquatic Fresh Chronic Criteria of AWQC
3 = Reference Level based on Human Fish Consumption Criteria of AWQC

Bold = Detected above lowest identified AWQC

(Data Validation and Data Quality Assessment Report, Kathy J. Gunderson, September 23, 2002)

TABLE 4
Summary of Validated Analytical Results for Groundwater Samples: Monitoring Wells
Metals and Cyanide
Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

Well Number	HAI Sample Number	Sample Date	Screen Interval (feet bgs)	Analytical Results – mg/l (ppm) Total Metals by EPA Methods 6010, 200.7 and/or 7000 Series																	
				Antimony	Antimony, Diss	Arsenic	Arsenic, Diss	Barium	Barium, Diss	Cadmium	Cadmium, Diss	Chromium	Chromium, Diss	Cobalt	Cobalt, Diss	Copper	Copper, Diss	Iron	Iron, Diss	Lead	Lead, Diss
WS-8-33	5237-011009-107	9-Oct-01	23-33	ND> 0.003	-	**0.0063**	-	0.184	-	ND> 0.001	-	0.0069	-	0.0041	-	**0.0264**	-	117.	-	**0.0083**	-
	5237-011213-105	13-Dec-01		ND> 0.005	-	**0.0162**	-	0.142	-	ND> 0.002	-	0.005	-	0.005	-	0.005	-	76.6	-	ND> 0.005	-
	5237-020403-105	3-Apr-02		ND> 0.005	ND> 0.005	**0.018**	**0.0148**	0.115	0.104	ND> 0.005	ND> 0.002	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.015	90.9	81.5	ND> 0.005	ND> 0.01
	5237-020403-106 (dup)	3-Apr-02		ND> 0.005	-	**0.0174**	-	0.114	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	89.6	-	ND> 0.005	-
	5237-020710-104	10-Jul-02		ND> 0.005	ND> 0.005	**0.0152**	**0.0198**	0.117	0.114	ND> 0.002	ND> 0.0222	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	80.6	80.7	ND> 0.005	ND> 0.0056
	5237-020710-105 (dup)	10-Jul-02		ND> 0.005	-	**0.0173**	-	0.116	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	80.3	-	ND> 0.005	-
WS-8-59	5237-011008-104	8-Oct-01	49-59	ND> 0.003	-	ND> 0.005	-	0.153	-	ND> 0.001	-	ND> 0.005	-	ND> 0.001	-	**0.0055**	-	49.6	-	ND> 0.005	-
	5237-011008-105 (dup)	8-Oct-01		ND> 0.003	-	ND> 0.005	-	0.142	-	ND> 0.001	-	ND> 0.005	-	ND> 0.001	-	**0.0037**	-	47.	-	ND> 0.005	-
	5237-011212-103	12-Dec-01		ND> 0.005	-	ND> 0.005	-	0.123	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	48.1	-	ND> 0.005	-
	5237-011212-104 (dup)	12-Dec-01		ND> 0.005	-	ND> 0.005	-	0.119	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	47.2	-	ND> 0.005	-
	5237-020403-104	3-Apr-02		ND> 0.005	-	ND> 0.005	-	0.0931	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	46.8	-	ND> 0.005	-
	5237-020710-103	10-Jul-02		ND> 0.005	-	ND> 0.005	-	0.1	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	45.7	-	ND> 0.005	-
WS-9-34	5237-011008-102	8-Oct-01	24-34	ND> 0.003	-	ND> 0.005	-	0.246	-	ND> 0.001	-	ND> 0.005	-	0.0281	-	**0.0074**	-	33.9	-	ND> 0.005	-
	5237-011212-101	12-Dec-01		0.0067	0.0108	**0.0607**	ND> 0.005	0.923	0.0348	ND> 0.002	ND> 0.002	0.0207	ND> 0.005	0.0437	0.0112	**0.0431**	ND> 0.005	188.	88.	**0.197**	ND> 0.005
	5237-020402-101	2-Apr-02		ND> 0.005	0.0086	**0.038**	0.007	0.607	0.0467	ND> 0.002	ND> 0.002	0.0187	ND> 0.005	0.0273	0.0132	**0.0391**	ND> 0.015	150.	37.7	**0.0948**	ND> 0.01
	5237-020710-101	10-Jul-02		ND> 0.005	ND> 0.0056	**0.0311**	ND> 0.0056	0.553	0.081	ND> 0.002	ND> 0.0022	**0.0326**	ND> 0.0056	0.0404	0.0231	**0.0359**	ND> 0.0056	146.	64.3	**0.131**	ND> 0.0056
Quality Control Samples																					
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020402-100	2-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020403-103	3-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020710-100	10-Jul-02	NA																		
Water EB	5237-011212-102	12-Dec-01	NA	ND> 0.003	-	ND> 0.005	-	ND> 0.005	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.0222	-	ND> 0.005	-
	5237-011008-103	8-Oct-01	NA	ND> 0.003	-	ND> 0.005	-	ND> 0.005	-	ND> 0.001	-	ND> 0.005	-	ND> 0.001	-	ND> 0.001	-	0.0417	-	ND> 0.005	-
	5237-020402-102	2-Apr-02	NA	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	0.0052	-	0.142	-	ND> 0.005	-
	5237-020710-102	10-Jul-02	NA	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005		ND> 0.01		ND> 0.005	
Ambient Water Quality Criteria (AWQC) for Surface Water [1]				4.3 [3]		0.00014 [2]		#		0.002 [2]		0.011 [2]		#		0.009 [2]		#		0.0025	

Note:
# = not established
bgs = below ground surface
Diss = dissolved
EB = equipment blank
EPA = U.S. Environmental Protection Agency
mg/l = milligrams/liter
ND = not detected above detection limit indicated
ppm = parts per million

1 = Reference Level indicated is the lowest guidance value provided in the Ambient Water Quality Criteria (EPA 822-Z-99-001) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health Protection)
2 = Reference Level based on Aquatic Fresh Chronic Criteria of AWQC
3 = Reference Level based on Human Fish Consumption Criteria of AWQC

Bold = Detected above lowest identified AWQC

(Data Validation and Data Quality Assessment Report, Kathy J. Gunderson, September 23, 2002)

HAHN AND ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

RECEIVED
OCT 07 2002
By

September 15, 2002

Mr. Eric Blischke
Oregon Department of Environmental Quality
Voluntary Cleanup and Site Assessment Section
2020 SW Fourth Avenue, Suite 400
Portland OR 97201-4987

HAI Project No. 5237

SUBJECT: August 2002 Progress Report for Remedial Investigation (RI) Activities, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon

Dear Mr. Blischke:

Hahn and Associates, Inc. (HAI) has prepared this Progress Report summarizing RI work activities conducted by NW Natural that have occurred relating to the Wacker Siltronic Corporation (Wacker) property (Figure 1) during the month of August 2002. RI field activities for the site are being conducted as per the approved *Final Focused Remedial Investigation (RI) Work Plan*[1] (RI Work Plan), as well as the approved *Supplemental RI Work Plan* [2]. This Progress Report has been prepared as per an Order (DEQ No. ECVC-NWR-00-27) issued jointly to both NW Natural and Wacker by the Oregon Department of Environmental Quality (ODEQ), dated October 4, 2000. As per the referenced Order, monthly progress reports are to be prepared by the 15th day of each month, with the reporting to continue for the duration of the project.

Summary of Activities in August 2002

A continuous short-term groundwater elevation monitoring event was completed at the Wacker and adjacent Gasco site during July and August in accordance with an HAI-prepared *Groundwater Elevation Monitoring Plan*, dated May 30, 2002, as conditionally approved by the ODEQ in an e-mail dated July 8, 2002 (Struck to Wyatt and Ede). This short-term groundwater elevation monitoring event involved the collection of water elevation data on a fifteen minute frequency from select monitoring points over a two week period from July 24, 2002 through August 7, 2002. Hydrographs depicting river and groundwater elevations measured during the monitoring event are attached.

---

[1] Hahn and Associates, Inc. (2001). *Final Focused Remedial Investigation Work Plan, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon.* June 1, 2001.

[2] Hahn and Associates, Inc. (2002). *Supplemental Remedial Investigation Work Plan, Wacker Siltronic Corporation,, 7200 NW Front Avenue, Portland, Oregon.* March 7, 2002.

434 NW 6th AVENUE, SUITE 203 • PORTLAND, OREGON 97209-3651
503/796-0717 OFFICE • 503/227-2209 FAX
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Anticipated / Completed Activities in September and October 2002

It is anticipated that an EPA Level III validation of all soil, surface water, and groundwater data generated by NW Natural as part of Focused RI activities at the Wacker site will be complete prior to the end of September 2002. Upon completion, the data validation report(s) will be provided to the ODEQ.

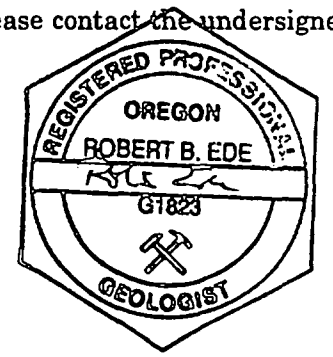
The remaining Phase I RI data collection task to be completed at the site involves an inspection and survey of the base of the drainage ditch located on BNSF property immediately west and south of the Wacker property. Initiation of this task will require receipt of access approval from BNSF, the owner of the right-of-way through which the ditch runs. A proposed access agreement has been prepared by representatives of BNSF, and is currently under review by NW Natural.

A full reporting and evaluation of the results of NW Natural's investigatory activities will be included within the Phase I Site Characterization Summary Report and the Technical Memorandum on Source Control Measures, both of which are due to the ODEQ within 90 days after completion of the Phase I RI activities.

NW Natural understands that work plans and results of Wacker's own TCE-related investigation activities will be documented by Wacker and will be submitted independently by them to the ODEQ.

Should you have any questions, please contact the undersigned.

Sincerely,



Robert Ede, R.G.
Associate

rede@hahnasoc.com

c: Mr. Bob Wyatt, NW Natural
Ms. Patty Dost, Schwabe, Williamson & Wyatt
Mr. Carl Stivers, Anchor Environmental, L.L.C.
Ms. Cathryn Young, Wacker Siltronic Corporation

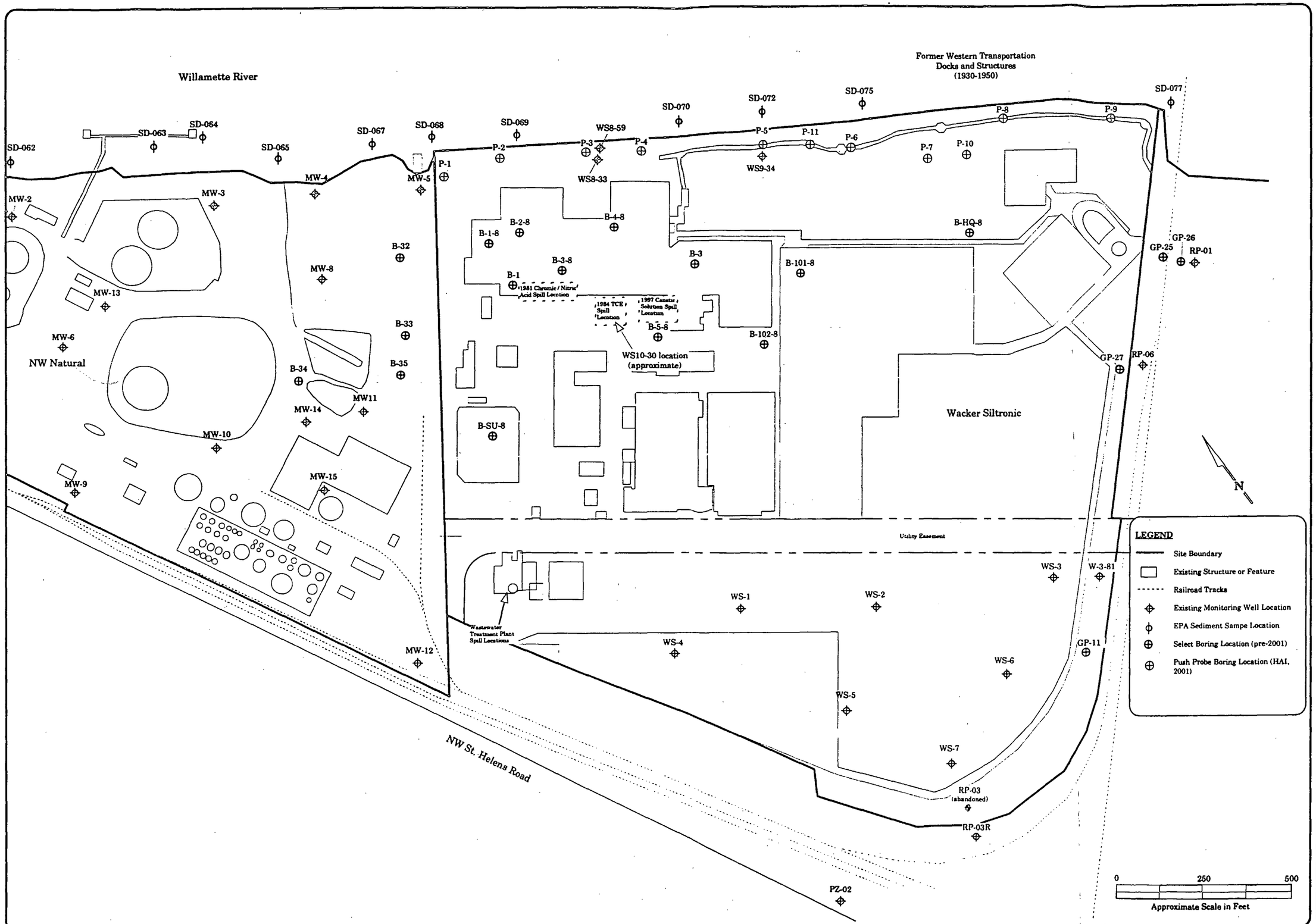


Figure 1

Monitoring Well and Push Probe Location Map

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN & ASSOCIATES, INC.
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

May 2002

Project No. 5237

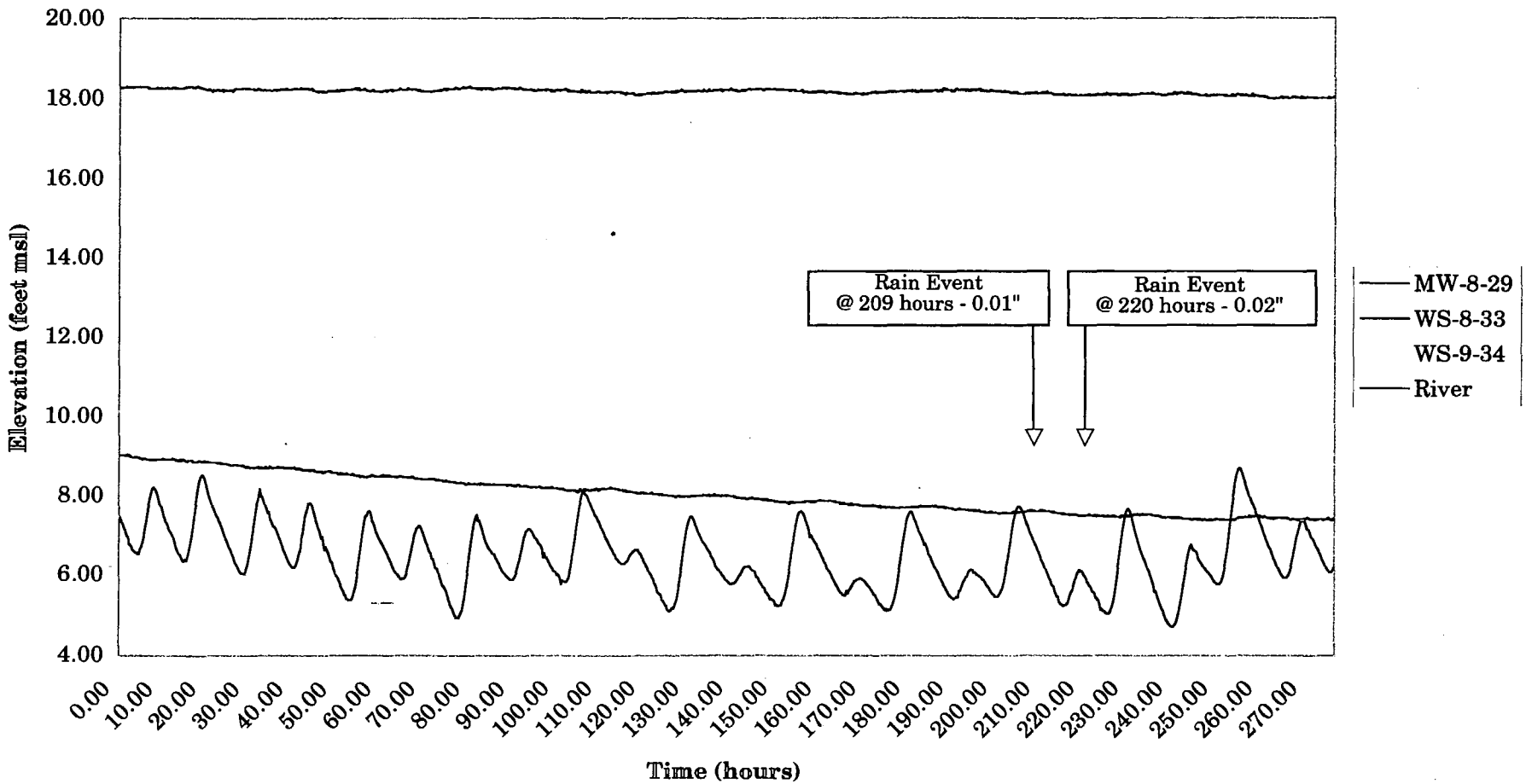
SCOEPA00012414

Hydrographs:

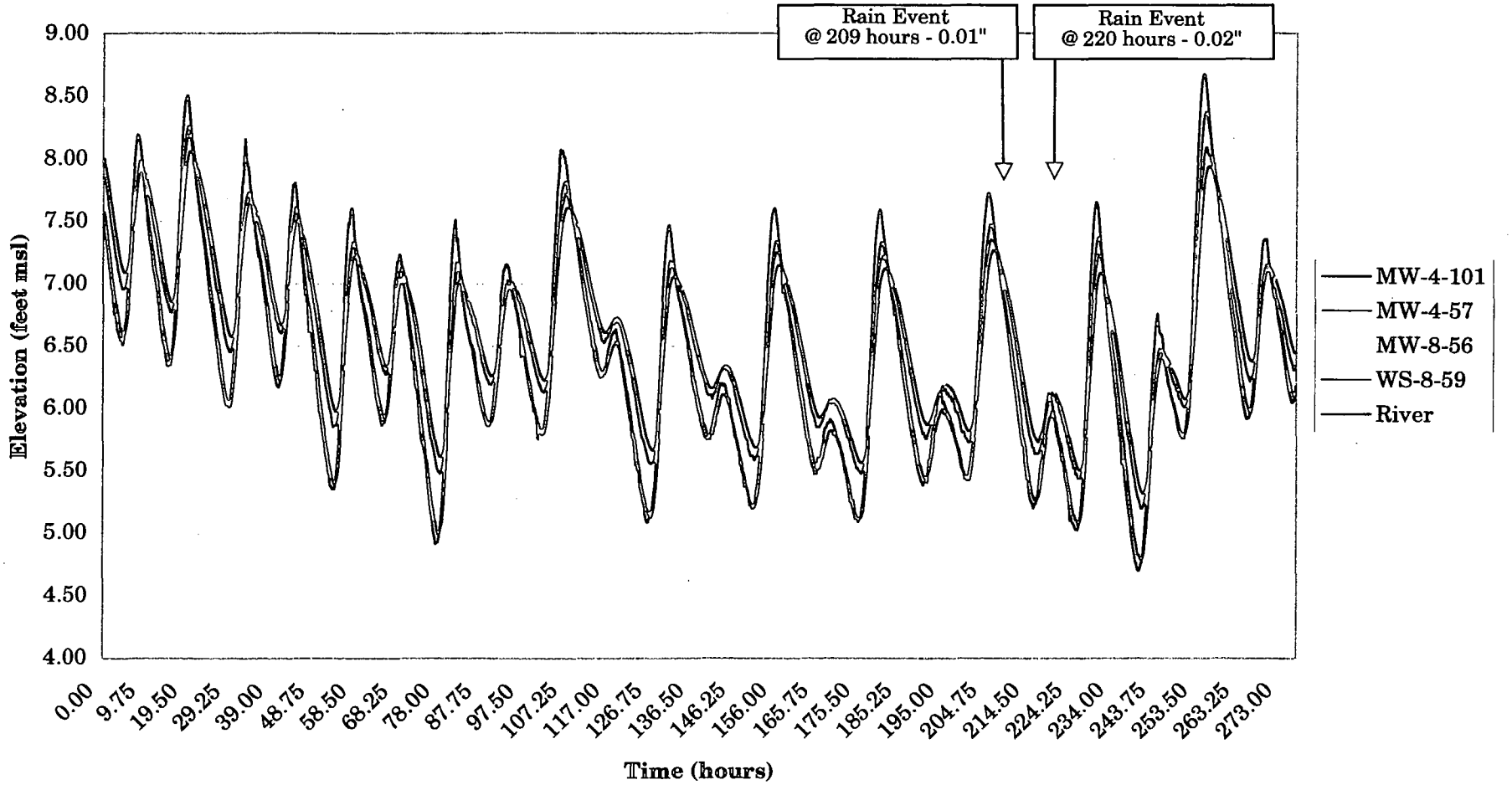
Continuous Short-Term Water Level Monitoring Test Conducted July 24, 2002 to August 7, 2002

HAHN AND ASSOCIATES, INC.

Continuous Water Level Monitoring Event
Select Surficial Fill WBZ Wells
and the Willamette River
NW Natural Gasco Facility & Wacker Siltronic Corporation Property



Continuous Water Level Monitoring Event
Select Alluvial WBZ Monitoring Wells
and the Willamette River
NW Natural Gasco Facility & Wacker Siltronic Corporation Property



Fax

8

To:	Tom McCue/Cathryn Young Dana Bayuk	From:	Eric Blischke DEQ (503) 229-5648
Fax:	(503) 219-7599 (503) 906-1958	Date:	September 26, 2002
Phone:	(503) 219-7406 (360) 694-2691	Pages:	3 (including cover page)
Re:	Revised TCE Work Plan	CC:	

☐ Urgent ☐ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

Approved with conditions

8128.01.03

RECEIVED
SEP 26 2002
By

Oregon
John A. Kitzhaber, M.D., Governor

Department of Environmental Quality
Northwest Region
2020 SW Fourth Avenue
Suite 400
Portland, OR 97201-4987
(503) 229-5263 Voice
TTY (503) 229-5471

September 25, 2002

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

Ms. Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210

Re: Work Plan for Supplemental Investigation to Further Assess Trichloroethene Detections in the Northern Corner of Wacker Siltronic Corporation Site

Dear Bob and Cathryn:

The Oregon Department of Environmental Quality has reviewed the revised Work Plan for Supplemental Investigation to Further Assess Trichloroethene Detections in the Northern Corner of Wacker Siltronic Corporation Site (Work Plan). The revised Work Plan was submitted by Maul Foster Alongi (MFA) on behalf of Wacker Siltronic Corporation and was received by DEQ on September 20, 2002. The revised Work Plan was submitted in response to DEQ's comment letter dated September 6, 2002.

As you are aware, in its May 31, 2002 letter, DEQ determined that further investigation was necessary to identify potential sources of TCE contamination and determine the vertical and lateral extent of TCE contamination at the Wacker site. The May 31, 2002 letter further stated that this work should, at a minimum, include:

- A review of company records (including records associated with facility construction) to identify potential TCE sources;
- Characterization of site stratigraphy using cone penetrometer or other techniques;
- Soil and groundwater sampling in identified source areas;
- Identification and delineation of the potential DNAPL source;
- The installation of monitoring wells in the vicinity of GP-02-02 and the 1984 TCE spill area to delineate the vertical and lateral extent of contamination in the upland portions of the site; and
- The installation of monitoring wells in the vicinity of P-2 to determine the vertical and lateral extent of TCE contamination adjacent to the Willamette River.

It is clear that the proposed work is inadequate to meet the objectives stated above. Furthermore, based on a conference call with representatives of Wacker on September 17, 2002 and MFA's September 20, 2002 letter, it is unclear whether the above objectives will be met in the near future. As a result, DEQ approves the proposed work with the following conditions:

1) All analytical data generated during the proposed investigation must be submitted within 30 days of the date of this letter.
2) A proposal for the installation of monitoring wells in the vicinity of P-2, GP-02-02 and the 1984 TCE spill area must be submitted to DEQ within 60 days of the date of this letter. The monitoring well installation proposal must include provisions for delineating the vertical extent of contamination below the 100 foot depth (where the TCE was detected) and selecting appropriate screen intervals. It is DEQ's expectation that a series of nested monitoring wells will be required to adequately define the extent of contamination.
3) The results of Wacker's research into the use of TCE at its facility and a proposal for the characterization of TCE source areas must be submitted to DEQ within 75 days of the date of this letter.

DEQ has stipulated the above time-frames due to its oft-stated concern regarding the lack of progress on further characterization of TCE contamination at the site. Under the terms of Unilateral Order No. ECVC-NWR-00-27, both Wacker and Northwest are obligated to perform the characterization necessary to evaluate sources and pathways of contamination from the Wacker site to the Willamette River. If the time-frames stated above are not met, DEQ will consider all enforcement options available under the Unilateral Order.

I may be reached at (503) 229-5648 if you wish to discuss this matter further or if you have any questions.

Sincerely,

Eric L. Blischke
Project Manager
Voluntary Cleanup and Portland Harbor Section

cc: Mike Rosen, NWR/DEQ
Kurt Burkholder, DOJ
Rod Struck, NWR/DEQ
Jennifer Peterson, NWR/DEQ

WACKER SILTRONIC

FIRST NAME NAME
JOB FUNCTION

Wacker Siltronic Corporation
7200 N.W. Front Avenue, M/S 10
Portland, OR 97210-3676, USA
Tel. 1-503-219-0000
Fax 1-503-218-0000
first name.name@wacker.com

Attn: Tom

8128.0

FAX

Date Sept. 9, 2002

To Mr. Dana Bayuk

From Tom McCue

Fax (971) 544-2140

3 Page(s) incl. coversheet

Reference
Comments and approval from DEQ on WSC work plan.

RECEIVED
SEP 09 2002
By

Uto-Ausgabe: 2002-04

Oregon
John A. Kitzhaber, M.D., Governor

Department of Environmental Quality
Northwest Region
2020 SW Fourth Avenue
Suite 400
Portland, OR 97201-4987
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TTY (503) 229-5471

September 6, 2002

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

Ms. Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210

Re: Work Plan for Supplemental Investigation to Further Assess Trichloroethene Detections in the Northern Corner of Wacker Siltronic Corporation Site

Dear Bob and Cathryn:

The Oregon Department of Environmental Quality has reviewed the Work Plan for Supplemental Investigation to Further Assess Trichloroethene Detections in the Northern Corner of Wacker Siltronic Corporation Site (Work Plan). The Work Plan was submitted by Maul Foster Alongi (MFA) on behalf of Wacker Siltronic Corporation and was received by DEQ on August 16, 2002. The Work Plan was submitted in response to DEQ's letter dated May 31, 2002.

General Comments:

Overall, DEQ supports the proposed work going forward with the modifications requested in the specific comments outlined below. However, DEQ would like to reiterate its concern that the scope of the proposed investigation somewhat limited. The proposed work does not include an evaluation of potential trichloroethene (TCE) source areas nor the installation of monitoring wells as requested in our May 31, 2002 letter. DEQ would like to make it clear that the installation of monitoring wells and characterization of TCE source areas will be required in the future based on the results of this GeoProbe investigation and the review of Wacker information regarding the historic use of TCE at the site.

Specific Comments:

Page 5. Task 2. Soil Sample Collection. Soil samples should be collected on a continuous basis to total depth for the purpose of understanding the stratigraphy at the site, developing the site hydrogeologic conceptual site model and evaluating the migration of dense non-aqueous phase liquid (DNAPL) at the site. The TCE concentrations detected in groundwater clearly indicate the potential presence of DNAPL at the site.

Page 5. Task 2. Soil Sample Collection. In the fifth paragraph, the work plan states that "After the portions of the soil core have been selected, soil samples will be removed....." The timing of these samples is unclear. Soil samples must be collected immediately after opening the soil core to prevent contaminant loss through volatilization.

Page 6. Task 2. Groundwater Sample Collection. The proposed depths of groundwater samples are unclear. The Work Plan states that up to 3 samples will be collected per boring but only two depths are proposed. Groundwater samples should be collected every 10 – 15 feet beginning at the 55 – 60' depth interval to the bottom of the borehole. In addition, a shallow groundwater sample (above the silt) should also be collected. This will provide data on the vertical water chemistry profile and aid the understanding of contaminant migration pathways, the identification of future monitoring well screen intervals and the identification of potential source areas. If possible, samples should be collected at depths greater than 100 feet in order to define the vertical extent of contamination.

Page 7. Task 2. Groundwater Sample Collection. The work plan does not indicate what field parameters will be measured. DEQ assumes at a minimum, temperature, specific conductivity, pH, and dissolved oxygen will be measured.

Page 7. Task 2. Groundwater Sample Analysis. Cyanide has been consistently detected in groundwater at concentrations exceeding AWQC. As a result, cyanide should be included in the target analyte list.

Please have a revised work plan submitted within 3 weeks of the date of this letter. I may be reached at (503) 229-5648 if you wish to discuss this matter further or if you have any questions.

Sincerely,

Eric L. Blischke
Project Manager
Voluntary Cleanup and Portland Harbor Section

cc: Mike Rosen, NWR/DEQ
Rod Struck, NWR/DEQ
Jennifer Peterson, NWR/DEQ

Project Number: 8128.01.03

File to Folder: In WORKING

provided by local maps and databases and
process will be used by the district engine
adversely affect" decision. General Cond
authorize discharges of dredged or fill ma
designated critical habitat of Federally-lis
activity complies with General Condition
determination of compliance.

Based on the safeguards discussed above,
determined that the activities authorized b
existence of any listed threatened or enda
adverse modification of designated critica
believe that these procedures ensure com
steps to provide further assurance. Corps
representatives of the FWS and NMFS to
necessary, to ensure that the Corps has th
location of any threatened or endangered
can also establish, through local procedur
ensure compliance with ESA. Through fe
Endangered Species Act, or through othe
as appropriate, the Corps will establish pr
jeopardize any threatened and endangerec
modification of designated critical habitat.

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JUL 15 2002
By

DEQ SITE ASSESSMENT PROGRAM - STRATEGY RECOMMENDATION

Site Name: Wacker Siltronic Corporation

Site CERCLIS Number: ORD096253737

DEQ ECSI Number: 183

Site Address: 7200 NW Front Avenue
Portland, OR 97210
(T1N/R1W-S13)

Recommendation By: Eric Blischke, Waste Management and Cleanup Division

Approved By: Mike Rosen, Portland Harbor Manager, DEQ Northwest Region FOR MER

Date: October 8, 1999

The Wacker Siltronic site has been the subject of a previous EPA Preliminary Assessment (October 1989), a DEQ Preliminary Assessment Equivalent (August 1991) and subsequent Site Priority Evaluation / Strategy Recommendation (May 1993), as well as DEQ subsurface soil and groundwater evaluations associated with the Doane Lake Study Area hydrogeological evaluation (ECSI #36; 1989-91). The purpose of this document is to summarize new site information that has become available since DEQ's May 1993 Site Priority Evaluation.

NOTE: This site (See Figures 1 and 2) is within a 6-mile stretch of the Lower Willamette River in which the U.S. Environmental Protection Agency (EPA) conducted a sediment study in 1997. This area, referred to as the *Portland Harbor*, is between the upstream ends of Sauvie Island (River Mile 3.5) and Swan Island (RM 9.5). The primary purpose of this Strategy Recommendation is to determine whether a specific hazardous substance release or a specific past operation at the site can be linked to contamination documented by EPA in sediments adjacent to the site. Because of this focus, the Strategy Recommendation may omit some historical site information, regulatory issues, or further-action conclusions that might otherwise be included in a DEQ Strategy Recommendation.

Background, Portland Harbor Sediment Evaluation

In September and October 1997, EPA's contractor, Roy F. Weston, Inc., collected 187 near-shore sediment samples within the Portland Harbor area defined above. Most samples (150) were collected as shallow grab samples within the upper 6 to 17 centimeters (cm) of sediments. 37 deeper composite core samples, from depths of between 55 and 139 cm, were also collected. All samples were analyzed for total metals, semi-volatile organic compounds (SVOCs), total organic carbon (TOC),

SCOEPA00012427

and sediment grain size. Selected samples were also variously analyzed for organotins (TBTs), pesticides, polychlorinated biphenyls (PCBs), chlorinated herbicides, and polychlorinated dioxins and dibenzofurans.

Based on analytical results from this study, which showed extensive sediment contamination, EPA is currently considering Portland Harbor for inclusion on the federal National Priority List (NPL - also known as Superfund).

Between late 1998 and mid-1999, DEQ examined EPA's analytical data to determine potential sources for sediment contamination in the Harbor. Potential sources associated with the most contaminated areas of sediment were sites already active in DEQ's Cleanup Programs.

DEQ categorized other areas of sediment contamination (i.e., those areas not thought to be associated with active Cleanup Program sites) by defining the areas:

- having the highest detected concentration of a given contaminant;
- with contaminant concentrations in the upper five percent of a given contaminant's detected concentrations; and
- having contaminant concentrations above an apparent "baseline range" most commonly detected throughout the harbor area.

DEQ categorized in this manner because there are no established freshwater sediment contaminant concentration guidelines or well-defined background contaminant concentrations for the harbor area. The contaminant "baseline range" was developed by examining the geometric distribution of concentrations for each contaminant detected. Any sediment concentrations that appeared to depart significantly from the ranges most commonly detected were suspected of lying near a potential contaminant source.

Six shallow and one deep sediment sample were collected adjacent to the Wacker Siltronics site as shown in Table 1 and on Figure 3. Sediment samples were found to contain concentrations of low- and high-molecular weight polycyclic aromatic hydrocarbons (LPAHs and HPAHs respectively) up to 100 times baseline concentrations established for Portland Harbor. In addition, PAH related compounds 2-methylnaphthalene, carbozole and dibenzofuran were also detected at concentrations more than 10 times baseline concentrations. Other organic contaminants detected above baseline include 2,4-D, 2,4-DB, pentachlorophenol and bis(2-ethylhexyl) phthalate.

Inorganic chemicals which exceed baseline include beryllium, cobalt, iron, manganese, selenium, silver, titanium, vanadium and zinc. However, the majority of these detections exceeded baseline by less than 20%.

SCOEPA00012428

Concentrations detected in the deep sediment sample (SD-072A) were generally higher than concentrations detected in the corresponding shallow sediment samples (SD-072). This indicates the contamination may be the result of historical releases of hazardous substances.

Operational History

Wacker Siltronic Corporation (Wacker) operates a silicon wafer fabricating plant on an 85 acre site along the southern bank of the Willamette River in Northwest Portland (see Figures 1 and 2). Silicon wafers are the substrate on which the electronics industry builds more than 90 percent of its integrated circuits (semiconductors).

The site is bounded on the northeast by the Willamette River, on the northwest by a liquefied natural gas (LNG) storage facility owned by Northwest Natural (NWN) (ECSI #84), and on the southeast and southwest by Burlington Northern / Santa Fe Railroad (BNSF) right-of-ways. Doane Creek passes between the Wacker and NWN properties. Koppers Industries, Inc., operates a creosote and tar pitch distribution terminal on property leased from NWN at the western corner of the Wacker site. US Highway 30 (NW St. Helens Road), a former rock quarry, and the Tualatin Mountains lie beyond the BNSF right-of-way to the southwest. Beyond the southeastern BNSF right-of-way lie the Rhone-Poulenc (ECSI #155), ESCO Corp. (ECSI #397), Gould / NL Industries (ECSI #49), and Elf Atochem North America (ECSI #398) environmental cleanup sites[1].

The Wacker property was originally owned by NWN who operated an oil gasification facility (the former GASCO facility) on the property. The Wacker parcel was sold by NWN in 1962 to V. Rosenfeld and H. Anderson. In 1978, this parcel was purchased by the Portland Development Commission (PDC) who in turn sold it to Wacker in August of the same year. Wacker began construction of their silicon wafer manufacturing plant in October, 1978. The plant was completed in December 1979 and operation began in March 1980.

Based on a review of aerial photographs and other historical information, it appears that wastewater settling ponds constructed as part of the former GASCO facility extended onto the northern portion of the Wacker property. These settling ponds were periodically excavated and the dredged tars disposed of in low lying areas on the Wacker property. However, the exact location and nature of these disposal areas is unknown.

Western Transportation operated a fueling dock at the northeast corner of the Wacker Facility which had two large above ground fuel

[1] Both the GASCO and Gould / NL Industries sites are currently listed on CERCLIS. The GASCO, Elf Atochem and Rhone-Poulenc sites are currently undergoing Remedial Investigations; the Gould / NL Industries site is currently in the Remedial Action phase of cleanup. The Gould site has been listed on EPA's National Priority List (NPL).

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tanks. EPA analysis of a 1970 air photo concluded that soils in this area were stained.

A pipeline that appears to have led from the southeast corner of the former GASCO operation (location of a tank farm that stored BTEX, naphthalene, tar and naphtha) to the Western Transportation facility was decommissioned when Wacker bought the site. Decommissioning consisted of capping the pipeline at both ends. A PDC diagram of the pipeline suggests that the pipeline terminated on the southwestern edge of the Wacker site. Apparent soil disturbances observed in a 1957 aerial photo suggest that the pipeline was constructed around the southwestern end of GASCO's wastewater lagoon and continued toward the GASCO tank farm.

The nature of any potential releases from the pipeline is unclear. Petroleum sheens have been released in the river in the Western Transportation boat dock area on two occasions during river dredging operations.

A utility corridor running across the site (See Figure 4) holds two Olympic petroleum pipelines and a sanitary sewer line. There are also indications that a Pacific Northern pipeline passes through the corridor, but this may be a reference to the Olympic pipelines.

One or both of the Olympic pipelines appear to have leaked on at least two occasions. On the first occasion, holes in one of the lines was repaired, but there is no record or documentation of the soil cleanup. On the second occasion, two sets of pipeline pressure tests (several months apart) appear to have indicated a pipeline leak. Bypasses were installed on both pipelines and old pipeline sections appear to have been capped in place. There is no documentation of whether a soil cleanup was performed.

Subsurface petroleum/tar was also encountered during construction of the Wacker wastewater treatment plant (shallow, free-flowing product), prior to the construction of Wacker's FAB 2 facility, and during soil borings and monitoring well construction at the southeastern end of the site.

A historic Chapmen Chemical release of herbicides killed extensive vegetation on the Wacker site in the 1960's. Contamination likely flowed from Doane Lake to North Doane Lake to a stream that flowed to Doane Creek and finally to the Willamette River.

Regulatory History

DEQ Cleanup Programs:

Over the past twenty years, a number of incidents involving the release of hazardous substances have occurred at the Wacker site. A summary is presented below.

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February/March 1979: In February 1979, DEQ personnel were called to the Wacker Siltronic facility during its construction to determine the origin of a petroleum release found on the property. An initial sample collected on March 1, 1979 from an undefined clarifier was found to contain 40 hydrocarbon components in the C_{10} to C_{22} range with a peak maximum at C_{15}. A sample of diesel fuel obtained from the Olympic Pipeline Company was also analyzed and found to match the sample collected from the clarifier. Another sample collected from an exploratory pit above the pipeline on March 12, 1979 was found to contain hydrocarbons in the C_8 to C_{19} range with a peak maximum at C_{12}. The DEQ laboratory concluded that this sample did not match the sample obtained from the Olympic Pipeline Company (Olympic). Although the above results were inconclusive, Olympic apparently determined that the pipeline had leaked and made the appropriate repairs.

December 1980: On December 16, 1980, a green color was noted in the wastewater treatment plant's concentrated acid system. A total of 5.5 pounds of chromium was taken to the Arlington hazardous waste landfill for disposal. It was estimated that approximately 1.3 pounds. of chromium discharged to river the following day.

December 1984: Spills at the Wacker facility's trichloroethene (TCE) stripper unit were reported on December 3, 1984 (360 gallons) and again on December 31, 1984 (900 gallons). Contaminated soils were excavated and sent to Arlington for disposal. A concrete containment dike and monitoring well were subsequently installed.

June 1987: On June 25, 1987, a wastewater line containing very weak detergents plugged and water overflowed onto a gravel yard and the main roadway, stormwater catch basin, then to a river outfall.

October 1990: On October 17, 1990 Wacker notified the Olympic Pipeline and National Response Center of a possible leak associated with the Olympic pipeline (EMD # 90-1462). Following the completion of a soil gas and groundwater investigation and pipeline pressure test, approximately 2000 feet of the pipeline was replaced. A summary of the investigation is presented in the Investigative History section of this strategy recommendation.

September 1991: On September 11, 1991 (OERS #91-062) a leak from a weak acid storage tank was reported. The cause of the leak was a sheared valve. Approximately 4,000 gallons of the weak acid was released to the ground; approximately 1000 gallons was subsequently recovered.

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April 1997: A release of caustic rinse water from a ion-exchange regeneration unit due to a severed wastewater pipeline was reported on 4/28/1997.

July 1998: An oil sheen was observed in the river along the Wacker site on July 29, 1998 (OERS #98-1792). The sheen was approximately 20-50 yards long and originated from subsurface sediments. The release occurred during riverbank repair conducted by Advanced American Diving. Silt was being dredged from sediments to be used as backfill in riprap. The contaminated sediments were placed on the bank before being transferred to 8 lined 20-yard drop boxes. Further offshore dredging discontinued and another backfill source was obtained off-site. A reported 75.72 tons of contaminated material was sent to Arlington for disposal. The primary contaminant detected was petroleum. Total petroleum hydrocarbon analysis was performed on eight samples and the following concentration ranges were reported: gasoline: 7.49-69 ppm; diesel: 399-5810 ppm, heavy oil: 293-2970 ppm.

Pollution Complaints:

The following pollution complaints were received by DEQ:

- On April 2, 1981, the storage of empty chemical barrels stored in an area that drains to the Willamette River. Subsequent inspection by DEQ determined that this situation did not represent an environmental threat.

- On February 25, 1981, the Arlington hazardous waste landfill reported the disposal of 6000 gallons of chromic and nitric acids (about 20 ppm each) from a spill (tank overflow). Chromic acid had entered a floor drain and sump at the Wacker facility.

Permits:

Wacker Siltronics currently holds the following permits:

- Air Contaminant Discharge Permit (ACDP Permit No. 26-3002) issued by DEQ.
- National Pollutant Discharge Elimination System Waste Water Discharge Permit (NPDES Permit No. 101128) issued by DEQ.
- Storm Water Discharge Permit (NPDES No. 1200-Z) issued by DEQ.
- Municipal Pretreatment Program Waste Water Discharge Permit (No. 469-001) issued by the City of Portland.

On January 11, 1988, PCP was detected in one of Wacker's wastewater permit monitoring samples at 0.2 mg/l. The source of this detection is unknown; however, it should be noted that PCP was also detected in Koppers wastewater stream, which discharges near the same location.

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Investigative History

In August, 1977, three soil test borings and penetrometer probes were installed on the Wacker parcel. The sampling was conducted by CH2M Hill and submitted in a September 1977 Geotechnical and Vibration Monitoring Investigation report to Wacker prior to their purchase of the property. Each boring log had multiple references to bitumen, a generic term applied to natural inflammable substances of variable color, hardness, and volatility composed principally of a mixture of hydrocarbons.

In April 1985, CH2M Hill conducted a soil investigation at the Wacker facility. Sample locations are presented in Figure 4. Wacker was concerned that contamination on their property would prevent or hinder the planned expansion of their facility. Seven soil borings were installed in the vicinity of a proposed polysilicon plant in western portion of the Wacker property. The borings were installed to depths ranging from 31.5 to 41.5 feet and were completed as monitoring wells. Soil samples were analyzed for oil and grease, phenols, volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs) and pesticides, herbicides and metals according to the extraction procedure - toxicity (EP-Tox) methodology.

Analysis of the soil boring samples detected the presence of chlorinated and aromatic volatiles, various phenolic compounds including pentachlorophenol and elevated concentrations of PAHs. EP-Tox analysis detected low concentrations of barium (below the regulatory threshold) and levels of 2,4-dichlorophenoxy acetic acid (2,4-D) above the regulatory threshold. Oil and grease levels ranged from 0.03% to 0.34%. Soil data are presented in Table 2.

Groundwater samples were collected from the newly installed monitoring wells in July and August 1985 as part of the investigation. Analysis detected the presence of aromatic VOCs (benzene, ethylbenzene and xylene); acetone and methylene chloride (which may represent laboratory contaminants); PAHs; cyanide and low levels of metals. United States Environmental Protection Agency (EPA) Drinking Water Maximum Contaminant Level (MCLs) were exceeded for many of the carcinogenic PAHs, benzene, lead and cyanide. Groundwater data are presented in Table 3.

In 1990, Geraghty and Miller conducted a Hydrogeological Investigation of the Doane Lake Area in northwest Portland. The primary purpose of the study was to evaluate the hydrogeologic conditions in the vicinity of the Gould Superfund site, calculate the zone of influence of potential Gould remedies and assess the impact that groundwater quality in the Doane Lake area could have on potential Gould site remedies.

As part of the investigation, two monitoring wells on the Wacker property were sampled. These included the existing MW-7 installed by CH2M Hill in 1985 and a newly installed intermediate depth well (MW-3I) installed adjacent to the existing MW-3. MW-3I was screened from

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55 to 60 feet while the existing MW-3 was screened from 12 to 27 feet. Low levels of phenol (0.003 mg/l) and PAHs (0.215 mg/l total PAHs) were detected in MW-3I while even lower levels of contamination (.016 mg/l total PAHs) were detected in MW-7 (See Table 3).

In July, 1990, two soil samples were collected from geotechnical borings installed as part of a proposed expansion by Wacker. The soil samples were found to be saturated with a black oily viscous substance. Elevated levels of BTEX, styrene, chlorobenzene and PAHs were detected. Total PAH concentrations detected in the two samples were 10,000 mg/kg and 6,100 mg/kg respectively.

In October 1990, CH2M Hill conducted a soil gas and groundwater investigation for Wacker to determine whether the Olympic pipeline was the source of subsurface hydrocarbon contamination previously detected on-site. This investigation was conducted in conjunction with Wacker's proposed expansion plans. Groundwater and soil gas samples were collected along a 600 foot length of the utility corridor adjacent to the proposed FAB 2 building site. However, the investigation concentrated on the collection of groundwater samples with the soil gas probes. Groundwater samples were collected just below the water table at a depth of approximately 25 feet. All samples were field analyzed for BTEX and TPH. A limited number of samples were sent to a laboratory for confirmatory analysis.

The results of the investigation detected elevated levels of BTEX and TPH in groundwater. Benzene concentrations ranged from non-detect to 23.3 mg/l. TPH concentrations ranged from 0.012 to 89.1 mg/l (see Table 4 for a summary of the analytical results). The highest concentrations of TPH and benzene were detected at a point south of and immediately adjacent to the pipeline utility corridor. Benzene and TPH concentrations correlated with one another. CH2M Hill concluded that the concentrations of benzene detected in groundwater samples are typical of those associated with a gasoline spill or leak. They further concluded that the location of the highest detected concentrations may indicate the source of the BTEX contamination. In addition to the BTEX contamination, the soil borings installed by CH2M Hill detected the presence of a black viscous substance thought to be associated with coal tar wastes. The visual observations of oil also correlated with the maximum BTEX and TPH concentrations. As a result, CH2M Hill was not able to ascertain the source of the BTEX contamination.

Based on the results of this investigation, Olympic pipeline excavated and pressure tested the pipeline to 250 psi. No obvious signs of contamination were observed and the pressure test was inconclusive. An additional pressure test was conducted by Marmac in February 1991. The test resulted in a failure of the pipeline. It is unclear whether the test caused the failure of the pipeline or whether a leak was present in the pipeline prior to the test. As a result of the leak, Olympic replaced approximately 2000 feet of the pipeline in March, 1991. In a June 1991 letter, Wacker contended that both lines were replaced.

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In 1995, petroleum contaminated soil was encountered during excavation activities associated with the construction of FAB 2 at the Wacker facility. 5490 tons of contaminated soil was thermally treated with a mobile soil remediation unit. Soils were treated under a solid waste letter of authorization issued by DEQ on April 17, 1995. Treated soils were disposed of at the St. Johns Landfill in Portland, Oregon. Due to the lack of adequate confirmation sampling results, it is unclear how much contaminated material was left in place at the conclusion of cleanup activities.

Since 1994, a remedial investigation has been underway at the adjacent GASCO site. A soil boring (B-33) installed adjacent to the Wacker/GASCO property line detected tar contamination to a depth of 67 feet below ground surface (bgs). In addition, groundwater collected from a monitoring well (MW-5-100) installed along the Willamette River adjacent to the GASCO/Wacker property line has been found to contain up to 11,400 ug/l of benzene and 7,400 ug/l of naphthalene.

Site Hydrogeology

The site lies in the northern-most Portland Basin, a major north-southeast trending sediment filled structural depression found in the northern part of the Willamette River valley and adjoining Columbia River valley (Swanson et al, 1993). The basin is filled with recent alluvium, Pleistocene cataclysmic flood deposits, Miocene to Holocene nonmarine sedimentary rocks, and is underlain by Eocene to Miocene volcanic and sedimentary rocks that are exposed along the basin margins.

The youngest deposits are recent alluvium (silt, sand and gravel mixtures) characteristic of an active fluvial environment. These are made up of shoreline, river channel, and adjacent floodplain deposits.

The Wacker Facility lies between U.S. Highway 30 (St. Helens Road) and the Willamette River, at the base of the Portland Hills. The facility was constructed on varying thicknesses of fill comprised of fine to medium sands and silts overlying alluvial floodplain deposits. Aquifers in the fill and floodplain deposits generally are unconfined and localized due to heterogeneity of the deposits. Occurring at various depths in the site vicinity, Columbia River Basalts (CRB) underlie these alluvial deposits. Deep wells installed in fractured CRB can be very productive and important supply wells. Site elevation is about 30 feet above mean sea level.

Pushprobe soil borings advanced along the river on the southeastern portion of the site during an October 1995 subsurface investigation found a surface cover of 4 to 6 inches of 1-inch minus crushed rock, with 4.5 to 7.5 feet of underlying fill comprised of fine to medium sand and sandy gravel. Soils beneath the fill consist of a somewhat

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tighter formation of interlayered silty fine and medium sands and clayey silts extending to depths of at least 36 feet.

In the southern portion of the site, groundwater has been encountered at depths of 14 to 25 feet bgs. In the area of the site's monitoring well network, groundwater flow appears to generally be toward North Doane Lake. However, since the site's monitoring well network covers only a portion of the site, information regarding overall groundwater flow is not available. Local topography suggests that site groundwater should generally flow to the northeast, toward the Willamette River.

Surface Drainage Routes

Site runoff is currently directed to the facility's oil/water separator system, which discharges to the Willamette River. Surface runoff at the southwestern edge of the site is directed along the Burlington Northern Railroad right-of-way via a stormwater catch basin, and discharges to the river about 1/2 mile to the southeast.

Air photos indicate that Doane Creek, which originates in the Portland Hills (Tualatin Mountains), historically passed beneath St. Helens Road near the northern corner of the Wacker facility, and reached the Willamette River by flowing along a route that approximates the current Wacker Siltronic / NWN property line. Beginning in the 1940's GASCO constructed a series of effluent settling lagoons in a low-lying area that extended onto the northwestern portion of the current Wacker Siltronic facility. Overflow from the various wastewater lagoons was directed to Doane Creek. In constructing the largest of these lagoons, a 7.5 acre lagoon, GASCO re-routed Doane Creek along the southwestern and southeastern edges of the lagoon. The creek reached the river along a route that passed beneath the location of Wacker Siltronic's current Process Building.

When developers began filling the Wacker site with rock and dredged river sediments in about 1969, Doane Creek was rerouted along a railroad right-of-way on the southwestern edge of the Wacker site. A catch basin near the southern corner of the Wacker property directed the surface water flow to an 84 inch diameter, concrete, underground storm sewer that passes along the southeastern Wacker property line and discharges to the Willamette River near the base of a Burlington Northern / Santa Fe Railroad bridge over the river (City of Portland Stormwater Outfall No. 22C).

During filling and development of the Wacker property, a drainage ditch, approximating the historic route of Doane Creek, and emptying to the Willamette River, was also constructed along the full length of the NWN/Wacker property line.

In 1986, NWN proposed installing an underground, perforated ceramic drain pipe along the southwestern edge of the Koppers tank farm to relieve water pressure on the containment structure wall, and

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eliminate groundwater infiltration into the tank farm. The drain line would have discharged through the city stormwater outfall at the northeast corner of Wacker. It's not known if the drain was ever installed, but deeper groundwater in this area of the Koppers site is contaminated, and historic Koppers materials loading/unloading spills in this area suggest a potential source for sediment contamination at the northeast end of the Wacker site.

Pathway Summary

The Wacker Facility lies just north of the Burlington Northern/Santa Fe Railroad Bridge in an area of mixed industrial, commercial, and residential use. Approximately 19 single family residences lie within 1/4 mile of the facility. The nearest residences lie southwest of the Wacker Facility across U.S. Highway 30.

The facility is fully fenced along its three upland sides, and is manned 24-hours a day so public access is limited. However, site workers could be exposed to contaminants present in surface soil. In addition, the presence of the Olympic Pipeline across the site indicates that utility trench workers could potentially be exposed to subsurface contaminants through direct contact, inhalation, or incidental ingestion.

Oregon Water Resources Department has a well log for at least one domestic water supply well within 1.0 mile of the Wacker facility. The well is located at much higher elevation to the northwest, along Old Germantown Road. The well is approximately 530 feet deep and is screened within broken basalt.

The nearest significant wetland is located along the west bank of the Willamette River, near the mouth of Multnomah Channel, about three miles downstream from the Wacker facility. North Doane Lake is located just south of the Wacker facility across the BNRR/SF railroad tracks. Because groundwater in the southern portion of the facility flows towards North Doane Lake, site contaminants have the potential to impact North Doane Lake.

Forest Park, a relatively undeveloped municipal park, lies to the northwest, west, and southwest, across U.S. Highway 30. Cathedral Park is located north of the Wacker facility on the east bank of the Willamette River.

Both recreational and subsistence fishing occur within the Lower Willamette River. Commercial fishing within the Portland Harbor is limited to a small Pacific lamprey fishery. Recreational boating, water skiing, swimming, and beach use also occur within the Harbor.

The Lower Willamette River provides habitat for 39 fish species, including populations of wild cutthroat trout, rainbow trout, and mountain whitefish. White sturgeon are plentiful within the Harbor. The Harbor is also an important migratory corridor, nursery habitat,

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and adult foraging area for two runs of chinook salmon, two runs of steelhead trout, and individual runs of coho and sockeye salmon.

Upper Willamette River populations of chinook and steelhead, which migrate through the Harbor, are listed as threatened species under the Federal Endangered Species Act. The Pacific lamprey is considered a federal species of concern.

Great blue herons, cormorants, osprey, mergansers, kingfishers, peregrine falcons, and bald eagles routinely forage within the Harbor. The area is also part of the wintering range for the Aleutian Canada goose. All are protected under the Migratory Bird Treaty Act. The peregrine falcon is federally listed as an endangered species, while the Aleutian Canada goose is federally listed as threatened species. The bald eagle also is a threatened species, but was recently proposed to be removed from this list.

There is little data on the nature and extent of the benthic community within Portland Harbor sediments. However, it is known that contamination in the benthos, which is a protected beneficial use, can be the source of food-chain effects that radiate up to the species listed above, including humans.

The Lower Willamette River is water quality limited for the following toxic compounds:

- Dioxins/furans (water column and sediments);
- Mercury (fish tissue);
- Pesticides (water column and sediments);
- Polynuclear Aromatic Hydrocarbons - PAHs - (water column and sediments); and
- Trace metals (water column and sediments).

A Total Maximum Daily Load requirements (TMDL) was established for 2,3,7,8-TCDD in 1991. The DEQ Water Quality Division is developing TMDLs for these other contaminants.

<u>Conclusions/Recommendations</u>

Contamination of river sediments adjacent to the Wacker site may represent a significant threat to human health and aquatic life within the river. The specific nature and significance of these threats cannot be determined without further characterization and delineation of contamination in groundwater, subsurface soil, and sediments. This conclusion is based on the following findings:

- Historical operations associated with oil gasification processes at the former GASCO site have resulted in petroleum related contamination at the Wacker site. This is evidenced by a review of aerial photographs, the presence of elevated levels of contamination adjacent to the Wacker/GASCO property line and the presence of petroleum contaminated soils encountered and treated

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during excavation activities associated with the construction of FAB 2. PAH concentrations detected in Willamette River sediments adjacent to the Wacker site exceed baseline concentrations by up to two orders of magnitude. Consequently, it appears that the Wacker site has contributed to the observed sediment contamination adjacent to the site. Although downstream concentrations of PAHs were more than twice the PAH concentration detected adjacent to the Wacker site, downstream contamination may be attributed to the known presence of tars at the former GASCO site.

- In addition to historical operations at the former GASCO facility, sediment contamination may also be attributed to pipeline leaks, AST leaks, spills or waste disposal activities associated with the former Western Transportation facility.

- Concentrations of 2,4-D and 2,4-DB were detected adjacent to the Wacker site at levels exceeding baseline concentrations. However, upstream levels of these contaminants exceed the levels detected adjacent to the Wacker site. In addition, concentrations of 2,4-D and 2,4-DB were highest at the upstream end of the Wacker site. Due to the presence of the former pesticide and herbicide manufacturer, Rhone-Poulenc upstream of the Wacker site, it does not appear that the presence of 2,4-D, and 2,4-DB in Willamette River sediments is related to the Wacker site.

- Wacker uses mercury and chromium in its processes. The site is known to have had chromium spills and discharges large volumes of wastewater known to have contained chromium. Sediment mercury concentrations exceed harbor baseline values approximately 250 feet downstream from the Wacker facility. In addition, chromium concentrations steadily increase along the full length of the Wacker site although chromium concentrations do not exceed baseline concentrations. Wacker also uses antimony in its process, however, sediments along the Wacker site were not analyzed for antimony.

- Wacker currently uses dioctylphthalate as a plasticizer. High concentrations of ethylhexylphthalate (approximately twice baseline concentrations) was observed along the Wacker site. It is unclear whether Wacker ever used this compound, However ethylhexylphthalate was detected in surface waters flowing into the city stormwater inlet that discharges adjacent to the Wacker site and has been detected in groundwater at the Wacker site.

Due the presence of contamination in both uplands and sediments and the high potential for significant groundwater contamination, DEQ has determined that a remedial investigation and feasibility study (RI/FS) is required for the Wacker Siltronics facility. The RI/FS should address potential risks to human health and the environment. The RI/FS should focus on upland as well as sediment issues and be completed in conjunction with harbor-wide investigative activities to

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be completed within the Portland Harbor Study Area. DEQ has determined that these actions warrant a high priority for follow-up.

References:

This following general references were consulted in preparing this Strategy Recommendation:

1. Preliminary Assessment Report, Wacker Siltronic Corporation, Portland, Oregon, prepared for USEPA by Ecology and Environment, Inc., October 1987.

2. DEQ Site Assessment Strategy Recommendation, Wacker Siltronic Corp., ECSI #183, May 15, 1993.

3. Wacker Siltronic Corporation, NL Gould Superfund Site; Doane Lake Study, Liability for Remedial Action Costs Under Oregon Lay, January 31, 1989 (Revised), by Marvin B. During, A Professional Services Corporation. (ECSI File #36, Doane Lake).

4. Region X Photo Analysis of Doane Lake Hazardous Waste Burial Site, Portland, Oregon, June 1980, EMSL-LV Project AMD 8031, Advanced Monitoring Systems Division, Environmental Monitoring Systems Division, Environmental Monitoring Systems Laboratory, Office of Research and Development, USEPA, Las Vegas, NV. (ECSI File #36, Doane Lake).

5. Site History, Wacker Siltronic Corporation, Portland, Oregon, by the Portland Development Commission, March 1985.

6. Hydrogeological Investigation of the Doane Lake Area, Portland, Oregon, prepared by Geraghty & Miller, Inc., or The Industrial Group, Doane Lake Area, February 22, 1991 (Doane Lake Area File, ECSI #36).

7. A Preliminary Report, Soil Investigation for Proposed Polysilicon Plant, Wacker Siltronic Corporation, for Wacker Siltronic Corp., by CH2M Hill Northwest, June 1985.

8. PRP 104(3) Response Final Report, Doane Lake Area, Portland, Oregon, prepared by Tetra Tech, Inc. for USEPA, July 1988.

9. Memorandum of Understanding, by the City of Portland, the Portland Redevelopment Corporation, and Wacker Chemical Corporation, April 1978.

10. First Amendment to Disposition and Development Agreement, between the City of Portland and Wacker Chemical Corporation, July 1978.

11. DEQ Air Contaminant Discharge Permit Files (Permit #26-3002) for Wacker Siltronics.

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12. Portland Harbor Sediment Investigation Report, Multnomah County, Oregon, prepared for US Environmental Protection Agency, by Roy F. Weston, Inc., May 1998.

Attachments:

Table 1: Willamette River Sediment Results

Table 2: Soil Data

Table 3: Groundwater Data (Monitoring Wells)

Table 4: Groundwater Data (October 1990 Investigation)

Figure 1: Site Location Map

Figure 2: Site Layout Map

Figure 3: Sediment Sample Locations

Figure 4: Sample Location Map

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Table 1

Contaminant	Units	Down-Stream SD065 0-17 cm	Down-Stream SD067 0-12 cm	Wacker Siltronic SD068 0-17 cm	SD069 0-15 cm	SD070 0-13 cm	SD072 0-14 cm	SD072A 0-84 cm	SD075 0-15 cm	SD077 0-10 cm	Up-Stream SD078 0-17 cm	Up-Stream SD080 0-13 cm	Apparent Portland Harbor Sediment Baseline Maximum Value
Aluminum	ppm	39000	40400	37500	38300	35000	30900	35700	31700	30600	25500	40000	42800
Antimony	ppm	NA	NA	NA	NA	NA	NA	<8	NA	NA	NA	<5	<5
Arsenic	ppm	<5	<5	<5	<9	<8	<9	<8	<9	<10	<8	<5	<5
Barium	ppm	179	190	168	179	167	150	189	180	153	149	175	195
Beryllium	ppm	0.7	0.7	0.65	0.7	0.7	0.6	0.6	**0.9**	0.7	0.5	0.7	0.7
Cadmium	ppm	0.4	0.4	0.5	0.5	0.4	0.4	0.6	0.6	0.4	<0.3	0.4	0.6
Chromium	ppm	36.5	38.9	37	34.4	29.7	27.4	30.2	26.7	22.6	24.9	37.1	41
Cobalt	ppm	19	17.8	18.2	**21.3**	**20.3**	18.4	**24.6**	**23.9**	**21.3**	15.4	18.3	19.7
Copper	ppm	40.5	48.7	46.2	39.3	34.1	31.7	36.9	32.4	29.4	25.4	42.6	60
Iron	ppm	43100	43800	44100	**54200**	**53000**	**51900**	**53900**	**64500**	**58600**	41400	44200	45000
Lead	ppm	16	27	25	24	19	17	25	24	27	25	14	30
Manganese	ppm	699	624	681	725	638	591	**863**	**909**	605	487	693	810
Mercury	ppm	0.06	0.24	0.08	0.06	0.05	0.05	0.09	0.05	0.03	0.10	0.06	0.1
Nickel	ppm	30	32	30	27	25	22	25	22	21	25	30	32
Selenium	ppm	11	**17**	12	**17**	**17**	**16**	14	**17**	14	11	14	15
Silver	ppm	1.0	1.2	1.2	**1.5**	1.4	1.3	1.3	**1.7**	**1.6**	1.0	1.2	1.4
Thallium	ppm	<5	<5	5	<9	<8	<9	<8	<9	<10	<8	<5	13
Titanium	ppm	NA	NA	NA	NA	**2840**	**2740**	**2850**	NA	**3200**	NA	NA	2075
Vanadium	ppm	107	**113**	110	**136**	**132**	**125**	**136**	**152**	**147**	89.1	106	112
Zinc	ppm	104	**150**	**134**	**144**	117	113	**145**	**120**	**124**	100	**131**	118
2-Methylnaphthalene	ppb	**11000**	**7600**	**2700**	**210**	**530**	130	**980**	**180**	**430**	24	<19	150
4-Methylphenol	ppb	300	250	160	64	73	250	<110	97	68	48	500	680
Benzoic Acid	ppb	<960	<2000	<200	<200	<190	<200	<1100	<190	<190	<190	<190	<200
Benzyl Alcohol	ppb	<96	<200	<20	<20	<20	<20	<110	<19	<19	<19	<19	<20
bis(2-Ethylhexyl)phthalate	ppb	<200	<200	150	76	94	210	260	**700**	<180	**210**	**260**	390
Butylbenzylphthalate	ppb	<96	<200	<20	<20	<19	<20	<110	<19	<19	<19	<19	<20
Carbazole	ppb	**3600**	**1800**	**1700**	**3400**	**2000**	86	**660**	**170**	**700**	40	<19	100
Di-N-Butylphthalate	ppb	<96	<200	<20	<20	<19	<20	<110	<19	<19	<19	**21**	<20
Di-N-Octylphthalate	ppb	<96	<200	<20	<20	<19	<20	<110	<19	<19	<19	<19	<20
Dibenzofuran	ppb	**1600**	**1300**	**700**	**1900**	**2600**	**220**	**3600**	**340**	**160**	20	<19	100
Dimethylphthalate	ppb	<96	<200	<20	<20	<19	<20	<110	<19	<19	<19	<19	<20
Pentachlorophenol	ppb	<480	<1000	<98	<98	<94	<99	<530	**7.1**	**6.4**	**4.6**	**11**	Detect
Phenol	ppb	<96	<200	<20	<20	<19	<20	<110	<19	<19	<19	<19	<20
LPAHs (total)	ppb	**165600**	**112400**	**60430**	**65680**	**70574**	**4995**	**31500**	**13490**	**6860**	425	337	700
HPAHs (total)	ppb	**268800**	**192000**	**89800**	**58390**	**46990**	**8630**	**18860**	**15260**	**9060**	**3034**	2134	2400
DDTs (total)	ppb	NA	NA	NA	NA	49.1	27.3	38.5	170	163	**380**	**570**	220
PCBs (total)	ppb	NA	NA	NA	NA	51	<40	57	NA	<760	NA	NA	<180
Organotins (total)	ppb	NA	NA	NA	NA	16	54	<22.8	NA	44	NA	NA	300
2,4-D	ppb	NA	NA	NA	NA	NA	NA	NA	**9**	**24**	**21**	**93**	<3.3
2,4-DB	ppb	NA	NA	NA	NA	NA	NA	NA	**19**	**13**	**23**	**130**	<5
TOC	%	1.5	**2.2**	1.8	1.1	1.1	0.97	1.2	0.89	1.3	0.98	1.5	1.75
Water Depth	ft	10	17	17	9	7	9.5	8	10	10	10	36	

Table 2
Wacker Siltronic Soil Data

		Date	SS-1	SS-2	SS-3	SS-4a	SS-4b	SS-5	SS-6	SS-7a	SS-7b
Chlorobenzene	ppm	4/30/1985	0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Phenol	ppm	4/30/1985	0.35	3.1	0.2	0.3	0.17	0.07	0.05	0.06	0.08
o-Cresol	ppm	4/30/1985	0.04	3.4	ND	0.02	ND	0.19	0.05	ND	ND
m+p-Cresols	ppm	4/30/1985	0.006	ND	ND	0.08	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ppm	4/30/1985	ND	3.1	ND	ND	ND	0.22	0.17	ND	ND
2-Nitrophenol	ppm	4/30/1985	ND	0.20	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ppm	4/30/1985	ND	ND	ND	ND	ND	0.81	ND	ND	ND
2-Chlorophenol	ppm	4/30/1985	ND	7.8	0.08	0.26	ND	ND	0.13	ND	0.14
3+4-Chlorophenols	ppm	4/30/1985	0.44	17.5	0.06	ND	ND	1.7	0.32	ND	ND
2,4-Dichlorophenol	ppm	4/30/1985	ND	2.7	ND	ND	ND	0.24	ND	ND	ND
2,4,5-Trichlorophenol	ppm	4/30/1985	ND	1.9	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ppm	4/30/1985	ND	ND	ND	ND	ND	0.22	ND	ND	ND
2,3,4,5-Tetrachlorophenol	ppm	4/30/1985	4.9	256	ND	0.4	ND	0.23	4.7	0.06	0.25
2,3,4,6-Tetrachlorophenol	ppm	4/30/1985	0.24	ND	ND	ND	ND	ND	ND	1	ND
2,3,5,6-Tetrachlorophenol	ppm	4/30/1985	ND	4	ND	0.58	0.11	0.33	0.55	ND	0.46
Pentachlorophenol	ppm	4/30/1985	<1	<1	<1	<1	0.31	6.9	5.1	<1	<1
2,4-D (EP-Tox)	ppm	4/30/1985	<10	<10	<10	<10	<10	10	160	<10	<10
Naphthalene	ppm	4/30/1985	6.7	360	<1	<1	<1	230	<1	<1	<1
Acenaphthylene	ppm	4/30/1985	5.6	230	<1	<1	<1	24	<1	<1	<1
Acenaphthene	ppm	4/30/1985	8	560	<1	<1	<1	28	<1	<1	<1
Fluorene	ppm	4/30/1985	5	290	<1	<1	<1	20	<1	<1	<1
Fluoranthene	ppm	4/30/1985	16	530	<1	<1	<1	50	<1	1.1	<1
Pyrene	ppm	4/30/1985	18	550	<1	<1	<1	57	<1	1.2	<1
Phenanthrene+Anthracene	ppm	4/30/1985	32	1400	3	<1	<1	150	<1	1.6	<1
Chrysene	ppm	4/30/1985	12	92	<1	<1	<1	36	<1	1.7	<1
Benzo(b+k)fluoranthene	ppm	4/30/1985	8	120	<1	<1	<1	200	<1	<1	<1
Benzo(a)pyrene	ppm	4/30/1985	19	120	<1	<1	<1	100	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	ppm	4/30/1985	<1	270	<1	<1	<1	7	<1	<1	<1
Benzo(g,h,I)perylene	ppm	4/30/1985	<1	360	<1	<1	<1	25	<1	<1	<1
Oil and Grease	%	4/30/1985	0.34	0.15	0.059	0.914	0.03	0.19	0.054	0.065	0.059

Table 3
Wacker Groundwater Data (mg/l)

	GW-1 (8/85)	GW-2 (8/85)	GW-3 (8/85)	GW-3I (10/90)	GW-4 (8/85)	GW-5 (8/85)	GW-6 (8/85)	GW-7 (8/85)	GW-7 (10/90)
Volatile Organic Compounds									
Benzene	1.1	0.1	0.39	ND	ND	ND	1.2	ND	ND
Toluene	ND	ND	ND	ND	ND	ND		ND	ND
Ethylbenzene	0.41	ND	ND	ND	ND	ND	0.35	ND	ND
Xylene (Total)	1.2	0.032	ND	ND	0.015	ND	0.43	ND	ND
Semivolatile Organic Compounds									
Phenol	ND	ND	ND	0.003	ND	ND	ND	ND	ND
2,4-Dimethylphenol	0.027	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene		0.26	0.067		0.019	0.012	0.041	ND	ND
Acenapthene	0.27	0.94	0.086	0.093	0.35	0.054	0.2	0.019	0.002
Acenaphthylene	0.088	0.2	ND	0.002	ND	0.031	0.032	ND	ND
Anthracene	0.039	0.63	ND	0.002	ND	ND	ND	ND	ND
Benzo(a)anthracene	0.031	0.48	ND	ND	ND	ND	ND	0.012	ND
Benzo(a)pyrene	0.04	0.76	ND	ND	ND	ND	ND	0.01	ND
Benzo(b)fluoranthene	0.024	0.4	ND	ND	ND	ND	ND	ND	ND
Benzo(ghi)perylene	0.025	0.37	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	0.12	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.036	0.65	ND	ND	ND	ND	ND	0.015	ND
Dibenzo(ah)anthracene	ND	ND	ND	ND	ND	ND	ND		ND
Indeno(123-cd)pyrene	0.02	0.3	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	0.077	0.075	ND	0.004	ND	ND	0.024	ND	0.003
Fluoranthene	0.073	1.38	ND	0.005	ND	ND	ND	0.023	0.003
Fluorene	0.095	0.44	0.013	0.022	0.053	0.012	0.035	ND	0.003
Naphthalene	ND	1.9	0.6	0.77	0.35	0.058	2.1	ND	0.005
Phenanthrene	0.19	0.63	0.013	0.006	0.028	0.021	0.056	ND	ND
Pyrene	0.081	1.43	ND	0.004	0.014	0.01	0.01	0.011	ND
Carcinogenic PAHs	0.176	3.08	ND	ND	ND	ND	ND	0.037	ND
Non-Carcinogenic PAHs	0.913	7.885	0.779	0.908	0.814	0.198	2.498	0.053	0.016

TABLE 4
Wacker Siltronic - TPH and BTEX in Groundwater - October 1990

(all concentrations in ppb)

Sampling Point	Benzene	Toluene	Ethylbenzene	Xylenes	TPH	
GW-01	<0.1	221	<0.1	<0.2	<0.1	
GW-02	**181**	<0.1	<0.1	<0.2	131	
GW-03	**13.5**	1.8	1.5	5.6	43.6	
GW-04A	**391**	<0.1	68	45	406	Gasoline
GW-04B	**384**	7.1	75	55	397	
GW-05	—	—	—	—	—	
GW-06	**59.8**	4.6	196	17.9	510	Gas+Diesel
GW-07	**17,560**	13.1	126	176.6	17,000	
GW-08	**285**	<0.1	129	65.4	369	Diesel
GW-09	**371**	13.1	74.4	66.6	791	Gasoline
GW-10	**1,820**	23.9	471	427	5,090	Diesel
GW-11A	**18,100**	**3,910**	**2,520**	3,510	56,500	Gas+Diesel
GW-11B	**23,270**	**5,960**	**4,680**	6,450	89,140	
GW-11C	**18,470**	**5,590**	**4,510**	6,422	88,240	
GW-14	**8.6**	<0.1	<0.1	<0.2	74.7	
GW-15	**23.2**	<0.1	75.9	21.3	1,330	
GW-16	**12,600**	214	**1,680**	1,918	21,400	Diesel
GW-17A	**11,300**	662	**1,680**	2,358	24,900	Diesel
GW-17B	**10,925**	574	**1,370**	2,042	19,350	
GW-18	**250**	20.4	64.2	87.3	623	Gasoline
GW-19	**52.4**	<0.1	13.8	20.6	148	Gasoline
GW-20A	**2,920**	80.6	**1,690**	1,903	16,600	Diesel
GW-20B	**3,120**	85.6	**1,720**	1,897	14,500	
GW-21	**2,510**	349	37.6	99.6	3,140	
GW-22A	<0.1	<0.1	<0.1	<0.2	12.1	
GW-22B	1	0.7	<0.1	<0.2	18.1	
GW-23	**335**	<0.1	419	91.9	635	
GW-24	**4,780**	594	**926**	1,550	6,330	Diesel
GW-25A	**<0.1**	<0.1	<0.1	<0.2	26.8	Diesel
GW-25B	**3.7**	<0.1	<0.1	3.6	25.3	
GW-26	**5,920**	910	584	881	12,040	Diesel
GW-27A	**10,300**	627	**1,220**	1,847	16,300	Diesel
GW-27B	**11,400**	320	**1,340**	2,086	20,800	
GW-28	**349**	9.7	<0.1	22.4	328	
GW-29	**541**	<0.1	263	19.4	735	
Drinking Water MCL:	5	1,000	700	10,000	——	
Fresh Water Aquatic Toxicity -						
Acute:	5,300	17,500	32,000	——	——	
Chronic:	——	——	——	——	——	

FIGURE 1

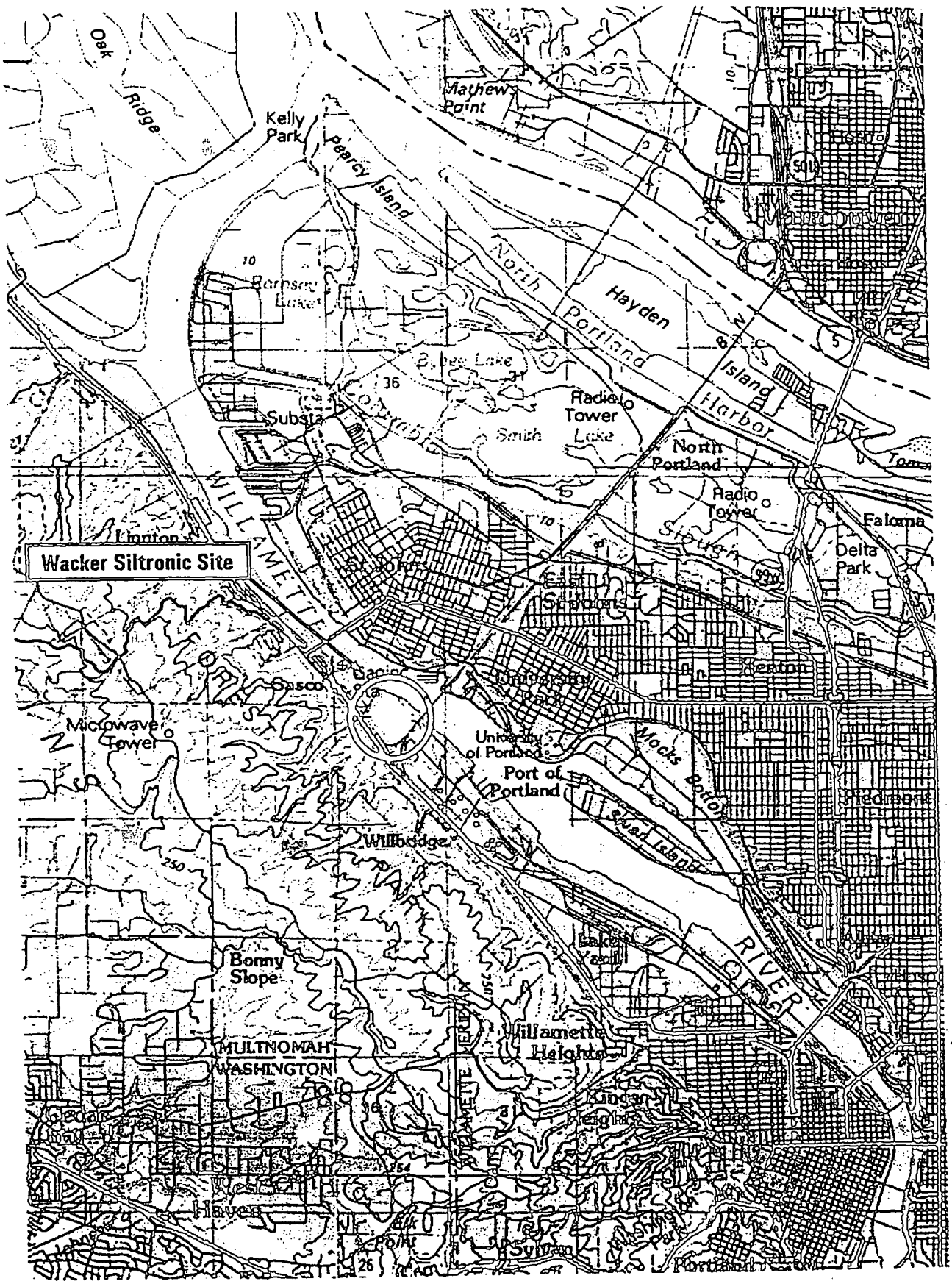

Wacker Siltronic Site
Oak Ridge
Kelly Park
Pearcy Island
Mathew Point
Barnsley Lake
Bybee Lake
Smith Lake
Radio Tower
Hayden Island
North Portland Harbor
North Portland
Radio Tower
Substa
Columbia
WILLAMETTE
Linnton
St. John
East Schools
Delta Park
Faloma
Slough
Gasco
Microwave Tower
University of Portland
Port of Portland
Mocks Bottom
Sauvie Island
Willbridge
Bonny Slope
Lake Vasoll
RIVER
MULTNOMAH
WASHINGTON
Willamette Heights
Kinnear Heights
Cedar Mill
Haven
Sylvan
Portland

FIGURE 2

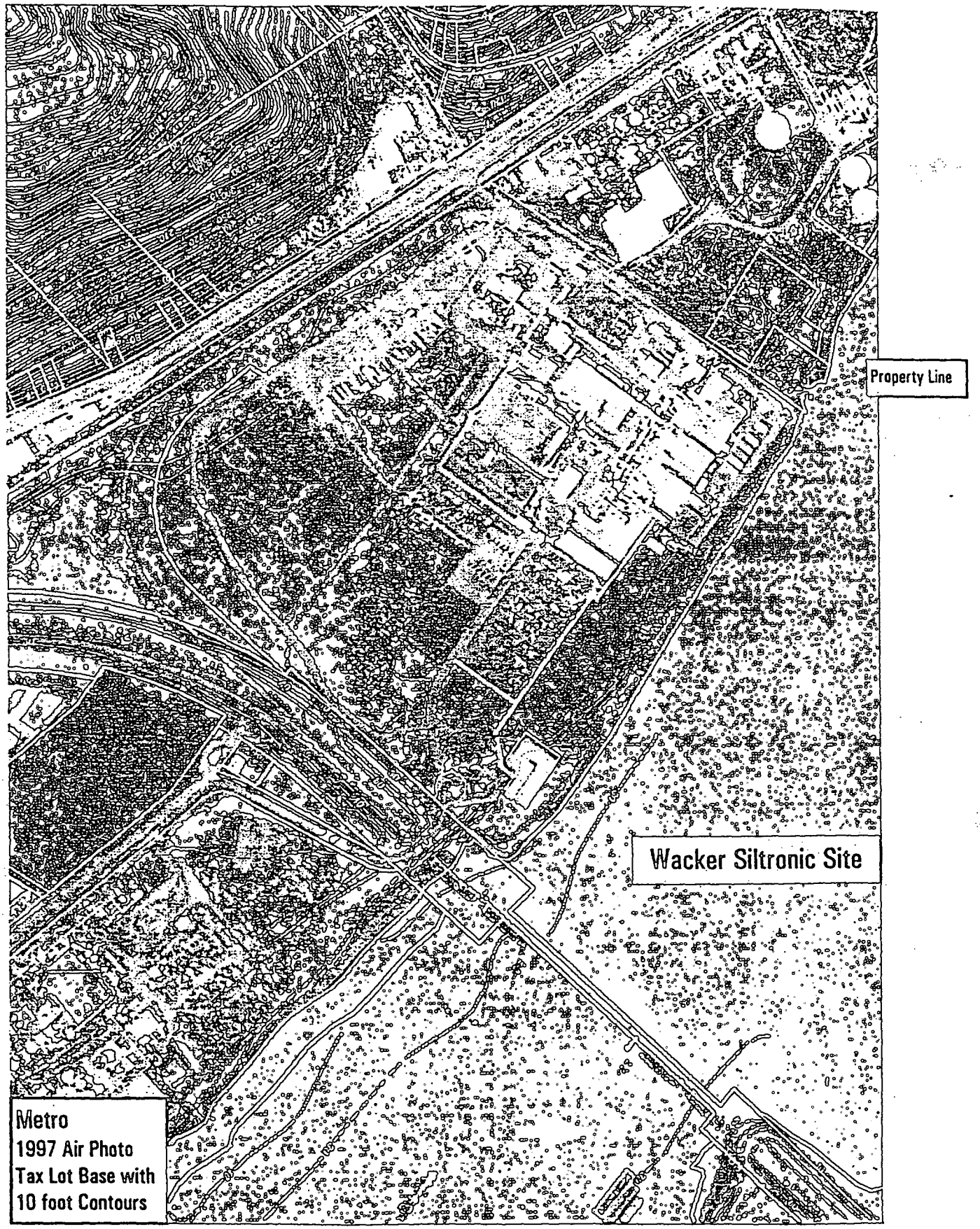
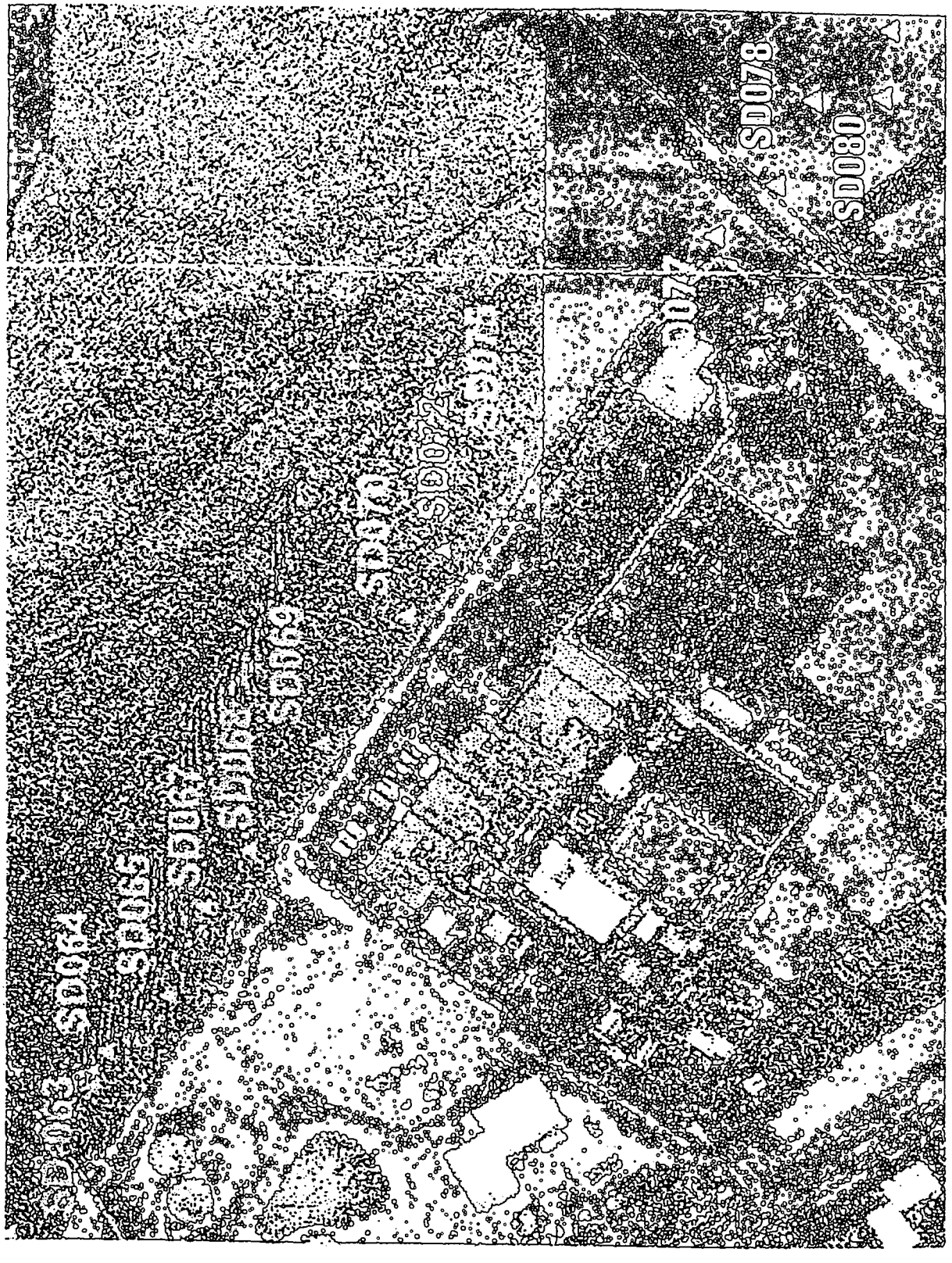

Property Line
Wacker Siltronic Site
Metro
1997 Air Photo
Tax Lot Base with
10 foot Contours

FIGURE 3



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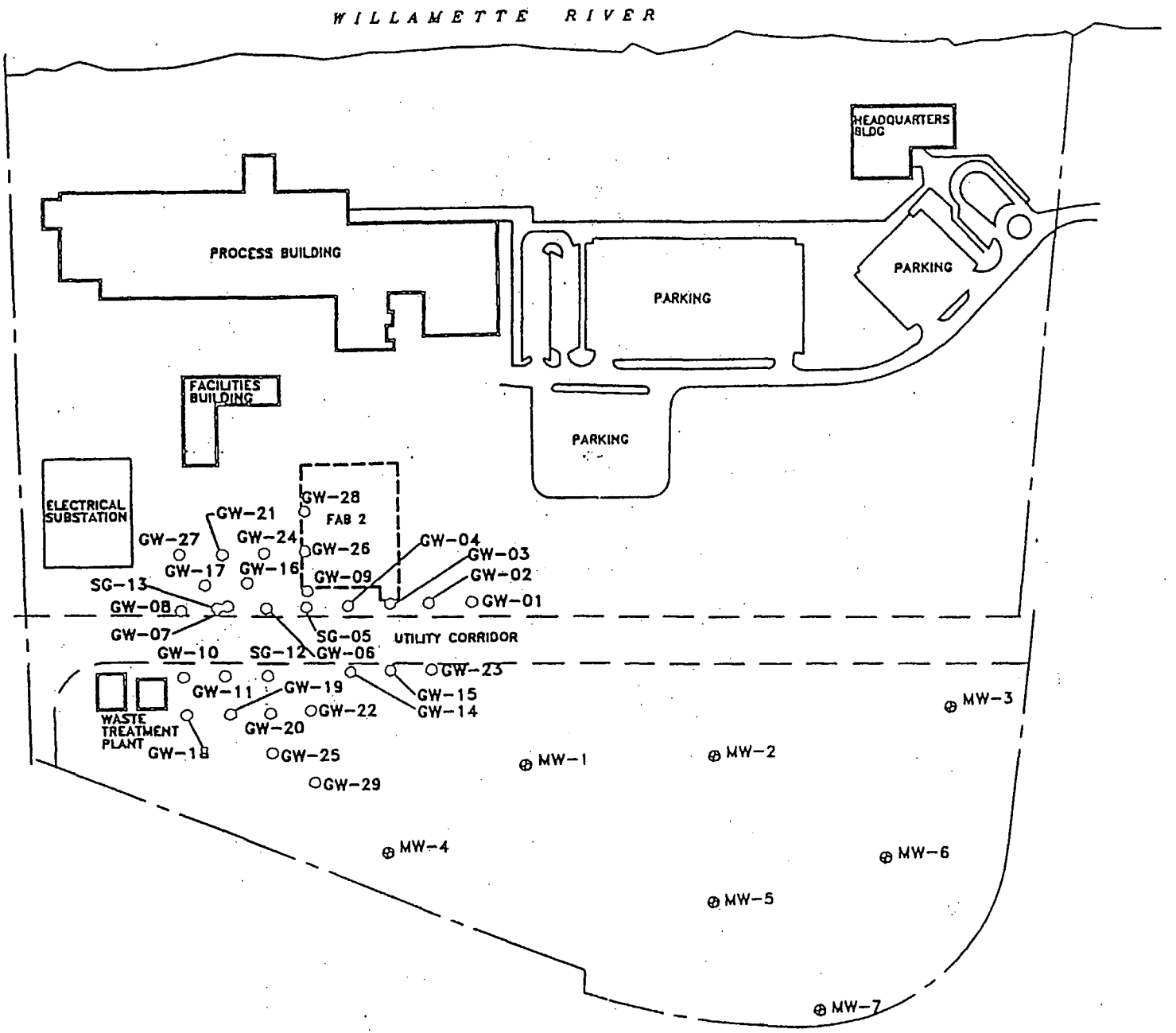

FIGURE 4

Figure 2
SITE PLAN
WACKER SILTRONIC CORPORATION
PORTLAND, OREGON

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Supplement to DEQ's Strategy Recommendation for the Wacker Siltronic Facility

Prepared for Wacker Siltronic Corporation

March 10, 1999

BRIDGEWATER GROUP, INC.

03/13/00

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7 Historical Aerial Photograph May 1957
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A Site Grading Plan

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INTRODUCTION

DEQ premised its request for Wacker Siltronic Corporation (Wacker Siltronic) to conduct a remedial investigation on *suspected* links between specific hazardous substance releases or past operations and contamination documented by EPA in sediments adjacent to the Wacker Siltronic facility. Bridgewater Group, Inc. (Bridgewater Group) has reviewed Wacker Siltronic's permit files, site investigation records, spill cleanup files, and property development history. Our analysis indicates that there are no links between Wacker Siltronic's past or current operations and constituents detected in sediments adjacent to the facility.

Bridgewater Group's analysis is presented in this document. The document includes the following:

- An expanded site history that supplements DEQ's *Strategy Recommendation* and provides additional information on site development and past operations.
- An analysis of why Wacker Siltronic's past or current operations are not the source of the constituents detected in Willamette River sediments above Portland Harbor baseline values

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SITE DEVELOPMENT HISTORY

Introduction

This section provides a revised and updated description of the site development history for the Wacker Siltronic facility located at 7200 NW Front Avenue in Portland, Oregon (see Figure 1). The information provided herein is being provided to DEQ to supplement the Wacker Siltronic facility *Strategy Recommendation* and to establish the technical basis for good faith negotiations between Wacker Siltronic and DEQ.

Pre 1900 - 1978

Property Ownership

According to a March 7, 1985 document entitled *Site History, Wacker Siltronic Corporation, Portland, Oregon* (Portland Development Commission, 1985), as of 1906 the Spokane, Portland and Seattle Railroad owned all or most of the property now occupied by the Wacker Siltronic facility. In 1962, Victor Rosenfeld and H.A. Andersen purchased the property. In 1964, an interest in the property was conveyed to Gilbert Schnitzer. These parties retained ownership until 1978 when the property was purchased by the Portland Development Commission (PDC).

Site Activities

Prior to 1900, the property was essentially undisturbed lowlands. A portion of the property contained part of a small, shallow lake known as Doane Lake. The property was swampy and subject to flooding in the winter and spring. A creek ran through the property, which was reported to have contained fish in the early part of the century.

In 1908, the Astoria and Columbia River Railroad constructed a double track railroad bridge across Doane Lake and the Willamette River. The railroad track berm split Doane Lake (see Figure 2).

Railroad construction was the only activity conducted on the property until sometime in the mid-1930's when several small marine terminal operations were active on the property. Western Transportation had five small buildings, two piers, and two storage tanks on the riverbank near the railroad bridge. The structures associated with this operation are shown in Figures 2 and 3.

According to the *Site History*, Western Transportation refueled tugs and moored log rafts and barges along the property waterfront. Access to

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Western Transportation's operation was from the east-southeast on a road under the railroad bridge.

Shell Oil Company had a building and dock near the northern corner of the property (see Figures 2 and 3). Shell shipped a by-product produced by the nearby Portland Gas & Coke (PG&C) facility by barge from its dock.

PG&C built a residual oil gasification facility, known as the GASCO facility, in 1913 (CDM, 1987). The plant produced 570 Btu town gas and pressed lampblack briquettes. In 1923, the gasification process was modified to increase aromatic generation and light oil recovery for motor fuel. Two years later, tar recovery and refining were initiated to provide tar for use as road binder. During the 1930's, the plant was expanded and in 1941 a coking plant began production of electrode grade coke and high Btu gas. The plant was shut down in 1956[1].

As part of PG&C's plant expansions that occurred in the 1930s and early 1940s, four effluent settling basins were installed on the eastern portion of their site. Several of these ponds were located on what is now the Wacker Siltronic property (see Figures 4 and 5). These settling basins received discharges from tar boxes and lampblack thickeners. Periodic flooding such as that which occurred in June 1948 (see Figure 6), may have scoured some of the tars deposited in the ponds (CDM, 1987). Prior to the construction of these ponds, tar may have been discharged directly to the river and to low-lying areas (CDM, 1987). Also, PG&C occasionally cleaned out the ponds and placed the dredged materials in low-lying areas, possibly onto what is now the Wacker Siltronic property (CDM, 1987).

During filling of the adjacent Wacker Siltronic property, the three settling ponds were eliminated and according to CDM (1987), the tar was incorporated into the soil fill material in a low lying area paralleling the northwest boundary of Wacker Siltronic's property (see Figures 7 through 10).

From at least 1952 to the mid-1960s, PG&C also stored lampblack on what is now the Wacker Siltronic property. Lampblack may have been discharged to the river and later to the settling ponds (CDM, 1987). Other wastes such as plant demolition rubble, tank bottom sludges, and other miscellaneous wastes may have been disposed in low-lying areas on what is now the Wacker Siltronic property (CDM, 1987). Wacker Siltronic has encountered demolition debris in several onsite excavations.

According to the *Site History*, PG&C contracted with Jack Eatch Construction Company at the nearby rock quarry to provide fill for the property, construct drainage ditches, and perform some clearing operations. Aerial photographs for the early 1960s through 1967 show how land-clearing operations on the property progressed from west to east (see Figures 8 through 10).

By 1957, the Western Transportation dock and piers were removed (see Figure 7). According to the *Site History*, the Shell Oil facility was abandoned by 1957.

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[1] PG&C became Northwest Natural Gas, the predecessor to Northwest Natural, in 1958. Northwest Natural Gas constructed a liquefied natural gas storage tank in the late 1960s and most of the old gasification plant facilities were demolished.

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The Wacker Siltronic property apparently remained idle from the late 1950s until May 23, 1966 when filling activities started (see Figures 10 and 11). The purchasers (i.e., Victor Rosenfeld and H.A. Andersen) agreed to fill the property to a minimum elevation of thirty feet by December 31, 1973 and to construct industrial buildings on the site by December 31, 1978.

Approximately 1,500,000 cubic yards of imported material were placed on the property. According to the *Site History*, approximately 700,000 cubic yards of material came from hydraulic dredging of the Willamette River. The remaining material came from the rock quarry located on the other side of Highway 30, immediately west of the property. Figure 11 is an aerial photograph of the property taken in 1971. It shows the berm constructed along the shoreline of the Willamette River, filling of the property with dredged materials, and the turbid discharge of water from the filling operation back into the Willamette River.

The Portland Planning Commission approved the request to fill the site. Site filling was completed by December 6, 1975. By 1973, the structures associated with both the Western Transportation and Shell Oil operations were no longer present at the property (see Figure 12). Also by 1967, an unnamed stream that drained the northeast slopes of the Tualatin Mountains, including the area occupied by the rock quarry, was channelized to route water through a ditch and culverts around the southern edge of the property (see Figure 10). The unnamed stream formerly ran across the northwest portion of the property (see Figure 9).

The DEQ *Strategy Recommendation* states that this ditch receives drainage from the Wacker Siltronic property. Bridgewater Group has reviewed the grading plan for the property and has found that none of the property drains to the ditch. Almost all of the facility storm water is collected and conveyed through the combined effluent outfall which discharges to the Willamette River at the far northwest corner of the property. Storm water from the Fab 2 Building area discharges through a separate outfall located at about the center of the property. Two of the Administration Building downspouts discharge through a separate outfall that runs along the west side of the building. The other two Administration Building downspouts and one catch basin near the main entrance (in the turnaround) discharge to a City of Portland storm water outfall that discharges just downstream of the Railroad Bridge.

As is shown in Figure 13, the property was completely filled and was ready for development by the end of 1977.

1978 - Present

Property Ownership

In 1978, the PDC purchased the property as part of a 360-acre urban renewal project. The area included in the project was characterized by poor access and a lack of major utility services. The City of Portland, through PDC, sold $15 million in urban redevelopment bonds to finance purchase of land,

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improvement and realignment of streets, relocation of an existing gas main, and installation of two major storm sewers that would serve the surrounding area. PDC in turn sold 85 acres to Wacker Siltronic on August 17, 1978 for construction of a new silicon wafer plant. Figure 14 shows the property in October 1978 with preliminary plant construction activities underway.

Wacker Siltronic's purchase came at the end of a two-year process where Wacker Chemie of Munich, Federal Republic of Germany, sought a location in the United States for a new silicon wafer plant. Wacker Siltronic, their transaction lawyers, and their design engineer did not suspect that hazardous substances were present at the site prior to the transaction. Wacker Siltronic consulted with DEQ, the City of Portland, the U.S. Army Corps of Engineers, Port of Portland, and Portland Chamber of Commerce regarding environmental requirements and permits needed for the site. PDC offered no information to the prospective purchaser, Wacker Siltronic, about the presence of hazardous substances. DEQ did not inform Wacker Siltronic about the potential presence of hazardous substances, even after the agency sent a representative to Germany to work with Wacker Siltronic on environmental issues.

Wacker Siltronic did not become aware of the potential presence of coal tar residues on its property until 1984 when the Company announced its intent to construct a large polysilicon production plant in the southern portion of the property. In April of 1985, as part of the preliminary engineering for design and construction of the proposed polysilicon plant, Wacker Siltronic confirmed the presence of petroleum products, polynuclear aromatic hydrocarbons (PAHs), and the pesticide 2,4-D in soil in the proposed construction area (CH2M HILL, 1985a). Later in 1985, Wacker Siltronic collected a series of air samples to ensure that its employees were not being exposed to hazardous vapors (CH2M HILL, 1985b). In June 1985, Walker Siltronic formally notified the U.S. Environmental Protection Agency (EPA) regarding the potential for the property to be a hazardous waste site as required under Section 103(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Site Activities

Construction of Wacker Siltronic's new plant began immediately after the property was purchased. Construction was completed in December 1979, and operation began in March 1980.

In 1995, Wacker Siltronic significantly expanded the production capacity of the Portland facility by constructing the Fab 2 Building.

DEQ's *Strategy Recommendation* states that "...Surface runoff at the southwestern edge of the site is directed along the Burlington Northern Railroad right-of-way via a stormwater catch basin, and discharges to the river about ½ mile to the southeast." This is incorrect. According to a topographical map for the property (see Appendix A), no surface runoff from the southwestern edge of the site drains toward the railroad right-of-way. All surface runoff is captured onsite and discharged through the combined effluent outfall, the Fab 2 Building stormwater outfall, the Adminstration Building roof drain outfall, or the City of Portland stormwater

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outfall. Koppers Industries discharges stormwater to the ditch the runs along the railroad right-of-way.

Spills or Releases

DEQ's *Strategy Recommendation* references several spills or releases that occurred after the time that Wacker Siltronic purchased the property. This section provides supplemental information regarding these spills or releases, and the Company's investigation and cleanup activities.

1979 Olympic Pipeline Petroleum Release

Olympic Pipeline operates two product lines that are buried within a utility corridor that transects the Wacker Siltronic property from north to south (see Figure 15). One pipeline conveys diesel and kerosene. The other conveys gasoline.

Wacker Siltronic discovered a petroleum release in February 1979 while excavating the foundation for a clarifier in the wastewater treatment plant area. A sample of diesel obtained from the pipeline was analyzed and found to match a sample collected from the clarifier excavation. Wacker Siltronic notified Olympic Pipeline regarding the potential for a leak in one or both of their product lines. Olympic Pipeline excavated and exposed their pipelines. Holes were discovered in a section of the pipeline and oil was found along a portion of the utility corridor to the northwest and southwest of the clarifier excavation. Wacker or Olympic Pipeline notified DEQ of the release and the agency visited the plant site in February of 1979.

Olympic Pipeline replaced the section of leaking pipeline. They also addressed floating product found in the clarifier and pipeline excavations by excavating a water separation pit southeast of the clarifier excavation and then pumping floating product and water into the pit. Olympic Pipeline then skimmed the floating product from the pit and pumped it into tanker trucks. After completing the skimming operation, Olympic Pipeline backfilled the pit. They also removed residual oil and stained soil remaining in the bottom of the clarifier excavation. Wacker Siltronic does not have a record of any cleanup action or closure report for this release.

1980 Chromium Release

According to DEQ's *Strategy Recommendation*, chromium was found in the Wacker Siltronic wastewater treatment plant concentrated acid system on December 16, 1980. On that date, chromic acid entered a concentrated acid drain. Some of the acid was treated in the neutralization tank and discharged before the acid release was observed. When Wacker Siltronic staff observed a green color in the plant's wastewater, the source of the chromic acid was found and stopped. An estimated 5.5 pounds of chromium was captured within the plant's wastewater treatment plant and taken to the hazardous waste landfill in Arlington, Oregon for disposal. None of the chromic acid was released to soil underlying the wastewater treatment plant. However, approximately 1.3 pounds of chromium was discharged to the Willamette

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River. This one time release is small when compared to the permitted discharge limits specified in Walker Siltronic's NPDES Waste Discharge Permit No. 93450. This permit allows Wacker Siltronic to discharge up to 0.5 pounds per day of total chromium as a monthly average and up to 1 pound per day as a daily maximum. Wacker Siltronic's actual average total chromium discharge is far less than is allowed by its permit. Wacker Siltronic only discharges between 0.02 and 0.03 pounds per day, or 7 to 11 pounds per year.

1981 Chromic and Nitric Acid Leak

According to DEQ's *Strategy Recommedation*, chromic acid was spilled after a tank overflowed. The chromic acid entered a floor drain and sump at the Wacker Siltronic facility.

Bridgewater Group reviewed Wacker Siltronic's spill records and found that the acid etch solution from a rinse operation in the materials characterization production area did enter a floor drain and sump, but there was no release to soil or surfacewater. The sump had a transfer pump that conveyed the acid to a storage tank. When the storage tank was completely filled it overflowed into the secondary containment for the storage tank. Flow into the storage tank and to its secondary containment continued until the source of the leak was discovered. Flow into the tank was stopped before the acid was able to overtop the secondary containment. Wacker Siltronic brought in a tanker truck to remove the acid and rinse water solution. Approximately 6,000 gallons of acid and rinse water solution were treated and disposed at the hazardous waste landfill in Arlington, Oregon.

1984 Trichloroethylene Spills

In December of 1984, two trichloroethylene (TCE) spills occurred from its TCE Stripper. The first spill occurred on December 3, 1984. A solution containing TCE was spilled when a surge tank overflowed. Wacker Siltronic estimated that 0.33 gallons of TCE were spilled. Wacker Siltronic determined that this spill did not exceed reportable quantity requirements. The second spill occurred on December 31, 1984, again due to overflow from a surge tank. Wacker Siltronic estimated that 11.6 gallons of TCE were spilled. This spill was reported to DEQ.

On January 2, 1985, Wacker Siltronic collected soil samples from the area around the TCE Stripper. The sampling results were provided to DEQ. DEQ and Wacker Siltronic agreed to a cleanup plan that included the removal of surface soils from an area immediately around the TCE Stripper and from a second area between the Reverse Osmosis/Deionized Water (RO/DI) Storage Tanks and sidewalks. Between January 14 and 20, 1985 Wacker Siltronic removed 113 cubic yards of soil and then resampled the spill area. Following several months of discussion between DEQ and Wacker Siltronic regarding the completeness of the soil removal action, Wacker Siltronic decided to remove an additional 15 cubic yards of soil on April 10, 1985. The soils from both removal actions were taken to the hazardous waste landfill in Arlington, Oregon. Soil sampling results indicated that TCE concentrations

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were less than 1 mg/kg. Because both TCE spills occurred in essentially the same location, the cleanup action addressed both spills.

Based on these results, DEQ issued a letter to Wacker Siltronic on April 16, 1985 which stated that "... all residue of the TCE spill which occurred at your facility ...has been removed to below background levels (less than one part per million)." In its letter, DEQ approved filling the soil excavations, construction of a spill containment area around the stripper, and Wacker Siltronic's cleanup work.

As of 1988, Wacker Siltronic stopped using TCE at the facility.

1987 Organic Wastewater Overflow

On June 25, 1987, a mixture of weak detergents and surfactants from the organic wastewater system overflowed onto a gravel yard and the main roadway when a wastewater line plugged. The overflow entered a stormwater catch basin and then discharged into the Willamette River through the combined effluent outfall located at the far northwest corner of the property. Wacker Siltronic estimated that the organic wastewater (OWW) flow was 3 to 5 gallons per minute and the pH was neutral (i.e., between 6 and 9). Wacker Siltronic estimates that the total discharge was 2,000 gallons.

Wacker Siltronic collected a soil sample near the catch basin. The soil sample was analyzed for pH, flash point, total metals, cyanide, sulfide, PCBs, phenol, and solvents. An EP Toxicity analysis was also performed on the soil sample. This suite of analyses was selected for purposes of profiling the soil for waste management purposes, in anticipation of the need for soil removal, not because the organic wastewater would have contained these constituents.

Six metals were detected in the soil sample: barium at 71.8 mg/kg, chromium at 9.37 mg/kg, copper at 16.3 mg/kg, lead at 41.9 mg/kg, nickel at 9.61 mg/kg, and zinc at 53.3 mg/kg[2]. No cyanide, sulfide, PCBs, phenol, or solvents were detected.

The only metal detected in the EP Toxicity analysis was barium at 0.276 mg/L.

No cleanup was conducted given the few constituents that were detected and low concentrations of the constituents that were detected.

1988 Pentachlorophenol Detection in Wastewater Discharge

According to DEQ's *Strategy Recommendation*, on January 11, 1988, pentachlorophenol (PCP) was detected in one of Wacker Siltronic's wastewater effluent samples at 0.2 mg/L.

Bridgewater Group reviewed Wacker Siltronic's NPDES Monitoring Reports and related correspondence for 1988. On January 27, 1988 DEQ requested

[2] These metal concentrations are below DEQ's residential and industrial maximum allowable soil concentrations in Appendix 1, Oregon Soil Cleanup Table in OAR 340-122.

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that Wacker Siltronic sample for PCP in its combined effluent discharge based on the detection of PCP during its annual analysis of toxic organic (TTO) compounds in accordance with permit requirements. On January 29, 1988 Wacker Siltronic collected two samples: RO/DI water and combined effluent. No PCP was detected in the RO/DI water sample at a detection limit of 0.002 mg/L. PCP was detected in the combined effluent sample at a concentration of 0.004 mg/L. Wacker Siltronic sampled the combined effluent for PCP in February, March, and April, and did not detect PCP at a detection limit of 0.005 mg/L. According to a May 5, 1998 letter, DEQ agreed that Wacker Siltronic could discontinue sampling after April.

1990 BTEX Discovery

In June of 1990, Wacker Siltronic installed two geotechnical borings in an area of a proposed manufacturing plant expansion (known as Fab 2). Benzene, toluene, ethylbenzene, and xylenes (BTEX) were found in soil samples collected from the two borings.

In October of 1990, Walker Siltronic retained CH2M HILL to assess the possibility that one or both of the Olympic Pipeline pipelines was the source of BTEX. As was discussed above, an earlier leak had occurred from one of the pipelines in 1979.

CH2M HILL conducted a groundwater and soil gas investigation along a 600-foot length of the utility corridor that contains the pipelines (see Figure 15). BTEX and total petroleum hydrocarbons (TPH) were found at a number of the sampling locations with the highest concentrations detected in groundwater at GW-11 and GW-7. These sampling locations were immediately adjacent to the utility corridor. BTEX and TPH concentrations generally decreased with distance away from the utility corridor, but were found at elevated concentrations (i.e., TPH at 12,040 ug/L and benzene at 5,920 ug/L in groundwater) in the proposed construction area. No free product was found, but a black, viscous substance that CH2M HILL presumed to be coal-tar-derived waste was found in several of the sampling locations. CH2M HILL concluded that the most likely source of the BTEX detected in groundwater was a gasoline leak (CH2M HILL, 1990).

In October, Wacker Siltronic reported the potential leak to Olympic Pipeline and DEQ. Several months later, Olympic Pipeline responded by retaining a contractor to excavate and expose the pipelines. No gasoline smell or leaks were observed. Olympic Pipeline subsequently pressurized the pipelines to 250 pounds per square inch (psi) for eight hours. Although Olympic Pipeline found that the pipelines held the pressurization, they concluded that the test was not conclusive. Olympic Pipeline agreed to pressurize the lines again to substantiate whether there was a leak.

Pressure testing of 2,500-foot sections of both pipelines at 790 psi was conducted February 27, 1991. Olympic Pipeline concluded that neither of the pipelines leaked, but that one of the pipelines ruptured during the test. Olympic Pipeline agreed to replace both pipelines.

In March of 1991, Olympic Pipeline capped the old pipelines in-place. New pipelines were connected and pressure tested at 1,100 psi.

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In 1995, Wacker Siltronic obtained a Petroleum Contaminated Soil Treatment Permit (#PCSLA-NWR-95-004) from DEQ to treat onsite soils excavated from the Fab 2 Building construction site. The permit allowed Wacker Siltronic to treat the soils using thermal treatment and to transport the soils to St. Johns Landfill if TPH as gasoline concentrations were at or below 40 mg/kg and TPH as waste oil, heating oil and heavy oil were at or below 100 mg/kg. In accordance with the DEQ-approved soil management plan, Wacker Siltronic staff determined whether soils were contaminated based on odor and visual staining. When contaminated soils were encountered, the soils were placed into drop boxes and sampled for waste management purposes in accordance with the soil management plan. Wacker Siltronic excavated and treated 5,491 tons of soil in accordance with a DEQ-approved soil management plan. All of the treated soils that were transported to St. Johns Landfill met the treatment requirements in the permit (Wacker Siltronic, 1995a and 1995b). The portion of the property used for soil treatment was cleaned, sampled, and closed in accordance with permit requirements (Wacker Siltronic, 1995b).

1991 Weak Acid Storage Tank Leak

On September 11, 1991 a weak acid storage tank leaked when a valve sheared off. Approximately, 4,000 gallons of weak acid was released to the ground. According to DEQ's Release Report and Evaluation Form for this leak (OERS #91-062), the release consisted of spent, deionized rinsewater. Wacker Siltronic blocked all storm drains to prevent the leak from leaving the wastewater treatment area. The pH of the weak acid at the time of the leak is unknown; the pH of the weak acid varies. According to Wacker Siltronic environmental staff, approximately, 1,000 gallons of the weak acid were recovered. The remainder would have likely neutralized within the soil column and not mobilized any significant quantities of metals. DEQ concluded that the release was not a hazardous waste, did not exceed a reportable quantity, and that no NPDES effluent limits were exceeded. DEQ further concluded that the release required no further investigation, removal, remedial action, or long-term environmental or institutional controls.

1997 Caustic Rinse Water Release

On April 28, 1997, a release of caustic rinse water from an ion-enchange regeneration unit occurred when a flange on the discharge side of a pump failed and allowed rinse water to spray outside a containment area. The area covered by the release was unpaved. The rinse water release wetted the soil and pooled in some locations, but did not runoff from the immediate area. Wacker Siltronic neutralized the spilled rinse water and then cleaned up the spill with a vacuum truck. The recovered rinse water was treated on site in the wastewater treatment plant. The failed equipment was repaired and placed back into service.

Wacker Siltronic calculated that between 36 and 55 pounds of caustic were released, which according to Wacker Siltronic was below the reportable quantity for caustic.

Soil samples were collected to determine if soil cleanup was necessary. Five samples, four from the spill area and one from a control area, were collected

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and analyzed for pH in accordance with EPA SW-846 Method 9045. The sample results for the spill area ranged from 7.4 to 11.3. The pH in the control sample was 7.6.

Based on these results, Wacker Siltronic removed soil surrounding the locations with the highest pH. Soil was excavated to a depth of approximately 6 inches and additional soil samples were collected. The pH of these soil samples was the same as the control sample +/- 0.5 pH unit.

The excavated soils were sent to USA Waste Services, Inc. for disposal under a special waste permit. The soil excavations were backfilled with new gravel.

1998 Release During Dredging

During the summer of 1998, Wacker Siltronic implemented a river bank stabilization project to repair damage caused by the February 1996 flood. The project included the placement of 5,415 cubic yards of Class 500 rock rip rap above ordinary high water (OHW) and 2,300 cubic yards of Class 1000 rock rip rap below OHW along 2,500 feet of the Willamette River shoreline.

An oil sheen was observed on July 29, 1998 when silt was being dredged to be used as backfill behind the rip rap. Figure 15 shows the approximate location where the silt was dredged. Wacker Siltronic notified the Coast Guard. The Coast Guard visually inspected the area and stated that it was under control. No followup was required by the Coast Guard. Wacker Siltronic also notified DEQ and EPA. DEQ stated that the oil sheen was not due to a spill, rather it was due to an existing problem. EPA stated that no followup was required.

Wacker Siltronic instructed the dredging contractor, Advanced American Diving, to place the dredged sediments on the bank and then transfer them into eight, 20-yard, lined drop boxes. The sediments were sampled and profiled for waste management purposes. Approximately, 115 tons of contaminated material, as opposed to the 75.72 tons stated in DEQ's *Strategy Recommendation*, was sent to Arlington for disposal. The sediments were found to contain total petroleum hydrocarbons. The laboratory quantified TPH concentrations falling within the following three hydrocarbon ranges: gasoline at 7.49 to 69 mg/kg, diesel at 399 to 5,810 mg/kg, and heavy oil at 293 to 2,970 mg/kg. According to Philip Neuremburg of North Creek Analytical, the laboratory that performed the TPH analyses, the chromatograms for the samples are consistent with coal tar or creosote standards, not gasoline or diesel standards. TCLP metals, pesticides, VOCs, SVOCs, and herbicides tests were run on a composite sediment sample. Barium was the only metal detected in the TCLP test at a concentration of 0.562 mg/L. No pesticides, VOCs, SVOCs, or herbicides were detected in the TCLP tests.

Bridgewater Group reviewed Wacker Siltronic's spill records and historic petroleum use. As will be discussed in the next section, Wacker Siltronic's past or current operations could not have lead to the contamination found during the 1998 bank stabilization project.

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Discussion of Constituents Detected in Near Shore Sediments Relative to Operations at Wacker Siltronic

Introduction

According to DEQ's *Strategy Recommendation*, a number of constituents were detected in seven sediment samples collected proximate to the Wacker Siltronic property above the apparent Portland Harbor sediment baseline maximum values. Figure 16 shows the location of the sediment samples collected adjacent to the property. DEQ's *Strategy Recommendation* asserts that past or current operations conducted by Wacker Siltronic led to the observed exceedances of the apparent harbor baseline maximum sediment concentrations. These exceedances are summarized in Table 1.

This section presents Bridgewater Group's analysis and conclusions regarding the observed sediment quality adjacent to the Wacker Siltronic site. A key outcome of Bridgewater Group's analysis is that there is no link between the constituents detected in Willamette River sediments and past or current operations conducted by Walker Siltronic.

Metals

According to DEQ's *Strategy Recommendation*, the following metals are present in sediment samples above the harbor baseline values: beryllium, cobalt, iron, manganese, selenium, silver, titanium, vanadium, and zinc. As DEQ states in its *Strategy Recommendation*, the majority of these constituents exceed harbor baseline by less than 20 percent.

The presence of these metals at concentrations above the harbor baseline values is not due to past or present operations conducted by Wacker Siltronic. Silicon wafer production involves a high purity process that is essentially metal-free. Virtually all of Wacker Siltronic's manufacturing processes are metal-free, even the process piping and tanks.

The only metal used in the process is chrome, which is used to test for defects during wafer production. As was discussed in the previous section, Wacker Siltronic is permitted to discharge up to 1 pound per day, on average, of total chromium, but typically only discharges 0.02 to 0.09 pounds per day of total chromium. As DEQ states in its *Strategy Recommendation*, chromium levels in sediments at the Wacker Siltronic facility do not exceed the harbor baseline values.

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DEQ's *Strategy Recommendation* suggests that Wacker Siltronic's facility is a potential source of antimony to Willamette River sediments. Antimony is used during the crystal growing process. It is placed in a furnace and heated along with silicon. Dust emissions from the furnace are captured by a filter collector system. The filtered dusts are managed as a solid waste. No water or scrubbing technology is used in the filter system. Therefore, it is unlikely that antimony would be present in any water-related discharges from the facility.

While the DEQ Strategy *Recommendation* is correct with respect to Wacker Siltronic's use of chromium and antimony, it is not correct about the Company's use of mercury. Mercury is not used in the process and, therefore, the downstream presence of mercury in sediments at concentrations above harbor baseline values is not associated with Wacker Siltronic's past or current operations. The only uses of mercury at the facility are in measurement systems, fluorescent lights, and electrical switches. Mercury used in the measurement systems is vacuumed into containers and sent to a mercury refiner for reclamation. Mercury contained in lights and switches is managed as a universal waste and sent offsite.

There are two potential explanations for the presence of certain metals in sediments above harbor baseline values. The first is that sediments transported into the Portland Harbor contain metals at concentrations equal to and greater than those found at the Wacker Siltronic site. Table 2 lists metal concentrations measured by the USGS on suspended sediments at the Willamette River gaging station at Portland (i.e., at the Morrison Bridge). Most of the metals concentrations detected in sediment samples collected adjacent to the Wacker Siltronic site are within the range, and are generally near the lower end of the range, of metals concentrations measured by the USGS.

Second, as was discussed above, the property was filled between 1966 and 1973 with 1,500,000 cubic yards of rock quarry overburden and dredged materials. The overburden was obtained from a rock quarry located across Highway 30 from the property. The overburden itself and any excess rock from the quarry may be a source of some of the metals detected in sediments. For instance, the iron detected in sediments may, in part, have come from the historic rock quarrying operation that drained into an unnamed creek that flowed across the northwest portion of the property before it was filled. Wacker Siltronic has observed iron staining at the City of Portland's stormwater outfall located just downstream of the Railroad Bridge and at the Fab 2 stormwater outfall located near the center of the property. Also, as Figure 11 illustrates, water that drained from the property during filling with dredged materials was turbid. Drainage from the dredge fill operation could have carried fine-grained sediments containing metals back into the river.

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Semivolatile Organics and PAHs

Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAH)

DEQ has grouped six low molecular weight PAHs into a single chemical category for the purposes of presenting harbor sediment information. LPAH constituents include naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene.

DEQ reported that all seven sediment samples collected off the Wacker Siltronic site exceeded the apparent harbor baseline maximum LPAH concentration of 700 μg/kg with surface sediment sample SD070 containing over 100 times the LPAH compared to the harbor baseline value. Downriver sediment samples SD065 and SD067 also exceeded the harbor baseline values by a factor of 237 and 161, respectively.

Chemical Background

While some individual uses and markets for the individual LPAH constituents exist, all LPAH, HPAH, and other semivolatile organic constituents detected in the sediments are major constituents in coal tar; coal tar creosote; and No. 2 diesel and fuel oil (see Table 3). See also discussion under HPAHs, 2-methylnapthalene, and carbazole.

In coal tar, naphthalene is present at an average concentration of 10 percent (100,000 ppm), phenanthrene (5%), fluorene (2%), and anthracene (1.8%). Similar concentrations are observed in coal tar creosote.

Coal tar creosote is the most common form of creosote. It is a thick, oily liquid that is typically amber to black in color, and is a distillation product of coal tar. Coal tar creosote is the most widely used wood preservative in the United States, and is used as a wood preservative and water-proofing agent for railroad ties, telephone poles, marine pilings, and fence posts. It is also a restricted-use pesticide, and is used as an animal and bird repellant, insecticide, animal dip, fungicide, and a pharmaceutical agent for the treatment of psoriasis. About 300 chemicals have been identified in coal tar creosote.

Coal tar and coal tar pitch are the by-products of the high-temperature treatment of coal to make coke or natural gas. They are usually thick, black or dark brown liquids or semi-solids with a naphthalene-like odor. Coal tar products are ingredients in medicines used to treat skin diseases such as psoriasis; they are also used as animal and bird repellants, insecticides, animal dips, and fungicides. Coal tar creosotes, coal tar, and coal tar pitch are similar in composition.

LPAHs are also components (by percent composition) in a number of distillate fuels. Data reported in Composition of Petroleum Mixtures (Total Petroleum Hydrocarbon Criteria Working Group, May 1998) for No. 2 diesel and fuel oil indicates that naphthalene averages 0.22% (2,200

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ppm), acenaphthylene (0.006%), acenaphthene (0.018%), fluorene (0.019%), phenanthrene (0.079%), and anthracene (0.0058%).

Assessment of Relevance to Wacker Siltronic Site

DEQ's *Strategy Recommendation* states that "...Historical operations associated with oil gasification processes at the former GASCO site have resulted in petroleum related contamination at the Wacker site." As was discussed earlier, direct discharges may have occurred to the river prior to when the GASCO plant was expanded in the 1930s. After that, tar was discharged into four settling ponds, three of which were on what is now Wacker Siltronic property. Two of the three sediment sample locations (i.e., SD068 and SD069) where elevated LPAH concentrations were detected are located just offshore of where the ponds were located (see Figure 7). One of the three sediment sampling locations (i.e., SD068) where elevated LPAH concentrations were detected is located about where the former Shell Oil Company dock was located (see Figure 2).

DEQ's *Strategy Recommendation* also states that there may have been spills or waste disposal activities associated with the former Western Transportation facility. Historical releases from this facility may explain the LPAH concentrations detected at sampling locations SD072A (at depth) and SD075 (see Figure 2).

LPAH releases from these historic sources to Willamette River sediments would have decreased in the 1950s when Western Transportation and Shell Oil Company stopped its operations, and in the 1960s when the settling ponds were filled. Subsequent releases would have been further reduced or eliminated in the 1970s when the property was filled with rock quarry overburden and dredged material.

After plant construction in 1978, Wacker Siltronic would not have contributed any additional LPAHs to the Willamette River sediments from its operations. The only source of LPAHs associated with Wacker Siltronic's past and present operations is diesel fuel stored for use in three emergency generators. All of the diesel fuel is stored in aboveground storage tanks that are integral to each generator. Wacker Siltronic has no record of any spill or leak of diesel fuel from its emergency generators.

Therefore, it is Bridgewater Group's conclusion that no link exists between the LPAHs detected in the Willamette River sediments and past or current operations conducted by Wacker Siltronic.

High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAH)

DEQ has grouped 10 high molecular weight PAHs into a single chemical category for the purposes of presenting harbor sediment information. HPAH constituents include fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene.

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DEQ reported that all seven sediment samples collected off the Wacker Siltronic site exceeded the apparent harbor baseline maximum HPAH concentration of 2,400 µg/kg with subsurface sediment sample SD068 contained over 37 times the HPAH compared to the harbor baseline value. Downriver sediment samples SD065 and SD067 also exceeded the apparent harbor baseline values by a factor of 112 and 80, respectively.

Chemical Background

While some individual uses and markets for the individual HPAH constituents exist, all HPAH, LPAH, and other semivolatile organic constituents detected in the sediments are major constituents in coal tar, coal tar creosote, and No. 2 diesel and fuel oil (see Table 3). See also discussion under LPAHs, 2-methylnapthalene, and carbazole.

Assessment of Relevance to Wacker Siltronic Site

The highest HPAH concentrations were detected at sampling locations SD068, SD069, and SD070. As was discussed above, two the these sampling locations are located just offshore of where the settling ponds were located and one of the sample locations is close to the former Shell Oil Company dock.

The next highest HPAH concentrations were detected at sample locations SD072A (at depth) and SD075. DEQ's *Strategy Recommendation* also states that there may have been spills or waste disposal activities associated with the former Western Transportation facility. Historical photographs (see Figures 2 and 3) show that the docks associated with this facility were close to these sampling locations.

HPAH releases from these historic sources to Willamette River sediments would have decreased in the 1950s when Western Transportation and Shell Oil stopped operations, and in the 1960s when the settling ponds were filled. Subsequent releases would have been further reduced or eliminated in the 1970s when the property was filled with rock quarry overburden and dredged material.

After plant construction in 1978, Wacker Siltronic would not have contributed any additional HPAHs to the Willamette River sediments from its operations. The only source of HPAHs associated with Wacker Siltronic's past and present operations is diesel fuel stored for use in three emergency generators. All of the diesel fuel is stored in aboveground storage tanks that are integral to each generator. Wacker Siltronic has no record of any spill or leak of diesel fuel from its emergency generators.

Therefore, it is Bridgewater Group's conclusion that no link exists between the HPAHs detected in the Willamette River sediments and past or current operations conducted by Wacker Siltronic.

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2-Methylnaphthalene

2-methylnapthalene was detected above the harbor baseline value of 150 ug/kg in six of the seven sediment samples collected off the Wacker Siltronic facility. The highest 2-methylnaphthalene concentrations were found in the same samples that had elevated LPAH and HPAH concentrations.

Chemical Background

2-methylnapthalene is present in coal tar at up to 1.4 percent (14,000 ppm). During distillation of coal tar, it comprises one of the distillate fractions of coal tar creosote. It is reported in material safety data sheets (MSDS) to be present at 1 to 5 percent (10,000-50,000 ppm) in commercial coal tar creosote treating solutions.

Data reported in *Composition of Petroleum Mixtures* indicates that 2-methylnapthalene is also present in No. 2 diesel fuel at an average concentration of 0.89 percent (8,900 ppm).

Assessment of Relevance to Wacker Siltronic Site

When viewed in the context of the total spectrum of PAHs and semivolatile organics detected in the sediments adjacent to the Wacker Siltronic facility, it appears that 2-methylnapthalene came from the same source(s) as the LPAHs and HPAHs detected in river sediments.

As was discussed above, the only material used by Wacker Siltronic that could be a source of 1-methylnaphthalene is diesel fuel. Wacker Siltronic has no records of any releases or spills of diesel fuel from its emergency generators.

Therefore, it is Bridgewater Group's conclusion that no link exists between the 2-methylnapthalene detected in the Willamette River sediments and past or current operations conducted by Wacker Siltronic.

Carbazole

Carbazole was detected in six of the seven sediment samples above the harbor baseline of 100 ug/kg. The concentrations reported for all of the surface sediment samples were *estimated* concentrations ranging from 170 to 3,400 ug/kg. The highest carbazole concentrations were detected in the three most downstream sampling locations (i.e., SD068, SD069, and SD070).

Chemical Background

Carbazole is a heterocyclic aromatic compound containing a dibenzopyrrole system, and is produced during coal gasification. Coal tar produced at high temperature contains an average of 1.5% (15,000 ppm) carbazole. Several thousand tons of carbazole are produced each year

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from coal tar and crude oil. It is used widely in synthesis of dyes, pharmaceuticals, and plastics.

Carbazole is also one of the 300+ constituents that comprise creosote used for wood preservation. Depending on the fractionation of the creosote solution, carbazole can comprise up to 1 percent of coal tar creosote.

Data reported in *Composition of Petroleum Mixtures* indicates that mono and di-methyl carbazoles are present in no. 2 diesel fuels at less than 0.001 percent by weight.

Assessment of Relevance to Wacker Siltronic Site

Viewed in the context of the total spectrum of PAHs and semivolatile organics detected in the sediments adjacent to the Wacker Siltronic facility, it appears that carbazole came from the same source(s) as the LPAHs and HPAHs.

Therefore, it is Bridgewater Group's conclusion that no link exists between the carbazole detected in the Willamette River sediments to past or current operations conducted by Wacker Siltronic.

Dibenzofuran

Dibenzofuran was detected in all seven sediment samples off the Wacker Siltronic site above the harbor baseline value of 100 ug/kg, as well as downriver sediment samples SD065 and SD067. The dibenzofuran concentrations are correlated with total LPAHs and HPAHs, indicating that the dibenzofuran in sediments originated from the same source(s).

Chemical Background

Dibenzofuran (diphenylene oxide) is present in coal tar at up to 1 percent (10,000 ppm). During coal tar distillation, it is recovered in the distillate fractions that comprise coal tar creosote. The only reported use of dibenzofuran as a separate distillate is in insecticides.

Data reported in *Composition of Petroleum Mixtures* does not indicate that dibenzofuran is a constituent in No. 2 diesel fuel.

Assessment of Relevance to Wacker Siltronic Site

When viewed in the context of the total spectrum of PAHs and semivolatile organics detected in the sediments adjacent to the Wacker Siltronic facility, it appears that the dibenzofuran came from the same source(s) as the LPAHs and HPAHs.

Furthermore, Wacker Siltronic has never applied insecticides at the facility.

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Therefore, it is Bridgewater Group's conclusion that no link exists between the dibenzofuran detected in the Willamette River sediments to past or current operations conducted by Wacker Siltronic.

Pentachlorophenol

Pentachlorophenol (PCP) was detected at concentrations of 7.1 and 6.4 ug/kg at sampling locations SD075 and SD077, respectively. These concentrations are less than the harbor baseline value of < 97ug/kg, as listed in Table F-1, Data Evaluation Summary Table, in the Portland Harbor Sediment Management Plan (PHSMP). The baseline value in the PHSMP is inconsistent with the "detect" value listed in Table 1 of DEQ's Strategy Recommendation.

PCP was also detected in upstream sediment samples SD078, SD080, SD081, and SD088 at concentrations ranging from 4.6 to 11 ug/kg. PCP was detected along with other chlorinated herbicides in a suite of samples collected between River Mile 7 and 7.5.

Chemical Background

PCP is one of the most heavily used pesticides in the U.S. It is used primarily as an industrial wood preservative. It is registered for use by the U.S. Environmental Protection Agency (EPA) as an insecticide (termicide), fungicide, herbicides, molluscide, algicide, disinfectant, and as an ingredient in antifouling paint.

Until the mid-1980s, PCP (sodium pentachlorophenate) was also used in sawmills as a mildew/sap-stain control agent, and as an ingredient in consumer wood-preserving formulations, herbicides, and pesticides.

Assessment of Relevance to Wacker Siltronic Site

Bridgewater Group reviewed Wacker Siltronic's chemical use files and found no records indicating that pentachlorophenol was ever used at the site.

As was discussed earlier, PCP was detected twice in 1988 in Wacker Siltronic's combined effluent. Subsequent sampling of the combined effluent over a period of three months did not detect any PCP. The combined effluent outfall is located at the far northwest corner of the property. Given the location of this outfall and the short period of time over which PCP was present in the discharge, it is unlikely that the combined effluent is the source of the PCP detected in sediments.

Soil samples collected by CH2M HILL in 1985 in the portion of the property where a polysilicon plant was proposed for construction found PCP to be present at 35- to 35.6-feet deep at MW-4, 10- to 11.5-feet deep at MW5, and 15- to 16.5-feet deep at MW-6 (CH2M HILL, 1985a). The detection of PCP at these depths is indicative of a historic source prior to the filling of the property. It does not appear that the PCP present in subsurface soils at these locations is the source of PCP in the Willamette River sediments, however, given that PCP was not detected,

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at a detection limit of 0.001 mg/L, in groundwater samples collected from the monitoring wells in 1985.

Therefore, it is Bridgewater Group's conclusion that no link exists between the PCP detected in Willamette River sediments and past or current operations conducted by Wacker Siltronic.

Pesticides

2,4-D and 2,4-DB were detected above the harbor baseline value of <3.3 ug/kg at SD075 and SD077, the two sediment samples located at the upstream end of the property. The same two pesticides were detected at similar or higher concentrations in the two sediment samples collected upstream of the property: SD078 and SD080. DEQ's *Strategy Recommendation* states that " ....Due to the presence of the former presticide and herbicide manufacturer, Rhone-Poulenc upstream of the Wacker site, it does not appear that the presence of 2,4-D and 2,4-DB in Willamette River sediments is related to the Wacker site."

Chemical Background

There are many forms or derivatives of 2,4-D including esters, amines, and salts. 2,4-D, a chlorinated phenoxy compound, functions as a systemic herbicide and is used to control many types of broadleaf weeds. It is used in cultivated agriculture, in pasture and rangeland applications, forest management, home, garden, and to control aquatic vegetation. It may be found in emulsion form, in aqueous solutions (salts), and as a dry compound. Commercial names for products containing 2,4-D include Aqua-Kleen, Barrage, Lawn-Keep, Malerbane, Planotox, Plantgard, Savage, Salvo, Weedone, and Weedtrine-II. The product Agent Orange, used extensively throughout Vietnam, was about 50% 2,4-D.

Traditionally, Rhone-Poulenc Ag. Co., has been a primary manufacturer of 2,4-D in the U.S.

2,4-DB is 4-(2,4-dichlorophenoxy)butyric acid. Trade names for products containing 2,4-DB include Butoxone, Butyrac, Butirex, Embutone, Embutox, and Venceweed. 2,4-DB may also be found in formulations with other herbicides such as cyanazine, MCPA, benazolin, linuron, and mecoprop.

2,4-DB is a selective systemic herbicide in the phenoxy family. It is used for the control of many annual and perennial broad-leaved weeds in alfalfa, peanuts, soybeans, and other crops. In the plant, the compound changes to 2,4-D and inhibits growth at the tips of stems and roots.

Traditionally, Rhone-Poulenc Ag. Co., has been a primary manufacturer of 2,4-DB in the U.S.

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Assessment of Relevance to Wacker Siltronic Site

Based on review of Wacker Siltronic's records, Bridgewater Group is in agreement with DEQ. The only pesticide used on a regular basis by Wacker Siltronic is Roundup™. This emergent herbicide is used for brush control. It is applied by a licensed applicator service. Therefore, there is no link between the 2,4-D and 2,4-DB present in Willamette River sediments and past or current operations conducted by Wacker Siltronic.

Phthalates

Bis(2-ethylhexyl)phthalate was detected at one sediment sampling location (i.e., SD075) at a concentration exceeding the harbor baseline value of 390 ug/kg. Bis(2-ethylhexyl)phthalate was not detected above the harbor baseline value immediately upstream or downstream of the property.

Chemical Background

Di(2-ethylhexyl) phthalate (DEHP), commonly called bis (2-ethylhexyl) phthalate, is a colorless, oily liquid with a slight odor. Patented in 1933, it is primarily used as one of several plasticizers in polyvinyl chloride (PVC) resins for fabricating flexible vinyl products. These PVC resins have been used to manufacture teething rings, pacifiers, soft squeeze toys, balls, shower curtains, raincoats, adhesives, polymeric coatings, components of paper and paperboard, defoaming agents, enclosures for food containers, animal glue, surface lubricants, lead-acid battery separators, and other products that must stay flexible for their lifetime. It is also used to manufacture vinyl gloves used for medical examinations and surgery.

As a non-plasticizer, bis(2-ethylhexyl) phthalate is used as a replacement for polychlorinated biphenyls (PCBs) in dielectric fluids for electric capacitors and transformers. It is also used as a solvent in erasable ink, an acaricide for use in orchards, an inert ingredient in pesticides, a component of cosmetic products, vacuum pump oil; and it is used to detect leaks in respirators and to test air filtration systems.

Assessment of Relevance to Wacker Siltronic Site

DEQ's *Strategy Recommendation* states that Wacker Siltronic uses dioctylphthalate as a plasticizer. This is incorrect. According to Wacker Siltronic, no phthalates are used anywhere in the manufacturing process.

In 1985, bis(2-ethylhexyl)phthalate was detected in groundwater at two locations (i.e., MW-2 and MW-4) on the portion of the property where a polysilicon plant was proposed for construction. According to North Creek Analytical laboratory, the bis(2-ethylhexyl)phthalate concentrations that were detected are trace levels that could easily be associated with cross-contamination from field sampling equipment or from sample

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handling in the laboratory. Thus, the bis(2-ethylhexyl)phthalate reportedly detected in groundwater may not have been present. Even if it was present, it does not appear to be the source of the bis(2-ethylhexyl)phthalate detected in Willamette River sediments. The monitoring of groundwater elevations between 1986 and 1998 in this area indicates that groundwater flow is to the southeast and east, away from the Willamette River. Bis(2-ethylhexyl)phthalate was not detected in groundwater in any of the four monitoring wells (i.e., MW-3, MW-5, MW-6 and MW-7) located downgradient from MW-2 and MW-4. Thus, the extent of bis(2-ethylhexyl)phthalate in groundwater, if it was present at all, was limited and it did not migrate offsite in groundwater.

It is important to note that sediment sample SD075 is located downstream of a City of Portland storm drain that discharges just downstream of the Railroad Bridge. Bis(2-ethylhexyl)phthalate is a constituent that is commonly found in sediments adjacent to stormwater discharges. Sampling conducted in 1995 at five stormwater discharge locations in the Willamette River found bis(2-ethylhexyl)phthalate to be present at each location (Port of Portland, 1998).

It is Bridgewater Group's conclusion is that there is no link between the bis(2-ethylhexyl)phthalate detected in one sediment sample and past or current operations conducted by Wacker Siltronic.

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Wacker Siltronic. December 15, 1995 letter to Laurie J. McCulloch DEQ regarding Wacker Siltronic Corporation Petroleum Contaminated Soil Closure Report from Thomas C. McCue, 1995b.

Table 1
Constituents Reported by DEQ to Exceed Apparent Portland Harbor Baseline Sediment Values

Analyte	Downstream		Adjacent to Wacker Siltronic Site							Upstream		Harbor Baseline Maximum
	SD065	SD067	SD068	SD069	SD070	SD072	SD072A	SD075	SD077	SD078	SD080	
Metals (mg/kg)												
Beryllium	0.7	0.7	0.65	0.7	0.7	0.6	0.6	***0.9***	0.7	0.5	0.7	0.7
Cobalt	19	17.8	18.2	***21.3***	***20.3***	18.4	***24.6***	***23.9***	***21.3***	15.4	18.3	19.7
Iron	43,100	43,800	44,100	***54,200***	***53,000***	***51,900***	***53,900***	***64,500***	***58,600***	41,400	44,200	45,000
Manganese	699	624	681	725	638	591	***863***	***909***	605	487	693	810
Selenium	11	***17***	12	***17***	***17***	***16***	14	***17***	14	11	14	15
Silver	1.0	1.2	1.2	***1.5***	1.4	1.3	1.3	***1.7***	***1.6***	1.0	1.2	1.4
Titanium	NA	NA	NA	NA	***2,840***	***2,740***	***2,850***	NA	***3,200***	NA	NA	2075
Vanadium	107	***113***	110	***136***	***132***	***125***	***136***	***152***	***147***	89.1	106	112
Zinc	104	***150***	***134***	***144***	117	113	***145***	***120***	***124***	100	***131***	118
Organics (µg/kg)												
2-Methylnaphthalene	***11,000***	***7,600***	***2,700***	***210***	***530***	130	***980***	***180***	***430***	24	19U	150
Bis(2-ethylhexyl)phthalate	200U	200U	150	76	94U	210	260	***700***	180U	210	260	390
Cabazole	***3,600***	***1,800***	***1,700J***	***3,400J***	***2,000EJ***	86J	***660***	***170J***	***700J***	40J	19U	100
Dibenzofuran	***1600***	***1300***	***700***	***1,900***	***2,600***	***220***	***3,600***	***340***	***160***	20	19U	100
Pentachlorophenol	480UJ	1,000U	98UJ	98UJ	94UJ	99UJ	530U	***7.1***	***6.4***	***4.6***	***11***	Detect
LPAHs	***165,600***	***112,400***	***60,430***	***65,680***	***70,574***	***4,995***	***31,500***	***13,490***	***6,860***	425	337	700
HPAHs	***268,800***	***192,000***	***89,800***	***58,390***	***46,990***	***8,630***	***18,860***	***15,260***	***9,060***	***3,034***	2,134	2,400
2,4-D	NA	NA	NA	NA	NA	NA	NA	***9***	***24***	***21***	***93***	<3.3
2,4-DB	NA	NA	NA	NA	NA	NA	NA	***19***	***13***	***23***	***130***	<5

Notes: Analyte concentrations shown in ***bold italics*** exceed the apparent Portland Harbor Baseline maximum value for that analyte.

J = The analyte was positively identified and detected: however, the concentration in an estimated value because the result is less than the quantitation limit or quality control criteria were not met.

It should be noted that Table 1 of DEQ's *Strategy Recommendation* did not report the "J" data qualifier. Data in the DEQ table is represented as an actual concentration, when, in fact, it is an estimated concentration.

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Table 2
Comparison of Metals Reported by DEQ to Exceed Apparent Portland Harbor Baseline Sediment Concentrations with Metals Concentrations Detected on Suspended in the Portland Harbor

Analyte	Adjacent to Wacker Siltronic Site							Concentration on Suspended Sediments in the Portland Harbor[a]	Concentration on Suspended Sediments in the Portland Harbor[b]
	SD068	SD069	SD070	SD072	SD07A	SD075	SD077		
Metals (mg/kg)									
Beryllium	0.65	0.7	0.7	0.6	0.6	***0.9***	0.7	1.1 – 3.0	1.1 – 1.6
Cobalt	18.2	***21.3***	***20.3***	18.4	***24.6***	***23.9***	***21.3***	21 – 32	22 -30
Iron	44,100	***54,200***	***53,000***	***51,900***	***53,000***	***64,500***	***58,900***	47,000 – 66,000	52,000 – 66,000
Manganese	681	725	638	591	***863***	***909***	605	1,300 – 4,100	800 – 3,700
Selenium	12	***17***	***17***	***16***	14	***17***	14	0.1 – 0.6	0.1 – 0.6
Silver	1.2	***1.5***	1.4	1.3	1.3	***1.7***	***1.6***	<0.1 - <0.5	<0.5 – 0.9
Titanium	NA	NA	***2,840***	***2,740***	***2,850***	NA	3,200	5,100 – 7,800	5,800 – 8,800
Vanadium	110	***136***	***132***	***125***	***136***	***152***	***147***	130 - 190	140 – 180
Zinc	***134***	***144***	117	113	***145***	120	***124***	120 - 180	38 – 250

Notes: Analyte concentrations shown in ***bold italics*** exceed the apparent Portland Harbor Baseline maximum value for that analyte.

[a] Metal concentrations measured by the USGS at the Willamette River at Portland gaging station (USGS, 1995, 1996, 1998)

b Metal concentrations measured by the USGS at the Willamette River at Portland gaging station, unpublished data for 1995 through 1996 provided by Chauncey Anderson

NA = Not analyzed

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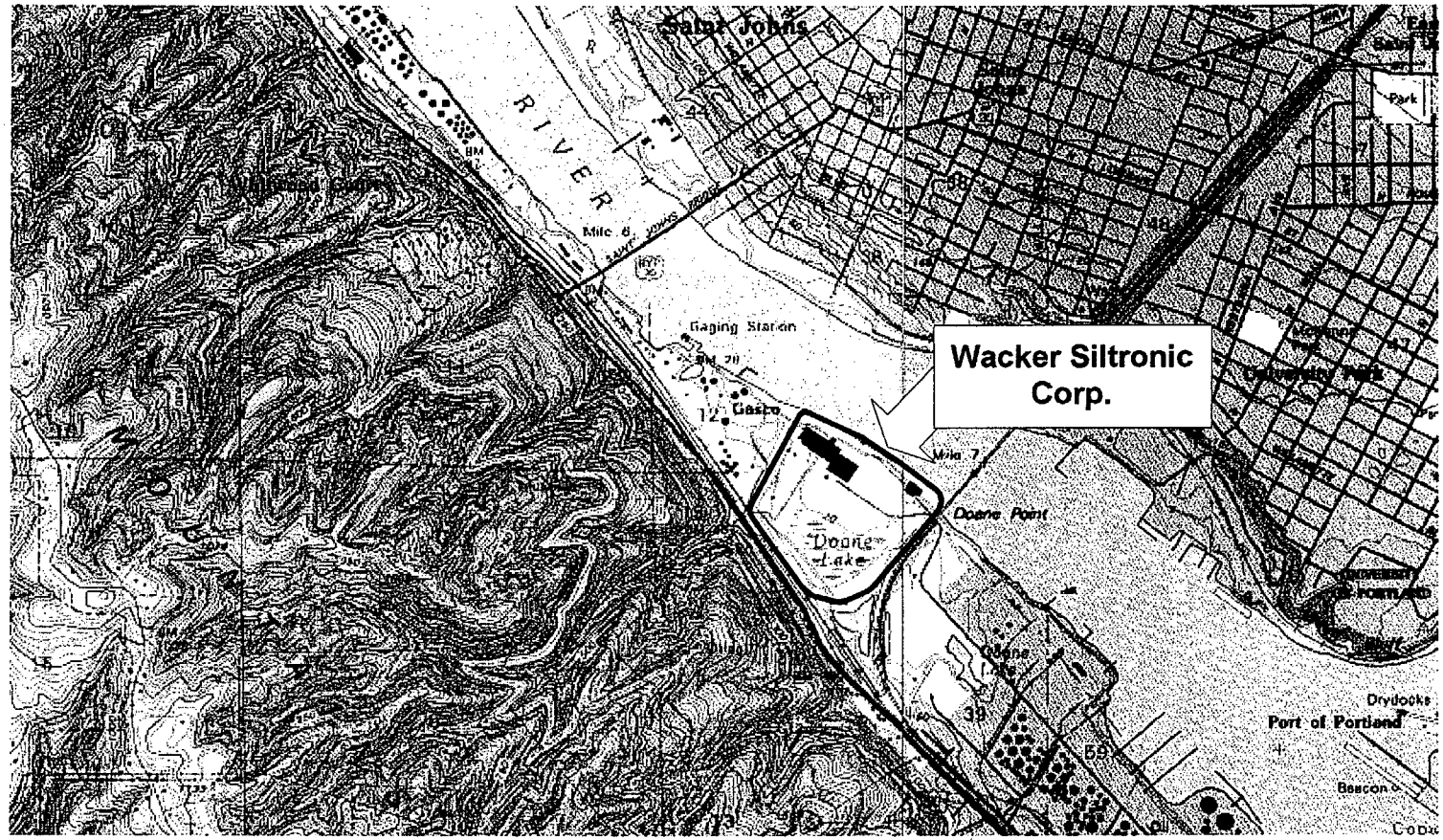
Table 3
Comparison of Sediment Sample Results Collected Near the Wacker Siltronic Site to Potential Source Chemicals

Constituent	SD068 (%)	SD069 (%)	SD070 (%)	SD072 (%)[a]	SD072A (%)	SD075 (%)	SD077 (%)	No.2 Diesel and Fuel Oil (%)[a]	Creosote (%)[b]	Coal Tar (%)[c]
Semivolatile Organics										
2-Methylnaphthalene	0.00027	0.000021	0.000053	0.000013	0.000098	0.000018	0.000043	0.68-0.89	1-6	1.4
Carbazole	0.00017	0.00034	0.00020	0.0000086J	0.000066	0.000017J	0.00007J	-	✓	1.5
Dibenzofuran	0.000070	0.00019	0.00026	0.000022	0.00036	0.000034	0.000016	-	✓	1.0
LPAHs										
Naphthalene	0.000079	0.000020	0.000051	0.000021	0.000020	0.000035	0.00003	0.026-0.22	1-6	10
Acenaphthylene	0.000074	0.000018	0.0000064	0.0000085	0.0000011U	0.000014	0.000014	0.006	✓	✣
Acenaphthene	0.0015D	0.00056D	0.0011D	0.00015	0.00072	0.00038D	0.00024D	0.018	1-6	1.4
Fluorene	0.00049D	0.00067D	0.0011D	0.000096	0.00050	0.00024D	0.00014	0.086	✓	2.0
Phenanthrene	0.0033D	0.0031D	0.0040D	0.00018D	0.0016D	0.00055D	0.00022	0.079-0.088	5-13	5.3
Anthracene	0.00060D	0.0022D	0.0008D	0.000044	0.00031	0.00013	0.000042	0.0028-0.0058	1-5	1.8
HPAHs										
Fluoranthene	0.0020D	0.0022D	0.0019D	0.00015D	0.00072D	0.00035D	0.00017D	0.0014-0.0059	✓	3.3
Pyrene	0.0026D	0.0017D	0.0017D	0.00016D	0.00066	0.00033D	0.00025D	0.0029-0.0046	✓	2.1
Benzo(a)anthracene	0.00063D	0.00048D	0.00029D	0.00007	0.00011	0.00015	0.000074	0.000045-0.000096	✓	✣
Chrysene	0.00086D	0.00063D	0.00032D	0.00011	0.00015	0.00017D	0.000092	0.000045-0.00014	✓	2.0
Benzo(b)fluoranthene	0.00039D	0.00019D	0.00011D	0.00008	0.000046	0.00011	0.000070	0.000031	✓	✣
Benzo(k)fluoranthene	0.00054D	0.00014	0.00012	0.000063	0.000069	0.00011	0.000067	Reported with Benzo(b)fluoranthene	✓	✣
Benzo(a)pyrene	0.00080D	0.00024D	0.00014	0.000098	0.000066	0.00013	0.000089	0.000021-0.00022	✓	✣
Indeno(1,2,3-cd)pyrene	0.00042D	0.00011	0.000052	0.000056	0.000031	0.000073	0.000038	0.000016	✓	✣
Dibenz(a,h)anthracene	0.00015	0.000039	0.000021	0.000016	0.000011U	0.000022	0.000014	-	✓	✣
Benzo(g,h,I)perylene	0.00059DJ	0.00011	0.000046	0.000060	0.000034	0.000081	0.000042J	0.0000057-0.000012	✓	✣

[a]From *Composition of Petroleum Mixtures – Volume 2*, Total Petroleum Hydrocarbon Criteria Working Group, May 1998.

[b]From material safety data sheet (MSDS), Reilly Industries, P2 Creosote Solution, July 1995. ✓ denotes that constituent was listed on MSDS, but percent composition was not listed.

[c]Chemical Process Industries, R. Norris Shreve, McGraw-Hill Book Company, 3rd Ed, 1967. ✣ denotes that constituent is present but percent composition not listed.



Source: USGS, Linnton and Portland Quadrangles (1990)

N

Approximate Scale: 1" = 2325'

Figure 1
Location Map
Wacker Siltronic Corp.

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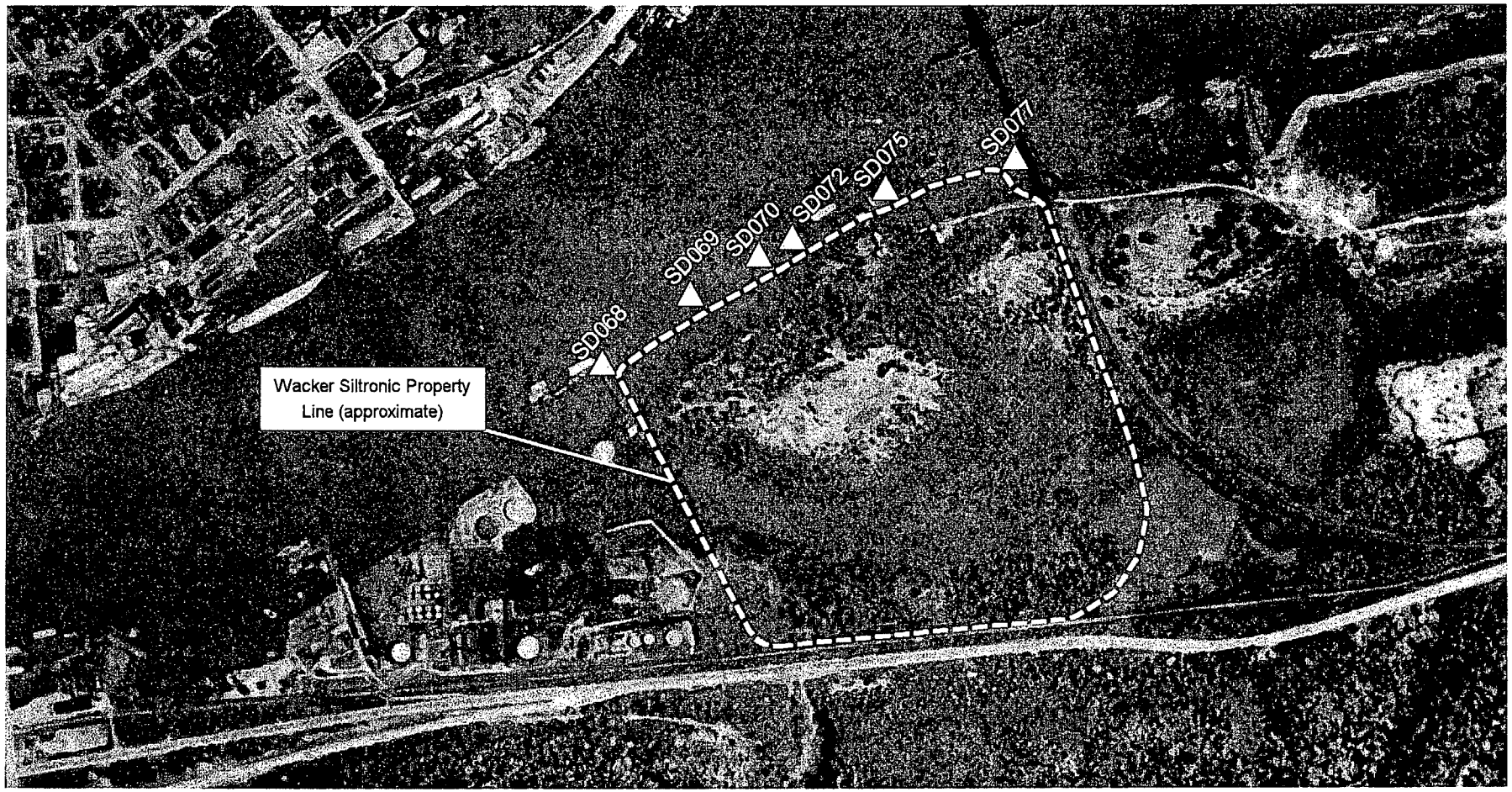


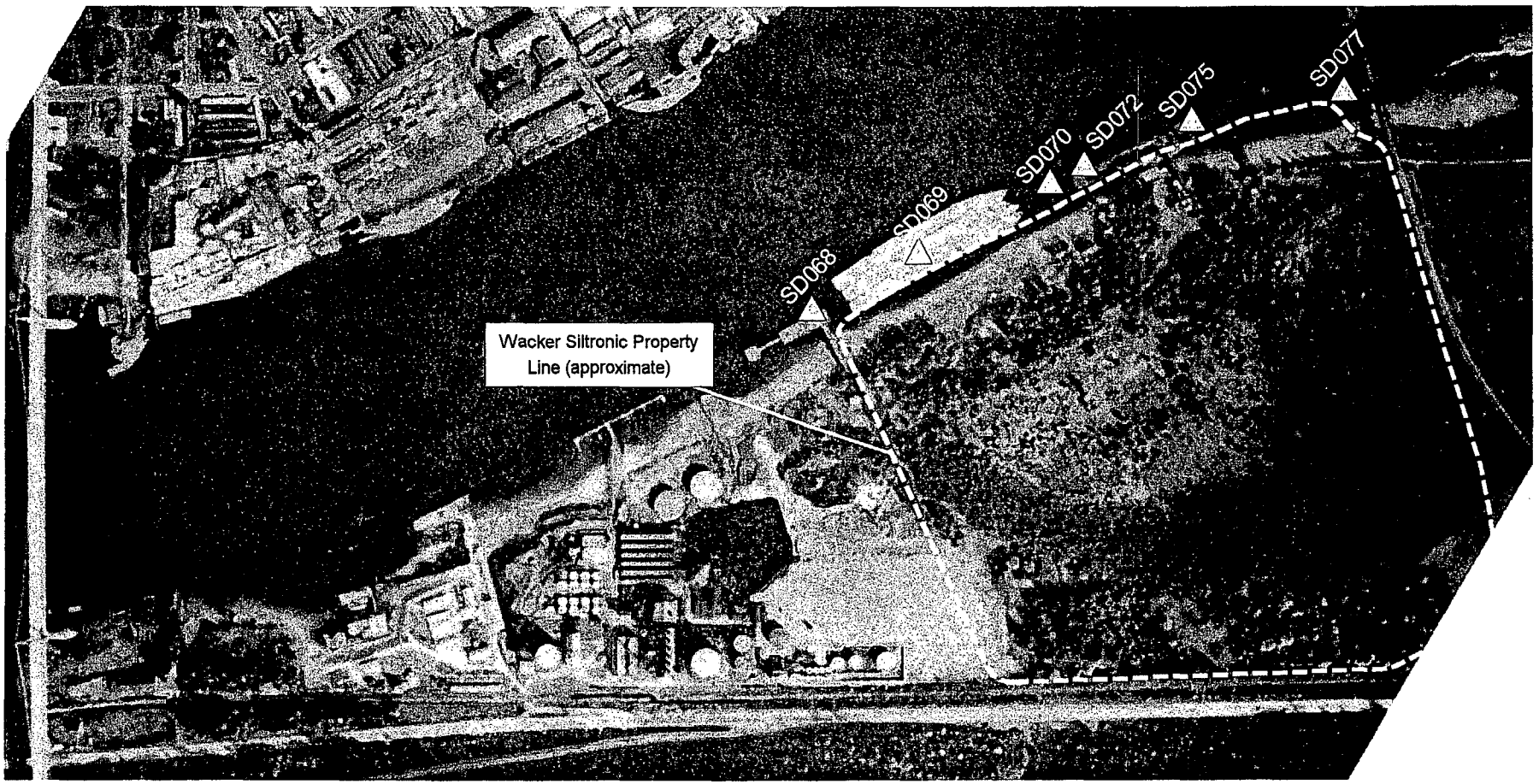
△ Approximate Location of EPA Sediment Sample Station (SDxxx)

N

Approximate Scale: 1 inch = 600 feet

Figure 2
Historical Aerial Photograph
May 1936

BRIDGEWATER GROUP, INC.



△ Approximate Location of EPA Sediment Sample Station (SDxxx)

Approximate Scale: 1 inch = 600 feet

Figure 3
Historical Aerial Photograph
October 1940

BRIDGEWATER GROUP, INC.

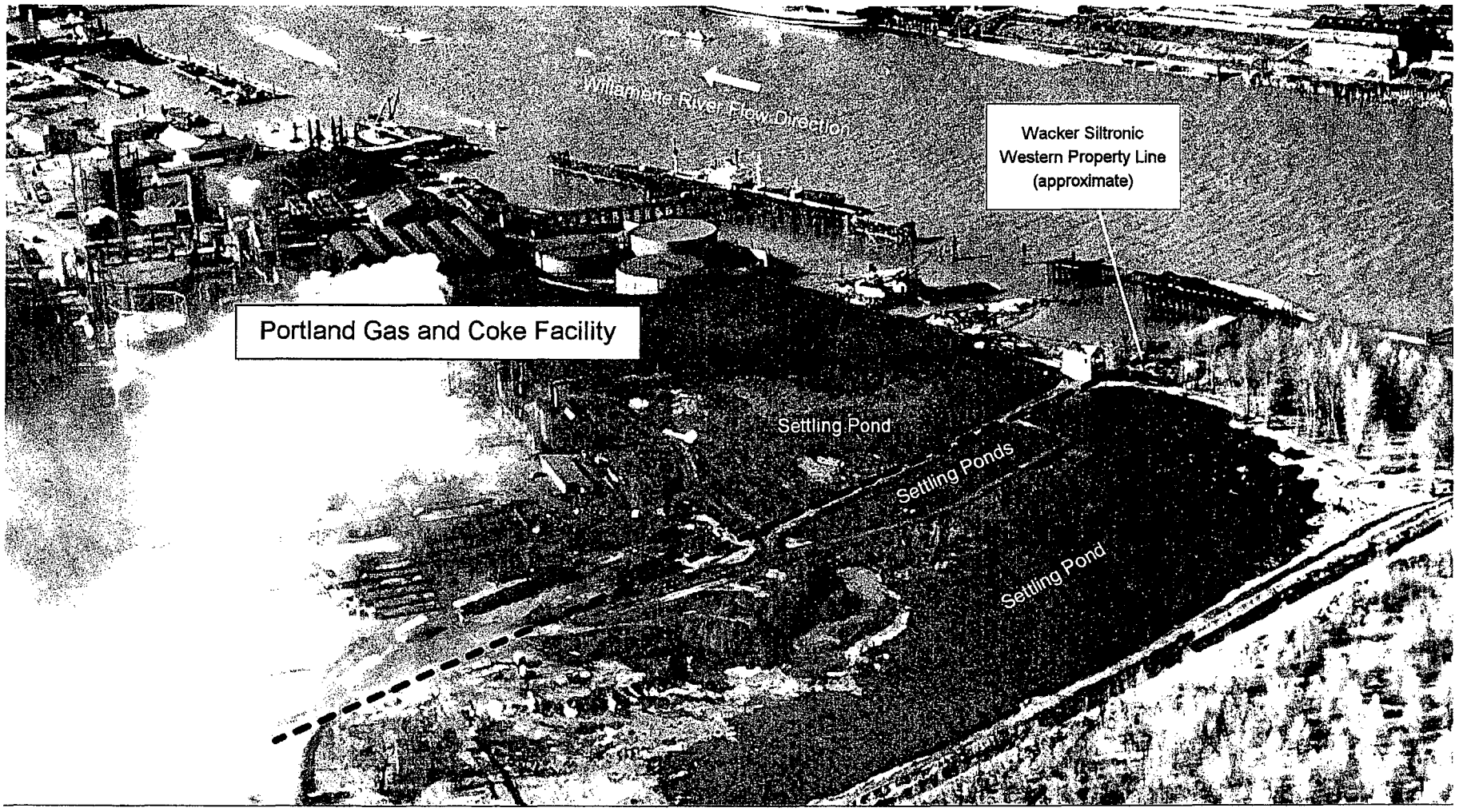


Figure 4
Historical Aerial Photograph
April 1952

BRIDGEWATER GROUP, INC.

Figure 5
Historical Aerial Photograph
March 1955

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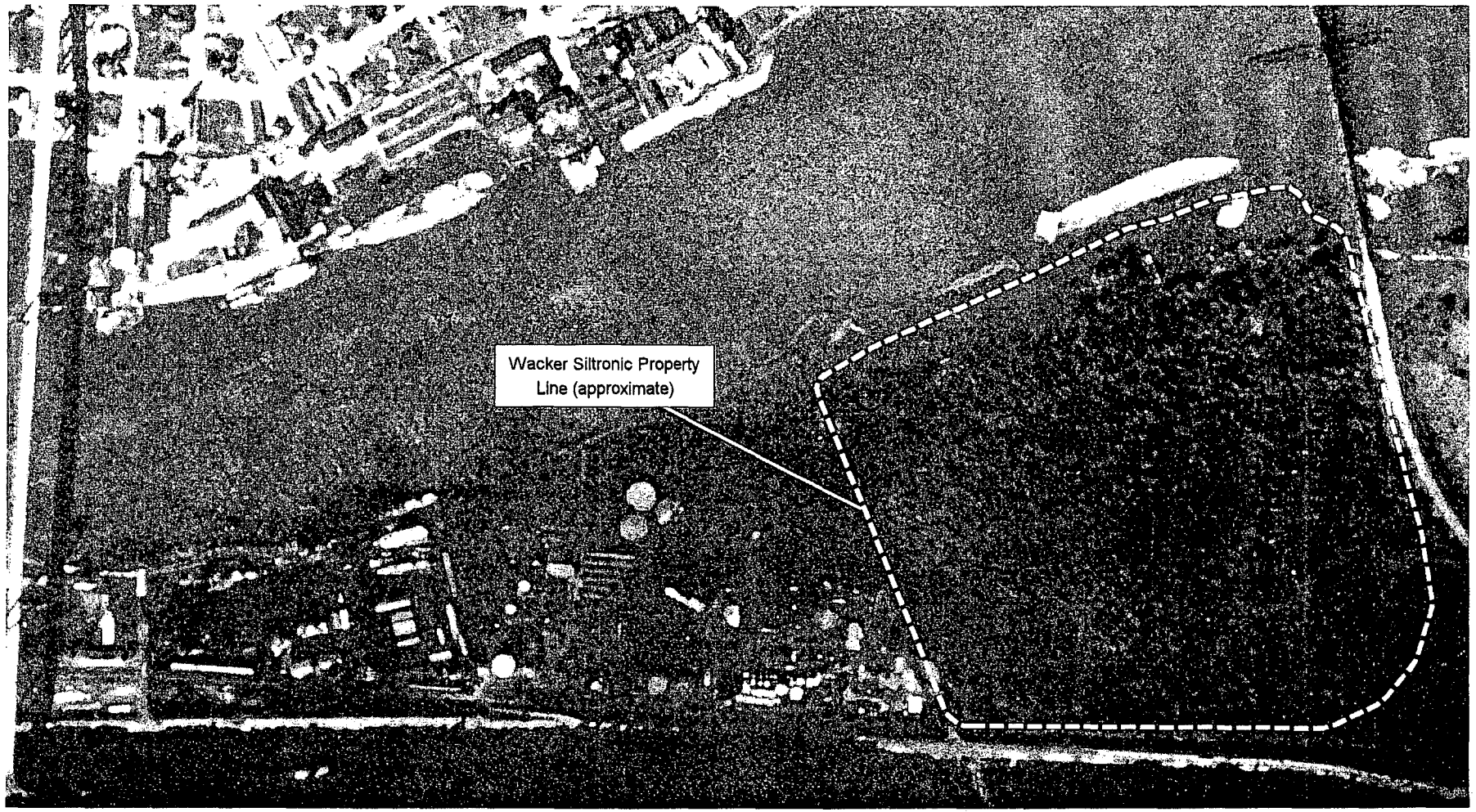
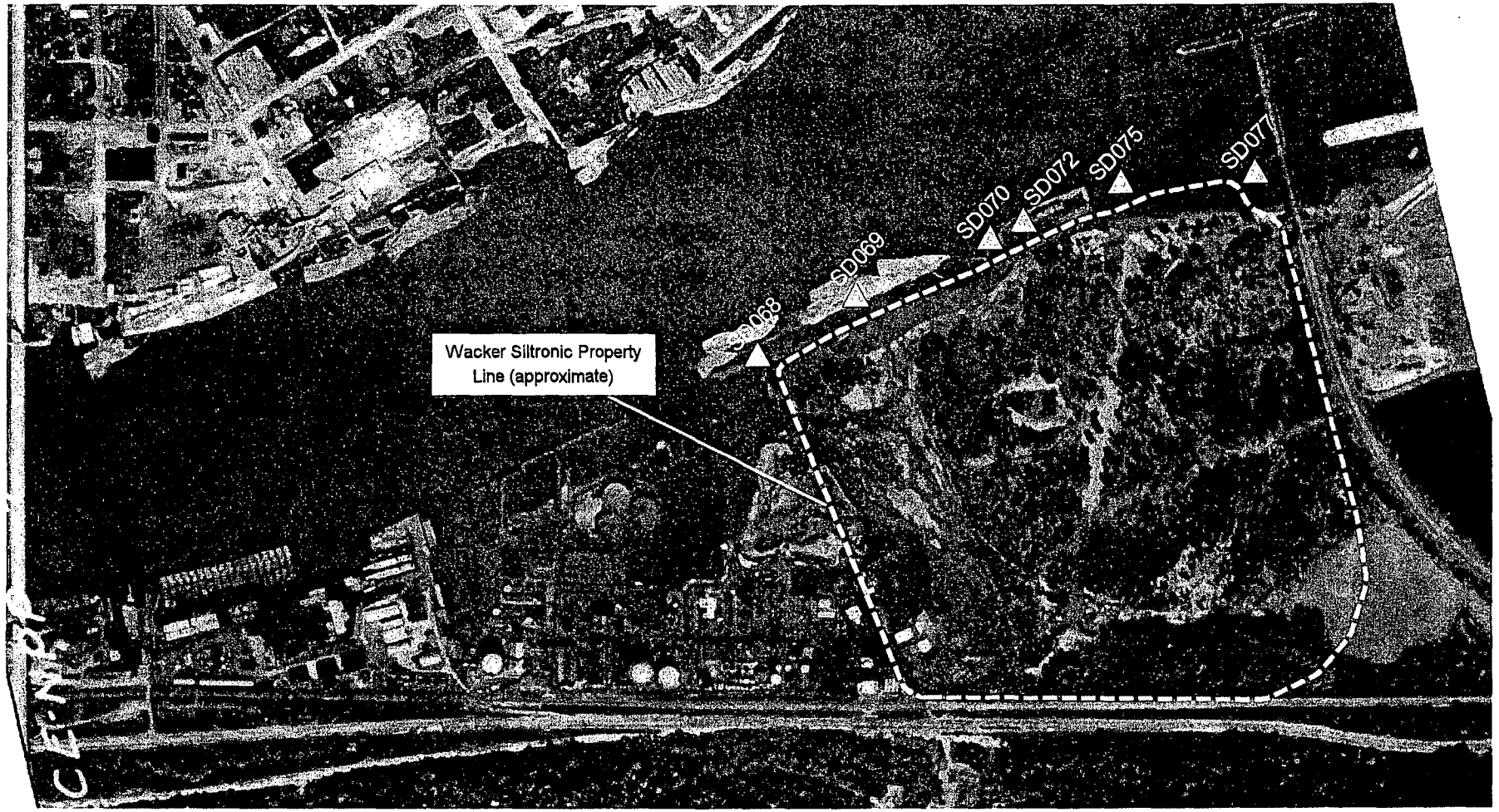


Approximate Scale: 1 inch = 600 feet

Figure 6
Historical Aerial Photograph
June 1948 Flood

BRIDGEWATER GROUP, INC.



△ Approximate Location of EPA Sediment Sample Station (SDxxx)

Approximate Scale: 1 inch = 600 feet

Figure 7
Historical Aerial Photograph
May 1957

BRIDGEWATER GROUP, INC.

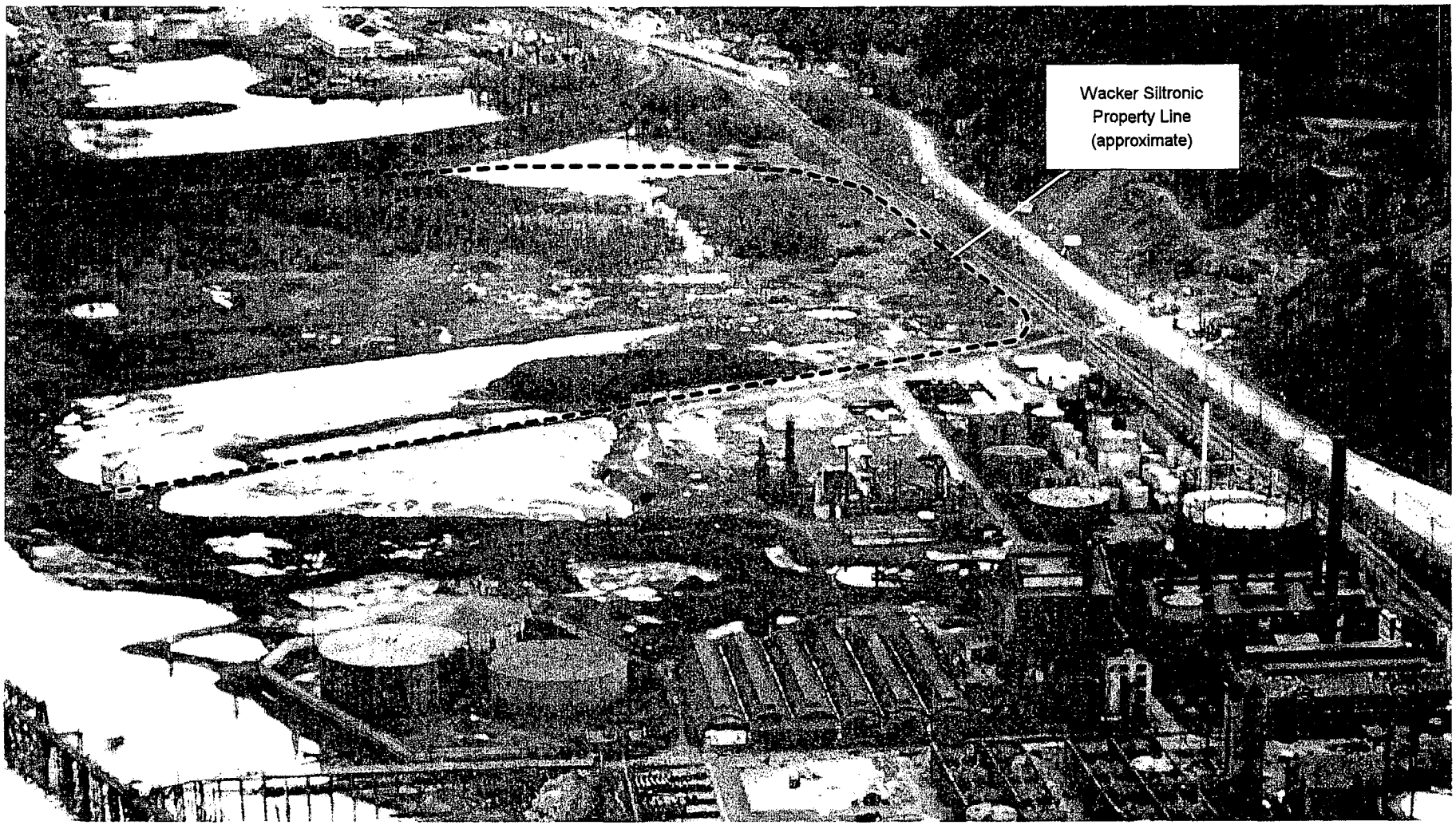
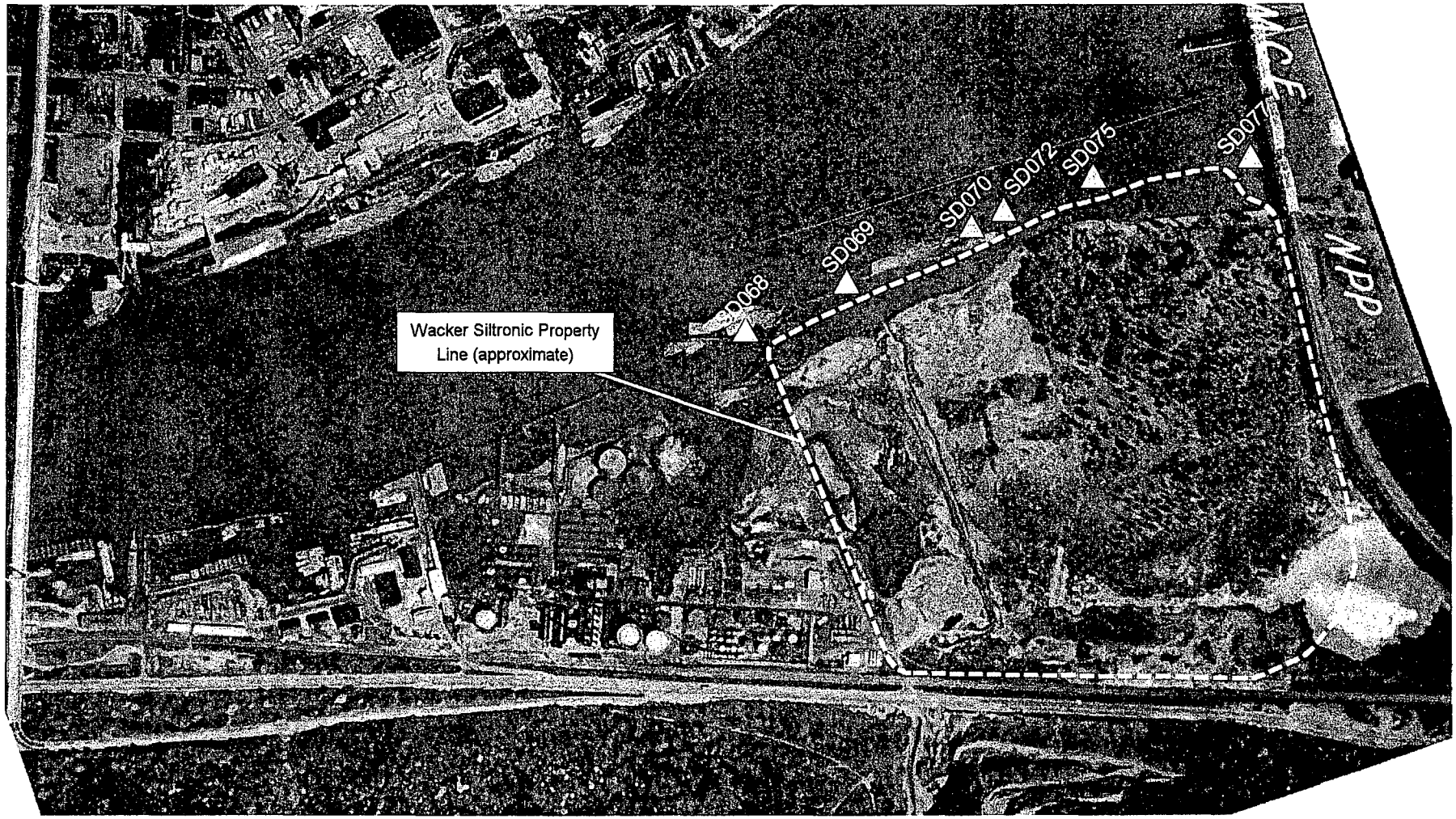


Figure 8
Historical Aerial Photograph
March 1961

BRIDGEWATER GROUP, INC.



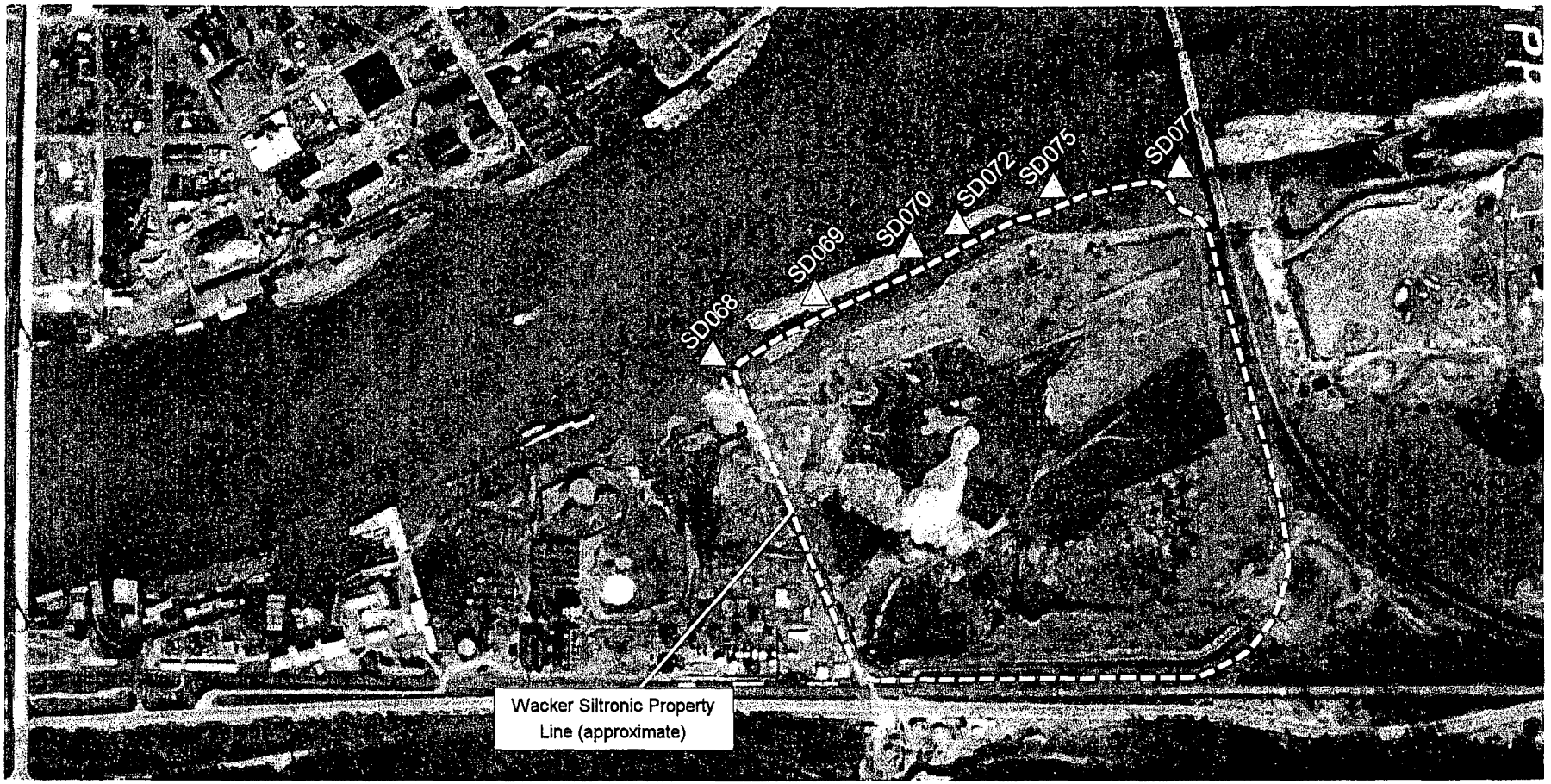
△ Approximate Location of EPA Sediment Sample Station (SDxxx)

N

Approximate Scale: 1 inch = 600 feet

Figure 9
Historical Aerial Photograph
April 1961

BRIDGEWATER GROUP, INC.

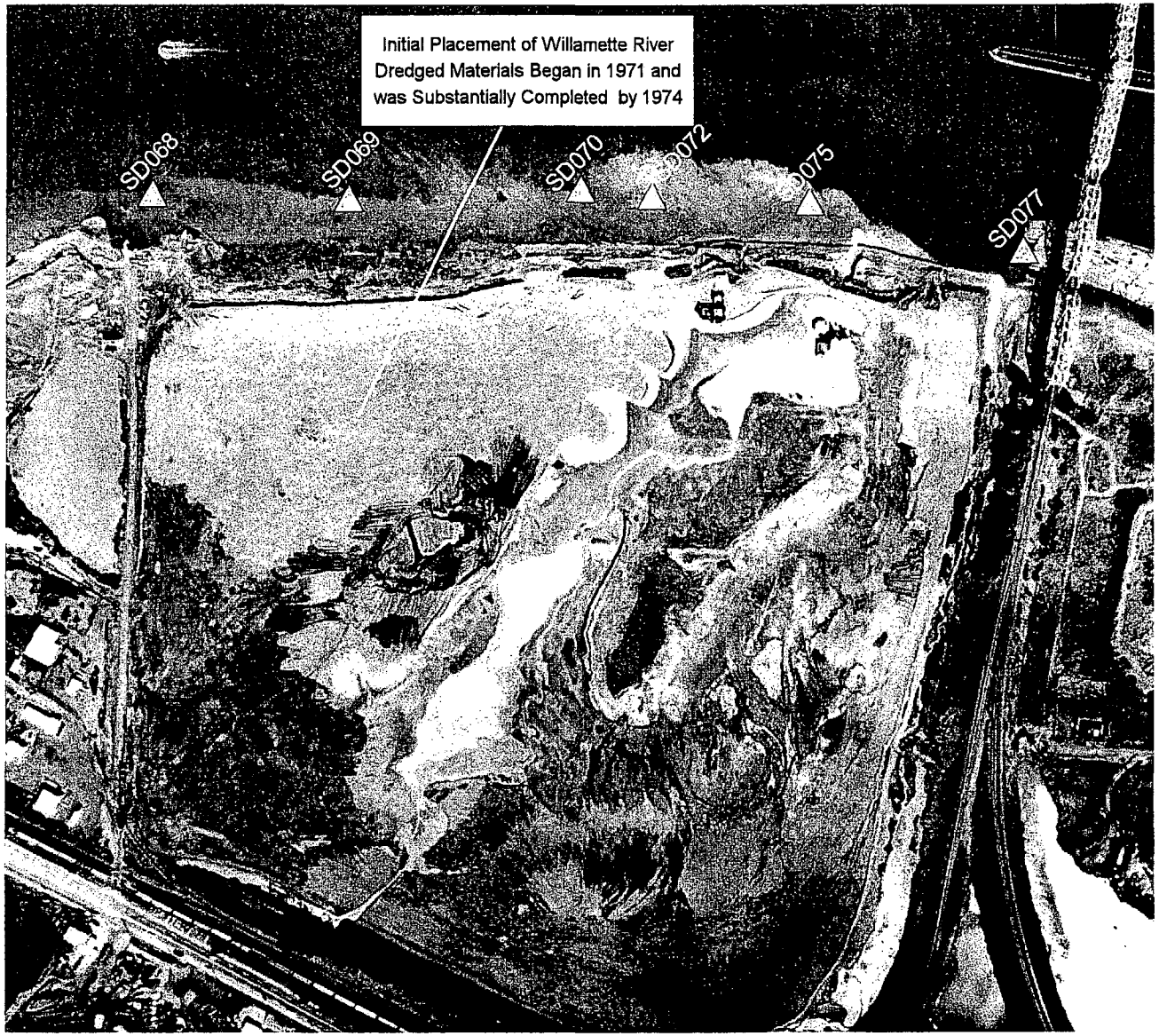


△ Approximate Location of EPA Sediment Sample Station (SDxxx)

Approximate Scale: 1 inch = 600 feet

Figure 10
Historical Aerial Photograph
April 1967

BRIDGEWATER GROUP, INC.



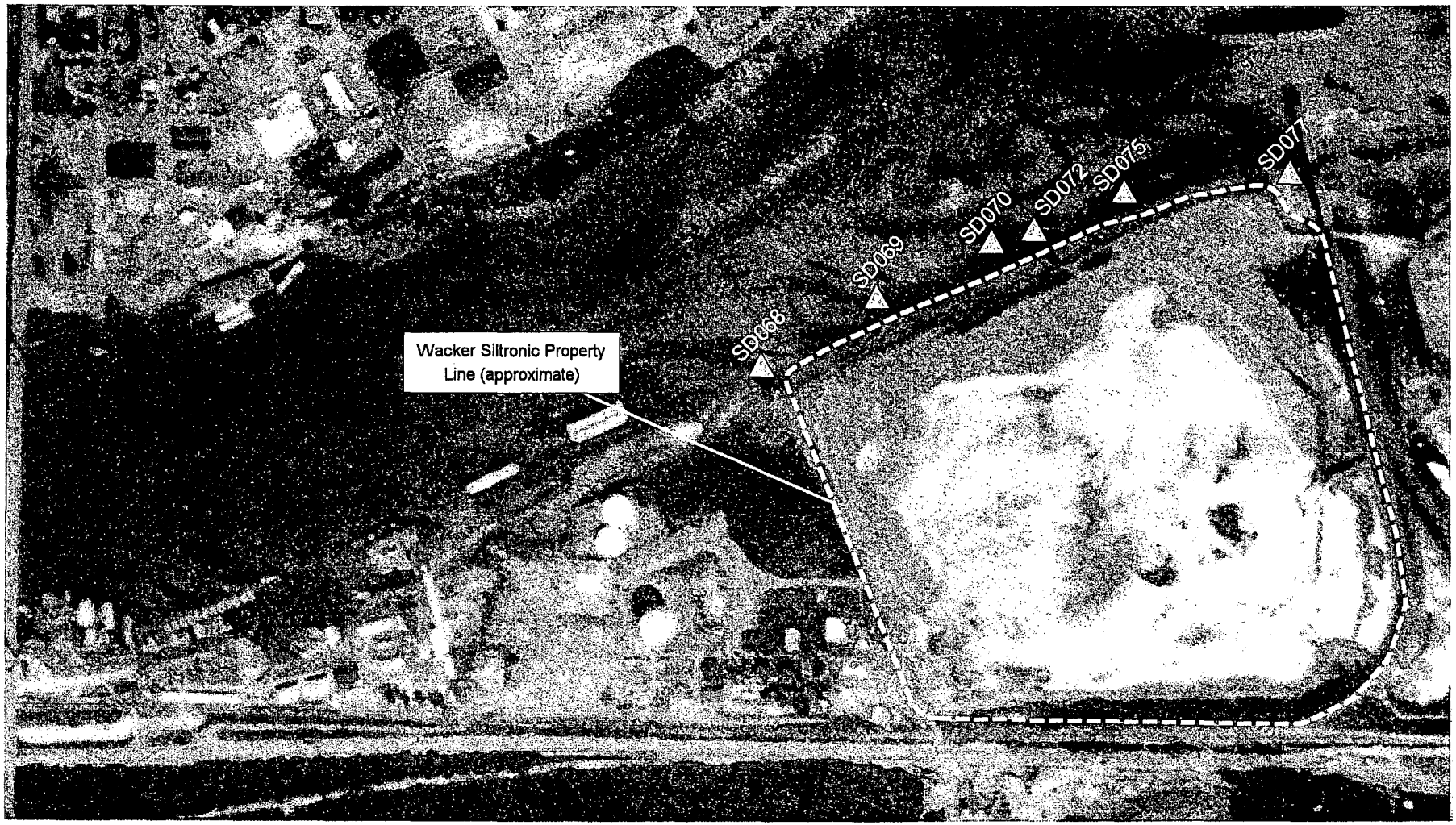
△ Approximate Location of EPA Sediment Sample Station (SDxxx)

N

Approximate Scale: 1 inch = 420 feet

Figure 11
Historical Aerial Photograph
1971

BRIDGEWATER GROUP, INC.



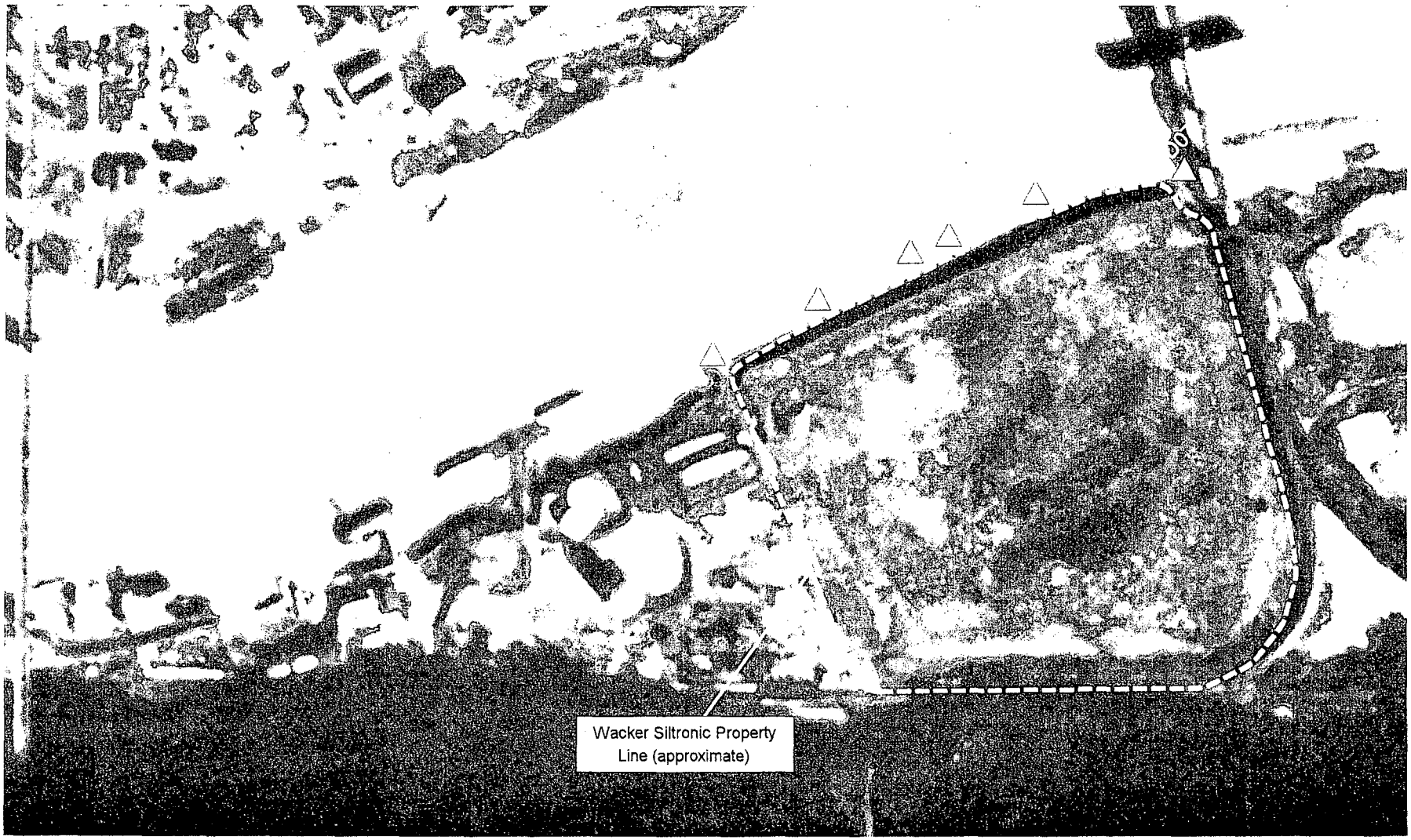
△ Approximate Location of EPA Sediment Sample Station (SDxxx)

N

Approximate Scale: 1 inch = 600 feet

Figure 12
Historical Aerial Photograph
August 1973

BRIDGEWATER GROUP, INC.



△ Approximate Location of EPA Sediment Sample Station (SDxxx)

N

Approximate Scale: 1 inch = 600 feet

Figure 13
Historical Aerial Photograph
December 1977

BRIDGEWATER GROUP, INC.

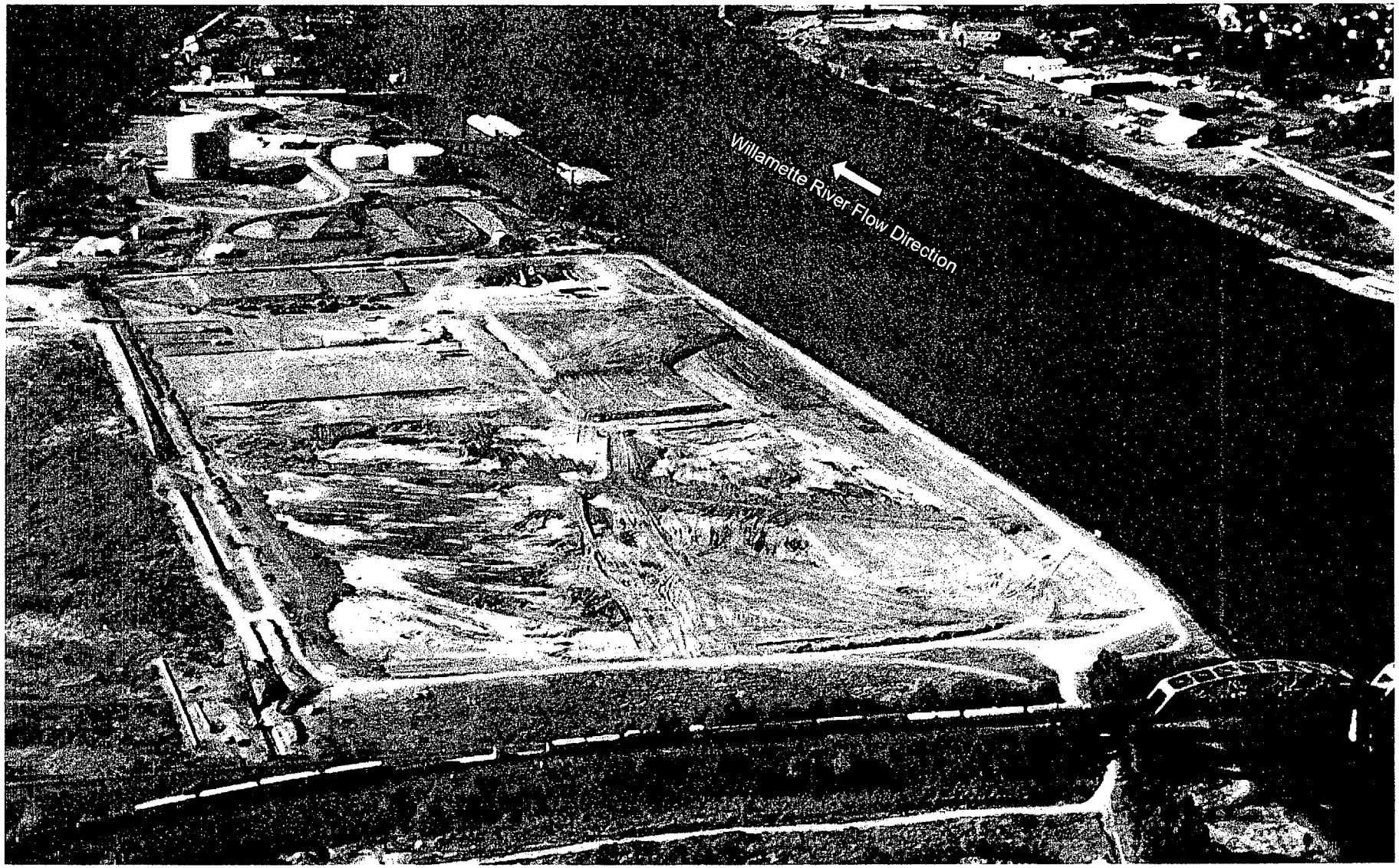


Figure 14
Historical Aerial Photograph
October 1978

BRIDGEWATER GROUP, INC.

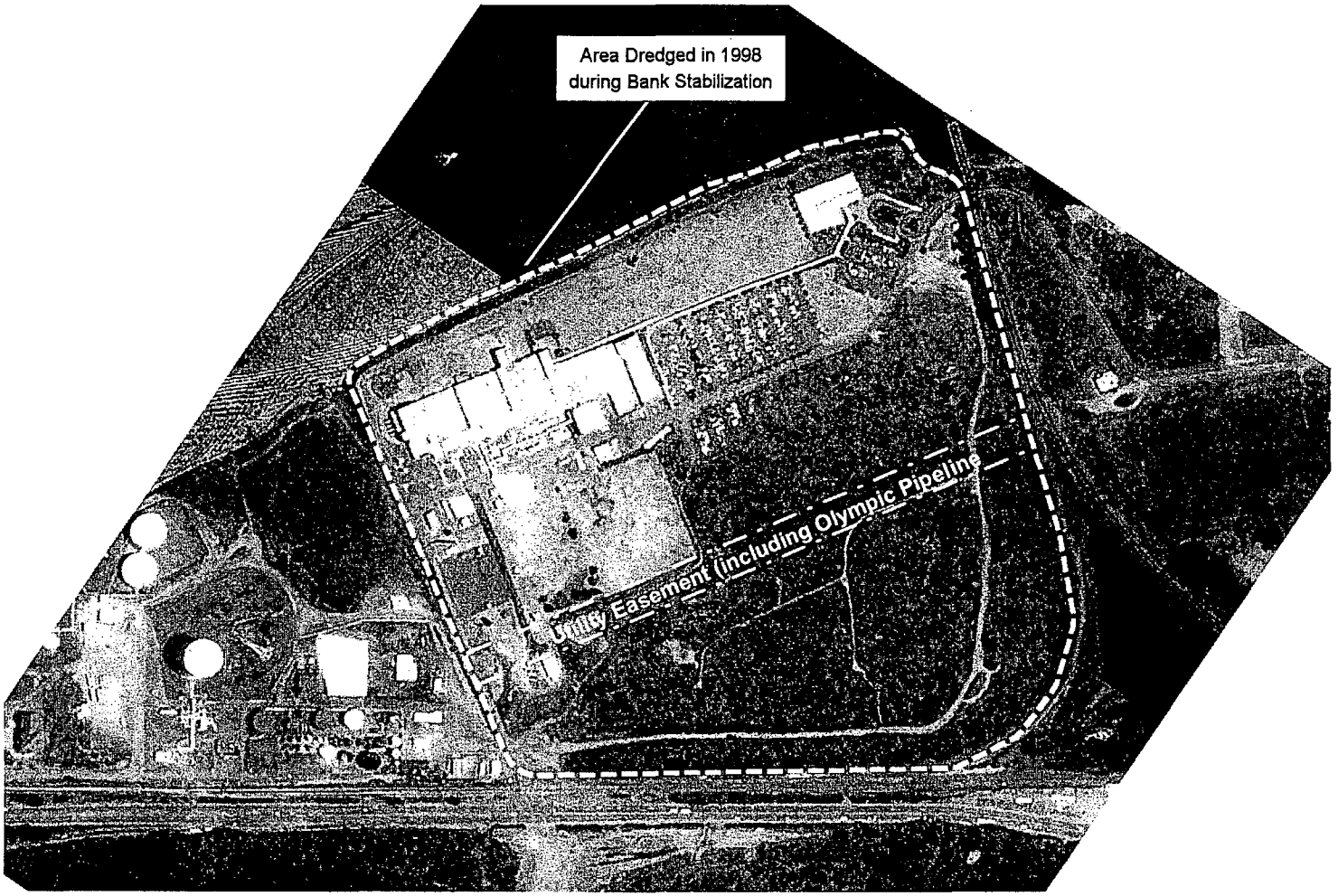
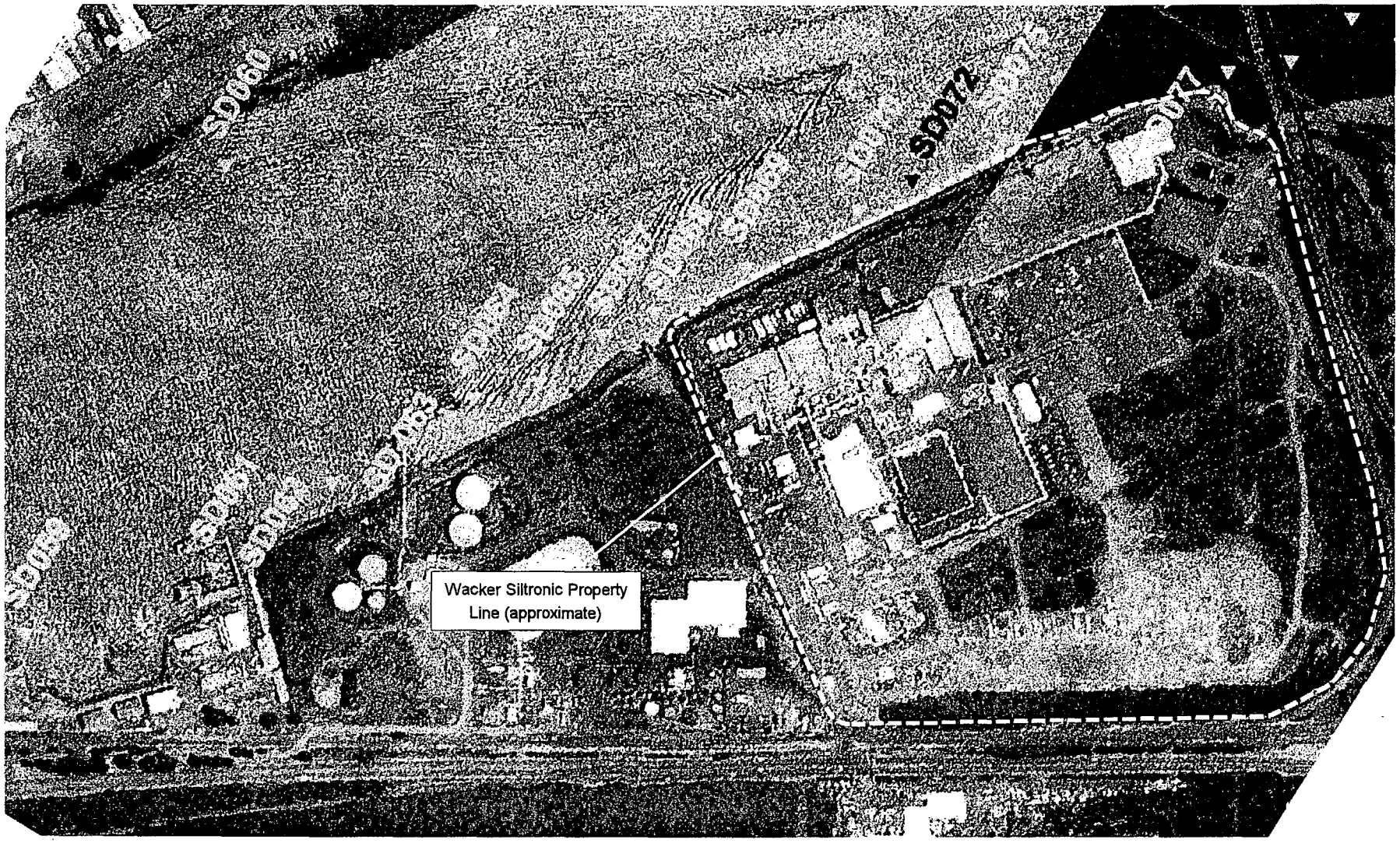


Figure 15
Historical Aerial Photo
September 1993

BRIDGEWATER GROUP, INC.

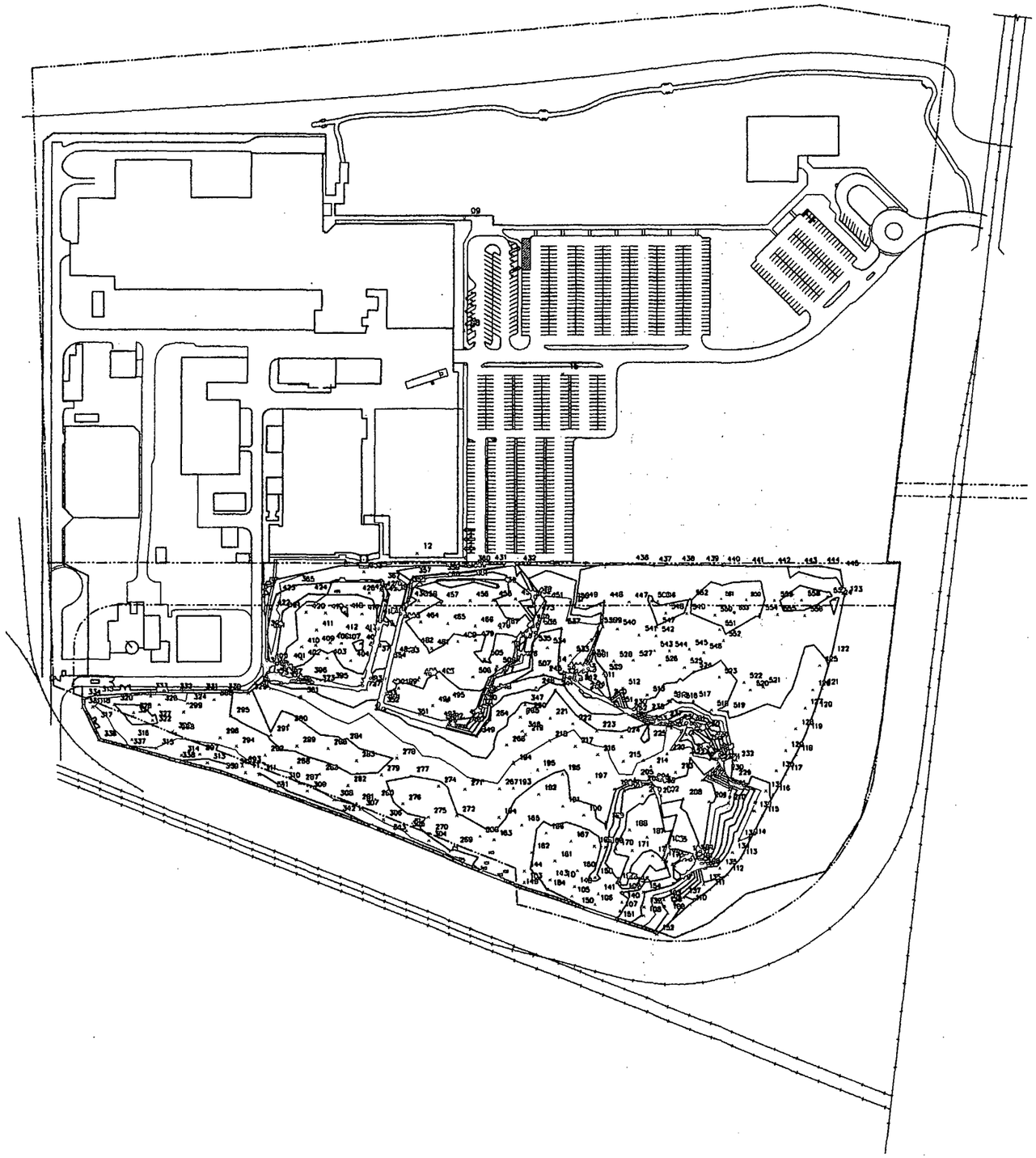


Source: EPA, May 1998

Figure 16
Sediment Sample Locations
Portland Harbor Sediment Investigation

BRIDGEWATER GROUP, INC.

APPENDIX A – SITE GRADING PLAN



Site Grading Plan

HAHN AND ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

RECEIVED
AUG 2 6 2002
BY

August 15, 2002

Mr. Eric Blischke
Oregon Department of Environmental Quality
Voluntary Cleanup and Site Assessment Section
2020 SW Fourth Avenue, Suite 400
Portland OR 97201-4987

HAI Project No. 5237

SUBJECT: July 2002 Progress Report for Remedial Investigation (RI) Activities, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon

Dear Mr. Blischke:

Hahn and Associates, Inc. (HAI) has prepared this Progress Report summarizing RI work activities conducted by NW Natural that have occurred relating to the Wacker Siltronic Corporation (Wacker) property (Figure 1) during the month of July 2002. RI field activities for the site are being conducted as per the approved *Final Focused Remedial Investigation (RI) Work Plan*[1] (RI Work Plan), as well as the approved *Supplemental RI Work Plan* [2]. This Progress Report has been prepared as per an Order (DEQ No. ECVC-NWR-00-27) issued jointly to both NW Natural and Wacker by the Oregon Department of Environmental Quality (ODEQ), dated October 4, 2000. As per the referenced Order, monthly progress reports are to be prepared by the 15th day of each month, with the reporting to continue for the duration of the project.

Summary of Activities in July 2002

The fourth, and final, quarterly groundwater monitoring event associated with the three monitoring wells installed in September 2001 at the Wacker property (WS-8-33, WS-8-59, and WS-9-34) was completed by HAI on July 10, 2002. These sampling activities were conducted synchronously with sampling activities conducted at the adjacent NW Natural-Gasco property.

Groundwater elevation data collected from the WS-8 and WS-9 series monitoring wells in July 2002, as well as during the previous three sampling events (October and December, 2001, and April 2002), are summarized on Table 1, while all available groundwater elevation data for the adjacent NW Natural – Gasco site are included on Table 2. Contoured groundwater elevation maps, depicting the Surficial Fill water-bearing zone (WBZ) and the intermediate depth interval of the Alluvial Sand WBZ during July 2002, are included as Figures 2 and 3. These groundwater elevation maps utilize available data from the Wacker (Table 1) the Gasco (Table 2) properties. Groundwater hydrographs for the WS-8 and WS-9 series wells are included as Figures 4 and 5.

---

[1] Hahn and Associates, Inc. (2001). *Final Focused Remedial Investigation Work Plan, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon.* June 1, 2001.

[2] Hahn and Associates, Inc. (2002). *Supplemental Remedial Investigation Work Plan, Wacker Siltronic Corporation,, 7200 NW Front Avenue, Portland, Oregon.* March 7, 2002.

434 NW 6th AVENUE, SUITE 203 • PORTLAND, OREGON 97209-3651
503/796-0717 OFFICE • 503/227-2209 FAX
www.hahnasoc.com

Recycled/Recyclable

A summary of the results of the April 2002 analyses of samples collected from the WS-8 and WS-9 series wells at Wacker, in addition to results from the previous sampling events (October and December 2001, and April 2002), is provided on Tables 3 through 6. As indicated on the referenced Tables, few compounds have been identified in groundwater at concentrations exceeding conservative screening levels (Ambient Water Quality Criteria). Although not relevant to groundwater, the AWQC was used as a very conservative screen with regard to the potential for groundwater discharge to impact surface water, assuming zero dilution in the receiving surface water body.

A continuous short-term groundwater elevation monitoring event was completed at the Wacker and adjacent Gasco site during July and August in accordance with an HAI-prepared *Groundwater Elevation Monitoring Plan*, dated May 30, 2002, as conditionally approved by the ODEQ in an e-mail dated July 8, 2002 (Struck to Wyatt and Ede). This short-term groundwater elevation monitoring event involved the collection of water elevation data on a fifteen minute frequency from select monitoring points over a two week period from July 24, 2002 through August 7, 2002.

Anticipated / Completed Activities in August and September 2002

It is anticipated that an EPA Level III validation of all soil, surface water, and groundwater data generated by NW Natural as part of Focused RI activities at the Wacker site will be complete prior to the end of September 2002. Upon completion, the data validation report(s) will be provided to the ODEQ.

The remaining Phase I RI data collection task to be completed at the site involves an inspection and survey of the base of the drainage ditch located on BNSF property immediately west and south of the Wacker property. Initiation of this task will require receipt of access approval from BNSF, the owner of the right-of-way through which the ditch runs. A proposed access agreement has been prepared by representatives of BNSF, and is currently under review by NW Natural. It is anticipated that issues related to the proposed access agreement may be identified and resolved such that the ditch survey may be completed during September 2002.

A full reporting and evaluation of the results of NW Natural's investigatory activities will be included within the Phase I Site Characterization Summary Report and the Technical Memorandum on Source Control Measures, both of which are due to the ODEQ within 90 days after completion of the Phase I RI activities.

NW Natural understands that work plans and results of Wacker's own TCE-related investigation activities will be documented by Wacker and will be submitted independently by them to the ODEQ.

Should you have any questions, please contact the undersigned.

Sincerely,

Robert Ede, R.G.
Associate

rede@hahnasoc.com

c: Mr. Bob Wyatt, NW Natural
Ms. Patty Dost, Schwabe, Williamson & Wyatt
Mr. Carl Stivers, Anchor Environmental, L.L.C.
Ms. Cathryn Young, Wacker Siltronic Corporation

TABLE 2 - Summary of Water Level Measurements and Groundwater Elevations
Remedial Investigation
NW Natural - Gasco Facility
Portland, Oregon

Project No. 2708

Elevation of Top of Casing

Date of Elevation Survey	Elevation of Top of Casing (feet msl)*																									River Benchmark (feet msl)**
	MW-1-22	MW-2-32	MW-2-61	MW-3-26	MW-3-56	MW-4-35	MW-4-57	MW-4-101	MW-5-32	MW-5-100	MW-5-175	MW-6-32	MW-6-61	MW-8-29	MW-8-56	MW-9-29	MW-10-25	MW-10-61	MW-11-32	MW-12-36	MW-13-30	MW-13-61	MW-14-110	MW-15-50	MW-15-66	
7-Dec-95	34.75	34.46	34.41	34.11	34.07	34.54	34.53	34.36	27.83	27.31	27.19	35.51	34.50	39.09	39.13	37.65	39.22	39.33	38.39	38.69	34.86	34.78	37.41	35.97[1]	36.06[1]	32.12

Measured Water Level

Date Measured	Measured Water Level (feet btc)																									River Level (feet bbm)
	MW-1-22	MW-2-32	MW-2-61	MW-3-26	MW-3-56	MW-4-35	MW-4-57	MW-4-101	MW-5-32	MW-5-100	MW-5-175	MW-6-32	MW-6-61	MW-8-29	MW-8-56	MW-9-29	MW-10-25	MW-10-61	MW-11-32	MW-12-36	MW-13-30	MW-13-61	MW-14-110	MW-15-50	MW-15-66	
5-Dec-95	14.15	15.23	-	15.58	15.79	16.12	16.39	-	9.46	-	-	16.71	15.77	19.75	20.61	6.20	14.98	13.42	12.69	9.37	-	-	-	-	-	-
5-Jan-96	14.47	20.04	-	19.47	21.85	22.47	22.38	-	15.57	-	-	14.84	21.58	19.01	26.74	7.33	15.20	16.32	12.19	10.82	-	-	-	-	-	-
12-Feb-96	7.74	8.61	-	8.52	8.63	9.09	9.10	-	2.41	-	-	9.55	8.97	16.99	13.56	3.32	11.11	8.92	8.95	5.27	-	-	-	-	-	-
18-Mar-96	12.44	18.03	-	17.87	19.66	20.24	20.21	-	13.37	-	-	12.10	19.39	15.22	24.54	6.13	11.95	14.47	9.42	9.01	-	-	-	-	-	-
16-Apr-96	13.65	18.83	-	18.13	19.47	20.26	20.07	-	13.36	-	-	13.42	19.51	15.58	24.44	6.93	12.63	15.07	10.12	9.69	-	-	-	-	-	-
10-May-96	13.75	19.47	-	18.98	22.01	22.58	22.60	-	15.78	-	-	13.30	21.55	15.77	26.93	6.94	12.98	15.90	10.40	10.24	-	-	-	-	-	-
17-Jun-96	13.88	17.40	-	17.40	18.21	18.61	18.73	-	11.96	-	-	13.40	18.13	16.00	23.15	5.03	13.51	13.96	10.90	9.98	-	-	-	-	-	-
16-Jul-96	15.51	20.71	-	20.07	24.41	24.30	24.93	-	17.91	-	-	14.60	23.55	17.26	29.05	6.65	15.90	17.21	11.93	12.43	-	-	-	-	-	-
21-Aug-96	16.51	21.80	-	22.24	26.99	26.77	27.51	-	20.46	-	-	16.17	26.27	19.18	31.93	8.47	16.58	19.43	13.40	14.53	-	-	-	-	-	-
17-Sep-96	17.06	22.06	-	20.61	28.02	27.15	28.53	-	21.27	-	-	16.94	26.81	20.13	32.63	7.52	16.80	19.30	14.02	14.86	-	-	-	-	-	-
30-Sep-96	17.17	22.24	-	23.32	27.04	27.46	27.61	-	20.68	-	-	17.08	27.01	20.19	32.45	8.70	16.89	19.84	14.26	14.97	-	-	-	-	-	-
15-Nov-96	16.38	22.02	-	20.76	26.48	26.85	27.00	-	19.84	-	-	17.00	25.71	20.63	31.37	6.61	16.42	18.38	14.20	13.85	-	-	-	-	-	-
24-Feb-97	12.41	18.71	-	18.61	20.48	20.82	21.02	-	14.17	-	-	12.83	19.79	18.43	25.33	4.35	14.85	14.33	11.18	9.71	-	-	-	-	-	-
10-Jun-97	12.89	14.23	-	13.80	14.20	14.70	14.56	-	7.97	-	-	13.81	14.61	18.56	19.25	4.84	16.01	12.20	12.50	8.49	-	-	-	-	-	-
26-Aug-97	15.38	21.70	-	22.61	26.10	26.56	25.84	-	19.63	-	-	18.53	25.58	20.31	31.13	11.71	17.10	20.16	14.30	14.13	-	-	-	-	-	-
25-Nov-97	14.42	21.50	-	19.25	24.64	25.14	24.80	-	18.23	-	-	16.29	24.33	20.85	29.85	7.85	16.36	17.89	13.88	11.79	-	-	-	-	-	-
19-Dec-97	-	-	-	-	22.75	-	23.28	-	-	-	-	-	22.62	-	27.90	-	-	16.90	-	-	-	23.71	-	-	-	-
16-Feb-98	12.60	20.13	-	18.65	23.55	23.25	24.10	-	17.09	-	-	14.29	-	20.05	28.50	5.33	15.60	15.89	12.02	9.72	14.73	23.98	-	-	-	21.91
1-Jun-98	14.49	16.97	-	16.61	16.51	16.90	17.00	-	10.33	-	-	15.75	-	20.05	21.63	7.25	14.63	14.36	12.85	9.83	15.69	17.11	-	-	-	14.57
25-Aug-98	17.62	22.74	-	23.68	27.79	27.32	28.36	-	21.14	-	-	17.73	-	20.89	32.46	12.67	14.32	21.19	14.29	14.97	17.56	28.22	-	-	-	25.72
16-Nov-98	18.42	24.59	28.36	22.20	27.57	27.32	28.10	28.29	20.99	21.19	21.05	18.23	-	21.19	32.13	12.10	14.30	20.81	14.45	14.92	17.78	28.11	24.84	-	-	26.32
15-Feb-99	11.97	19.02	23.94	18.27	23.20	23.94	23.71	23.75	16.75	16.72	16.54	12.35	-	17.66	27.97	5.11	12.41	15.34	10.03	9.51	13.04	23.62	20.35	-	-	21.94
11-May-99	14.32	20.19	22.99	18.76	22.44	22.92	22.99	22.94	16.06	15.87	15.68	13.41	-	16.56	27.31	8.50	15.82	16.94	10.82	11.11	14.03	22.91	20.62	-	-	21.21
20-Aug-99	17.37	22.16	26.95	21.92	26.31	25.98	26.81	26.87	19.73	19.80	19.62	19.80	-	19.65	31.04	12.04	15.00	20.46	14.25	14.40	17.18	26.81	23.93	15.05	15.37	25.80
25-Oct-99	18.48	24.73	28.77	24.40	28.05	28.02	28.49	28.44	21.56	21.36	21.11	19.00	-	20.83	32.78	13.86	16.40	22.15	15.60	16.51	18.52	28.63	25.68	16.92	17.28	26.49
27-Mar-00	12.88	20.09	26.94	19.24	26.27	25.69	26.80	26.91	19.36	19.83	19.64	14.05	-	19.43	31.08	6.25	17.70	17.32	12.90	11.65	14.45	26.71	23.11	14.05	14.68	25.30
15-Jun-00	16.26	21.18	24.08	20.01	23.56	24.42	24.14	24.10	17.40	17.07	16.86	16.05	-	19.53	28.42	10.15	14.74	18.55	13.36	13.11	15.82	24.10	22.02	14.14	14.96	21.70
4-Oct-00	18.15	23.24	28.92	22.12	28.42	28.02	28.95	28.92	21.93	21.88	21.69	-	-	20.31	33.46	13.67	14.09	22.31	14.15	16.85	17.32	28.98	26.31	17.81	18.66	26.00
20-Dec-00	17.98	22.73	27.13	19.50	26.89	26.13	27.27	26.76	20.33	19.63	19.31	-	-	19.24	32.12	12.22	13.02	20.20	13.09	15.17	16.70	27.70	26.05	16.25	17.08	25.00
27-Mar-01	16.91	21.94	28.05	20.86	27.35	27.01	27.91	28.10	20.66	21.05	20.88	-	-	19.19	32.07	11.91	13.74	20.85	13.63	14.96	16.81	27.86	25.24	16.40	17.23	25.70
28-Jun-01	18.02	23.49	28.58	24.14	28.11	27.51	28.52	28.25	21.59	21.23	20.97	-	-	21.14	33.04	13.31	17.27	22.92	15.25	16.06	18.06	28.72	25.88	17.32	18.11	27.01
8-Oct-01	19.24	26.16	29.85	25.45	29.10	29.05	29.68	28.72	22.67	22.60	22.45	-	-	21.99	34.11	15.50	18.28	23.89	17.10	18.45	19.41	29.78	27.51	19.41	20.19	28.15
12-Dec-01	16.73	22.68	26.54	20.49	25.81	24.12	26.33	26.46	19.01	19.41	19.21	-	-	21.58	30.43	9.71	16.50	19.00	16.00	13.67	17.89	26.34	23.66	15.05	15.86	24.44
2-Apr-02	14.98	20.47	25.78	20.61	25.33	26.38	25.84	25.59	18.71	18.56	18.34	-	-	20.24	30.61	7.99	16.77	18.46	13.16	12.48	15.35	25.85	23.59	14.56	15.42	23.60
10-Jul-02	17.18	21.78	25.31	21.42	24.69	25.12	25.22	25.13	18.28	18.10	17.92	-	-	20.43	29.73	11.61	16.20	19.92	14.00	13.98	17.09	25.31	23.29	15.91	15.22	23.16

NOTE: * = City of Portland Datum
bbm = below bench mark
btc = below top of casing
msl = mean sea level

**Willamette River, Portland Harbor Stage, obtained from National Weather Service and adjusted to feet msl - City of Portland datum: December 1995 to December 1997. Post December 1997 River Stage data measured directly from surveyed bench mark located on north end of FAMM Dock.

1=Well casing raised in January 2000. Pre-2000 top of casing elevations are: MW-15-50 (35.15 feet); MW-15-66 (35.36 feet)

TABLE 2 - Summary of Water Level Measurements and Groundwater Elevations
Remedial Investigation
NW Natural - Gasco Facility
Portland, Oregon

Project No. 2708

Groundwater Elevation

Date Measured	Groundwater Elevation (feet msl)*																									River Stage (feet msl)**
	MW-1-22	MW-2-32	MW-2-61	MW-3-26	MW-3-56	MW-4-35	MW-4-57	MW-4-101	MW-5-32	MW-5-100	MW-5-175	MW-6-32	MW-6-61	MW-8-29	MW-8-56	MW-9-29	MW-10-25	MW-10-61	MW-11-32	MW-12-36	MW-13-30	MW-13-61	MW-14-110	MW-15-50	MW-15-66	
5-Dec-95	20.60	19.23	-	18.53	18.28	18.42	18.14	-	18.37	-	-	18.80	18.73	19.34	18.52	31.45	24.24	25.91	25.70	29.32	-	-	-	-	-	18.9
5-Jan-96	20.28	14.42	-	14.64	12.22	12.07	12.15	-	12.26	-	-	20.67	12.92	20.08	12.39	30.32	24.02	23.01	26.20	27.87	-	-	-	-	-	12.4
12-Feb-96	27.01	25.85	-	25.59	25.44	25.45	25.43	-	25.42	-	-	25.96	25.53	22.10	25.57	34.33	28.11	30.41	29.44	33.42	-	-	-	-	-	26.4
18-Mar-96	22.31	16.43	-	16.24	14.41	14.30	14.32	-	14.46	-	-	23.41	15.11	23.87	14.59	31.52	27.27	24.86	28.97	29.68	-	-	-	-	-	14.4
16-Apr-96	21.10	15.63	-	15.98	14.60	14.28	14.46	-	14.47	-	-	22.09	14.99	23.51	14.69	30.72	26.59	24.26	28.27	29.00	-	-	-	-	-	14.5
10-May-96	21.00	14.99	-	15.13	12.06	11.96	11.93	-	12.05	-	-	22.21	12.95	23.32	12.20	30.71	26.24	23.43	27.99	28.45	-	-	-	-	-	11.6
17-Jun-96	20.87	17.06	-	16.71	15.86	15.93	15.80	-	15.87	-	-	22.11	16.37	23.09	15.98	32.62	25.71	25.37	27.49	28.71	-	-	-	-	-	15.7
16-Jul-96	19.24	13.75	-	14.04	9.66	10.24	9.60	-	9.92	-	-	20.91	10.95	21.83	10.08	31.00	23.32	22.12	26.46	26.26	-	-	-	-	-	-
21-Aug-96	18.24	12.66	-	11.87	7.08	7.77	7.02	-	7.37	-	-	19.34	8.23	19.91	7.20	29.18	22.64	19.90	24.99	24.16	-	-	-	-	-	6.6
17-Sep-96	17.69	12.40	-	13.50	6.05	7.39	6.00	-	6.56	-	-	18.57	7.69	18.96	6.50	30.13	22.42	20.03	24.37	23.83	-	-	-	-	-	5.8
30-Sep-96	17.58	12.22	-	10.79	7.03	7.08	6.92	-	7.15	-	-	18.43	7.49	18.90	6.68	28.95	22.33	19.49	24.13	23.72	-	-	-	-	-	5.4
15-Nov-96	18.37	12.44	-	13.35	7.59	7.69	7.53	-	7.99	-	-	18.51	8.79	18.46	7.76	31.04	22.80	20.95	24.19	24.84	-	-	-	-	-	7.2
24-Feb-97	22.34	15.75	-	15.50	13.59	13.72	13.51	-	13.66	-	-	22.68	14.71	20.66	13.80	33.30	24.37	25.00	27.21	28.98	-	-	-	-	-	13.6
10-Jun-97	21.86	20.23	-	20.31	19.87	19.84	19.97	-	19.86	-	-	21.70	19.89	20.53	19.88	32.81	23.21	27.13	25.89	30.20	-	-	-	-	-	19.8
26-Aug-97	19.37	12.76	-	11.50	7.97	7.98	8.69	-	8.20	-	-	16.98	8.92	18.78	8.00	25.94	22.12	19.17	24.09	24.56	-	-	-	-	-	7.9
25-Nov-97	20.33	12.96	-	14.86	9.43	9.40	9.73	-	9.60	-	-	19.22	10.17	18.24	9.28	29.80	22.86	21.44	24.51	26.90	-	-	-	-	-	8.72
19-Dec-97	-	-	-	-	11.32	-	11.25	-	-	-	-	-	11.88	-	11.23	-	-	22.43	-	-	-	11.07	-	-	-	-
16-Feb-98	22.15	14.33	-	15.46	10.52	11.29	10.43	-	10.74	-	-	21.22	-	19.04	10.63	32.32	23.62	23.44	26.37	28.97	20.13	10.80	-	-	-	10.21
1-Jun-98	20.26	17.49	-	17.50	17.56	17.64	17.53	-	17.50	-	-	19.76	-	19.04	17.50	30.40	24.59	24.97	25.54	28.86	19.17	17.67	-	-	-	17.55
25-Aug-98	17.13	11.72	-	10.43	6.28	7.22	6.17	-	6.69	-	-	17.78	-	18.20	6.67	24.98	24.90	18.14	24.10	23.72	17.30	6.56	-	-	-	6.40
16-Nov-98	16.33	9.87	6.05	11.91	6.50	7.22	6.43	6.07	6.84	6.12	6.14	17.28	-	17.90	7.00	25.55	24.92	18.52	23.94	23.77	17.08	6.67	12.57	-	-	5.80
15-Feb-99	22.78	15.44	10.47	15.84	10.87	10.60	10.82	10.61	11.08	10.59	10.65	23.16	-	21.43	11.16	32.54	26.81	23.99	28.36	29.18	21.82	11.16	17.06	-	-	10.18
11-May-99	20.43	14.27	11.42	15.35	11.63	11.62	11.54	11.42	11.77	11.44	11.51	22.10	-	22.53	11.82	29.15	23.40	22.39	27.57	27.58	20.83	11.87	16.79	-	-	10.91
20-Aug-99	17.38	12.30	7.46	12.19	7.76	8.56	7.72	7.49	8.10	7.51	7.57	15.71	-	19.44	8.09	25.61	24.22	18.87	24.14	24.29	17.68	7.97	13.48	20.10	19.99	6.32
25-Oct-99	16.27	9.73	5.64	9.71	6.02	6.52	6.04	5.92	6.27	5.95	6.08	16.51	-	18.26	6.35	23.79	22.82	17.18	22.79	22.18	16.34	6.15	11.73	18.23	18.08	5.63
27-Mar-00	21.87	14.37	7.47	14.87	7.80	8.85	7.73	7.45	8.47	7.48	7.55	21.46	-	19.66	8.05	31.40	21.52	22.01	25.49	27.04	20.41	8.07	14.30	21.92	21.38	6.82
15-Jun-00	18.49	13.28	10.33	14.10	10.51	10.12	10.39	10.26	10.43	10.24	10.33	19.46	-	19.56	10.71	27.50	24.48	20.78	25.03	25.58	19.04	10.68	15.39	21.83	21.10	10.42
4-Oct-00	16.60	11.22	5.49	11.99	5.65	6.52	5.58	5.44	5.90	5.43	5.50	-	-	18.78	5.67	23.98	25.13	17.02	24.24	21.84	17.54	5.80	11.10	18.16	17.40	6.12
20-Dec-00	16.77	11.73	7.28	14.61	7.18	8.41	7.26	7.60	7.50	7.68	7.88	-	-	19.85	7.01	25.43	26.20	19.13	25.30	23.52	18.16	7.08	11.36	19.72	18.98	7.12
27-Mar-01	17.84	12.52	6.36	13.25	6.72	7.53	6.62	6.26	7.17	6.26	6.31	-	-	19.90	7.06	25.74	25.48	18.48	24.76	23.73	18.05	6.92	12.17	19.57	18.83	6.42
28-Jun-01	16.73	10.97	5.83	9.97	5.96	7.03	6.01	6.11	6.24	6.08	6.22	-	-	17.95	6.09	24.34	21.95	16.41	23.14	22.63	16.80	6.06	11.53	18.65	17.95	5.11
8-Oct-01	15.51	8.30	4.56	8.66	4.97	5.49	4.85	5.64	5.16	4.71	4.74	-	-	17.10	5.02	22.15	20.94	15.44	21.29	20.24	15.45	5.00	9.90	16.56	15.87	3.97
12-Dec-01	18.02	11.78	7.87	13.62	8.26	10.42	8.20	7.90	8.82	7.90	7.98	-	-	17.51	8.70	27.94	22.72	20.33	22.39	25.02	16.97	8.44	13.75	20.92	20.20	7.68
2-Apr-02	19.77	13.99	8.63	13.50	8.74	8.16	8.69	8.77	9.12	8.75	8.85	-	-	18.85	8.52	29.66	22.45	20.87	25.23	26.21	19.51	8.93	13.82	21.41	20.64	8.52
10-Jul-02	17.57	12.68	9.10	12.69	9.38	9.42	9.31	9.23	9.55	9.21	9.27	-	-	18.66	9.40	26.04	23.02	19.41	24.39	24.71	17.77	9.47	14.12	20.06	20.84	8.96

NOTE: * = City of Portland Datum
msl = mean sea level

**Willamette River, Portland Harbor Stage, obtained from National Weather Service and adjusted to feet msl - City of Portland datum: December 1995 to December 1997. Post December 1997 River Stage data measured directly from surveyed bench mark located on north end of FAMM Dock.

1=Well casing raised in January 2000. Pre-2000 top of casing elevations are: MW-15-50 (35.15 feet); MW-15-66 (35.36 feet)

TABLE 4
Summary of Analytical Results for Groundwater Samples: Monitoring Wells
Polynuclear Aromatic Hydrocarbons by EPA Method 8270 SIM

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

PAHs by EPA Method 8270 (SIM)				Analytical Results ug/l (ppb)																	
				Carcinogenic PAHs							Non-carcinogenic PAHs										
Well Number	HAI Sample Number[1]	Sample Date	Screen Interval (feet bgs)	Benzo (a) anthracene	Benzo (b) fluoranthene	Benzo (k) fluoranthene	Benzo (a) pyrene	Chrysene	Dibenzo (a,h) anthracene	Indeno (1,2,3-cd) pyrene[2]	Acenaphthene	Acenaphthylene	Anthracene	Benzo (g,h,i) perylene	Fluoranthene	Fluorene	Naphthalene	Phenanthrene	Pyrene	Total PAHs
WS-8-33	5237-011009-107	9-Oct-01	23-33	**0.55**	**0.19**	ND> 0.1	**0.27**	**0.6**	ND> 0.1	**0.11**	98.7	1.17	8.42	0.15	7.83	32.5	485.	85.	7.65	728.1
	5237-011213-105	13-Dec-01		**0.25**	**0.1**	ND> 0.1	**0.27**	**0.3**	ND> 0.1	**0.11**	105.	2.35	11.9	ND> 0.1	7.35	31.9	287.	70.5	7.15	524.2
	5237-020403-105	3-Apr-02		**0.31**	ND> 0.1	ND> 0.1	ND> 0.1	**0.42**	ND> 0.1	ND> 0.1	91.6	1.01	6.43	ND> 0.1	7.18	18.4	110.	34.1	5.16	274.6
	5237-020403-106 (dup)	3-Apr-02		**0.32**	ND> 0.1	ND> 0.1	ND> 0.1	**0.44**	ND> 0.1	ND> 0.1	84.	1.39	7.14	ND> 0.1	8.2	19.5	101.	33.8	6.38	262.2
	5237-020710-104	10-Jul-02		**0.53**	**0.11**	**0.12**	**0.15**	**0.53**	ND> 0.1	ND> 0.1	129.	1.65	8.42	0.11	7.7	34.4	77.4	72.	8.16	340.3
	5237-020710-105 (dup)	10-Jul-02		**0.68**	**0.19**	**0.17**	**0.26**	**0.67**	ND> 0.1	**0.13**	132.	1.48	8.63	0.2	8.15	36.2	77.6	80.4	7.37	354.1
WS-8-59	5237-011008-104	8-Oct-01	49-59	**0.25**	ND> 0.1	ND> 0.1	ND> 0.1	**0.29**	ND> 0.1	ND> 0.1	18.5	0.38	4.2	ND> 0.1	5.8	7.9	22.7	31.8	6.4	98.2
	5237-011008-105 (dup)	8-Oct-01		**0.2**	ND> 0.1	ND> 0.1	ND> 0.1	**0.24**	ND> 0.1	ND> 0.1	18.9	0.39	4.1	ND> 0.1	5.5	7.9	22.5	29.8	6.3	95.8
	5237-011212-103	12-Dec-01		**0.32**	**0.1**	**0.1**	**0.14**	**0.41**	ND> 0.1	ND> 0.1	12.9	0.24	2.97	0.1	4.72	4.77	10.5	22.8	5.07	65.1
	5237-011212-104 (dup)	12-Dec-01		**0.23**	ND> 0.1	ND> 0.1	ND> 0.1	**0.29**	ND> 0.1	ND> 0.1	12.6	0.23	2.94	ND> 0.1	4.46	5.13	10.8	21.8	4.49	63.
	5237-020403-104	3-Apr-02		**0.16**	ND> 0.1	ND> 0.1	ND> 0.1	**0.24**	ND> 0.1	ND> 0.1	5.03	ND> 0.1	1.91	ND> 0.1	3.5	2.34	1.13	9.9	2.57	26.8
	5237-020710-103	10-Jul-02		**0.17**	ND> 0.1	ND> 0.1	ND> 0.1	**0.23**	ND> 0.1	ND> 0.1	4.53	ND> 0.1	1.31	ND> 0.1	3.15	1.92	0.63	3.45	3.49	18.9
WS-9-34	5237-011008-102	8-Oct-01	24-34	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	2.07	0.15	ND> 0.1	ND> 0.1	0.36	0.18	0.45	ND> 0.1	0.38	3.6
	5237-011212-101	12-Dec-01		**0.11**	**0.1**	**0.1**	**0.15**	**0.17**	ND> 0.1	**0.12**	17.8	0.33	0.33	0.17	1.91	6.43	0.4	2.45	1.74	32.3
	5237-020402-101	2-Apr-02		ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	17.5	0.19	0.44	ND> 0.1	1.59	1.8	ND> 0.1	4.81	ND> 0.1	26.3
	5237-020710-101	10-Jul-02		ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	11.1	0.17	0.22	ND> 0.1	0.91	2.09	0.13	2.06	1.13	17.8
Quality Control Samples																				
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020402-100	2-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020403-103	3-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020710-100	10-Jul-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water EB	5237-011008-103	8-Oct-01	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
	5237-011212-102	12-Dec-01	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
	5237-020402-102	2-Apr-02	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
	5237-020710-102	10-Jul-02	NA	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND> 0.1	ND
Ambient Water Quality Criteria (AWQC) for Surface Water[1]				0.049 [2]	0.049 [2]	0.049 [2]	0.049 [2]	0.049 [2]	0.049 [2]	0.049 [2]	2,700. [2]	#	110,000. [2]	#	370. [3]	14,000. [3]	620. [4]	#	11,000. [2]	#

Note:
# = not established
bgs = below ground surface
EB = equipment blanks
EPA = U.S. Environmental Protection Agency
ND = not detected above detection limit indicated
PAHs = polynuclear aromatic hydrocarbons
ppb = parts per billion
ug/l = micrograms per liter

1 = Reference Level indicated is the lowest guidance value provided in the Ambient Water Quality Criteria (EPA 822-Z-99-001) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health Protection)
2 = Reference Level based on Aquatic Fresh Chronic Criteria of AWQC
3 = Reference Level based on Human Fish Consumption Criteria of AWQC
4 = Reference Level based on Lowest Observable Health Effect Level for Freshwater, as provided within NOAA Screening Quick Reference Tables, updated September 1999
Bold = Detected above lowest identified AWQC

TABLE 5
Summary of Analytical Results for Groundwater Samples: Monitoring Wells
Detected Semi-Volatile Organic Compounds by EPA Method 8270C

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

SVOCs by EPA Method 8270				Analytical Results ug/l (ppb)			
Well Number	HAI Sample Number	Sample Date	Screen Interval (feet bgs)	Carbazole	Dibenzofuran	2-Methylnaphthalene	PAHs
WS-8-33	5237-011009-107	9-Oct-01	23-33	14.7	4.26	59.2	See Table 4
	5237-011213-105	13-Dec-01		45.2	3.97	65.8	See Table 4
	5237-020403-105	3-Apr-02		11.5	2.12	5.48	See Table 4
	5237-020403-106 (dup)	3-Apr-02		-	-	-	See Table 4
	5237-020710-104	10-Jul-02		18.3	3.05	41.9	See Table 4
	5237-020710-105 (dup)	10-Jul-02		-	-	-	See Table 4
WS-8-59	5237-011008-104	8-Oct-01	49-59	ND> 4.	ND> 2.	6.74	See Table 4
	5237-011008-105 (dup)	8-Oct-01		ND> 4.	ND> 2.	7.17	See Table 4
	5237-011212-103	12-Dec-01		ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-011212-104 (dup)	12-Dec-01		ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-020403-104	3-Apr-02		ND> 8.	ND> 4.	ND> 4.	See Table 4
	5237-020710-103	10-Jul-02		ND> 4.	ND> 2.	ND> 2.	See Table 4
WS-9-34	5237-011008-102	8-Oct-01	24-34	ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-011212-101	12-Dec-01		ND> 4.	ND> 2.	ND> 2.	See Table 4
	5237-020402-101	2-Apr-02		ND> 8.	ND> 4.	ND> 4.	See Table 4
	5237-020710-101	10-Jul-02		ND> 4.	ND> 2.	ND> 2.	See Table 4
Quality Control Samples							
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-
	5237-020710-100	10-Jul-02	NA	-	-		-
Water EB	5237-011008-103	8-Oct-01	NA	ND> 4.	ND> 2.	ND> 2.	See Table 2
	5237-011212-102	12-Dec-01	NA	ND> 4.	ND> 2.	ND> 2.	See Table 2
	5237-020402-102	2-Apr-02	NA	-	-	-	See Table 2
	5237-020710-102	10-Jul-02	NA	-	-	-	See Table 2
Ambient Water Quality Criteria (AWQC) for Surface Water [1]				0	0	0	0

Note:
bgs = below ground surface
EB = equipment blanks
EPA = U.S. Environmental Protection Agency
ND = Not detected above detection limit indicated
PAHs = polynuclear aromatic hydrocarbons
ppb = parts per billion
ug/l = micrograms/liter
0 = not established

1 = Ambient Water Quality Criteria (EPA 822-Z-99-001)

TABLE 6
Summary of Analytical Results for Groundwater Samples: Monitoring Wells
Metals and Cyanide

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

Well Number	HAI Sample Number	Sample Date	Screen Interval (feet bgs)	Analytical Results – mg/l (ppm) Total Metals by EPA Methods 6010, 200.7 and/or 7000 Series																	
				Antimony	Antimony, Diss	Arsenic	Arsenic, Diss	Barium	Barium, Diss	Cadmium	Cadmium, Diss	Chromium	Chromium, Diss	Cobalt	Cobalt, Diss	Copper	Copper, Diss	Iron	Iron, Diss	Lead	Lead, Diss
WS-8-33	5237-011009-107	9-Oct-01	23-33	ND> 0.003	-	**0.0063**	-	0.184	-	ND> 0.001	-	0.0069	-	0.0041	-	**0.0264**	-	117.	-	**0.0082**	-
	5237-011213-105	13-Dec-01		ND> 0.005	-	**0.0162**	-	0.142	-	ND> 0.002	-	0.005	-	0.006	-	0.005	-	76.6	-	ND> 0.005	-
	5237-020403-105	3-Apr-02		ND> 0.005	ND> 0.005	**0.018**	**0.0148**	0.115	0.104	ND> 0.005	ND> 0.002	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.015	90.9	81.5	ND> 0.005	ND> 0.01
	5237-020403-106 (dup)	3-Apr-02		ND> 0.005	-	**0.0174**	-	0.114	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	89.6	-	ND> 0.005	-
	5237-020710-104	10-Jul-02		ND> 0.005	ND> 0.005	**0.0162**	**0.0198**	0.117	0.114	ND> 0.002	ND> 0.0222	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	80.6	80.7	ND> 0.005	ND> 0.0056
	5237-020710-105 (dup)	10-Jul-02		ND> 0.005	-	**0.0173**	-	0.116	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.0803	-	ND> 0.005	-
WS-8-59	5237-011008-104	8-Oct-01	49-59	ND> 0.003	-	ND> 0.005	-	0.153	-	ND> 0.001	-	ND> 0.005	-	ND> 0.001	-	0.0055	-	49.6	-	ND> 0.005	-
	5237-011008-105 (dup)	8-Oct-01		ND> 0.003	-	ND> 0.005	-	0.142	-	ND> 0.001	-	ND> 0.005	-	ND> 0.001	-	0.0037	-	47.	-	ND> 0.005	-
	5237-011212-103	12-Dec-01		ND> 0.005	-	ND> 0.005	-	0.123	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	48.1	-	ND> 0.005	-
	5237-011212-104 (dup)	12-Dec-01		ND> 0.005	-	ND> 0.005	-	0.119	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	47.2	-	ND> 0.005	-
	5237-020403-104	3-Apr-02		ND> 0.005	-	ND> 0.005	-	0.0931	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	46.8	-	ND> 0.005	-
	5237-020710-103	10-Jul-02		ND> 0.005	-	ND> 0.005	-	0.1	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	45.7	-	ND> 0.005	-
WS-9-34	5237-011008-102	8-Oct-01	24-34	ND> 0.003	-	ND> 0.005	-	0.246	-	ND> 0.001	-	ND> 0.005	-	0.0281	-	0.0074	-	33.9	-	ND> 0.005	-
	5237-011212-101	12-Dec-01		0.0067	0.0108	**0.0607**	ND> 0.005	0.923	0.0348	ND> 0.002	ND> 0.002	**0.0207**	ND> 0.005	0.0437	0.0112	0.0431	ND> 0.005	188.	88.	**0.197**	ND> 0.005
	5237-020402-101	2-Apr-02		ND> 0.005	0.0086	**0.038**	0.007	0.607	0.0467	ND> 0.002	ND> 0.002	**0.0187**	ND> 0.005	0.0273	0.0132	0.0391	ND> 0.015	150.	37.7	**0.0948**	ND> 0.01
	5237-020710-101	10-Jul-02		ND> 0.005	ND> 0.0056	**0.0311**	ND> 0.0056	0.553	0.081	ND> 0.002	ND> 0.0022	**0.0326**	ND> 0.0056	0.0404	0.0231	0.0359	ND> 0.0056	146.	64.3	**0.131**	ND> 0.0056
Quality Control Samples																					
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020402-100	2-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020403-103	3-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020710-100	10-Jul-02	NA																		
Water EB	5237-011212-102	12-Dec-01	NA	ND> 0.003	-	ND> 0.005	-	ND> 0.005	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.0222	-	ND> 0.005	-
	5237-011008-103	8-Oct-01	NA	ND> 0.003	-	ND> 0.005	-	ND> 0.005	-	ND> 0.001	-	ND> 0.005	-	ND> 0.001	-	ND> 0.001	-	0.0417	-	ND> 0.005	-
	5237-020402-102	2-Apr-02	NA	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	0.0052	-	0.142	-	ND> 0.005	-
	5237-020710-102	10-Jul-02	NA	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.002	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005		ND> 0.01		ND> 0.005	
Ambient Water Quality Criteria (AWQC) for Surface Water [1]				4.3 [2]		0.00014 [3]		0		0.002 [2]		0.011 [2]		0		0.009 [2]		0		0.0025	

Note:
0 = not established
bgs = below ground surface
Diss = dissolved
EB = equipment blank
EPA = U.S. Environmental Protection Agency
mg/l = milligrams/liter
ND = not detected above detection limit indicated
ppm = parts per million

1 = Reference Level indicated is the lowest guidance value provided in the Ambient Water Quality Criteria (EPA 822-Z-99-001) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health Protection)
2 = Reference Level based on Aquatic Fresh Chronic Criteria of AWQC
3 = Reference Level based on Human Fish Consumption Criteria of AWQC

Bold = Detected above lowest identified AWQC

SCOEPA00012504

TABLE 6
Summary of Preliminary Analytical Results for Groundwater Samples: Monitoring Wells
Metals and Cyanide

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

Well Number	HAI Sample Number	Sample Date	Screen Interval (feet bgs)	Analytical Results – mg/l (ppm)																	
				Total Metals by EPA Methods 6010, 200.7 and/or 7000 Series																EPA 9010 B	EPA 9010 B
				Magnesium	Magnesium, Diss	Manganese	Manganese, Diss	Nickel	Nickel, Diss	Selenium	Selenium, Diss	Silver	Silver, Diss	Titanium	Titanium, Diss	Vanadium	Vanadium, Diss	Zinc	Zinc, Diss	Total Cyanide	Amenable Cyanide
WS-8-33	5237-011009-107	9-Oct-01	23-33	27.2	-	5.07	-	0.0039	-	ND> 0.005	-	ND> 0.0019	-	0.766	-	0.0397	-	0.0496	-	ND> 0.02	ND> 0.02
	5237-011213-105	13-Dec-01		30.	-	5.57	-	ND> 0.005	-	0.0063	-	ND> 0.005	-	0.0762	-	0.0069	-	0.0147	-	**0.854**	ND> 0.02
	5237-020403-105	3-Apr-02		21.8	19.9	4.88	4.51	ND> 0.005	ND> 0.005	ND> 0.005	0.0084	ND> 0.005	ND> 0.005	0.022	ND> 0.01	ND> 0.005	ND> 0.005	0.0243	ND> 0.015	**0.416**	0.064
	5237-020403-106 (dup)	3-Apr-02		21.5	-	4.85	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.013	-	ND> 0.005	-	ND> 0.005	-	**0.615**	0.183
	5237-020710-104	10-Jul-02		24.1	24.3	4.89	5.02	ND> 0.005	ND>.00556	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	0.0286	ND> 0.0111	0.0053	ND> 0.0056	0.0053	ND> 0.0056	**0.724**	ND> 0.08
	5237-020710-105 (dup)	10-Jul-02		24.2	-	4.89	4.89	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.0171	-	ND> 0.005	-	ND> 0.005	-	**0.726**	ND> 0.08
WS-8-59	5237-011008-104	8-Oct-01	49-59	ND> 0.05	-	2.85	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	0.564	-	0.0233	-	0.0307	-	**0.468**	ND> 0.02
	5237-011008-105 (dup)	8-Oct-01		ND> 0.05	-	2.84	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	0.448	-	0.0173	-	0.0236	-	**0.456**	ND> 0.02
	5237-011212-103	12-Dec-01		54.7	-	1.83	-	0.0056	-	ND> 0.005	-	ND> 0.005	-	0.169	-	0.0084	-	0.0104	-	**0.725**	0.263
	5237-011212-104 (dup)	12-Dec-01		54.2	-	1.83	-	0.0055	-	ND> 0.005	-	ND> 0.005	-	0.132	-	0.0066	-	0.0094	-	**0.066**	ND> 0.02
	5237-020403-104	3-Apr-02		39.9	-	3.33	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.0694	-	ND> 0.005	-	0.0086	-	**1.42**	ND> 0.4
	5237-020710-103	10-Jul-02		46.4	-	2.19	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	0.108	-	0.0063	-	0.0055	-	**0.459**	ND> 0.04
WS-9-34	5237-011008-102	8-Oct-01	24-34	53.3	-	4.31	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	0.0055	-	ND> 0.001	-	0.0055	-	**0.14**	ND> 0.02
	5237-011212-101	12-Dec-01		60.2	15.6	7.1	2.24	0.0369	0.006	ND> 0.005	ND> 0.005	ND> 0.005	ND> 0.005	0.217	ND> 0.001	0.0548	ND> 0.005	**0.376**	0.0155	**0.074**	ND> 0.02
	5237-020402-101	2-Apr-02		45.5	22.7	4.35	2.59	0.0229	0.0087	ND> 0.005	0.0054	ND> 0.005	ND> 0.005	0.254	ND> 0.01	0.0482	ND> 0.005	**0.197**	ND> 0.015	**0.11**	ND> 0.04
	5237-020710-101	10-Jul-02		57.1	36.4	6.66	4.73	0.0365	0.0064	ND> 0.005	ND> 0.0056	ND> 0.005	ND> 0.0056	0.27	ND> 0.0111	0.043	ND> 0.0056	**0.224**	0.0153	**0.074**	ND> 0.04
Quality Control Samples																					
Trip Blanks	5237-011008-101	8-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011009-106	9-Oct-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011212-100	12-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-011213-106	13-Dec-01	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020402-100	2-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020403-103	3-Apr-02	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5237-020710-100	10-Jul-02	NA																		
Water Eq. Blanks	5237-011212-102	8-Oct-01	NA	0.05	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.01	-	ND> 0.005	-	ND> 0.01	-	ND> 0.02	ND> 0.02
	5237-011008-103	12-Dec-01	NA	0.0775	-	ND> 0.005	-	ND> 0.003	-	ND> 0.005	-	ND> 0.0019	-	ND> 0.001	-	ND> 0.005	-	ND> 0.005	-	ND> 0.02	ND> 0.02
	5237-020402-102	2-Apr-02	NA	ND> 0.05	-	0.0059	-	ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.01	-	ND> 0.005	-	0.0359	-	ND> 0.04	-
	5237-020710-102	10-Jul-02	NA	ND> 0.05		ND> 0.005		ND> 0.005	-	ND> 0.005	-	ND> 0.005	-	ND> 0.01	-	ND> 0.005		0.0079		ND> 0.04	ND> 0.04
Ambient Water Quality Criteria (AWQC) for Surface Water [1]				0	0	0	0	0.052 [2]		0.005 [2]		0.003 [3]		0	0	0	0	0.12 [2]		0.005 [2]	

Note:
0 = not established
bgs = below ground surface
Diss = dissolved
EB = equipment blank
EPA = U.S. Environmental Protection Agency
mg/l = milligrams/liter
ND = not detected above detection limit indicated
ppm = parts per million

1 = Reference Level indicated is the lowest guidance value provided in the Ambient Water Quality Criteria (EPA 822-Z-99-001) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health Protection)
2 = Reference Level based on Aquatic Fresh Chronic Criteria of AWQC
3 = Reference Level based on Human Fish Consumption Criteria of AWQC

Bold = Detected above lowest identified AWQC

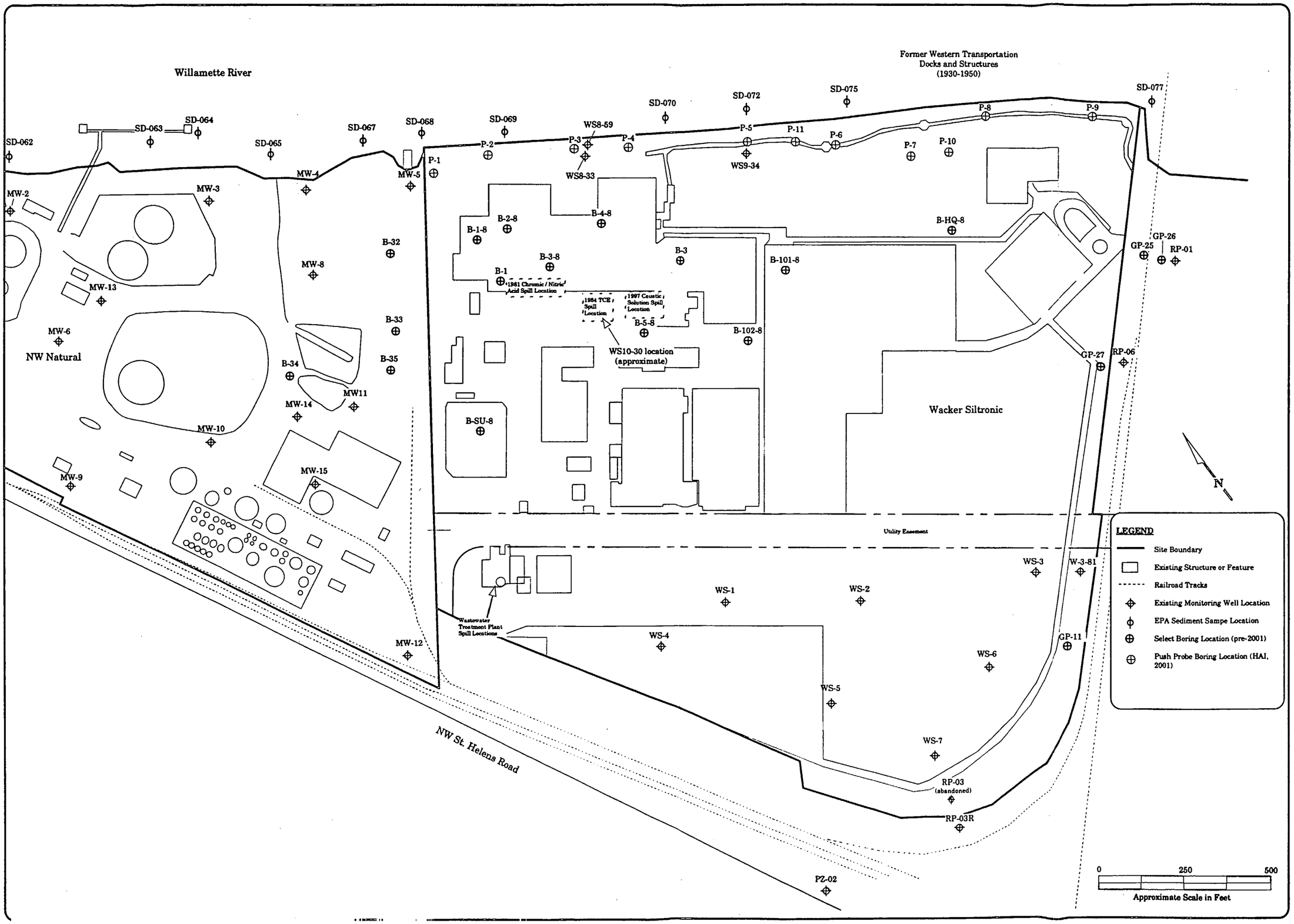


Figure 1

Monitoring Well and Push Probe Location Map

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN & ASSOCIATES, INC.
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

May 2002

Project No. 5237

Figure 2

Willamette River

SD-062 8.96 SD-063 SD-064 SD-065 SD-067 SD-068 SD-069 SD-070 SD-072 SD-075 SD-077

P-1 P-2 P-3 P-4 P-5 P-6 P-7 P-8 P-9 P-10 P-11

WS8-59 10.27 WS8-33 11.26 WS9-34

MW-2 12.68 MW-3 12.69 MW-4 9.42 MW-5 9.55 MW-6 MW-8 18.66 MW-9 26.04 MW-10 23.02 MW-11 24.39 MW-12 24.71 MW-13 17.77 MW-14 MW-15

B-1 B-1-8 B-2-8 B-3 B-3-8 B-4-8 B-5-8 B-32 B-33 B-34 B-35 B-101-8 B-102-8 B-HQ-8 B-SU-8

1981 Chromic / Nitric Acid Spill Location

1984 TCE Spill Location

1997 Caustic Solution Spill Location

GP-25 GP-26 GP-27 RP-01 RP-06

NW Natural

Wacker Siltronic

Utility Easement

WS-1 23.75 WS-2 21.55 WS-3 WS-4 WS-5 17.90 WS-6 WS-7 W-3-81 GP-11

RP-03 (abandoned) RP-03R

PZ-02

NW St. Helens Road

12 16 18.66 20 24

N

LEGEND

- Site Boundary
- Existing Structure or Feature
- Railroad Tracks
- Existing Monitoring Well Location
- EPA Sediment Sampe Location
- Select Boring Location (pre-2001)
- Push Probe Boring Location (HAI, 2001)
- 4.58 Groundwater Elevation (feet MSL)
- Groundwater Elevation Isocontour - Contour Interval: 1.00 feet

0 250 500

Approximate Scale in Feet

Groundwater Elevation Map - Surficial Fill Wells
July 10, 2002

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN & ASSOCIATES, INC.
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

August 2002

Project No. 5237

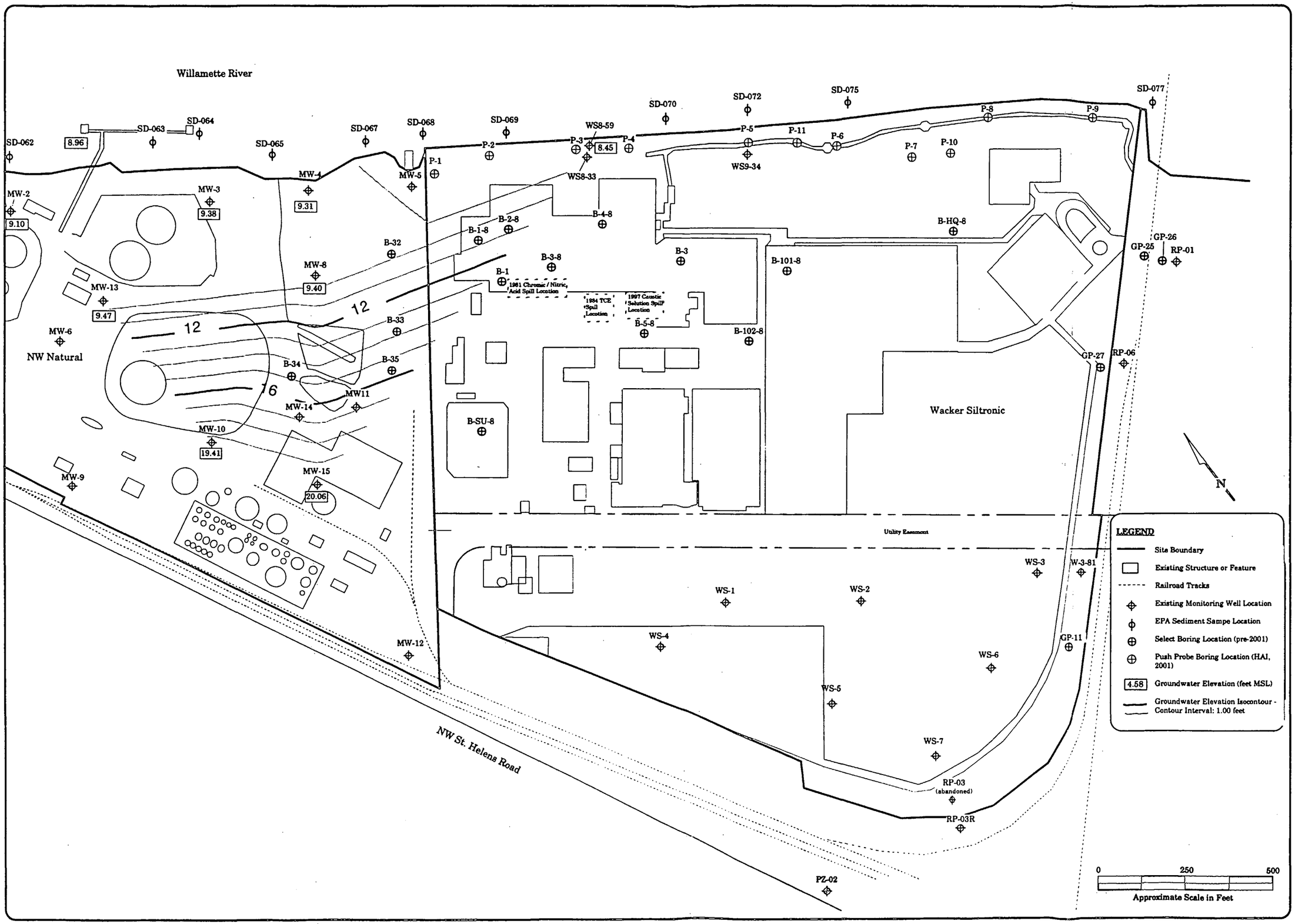


Figure 3

Groundwater Elevation Map - Intermediate Wells (40 to 81 feet bgs)
July 10, 2002

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN & ASSOCIATES, INC.
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

August 2002

Project No. 5237

SCOEPA00012508

TABLE 1 - Summary of Water Level Measurements and Groundwater Elevations
Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAI Project No. 5237

Elevation of Top of Casing

Date of Elevation Survey	Elevation of Top of Casing (feet msl)*						River Benchmark (feet msl)**
	WS-1-27[1]	WS-2-27[1]	WS-5-24[1]	WS-8-33	WS-8-59	WS-9-34	
23-Oct-01	35.18	33.67	37.83	34.28	34.16	33.51	32.12

Measured Water Level

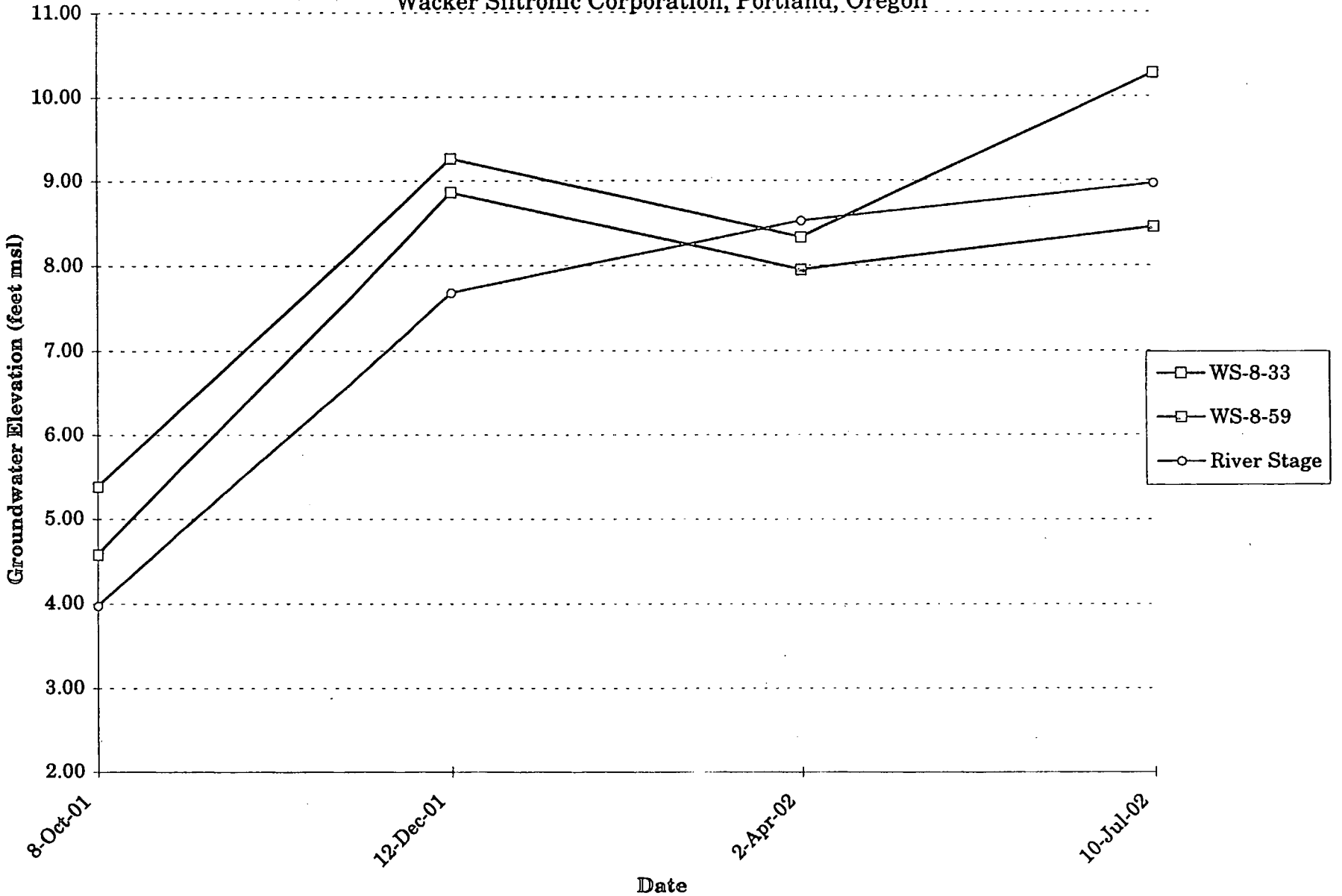
Date Measured	Measured Water Level (feet btc)						River Level (feet bbm)
	WS-1-27	WS-2-27	WS-5-24	WS-8-33	WS-8-59	WS-9-34	
8-Oct-01	-	-	-	28.90	29.58	27.15	28.15
12-Dec-01	-	-	-	25.02	25.30	22.77	24.44
2-Apr-02	3.57	6.02	7.60	25.95	26.21	23.40	23.60
10-Jul-02	11.43	12.12	19.93	24.01	25.71	22.25	23.16

Groundwater Elevation

Date Measured	Groundwater Elevation (feet msl)*						River Stage (feet msl)**
	WS-1-27	WS-2-27	WS-5-24	WS-8-33	WS-8-59	WS-9-34	
8-Oct-01	-	-	-	5.38	4.58	6.36	3.97
12-Dec-01	-	-	-	9.26	8.86	10.74	7.68
2-Apr-02	31.61	27.65	30.23	8.33	7.95	10.11	8.52
10-Jul-02	23.75	21.55	17.90	10.27	8.45	11.26	8.96

NOTE: * = City of Portland Datum
**River Stage data measured directly from surveyed bench mark located on north end of dock at adjacent NW Natural property.
bbm = below bench mark
btc = below top of casing
msl = mean sea level
1= elevation survey not conducted by NW Natural - survey date is unknown. All measurements made by Wacker representatives at these well locations.

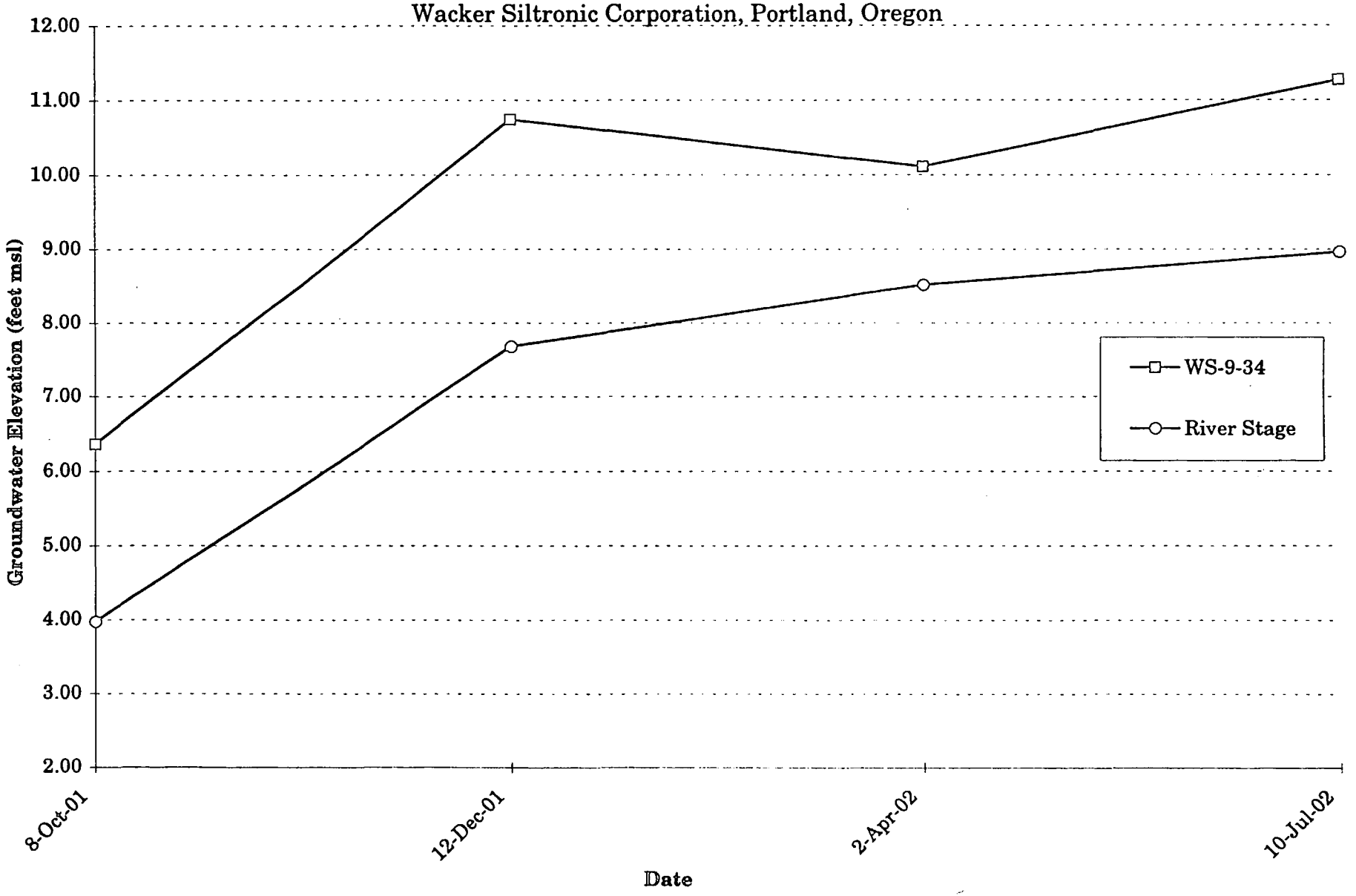
Figure 4
Groundwater Hydrograph
WS-8 Series Monitoring Wells
Wacker Siltronic Corporation, Portland, Oregon



Updated: 8/12/02 RBE
File Name: 5237 GW Elevations ; Hydrograph - WS-8 Series

Project No. 5237
HAHN AND ASSOCIATES, INC.

Figure 5
Groundwater Hydrograph
Well WS-9-34
Wacker Siltronic Corporation, Portland, Oregon



Updated: 8/12/02 MSM
File Name: 5237 GW Elevations ; Hydrograph - WS-9-34

Project No. 2708
HAHN AND ASSOCIATES, INC.

HAHN AND ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

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JUL 19 2002
By

July 15, 2002

Mr. Eric Blischke
Oregon Department of Environmental Quality
Voluntary Cleanup and Site Assessment Section
2020 SW Fourth Avenue, Suite 400
Portland OR 97201-4987

HAI Project No. 5237

SUBJECT: June 2002 Progress Report for Remedial Investigation (RI) Activities, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon

Dear Mr. Blischke:

Hahn and Associates, Inc. (HAI) has prepared this Progress Report summarizing RI work activities conducted by NW Natural that have occurred relating to the Wacker Siltronic Corporation (Wacker) property (Figure 1) during the month of June 2002. RI field activities for the site are being conducted as per the approved *Final Focused Remedial Investigation (RI) Work Plan*[1] (RI Work Plan), as well as the approved *Supplemental RI Work Plan* [2]. This Progress Report has been prepared as per an Order (DEQ No. ECVC-NWR-00-27) issued jointly to both NW Natural and Wacker by the Oregon Department of Environmental Quality (ODEQ), dated October 4, 2000. As per the referenced Order, monthly progress reports are to be prepared by the 15th day of each month, with the reporting to continue for the duration of the project.

Summary of Activities in June 2002

Groundwater level data collected by Wacker during a May 4, 2002 "area-wide" water level monitoring event were submitted to the ODEQ by Wacker in correspondence dated June 18, 2002 (Young to Blischke). These data, in addition to select, previously submitted data collected on the same date from Wacker area wells by representatives of NW Natural and Aventis CropScience, are summarized on Tables 1 and 2. Contoured groundwater elevation maps, depicting the Surficial Fill water-bearing zone (WBZ) and the intermediate depth interval of the Alluvial Sand WBZ during April 2002, updated to reflect the area-wide data, are included as Figures 2 and 3, respectively. As indicated on these figures, overall groundwater flow direction across the Wacker property is interpreted as being to the northeast, toward the Willamette River. One exception to the preceding is an apparent southward component of flow within the Surficial Fill WBZ at the southern portion of the property.

---

[1] Hahn and Associates, Inc. (2001). *Final Focused Remedial Investigation Work Plan, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon.* June 1, 2001.

[2] Hahn and Associates, Inc. (2002). *Supplemental Remedial Investigation Work Plan, Wacker Siltronic Corporation,, 7200 NW Front Avenue, Portland, Oregon.* March 7, 2002.

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Anticipated / Completed Activities in July and August 2002

The fourth, and final, quarterly groundwater monitoring event associated with the three monitoring wells installed in September 2001 at the Wacker property (WS-8-33, WS-8-59, and WS-9-34) was completed by HAI on July 10, 2002. These sampling activities have been conducted synchronously with sampling activities conducted at the adjacent NW Natural-Gasco property.

Remaining Phase I RI data collection tasks to be completed at the site include: 1) completion of a continuous short-term (48 hours) groundwater elevation monitoring event; and 2) an inspection and survey of the base of the drainage ditch located on BNSF property immediately west and south of the Wacker property. Task 1, conditionally approved by the ODEQ via a July 8, 2002 electronic mail (Struck to Wyatt), will be scheduled for completion during mid to late July 2002, while Task 2 will require receipt of access approval from BNSF, the owner of the right-of-way through which the ditch runs. A proposed access agreement has been prepared by representatives of BNSF, and is currently under review by NW Natural. It is anticipated that issues related to the proposed access agreement may be identified and resolved such that the ditch survey may be completed during July or August 2002.

A full reporting and evaluation of the results of NW Natural's investigatory activities will be included within the Phase I Site Characterization Summary Report and the Technical Memorandum on Source Control Measures, both of which are due to the ODEQ within 90 days after completion of the Phase I RI activities. NW Natural understands that work plans and results of Wacker's own TCE-related investigation activities will be documented by Wacker and will be submitted independently by them to the ODEQ.

Should you have any questions, please contact the undersigned.

Sincerely,

Robert Ede, R.G.
Associate

rede@hahnasoc.com

REGISTERED PROFESSIONAL
OREGON
ROBERT B. EDE
G1823
GEOLOGIST

c: Mr. Bob Wyatt, NW Natural
Ms. Patty Dost, Schwabe, Williamson & Wyatt
Mr. Carl Stivers, Anchor Environmental, L.L.C.
Ms. Cathryn Young, Wacker Siltronic Corporation

TABLE 1 - Summary of Water Level Measurements and Groundwater Elevations: April 2, 2002 Area-Wide Groundwater Monitoring Event
Wacker Siltronic Corporation, Burlington Northern Santa Fe Railroad Company, and City of Portland Right-of-Way Properties

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAI Project No. 5237

Elevation of Top of Casing

Elevation of Top of Casing (feet msl)*																	River Benchmark
Wacker Siltronic Corporation Property Wells									BNSF Property Wells							COP ROW	
WS-1-27	WS-2-27	WS-3-32	WS-3-81	WS-5-24	WS-6-29	WS-8-33	WS-8-59	WS-9-34	RP-1-31	RP-1-51	RP-1-65	RP-3-30R	RP-3-52R	RP-6-30	RP-6-87	PZ-2-40	(feet msl)**
35.18	33.67	37.02	35.54	37.83	36.37	34.28	34.16	33.51	35.38	35.28	35.00	36.61	36.60	37.10	37.20	64.53	32.12

Measured Water Level

Date Measured	Measured Water Level (feet btc)																	River Level[3]
	WS-1-27[1]	WS-2-27[1]	WS-3-32[2]	WS-3-81[2]	WS-5-24[1]	WS-6-29[2]	WS-8-33[2]	WS-8-59[2]	WS-9-34[2]	RP-1-31[2]	RP-1-51[2]	RP-1-65[2]	RP-3-30R[2]	RP-3-52R[2]	RP-6-30[2]	RP-6-87[2]	PZ-2-40[2]	(feet bbm)
2-Apr-02	3.57	6.02	16.04	18.41	7.60	11.36	25.95	26.21	23.40	25.21	25.15	24.95	14.84	17.10	16.60	25.41	36.29	23.60

Groundwater Elevation

Date Measured	Groundwater Elevation (feet msl)*																	River Stage
	WS-1-27	WS-2-27	WS-3-32	WS-3-81	WS-5-24	WS-6-29	WS-8-33	WS-8-59	WS-9-34	RP-1-31	RP-1-51	RP-1-65	RP-3-30R	RP-3-52R	RP-6-30	RP-6-87	PZ-2-40	(feet msl)**
2-Apr-02	31.61	27.65	20.98	17.13	30.23	25.01	8.33	7.95	10.11	10.17	10.13	10.05	21.77	19.50	20.50	11.79	28.24	8.52

NOTE:
* = City of Portland Datum
**River Stage data measured directly from surveyed bench mark located on north end of dock at adjacent NW Natural property.
bbm = below bench mark
BNSF = Burlington Northern Sante Fe Railroad Company
COP ROW = City of Portland Right-of-Way
btc = below top of casing
msl = mean sea level
1 = Measured by representatives of Wacker Siltronic Corporation
2 = Measured by representatives of Aventis CropScience
3 = Measured by representatives of NW Natural

TABLE 2 - Summary of Water Level Measurements and Groundwater Elevations: April 2, 2002 Area-Wide Groundwater Monitoring Event
NW Natural - Gasco Property

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

Project No. 5237

Date of Elevation Survey	Elevation of Top of Casing (feet msl)*																									River Benchmark (feet msl)**
	MW-1-22	MW-2-32	MW-2-61	MW-3-26	MW-3-56	MW-4-35	MW-4-57	MW-4-101	MW-5-32	MW-5-100	MW-5-175	MW-6-32	MW-6-61	MW-8-29	MW-8-56	MW-9-29	MW-10-25	MW-10-61	MW-11-32	MW-12-36	MW-13-30	MW-13-61	MW-14-110	MW-15-50	MW-15-66	
7-Dec-95	34.75	34.46	34.41	34.11	34.07	34.54	34.53	34.36	27.83	27.31	27.19	35.51	34.50	39.09	39.13	37.65	39.22	39.33	38.39	38.69	34.86	34.78	37.41	35.97[1]	36.06[1]	32.12

Measured Water Level

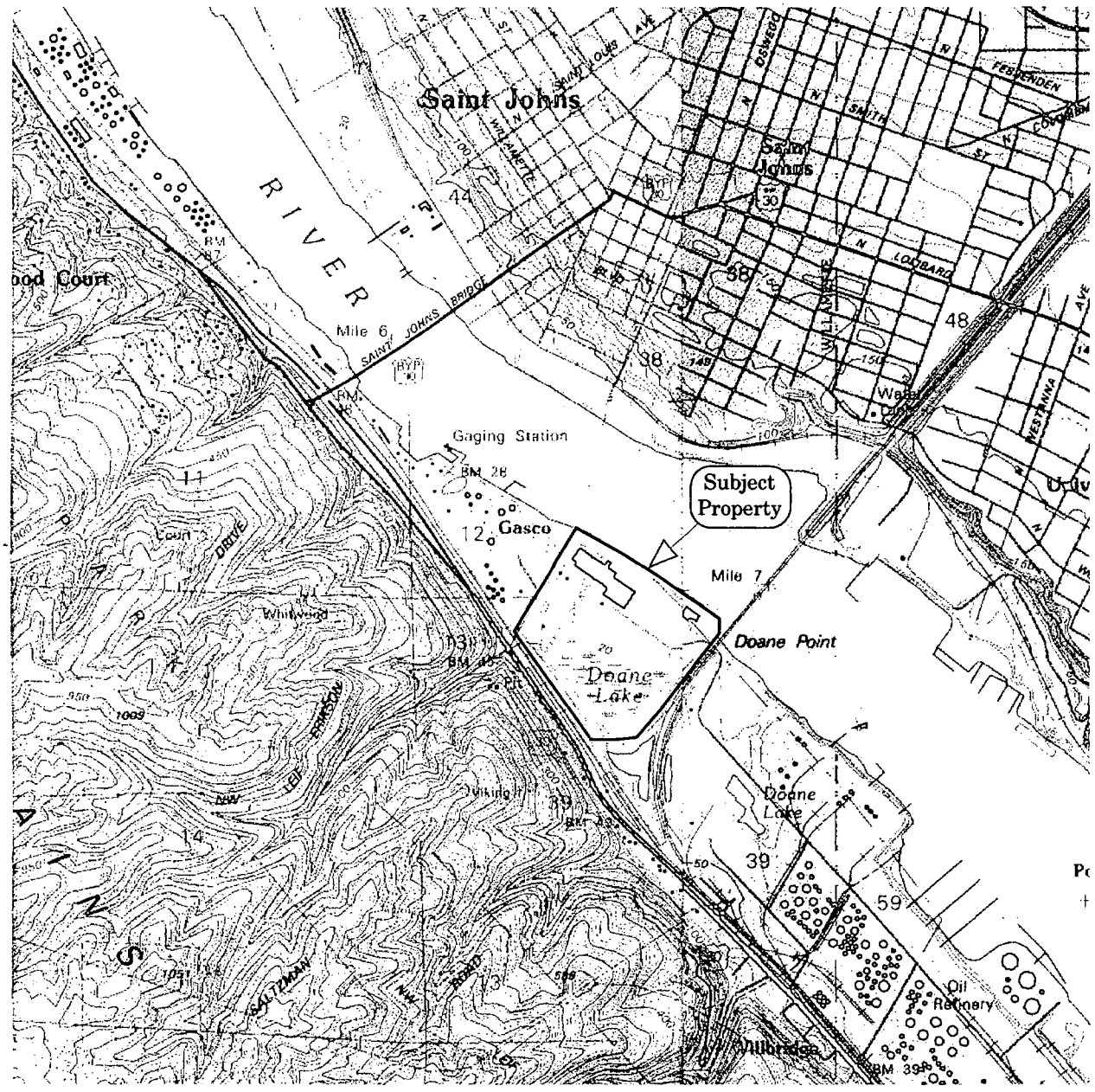
Date Measured	Measured Water Level (feet btc)																									River Level (feet bbm)
	MW-1-22	MW-2-32	MW-2-61	MW-3-26	MW-3-56	MW-4-35	MW-4-57	MW-4-101	MW-5-32	MW-5-100	MW-5-175	MW-6-32	MW-6-61	MW-8-29	MW-8-56	MW-9-29	MW-10-25	MW-10-61	MW-11-32	MW-12-36	MW-13-30	MW-13-61	MW-14-110	MW-15-50	MW-15-66	
2-Apr-02	14.98	20.47	25.78	20.61	25.33	26.38	25.84	25.59	18.71	18.56	18.34	-	-	20.24	30.61	7.99	16.77	18.46	13.16	12.48	15.35	25.85	23.59	14.56	15.42	23.60

Groundwater Elevation

Date Measured	Groundwater Elevation (feet msl)*																									River Stage (feet msl)**
	MW-1-22	MW-2-32	MW-2-61	MW-3-26	MW-3-56	MW-4-35	MW-4-57	MW-4-101	MW-5-32	MW-5-100	MW-5-175	MW-6-32	MW-6-61	MW-8-29	MW-8-56	MW-9-29	MW-10-25	MW-10-61	MW-11-32	MW-12-36	MW-13-30	MW-13-61	MW-14-110	MW-15-50	MW-15-66	
2-Apr-02	19.77	13.99	8.63	13.50	8.74	8.16	8.69	8.77	9.12	8.75	8.85	-	-	18.85	8.52	29.66	22.45	20.87	25.23	26.21	19.51	8.93	13.82	21.41	20.64	8.52

NOTE: * = City of Portland Datum
msl = mean sea level

**Willamette River, Portland Harbor Stage, obtained from National Weather Service and adjusted to feet msl - City of Portland datum: December 1995 to December 1997. Post December 1997 River Stage data measured directly from surveyed bench mark located on north end of FAMM Dock.



Note: Base Map from Linnton (1990) and Portland (1990), Oregon, USGS 7.5-Minute Quadrangles

Project No. 5237	HAHN AND ASSOCIATES INCORPORATED	LOCATION MAP	FIGURE
October 2001	ENVIRONMENTAL MANAGEMENT 434 NW SIXTH AVENUE, SUITE 203 PORTLAND, OREGON 97209 (503) 796-0717	Wacker Siltronic Corporation 7200 NW Front Avenue Portland, Oregon	1

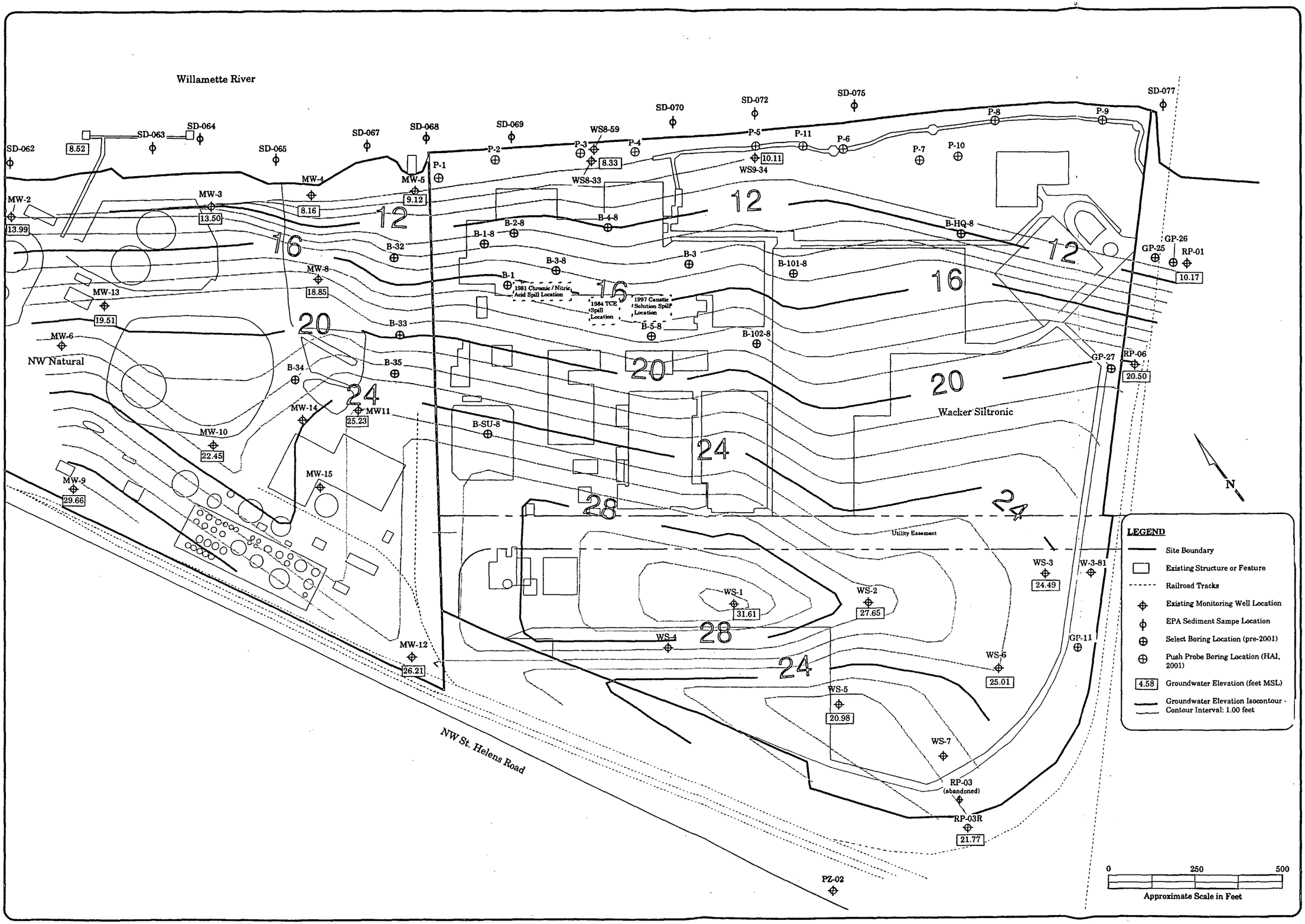


Figure 2

Groundwater Elevation Map - Surficial Fill Wells
April 2, 2002

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN & ASSOCIATES, INC.
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

May 2002

Project No. 5237

SCOEPA00012517

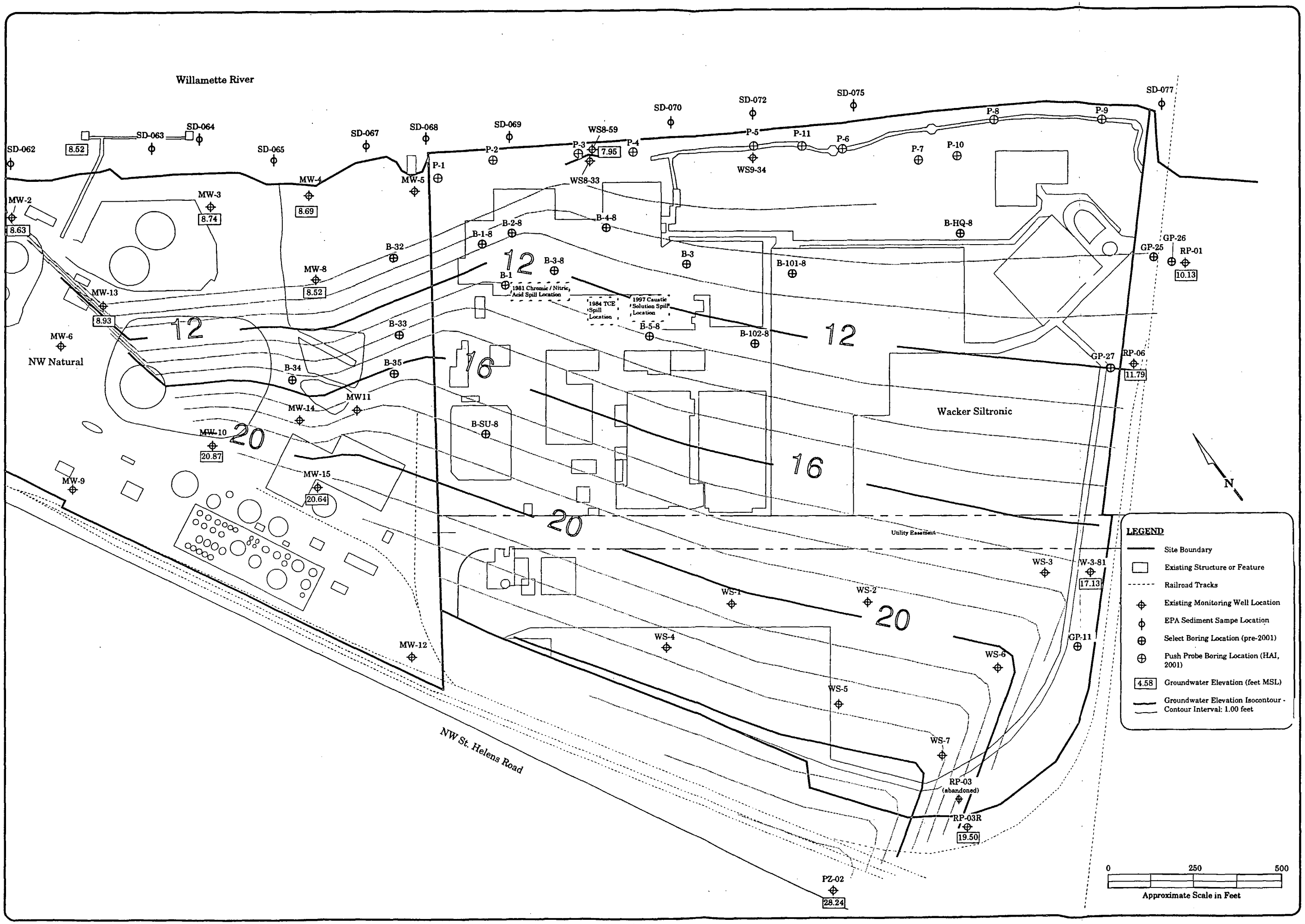


Figure 3

Groundwater Elevation Map - Intermediate Wells (40 to 81 feet bgs)
April 2, 2002

Focused Remedial Investigation
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN & ASSOCIATES, INC.
ENVIRONMENTAL MANAGEMENT
434 NW SIXTH AVENUE, SUITE 203
PORTLAND, OREGON 97209
503/796-0717

May 2002

Project No. 5237

SCOEPA00012518

8128.01.04

Tom Foster

From: Chris Reive [Chris.Reive@jordanschrader.com]
Sent: Tuesday, February 25, 2003 4:35 PM
To: 'Burkholder Kurt'
Cc: 'Cathryn Young - Wacker'; Jim Maul; Tom Foster
Subject: Wacker/NW Natural Unilateral Order

Kurt:

In reply to your voice-mail message regarding Wacker's reaction to NW Natural's request to be released from compliance with the Unilateral Order to conduct an RI on the Wacker Site - I have relayed your question to Cathryn Young at Wacker. Cathryn reports that she received a similar request from Eric at her most recent meeting with him - which was to discuss the scope of work for Phase II of the subsurface TCE investigation below the Wacker site.

Hahn & Assoc reports that NW Natural's "only remaining RI data collection task to be completed at the site involves an inspection and survey of the base of the drainage ditch located on BNSF property immediately west and south of the Wacker property." I have asked Wacker's consultant - Maul Foster & Alongi to evaluate that statement in light of the scope of work contemplated by DEQ's Order, and to describe for Wacker what additional work, if any, remains to be done. For example, Hahn & Associates acknowledges that, distinct from 'data collection', there remains a "Phase I Site Characteristic Summary Report" and a "Technical Memorandum on Source Control Measures" to be prepared from the information it has gathered.

Of all the contaminants that have been documented in the subsurface soils and groundwater below the Wacker Property - only the source of the TCE remains in question. The PAHs, BTEX, naphthalene, cyanide, arsenic, chromium, copper, lead, nickel and zinc, etc., etc, are all attributable to NW Natural's past operations and many of these compounds are chemicals of concern or chemicals of potential concern in the Portland Harbor. They are therefore candidates for source control measures - independent of the TCE contamination that Wacker is investigating. At a minimum, we don't yet know what conclusions will be drawn in Hahn's "Phase I" report, and whether there will be a Phase II or Phase III to follow.

And so, although Wacker is seriously considering DEQ's request for a dialogue about amending or eliminating the existing Order, it is not prepared to simply consent to such an arrangement until it knows more about NW Natural's conclusions related to contaminants for which it bears sole responsibility and what if any responsibility NW Natural will retain for those contaminants under whatever modification is proposed. It is clear is that NW Natural took no responsibility for those contaminants below the Wacker site until the current Order was issued, even though it had a clear prior responsibility to investigate the 'off-site' contamination under the Order that DEQ had issued to NW Natural years before to compel an RI on the NW Natural site. In light of that track record, Wacker is understandably reluctant to agree to DEQ's request without having answers to these questions.

Obviously, DEQ's question - which seems to be prompted by NW Natural's desire to be set free - creates several legitimate concerns. Wacker believes it is being reasonable here, particularly with regard to the TCE investigation - which it does not concede is its ultimate responsibility. In the meantime, it expects a similar commitment from NW Natural as to its known historical contamination. How do you suggest we pursue this issue? Are there easy answers to Wacker's questions? Do you have a proposal for us to consider other than to simply release NW Natural from the existing Order?

Feel free to share these comments with DEQ and/or NW Natural - we are willing to discuss solutions that address Wacker's concerns.

Chris

PLEASE DO NOT read, copy, or disseminate this communication unless you are

the intended addressee. This e-mail communication may contain confidential

and/or privileged information intended only for the addressee. If you have received this communication in error, please call me immediately at 503-598-7070. Also, please notify me immediately via e-mail that you have received the communication in error. Thank you.

JORDAN SCHRADER

ATTORNEYS AT LAW

Project No: 8128.01.05

File To Folder: _____

Fax Transmittal Cover

To:	Dana Bayuk, Maul Foster & Alongi	From:	Chris Reive/Debra Braddock
		Matter #:	29619
Fax:	(971) 544-2140	Total Pages:	5
Phone:	(360) 694-2691	Date:	11/5/02
Re:	Wacker Siltronic Corporation/Portland Harbor	cc:	

☐ FYI ☐ As requested ☐ Please review and reply Originals ☐ will ☒ will not follow

Comments/Description of documents being faxed:

Correspondence dated 11/1/02 from Eric Blischke of DEQ to Cathryn Young and Bob Wyatt.

RECEIVED
NOV 05 2002
By AMF

Please contact the Service Center at 503.598.7070 or toll free at 1.888.598.7070 if there is any problem with this fax. Documents can be returned by fax to 503.598.7373 or mail to PO Box 230669, Portland, Oregon 97281.

PLEASE NOTE: THIS IS A CONFIDENTIAL TRANSMISSION. This fax transmission may contain confidential, legally privileged information belonging to the sender. The information is intended only for the individuals or entities to whom it is addressed. If you are not the intended recipient, you are hereby notified that any disclosure, copying, distribution, or taking of action in reliance on the contents of this information is strictly prohibited. If you receive this transmission in error, please notify us immediately.

Return fax documents to DB

29619 059 db fax.doc\db/11/05/02-1

Wacker Siltronic Corporation

ROUTED TO: DB
CLR

7200 NW Front Avenue
Portland, Oregon 97210
Phone: (503) 243-2020
Fax: (503) 219-7599 Central Engineering

FACSIMILE TRANSMITTAL SHEET

TO: Chris Reive
Jordan Schrader

FROM: Cathryn Young

FAX No: (503) 598-7373

DATE: November 4, 2002

NUMBER OF PAGES (including this page): 4

MESSAGE/SPECIAL INSTRUCTIONS:

DEQ 11/1/02 letter re: Supplemental Investigation

Oregon

John A. Kitzhaber, M.D., Governor

Department of Environmental Quality
Northwest Region
2020 SW Fourth Avenue
Suite 400
Portland, OR 97201-4987
(503) 229-5263 Voice
TTY (503) 229-5471

November 1, 2002

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

Ms. Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210

Re: Supplemental Investigation to Further Assess Trichloroethene Detections - Wacker Siltronic Corporation Site

Dear Bob and Cathryn:

The Oregon Department of Environmental Quality (DEQ) is in receipt of Cathryn Young's letter dated October 16, 2002. Although DEQ also regrets that this exchange of letters is necessary, we believe it is imperative that we further clarify our position. This is especially important given the extraordinary concentrations of trichloroethene (TCE) detected in groundwater (up to 575,000 ug/l) and the likely presence of dense non-aqueous phase liquid (DNAPL) at the Wacker site. Furthermore, DEQ is concerned that Wacker failed to adequately address DEQ comments regarding the vertical extent of groundwater contamination and vertical groundwater concentration profile provided in its September 6, 2002 letter. DEQ would like to reiterate its oft-stated desire to see the investigation of TCE detections move forward in a timely manner consistent with the source control objectives of the Portland Harbor Superfund site.

As you are aware, a unilateral order was issued jointly to Northwest Natural and Wacker Siltronics Corporation (Wacker) for the performance of a remedial investigation and source control evaluation at the Wacker site. During the initial stages of the investigation, groundwater collected from a GeoProbe boring installed along the Willamette River was found to contain 11,200 ug/l of TCE. A follow-up investigation completed in March 2002 detected TCE in groundwater collected from boring GP-02-02 at 575,000 ug/l. Based on these results, DEQ determined that further investigation was necessary to identify potential sources of TCE contamination and determine the vertical and lateral extent of TCE contamination at the Wacker site.

On August 1, 2002, DEQ met with representatives of Wacker to discuss a proposed sampling approach. The approach outlined to DEQ included the installation of additional GeoProbe borings adjacent to the Willamette River and a review of company records to identify potential sources of TCE contamination at the Wacker facility. DEQ agreed conceptually to the proposed approach and a draft plan was submitted to DEQ by Maul Foster & Alongi, Inc. (MFA) on behalf of Wacker on August 16, 2002. DEQ commented on the draft work plan in the September 6, 2002 letter and reiterated its concern that the draft work plan did not include a proposal for the installation of monitoring wells as requested its May 31, 2002 letter. DEQ also commented that the proposed sampling approach would not gather the vertical groundwater concentration profile and vertical extent of groundwater contamination information necessary to select appropriate screen depths for future monitoring wells. During a conference call held September 17, 2002, DEQ agreed to conditionally approve the proposed work without incorporation of DEQ comments on the vertical groundwater concentration profile and vertical extent of groundwater contamination. A revised work plan was submitted to DEQ by MFA on September 20, 2002.

In DEQ's letter dated September 25, 2002 approving the work plan, DEQ requested analytical data generated during implementation of the September 20, 2002 work plan be submitted by October 25, 2002. DEQ also requested submittal of a monitoring well installation proposal by November 25, 2002. DEQ is sympathetic to the contractual arrangements between MFA and its laboratory and the need to incorporate this information into a monitoring well installation plan. As a result, DEQ is modifying its September 25, 2002 request as outlined below:

1. In accordance with Section 5.F. of Unilateral Order ECVC-NWR-00-27, DEQ requests that all analytical data generated during implementation of the September 20, 2002 work plan be submitted to DEQ no later than November 8, 2002. In addition, DEQ requests that all field notes, boring logs and other information generated during implementation of the September 20, 2002 work plan be submitted to DEQ within 10 calendar days following receipt of this letter. Failure to comply with these requests will be considered a violation of the terms of the unilateral order.

2. In accordance with Section 5.C.(2) of Unilateral Order ECVC-NWR-00-27, DEQ has determined that the installation of monitoring wells in the vicinity of the 1984 TCE spill, and the P-2 and GP-02-02 locations is necessary to address unanticipated threats to human health and the environment. The monitoring well installation effort must also include steps to evaluate the vertical groundwater contamination concentration profile and delineate the vertical extent of groundwater contamination. This is required to properly select monitoring well depths and screen intervals. DEQ requests that a monitoring well installation proposal be submitted to DEQ no later than December 10, 2002. Failure to comply with this request will be considered a violation of the terms of the unilateral order.

3. In accordance with Section 5.C.(2) of Unilateral Order ECVC-NWR-00-27, DEQ has determined that the results of Wacker's research into the use of TCE at its facility must be submitted to DEQ along with its monitoring well installation proposal. This is necessary

to address unanticipated threats to human health and the environment. This information may be used to select additional monitoring well locations, if needed, or modify the monitoring well locations identified by DEQ above. DEQ requests that this information be submitted to DEQ no later than December 10, 2002. Failure to comply with this request will be considered a violation of the terms of the unilateral order.

DEQ is very concerned about the presence of elevated concentrations of TCE at the Wacker site and that TCE may be discharging to the Willamette River at concentrations that represent a threat to human health or the environment. Because of the aggressive schedule established for the Portland Harbor Superfund Site and because of DEQ's obligations under the Memorandum of Understanding between the U.S. Environmental Protection Agency (USEPA), DEQ, Natural Resource Trustee Agencies and Tribes, it is necessary that any potential sources of contamination to the Willamette River be characterized, evaluated and controlled in a timely manner.

I want to thank you in advance for your attention to these important requests. I may be reached at (503) 229-5648 if you wish to discuss this matter further or if you have any questions.

Sincerely,

Eric L. Blischke
Project Manager
Voluntary Cleanup and Portland Harbor Section

cc: Neil Mullane, NWR/DEQ
Dick Pederson, LQ/DEQ
Mike Rosen, NWR/DEQ
Kurt Burkholder, DOJ
Rod Struck, NWR/DEQ
Jennifer Peterson, NWR/DEQ
Wallace Reid, USEPA

8128.01.05

Oregon
Theodore R. Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

April 10, 2003

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

RECEIVED
APR 12 2003
By

Ms. Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210

Re: Work Plan – Exploratory Boring and Groundwater Assessement
Wacker Siltronic Corporation Site
ECSI No. 183

Dear Bob and Cathryn:

The Oregon Department of Environmental Quality (DEQ) has reviewed the "*Work Plan – Exploratory Boring and Groundwater Assessment - Wacker Siltronic Corporation Site*" (Work Plan). The work plan was submitted by Maul Foster Alongi (MFA) on behalf of Wacker Siltronic Corporation (Wacker) and was received by DEQ on March 10, 2003. Our comments are presented below:

General Comments

A. Overall the proposed investigation provides a sound approach for further characterizing of TCE contamination at the Wacker site.

B. The work plan proposes to only report the results of selected volatile organic compounds in soil and groundwater. Reducing the list of compounds is not acceptable during the initial phase of an investigation. DEQ requires that the full EPA Method 8260B list be analyzed and reported.

Specific Comments

1. Section 2.1. Wacker's response to several of DEQ's comments indicates that additional research is being performed on the underground storage tank (UST) system. DEQ will evaluate the results of this research and the results of the proposed investigation to determine if additional work is required.

2. Section 5.0. Page 5-1. Second Paragraph. Last sentence. Please revise the last sentence to read: "....screened zones will be located to provide depth-discrete samples between 50 ~~about 100~~ and 215 feet."

3. Section 5.2.1. Page 5-2. Third Paragraph. Please revise the first sentence to read "The upper water bearing zone has been ~~thoroughly~~ characterized for potential contaminants of interest (COI). ~~with respect to the COCs.~~

4. Section 5.2.1. Page 5-3. Fifth Paragraph. The work plan proposes to analyze numerous soil samples on a 24-hour turn-around schedule to facilitate the selection of screen intervals. While soil analyses may be useful to quantify VOC concentrations in samples with high PID reading or testing positive for the presence of NAPL, DEQ questions the useability and value of this data for selection of groundwater monitoring intervals. It is our understanding that the rotosonic drilling method results in generating significant heat and which may result in volatizing the contaminants of interest. Therefore, DEQ prefers to select screen intervals using groundwater grab data.

   DEQ requests that groundwater reconnaissance samples be collected at pre-selected depths using to assess the vertical distribution of VOCs prior to well installation. Groundwater reconnaissance samples may be collected using either Hydropunch™ (or equivalent methods) or packer technologies (e.g., "K-packer") DEQ believes the monitoring intervals can be best selected using groundwater concentrations, lithology, and field screening data.

5. Section 5.3. Page 5-4. A variance from the Oregon Water Resources Department (WRD) will be required for the installation of the multichannel wells. Please contact WRD to verify they will grant a variance for this project.

6. Section 5.3. Page 5-4. Please identify the drilling company and Oregon licensed monitoring well constructor that will install the CMT wells. It is DEQ's expectation that the contractors will have direct experience with the installation of CMT wells. Please provide DEQ with documentation of the contractors experience with the CMT technology.

7. Section 5.3. Page 5-4. Please provide additional information regarding the proposed length of the screened intervals and the spacing of the drilled 0.38-inch holes within this interval. DEQ recommends screened intervals of at least 2-feet, if practicable.

8. Section 5.3 Page 5-5. It is unclear if the use of coated bentonite is planned. Coated bentonite pellets do not hydrate as quickly, and therefore are useful for deeper placement. Some coated pellets give off either ethanol or acetone which may result in elevated detection limits for VOCs. The use of coated bentonite may be appropriate to increase the likelihood of good seals between sampling interval. Please evaluate the type and source of the proposed bentonite packers and assess the potential for acetone or ethanol contamination and the risks associated of not using a coated pellet.

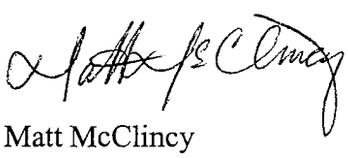
9. Section 6. Page 6-1. DEQ will evaluate the groundwater data after each sampling event to assess if modifications to the monitoring program are necessary. For example, are additional monitoring points or traditional groundwater monitoring wells necessary to determine the extent of contamination; are additional analyses necessary to define the nature of contamination; or can some sampling intervals be eliminated?

10. Section 6. Page 6-1. The work plan does not include an adequate groundwater elevation monitoring program. At a minimum, monthly groundwater elevations should be collected in the new CMT wells and groundwater elevations should be monitored over at least a full tide cycle in a selected CMT well.

11. Section 6.1. Page 6-1. Please revise the first sentence to read "...until a minimum of seven days ~~24 hours~~ after well development is competed."

DEQ comments should be incorporated into a revised work plan. The work plan should be submitted to DEQ within 15 business days following the date of this letter. Please call me at (503) 229-5538 if you have any questions or to discuss any of the comments.

Sincerely,



Matt McClincy
Project Manager
Cleanup and Portland Harbor Section

cc: Mike Rosen, NWR/DEQ
Rod Struck, NWR/DEQ
Jennifer Peterson, NWR/DEQ
Jim Maul, Maul Foster Alongi

MAUL FOSTER ALONGI
ENVIRONMENTAL & ENGINEERING CONSULTANTS

VANCOUVER ■
SEATTLE ■
PORTLAND ■

TRANSMITTAL

3121 Moody Avenue, Suite 200 | Portland, OR 97239 | Phone 971.544.2139 | Fax 971.544.2140

PROJECT/TASK NO.: 8128.01.05

DATE: June 16, 2003

TO: Attn: Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue – MS 30
Portland, OR 97210

RE: Attachments

ENCLOSED, PLEASE FIND THE FOLLOWING:

QUANTITY	DESCRIPTION
3	Attachments 1 and 2 from June 10, 2003 Transmittal Letter by MFA

FOR YOUR:

- x USE
- ___ APPROVAL
- ___ REVIEW/COMMENTS
- ___ INFORMATION
- ___ OTHER

SENT BY:

- ___ REGULAR MAIL
- ___ FEDEX / AIRBORNE
- ___ UPS
- x COURIER
- ___ OTHER

COMMENTS: Cathryn -- these attachments were referenced in our June 10, 2003 transmittal letter to DEQ but were inadvertently omitted. I've included 3 copies.

CC: Chris Reive, Jordan Schrader
Matt McClincy, DEQ

BY: James Peale

Print 3 copies: ORIGINAL - Recipient COPY - MFA File COPY - Originator

ATTACHMENT 1 – PHOTOGRAPHS

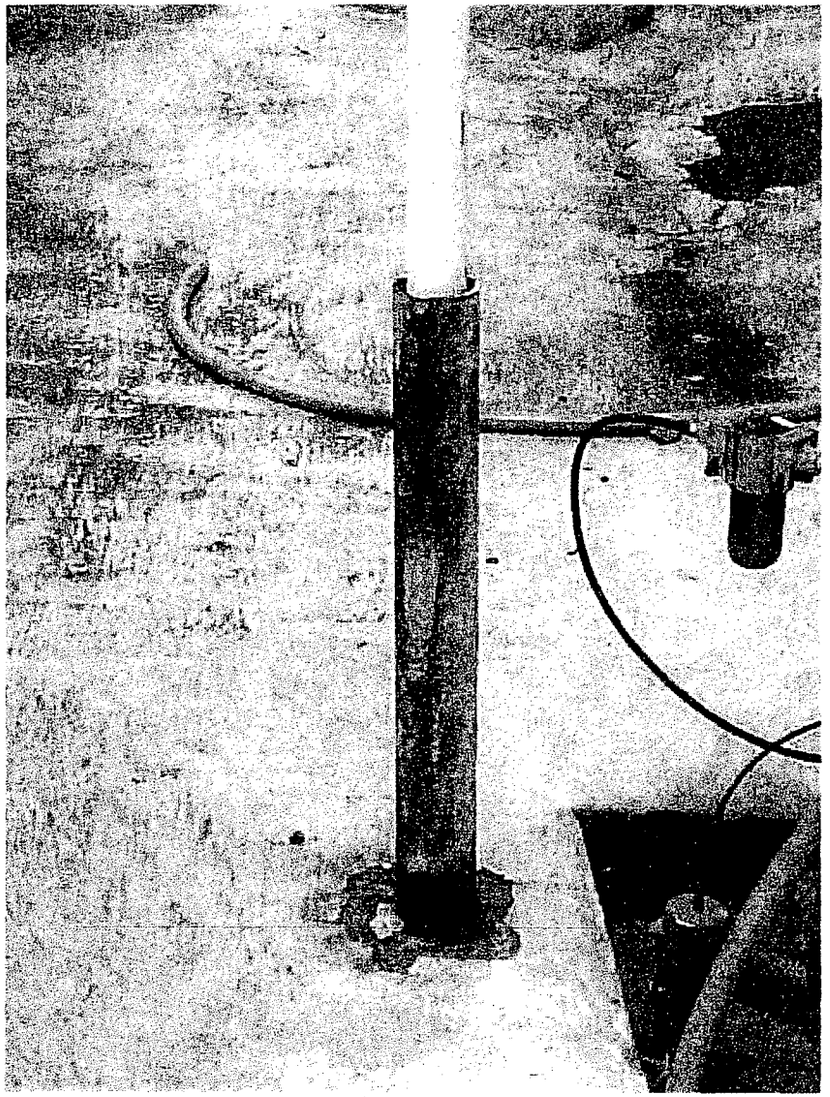


Photo 1 – Bottom of standpipe.

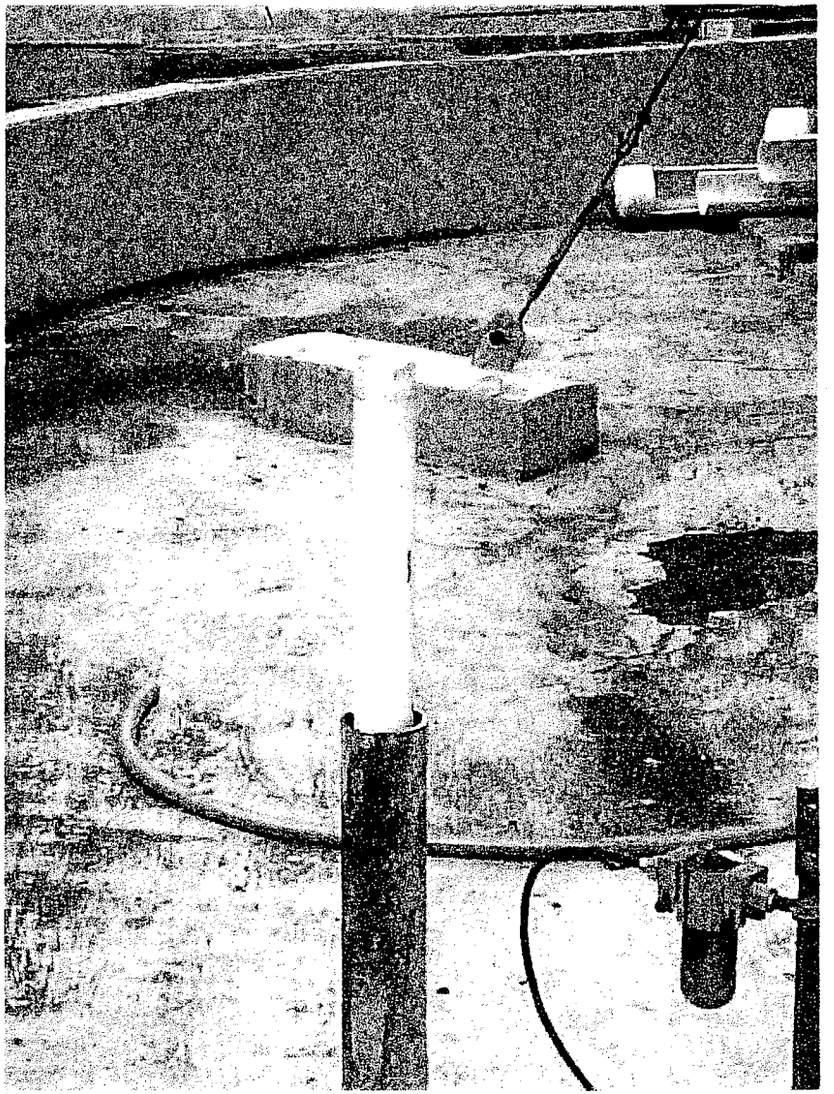


Photo 2 – Top of PVC pipe and standpipe.

ATTACHMENT 2 – BORING LOG

ATTACHMENT B

Boring Log:
Wacker Siltronic Corporation
Well MW-1 (WS10-30)

HAHN AND ASSOCIATES, INC.

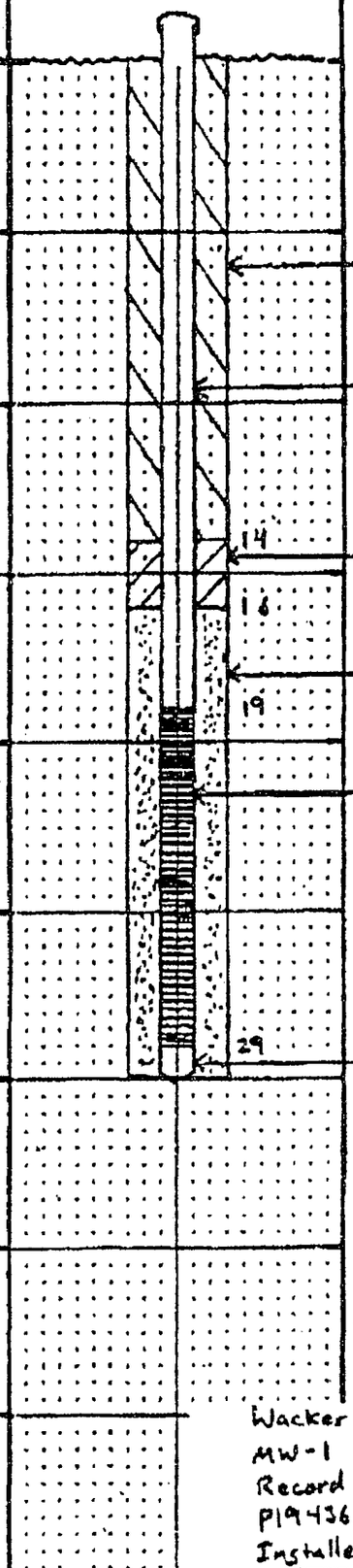
GEOLOGIC LOG

Depth	Description	Hnu reading (ppm)
	GROUND SURFACE	
	Gray silty fine to medium SAND	0
3	Gray plastic fine sandy SILT.	30-50
5	Occasional wood fragments	5
	Gray medium SAND with some silt. Silty from 6 to 8 feet.	5-15
8		15-30
	Grayish-brown medium SAND with some silt.	1-2
11		
	Gray silty fine to medium SAND grading to a gray SILT with some fine sand.	50
		70
		10
24		
	Gray medium SAND with some silt.	
29		
	Gray plastic SILT or CLAY. Strongly cohesive. Some orange mottling (probably due to ferric iron) in hairline fractures	
30		

Hnu reading taken at the top of the hollow-stem auger when the auger bottom was at the depth indicated by the position of the number

approximate water level (3-11-85)

RECORD DRAWING



CONSTRUCTION DETAILS

- Bentonite slurry seal
- 2" Sch. 40 pvc casing. Flush threaded joints.
- Hydrated bentonite pellets
- Monterey Sand Pack
- 2" Sch 40 pvc 10-slot screen. Flush threaded joints.
- Threaded PVC end cap

Wacker Siltronics
MW-1
Record Drawing
P19436.A1
Installed 3-11-85

To: S. Payne/PDX
from: K. Shump/SEA

Post-it® Fax Note 7671	Date 3/6/02	# of pages ▶ 1
To Rob Ede	From Myron Burr	
Co./Dept. Hahn	Co. Wacker Siltronic	
Phone #	Phone # 503-219-7832	
Fax # 503-227-2248	Fax #	

MAUL FOSTER ALONGI
ENVIRONMENTAL & ENGINEERING CONSULTANTS

PORTLAND, OREGON
SEATTLE, WASHINGTON
VANCOUVER, WASHINGTON

June 10, 2003
Project 8128.01.05

Mr. Matt McClincy
Oregon Department of Environmental Quality
2020 SW 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Re: Final Work Plan – Groundwater Assessment
Wacker Siltronic Corporation, ECSI No. 183

Dear Matt:

On behalf of Wacker Siltronic Corporation (Wacker), Maul Foster & Alongi, Inc. (MFA) has prepared this response to the Oregon Department of Environmental Quality's (DEQ) letter dated May 21, 2003. The work plan for the groundwater assessment has been revised consistent with the DEQ's comments, is considered to be final, and is enclosed with this letter.

DEQ's letter included a specific request for information regarding a monitoring well located near the former UST area (Specific Comment #1). Wacker has tentatively identified the well in question. However, a positive identification could not be made due to conflicting information. The initial assessment of this well's possible use as a groundwater quality or elevation monitoring point is presented here, followed by brief responses to the remaining DEQ comments.

INITIAL MONITORING WELL ASSESSMENT

MFA completed a preliminary assessment of the monitoring well near the former UST area, based on a site visit and available documents provided by Wacker. The following summarizes current information regarding the monitoring well:

- A 2-inch diameter polyvinylchloride (PVC) pipe is mounted inside a 3-inch (nominal) diameter steel pipe in the containment area surrounding the former stripper equipment (see photographs in Attachment 1). The location generally corresponds to a soil core sampling point completed in 1984. The steel pipe appears to be mounted in the concrete floor of the containment area. The steel pipe does not appear to be sealed into the concrete, and the concrete at the base is moderately cracked. The PVC pipe extends beyond the top of the steel pipe and is

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covered by a slip cap. The rim of the PVC pipe is about 3.6 feet above ground surface.

- MFA measured the depth to water and the total depth of the PVC pipe. Measurements were made from the rim of the PVC pipe using an electronic water-level indicator. Water was found in the pipe at about 18.2 feet below ground surface (bgs). The total depth of the pipe was about 31.6 bgs. The bottom of the pipe felt "soft" using a weighted tape. Upon removal, the weighted part of the tape was coated with a viscous, dark brown substance with a strong coal tar-like odor.

- MFA reviewed a letter from Hahn and Associates (Hahn) to DEQ dated March 7, 2002 (Attachment 2). The letter identified monitoring well MW-1 as being located near the former trichloroethylene (TCE) spill area, and renames it WS-10-30. The letter includes an attachment with a well construction and boring log for a well identified as MW-1. The total depth of the well on the log is 30 feet bgs. The stick-up is shown as about 1 foot above ground surface. The well on the log is constructed of PVC. The log is dated March 11, 1985. The log does not include any information regarding location, the driller responsible for installation, or similar information as required by the Water Resources Department (WRD). MFA did not locate a record for this well (based on the installation date) in the WRD database.

- The Hahn letter indicated that Hahn expected to complete a field inspection of the well and assess its integrity with the intent of including it in a monitoring program. MFA was unable to identify the results of such an investigation or any subsequent water level or water quality data from this well.

Based on this information, MFA recommends abandoning of the PVC pipe in accordance with WRD rules, for the following reasons:

- The pipe currently represents a potential conduit to water. The pipe may not actually intersect the water table (generally understood to be about 25-30 feet bgs), but could contain infiltration or precipitation.

- No evidence has been found to corroborate the well log with the pipe in the ground.

- The "soft bottom" of the pipe indicates that the bottom of the pipe may be open or filled with silt or coal tar. Groundwater samples collected from the pipe would

probably not meet the 5 nephelometric turbidity unit (NTU) goal referenced by DEQ in their May 21, 2003 letter due to the silt.

- If the PVC pipe represents MW-1/WS-10-30, it does not appear to have been installed by a licensed driller. Furthermore, the presence of product in the pipe raises the question of its integrity. In the presence of pure product, the PVC casing and screen and bentonite seal are likely to have degraded substantially during the 18 years since its installation.

Subsequent to DEQ's approval, MFA will proceed with planning for the decommissioning of the PVC pipe consistent with WRD rules.

RESPONSE TO COMMENTS

The following section provides DEQ's comments followed by MFA's response. To facilitate your review, the DEQ's comment is in bold type and included in its entirety.

General Comments

A. **The sequencing of the Rotosonic soil borings is not clear in the work plan, although the drilling of RSB-1 initially is inferred. Since earlier investigation in the former underground storage tank area encountered trichloroethene (TCE) at concentration levels that are indicative of the presence of TCE product – dense non-aqueous phase liquid (DNAPL) – and the local stratigraphy below a 100 feet is uncertain, DEQ recommends that an outside-in investigative approach be used (e.g., background boring/well, downgradient borings/wells followed by investigation in the potential source area).**

   Noted. The work plan has been modified.

B. **Wacker should be prepared to construct nested monitoring wells in the source area at the RSB-1 location pending the field screening and grab sample results.**

   Noted. The work plan has been modified.

Specific Comments

1. **Section 1.3 Page 1-2. DEQ was previously made aware of the presence of a monitoring well in the vicinity of the former UST area. DEQ requested information regarding the construction of this well (e.g., boring log, screened interval, total depth) and that this well be assessed for its possible use as a groundwater quality or elevation monitoring point. This task should be included in this plan. DEQ requests that DEQ be provided with the location of this well and available information within 15 days of this letter.**

   Discussed above.

2. **Section 2.2.2, Page 2-6. No. 9. The referenced Section 7.2 is not present in the revised work plan.**

   The work plan has been corrected.

3. **Section 2.2.2, Page 2-6. No. 10. Groundwater Elevation Monitoring. DEQ does not agree with the response to this comment. Given the extremely high concentrations of TCE detected at this site and the potential impacts to the Willamette River, DEQ is requiring that groundwater elevation measures be obtained on a monthly basis for a minimum period of 3 months so that groundwater flow directions can be determined and temporal variability in groundwater elevations can begin to be evaluated. In addition, understanding the tidal influences on the water bearing units beneath the site is crucial in understanding the site hydrogeology and contaminant fate and transport. While DEQ concurs tidal response may be minimal in the shallow water-bearing zone, DEQ expects tidal response to increase with depth. Tidal monitoring should be conducted within the first quarter after the wells are installed.**

   The work plan has been revised to reflect the change in the scope of work. Water level measurements will be collected monthly for at least three months following completion of the new wells. A tidal influence evaluation will be completed during the same three-month period.

4. **Section 3. Page 3-1. The work plan states that GP-11 will be located near former monitoring well MW-2. The location of MW-2 is not shown on Figure 3 as indicated. Please provide the location of MW-2 on subsequent**

figures and provide DEQ with the abandonment records for MW-2 in the first data report.

Subsequent figures will include the location of former monitoring well MW-2 and GP-11. The abandonment record for MW-2 will be included in the first data report.

5. **Section 4.3. Page 4-4. The well installation procedures should include at a minimum the following information or discuss how the following will be determined**

   - **Screen length;**
   - **Screen size;**
   - **Filter pack specifications (will a finer sand be placed over the filter pack material to prevent grout from clogging the filter pack?);**
   - **Well seal materials; and**
   - **Minimum thickness of well seal.**

   The work plan has been modified to include the above information regarding well installation. As stated in the work plan, each well will be installed consistent with WRD rules.

6. **Section 4.5, Page 4-6. Please provide a copy of the waste determination for the investigation derived waste prior to managing the waste off-site. This determination should include an evaluation as to whether the TCE-containing soil or groundwater is subject to management as a listed and/or characteristic hazardous waste.**

   A waste determination will be made prior to managing the waste off-site. The waste determination will be provided to the DEQ.

7. **Section 4.6. Page 4-6. The goal for well development should include a goal for turbidity of 5 NTS. If the turbidity goal cannot be achieved alternative well development and or sampling methodologies should be considered to assure representative samples are collected.**

   Noted. MFA understands the comment to suggest a well development goal for turbidity of 5 nephelometric turbidity units (NTU), which is a maximum contaminant level (MCL) for drinking water. This goal is acceptable.

Please call either of us at (971) 544-2139 if you have questions or comments.

Sincerely,

Maul Foster & Alongi, Inc.

Thomas L Foster
for
James Peale, RG
Senior Hydrogeologist

James J. Maul
Principal Hydrogeologist

cc: Cathryn Young and Tom McCue; Wacker Siltronic
Chris Reive; Jordan Schrader

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MAUL FOSTER ALONGI
ENVIRONMENTAL & ENGINEERING CONSULTANTS

PORTLAND, OREGON
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March 19, 2004
Project 8128.01.08

Mr. Matt McClincy
Oregon Department of Environmental Quality
2020 SW 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Re: Non-Aqueous Phase Liquid Sample Analysis

Dear Matt:

On behalf of Siltronic Corporation (Siltronic), Maul Foster & Alongi, Inc. (MFA) has prepared this letter transmitting the analysis of a dense non-aqueous phase liquid (DNAPL) sample collected during recent quarterly groundwater monitoring activities. The sampling and analytical results indicate that DNAPL from the former Pacific Gas & Coke (PG&C)/Gasco (referred to collectively as Gasco) waste disposed near and on Siltronic's property is present in groundwater as deep as 125 feet below ground surface.

BACKGROUND

As discussed in the *Groundwater Summary Report* (MFA, 2003), previous water level measurements had identified approximately 1.5 feet of DNAPL in monitoring well WS-11-125 (the boring log is included in Attachment 1). This well monitors the Lower Water Bearing Zone (LWBZ, as identified in the Groundwater Summary Report) and is screened from 109 to 124 feet below ground surface (ft. bgs), with a sump from 124 to 125 ft. bgs. The well is located in the northwest corner of the Siltronic property, adjacent to the Willamette River (see Figure 1).

The well is located downgradient of the footprint of former waste disposal ponds or areas used by Gasco from roughly 1941 to 1970. Manufactured-gas plant (MGP) related wastes probably included hydrocarbons ranging from light aromatics to tars; however, detailed operational records have not been made available.

During drilling of monitoring well WS-11-125, MFA observed a strong naphthalene odor and sheen in saturated soil samples from 12 to 18 feet bgs, at 31.5 feet bgs, 108 to 112 feet bgs, and from 117 to 118.5 feet bgs. The observation of DNAPL is also consistent with observations of DNAPL at the Northwest Natural (NWN) site, as identified in the Environmental Cleanup Site information (ECSI) database.

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SAMPLE COLLECTION AND FIELD DESCRIPTION

During the second quarterly groundwater sampling event at the Siltronic facility (i.e., on January 28, 2004), MFA field staff detected a discrete layer of NAPL in WS-11-125 using a Solinst® Oil-Water Interface Probe. A disposable, double-check ball weighted bailer was used to confirm the presence of NAPL and collect a sample. The NAPL in the bailer was about 1.5 feet thick and overlain by water, indicating that it was likely dense NAPL (DNAPL). The DNAPL was dark-brown to black in color and exhibited a strong petroleum or naphthalene odor. The DNAPL was decanted into a laboratory-supplied container and submitted under chain-of-custody to Specialty Analytical (Specialty), of Tualatin, Oregon.

The analytical methods included US Environmental Protection Agency (USEPA) Methods 8015M (Hydrocarbon Fuel Fingerprint), 8270D (Semivolatile Organic Compounds [SVOCs]), 8270SIM (Polycyclic Aromatic Hydrocarbons [PAHs]), 8260B (Volatile Organic Compounds [VOCs]), and 9045B (pH); and also American Society for Testing and Materials (ASTM) Method D1298 (Specific Gravity).

ANALYTICAL RESULTS

The laboratory analytical report and MFA's data validation report are attached. The results for each analytical method are described below.

Fuel Fingerprinting by 8015M –

The results (Table 1, attached) indicated the presence of diesel-range organics (DRO) and oil-range organics (ORO) at concentrations of 593,000 and 180,000 milligrams per kilogram (mg/kg)[1], respectively. However, Specialty included the following information in their case narrative for clarification:

> "The chromatogram showed the presence of Flame Ionization Detector (FID) responding compounds, indicating the presence of hydrocarbons. The product covered regulatory ranges for Diesel Range Organics (DRO) and Oil Range Organics (ORO), represented by C12-C24 for DRO, and C24-C40 for ORO. Oil Range contamination present appears to be primarily from the DRO product present. No discrete Oil-type products were present (i.e., Motor Oil, Hydraulic Oil, etc.). Diesel Range Organics that were found are not matched by any distillate fuel type represented in Specialty Analytical's fuel identification library. The product does not appear to be consistent with a distillate fuel (refined product). The hydrocarbon pattern expressed on the chromatogram appears to be an un-refined product type, falling primarily in the Diesel Range Organics boiling range, with

[1] NAPL sample results are reported using milligrams per kilogram (wet weight basis) to correct for the density of the fluid.

some percentage falling into the Oil Range Organics boiling point range. The product analyzed does not appear to be Diesel #1, Diesel #2, Light Industrial Diesel, Kerosene, or other distillate product. The aggregate of large, single component peaks suggest a non-refined product of unknown type, falling primarily in the DRO range. It is not consistent with Bunker Fuels, Fuel Oils, or other semi-defined oil products. Its source is unidentifiable at this time."

Specialty's analysis suggests that the DNAPL is not a result of the releases from the Olympic Pipeline. Absent other potential sources, it appears likely that the DNAPL is composed of constituents typical of Gasco hydrocarbon wastes disposed near and/or on Siltronic's property.

SVOCs by 8270D – The only SVOCs detected were acenapthene, benzo(k)fluoranthene, fluoranthene, naphthalene, and pyrene (Table 2, attached) all of which are polycyclic aromatic hydrocarbons. These compounds all exhibit a specific gravity greater than water (i.e., 1.0 gram/cubic centimeter [g/cc] at 25° C)[2].

PAHs by 8270SIM – With the exception of dibenz(a,h)anthracene and benzo(k)fluoranthene, all of the PAHs included in the 8270SIM list were detected (Table 3, attached). These compounds all exhibit a specific gravity greater than water.

VOCs by 8260B – The VOC results are included in Table 4. Naphthalene was detected at 5,520,000 ug/kg. Other non-chlorinated VOCs (specifically, ethyl- and methylbenzenes, benzene, xylenes, and toluene) were detected at concentrations ranging from 54,200 ug/kg to 379,000 ug/kg. The only chlorinated VOC detected was cis-1,2-dichloroethylene (DCE) (75,200 ug/kg). Trichloroethylene (TCE) was not detected above the MRL.

pH and Specific Gravity – The pH of the sample was 7.93; the specific gravity was 1.09 g/cc. The high (relative to water) specific gravity is due to the high concentrations of PAHs. The results are included in Table 5.

DISCUSSION

The analytical results indicate the following:

- The DNAPL is typical of Gasco waste disposed near and/or on Siltronic's property. The DNAPL was found in a well located immediately downgradient and directly underneath the former disposal areas used by Gasco.

[2] The density of naphthalene is often reported as 0.997 g/cc at 100°C, and 1.145 g/cc at 20°C. The groundwater temperature during sample collection was about 14.2°C.

- The concentration of TCE in groundwater samples from this location have ranged from 2.02 milligrams per liter (mg/L) (October 2003) to 1.1 mg/L (January, 2004). The solubility of TCE in water is 1,100 mg/L. The concentrations of TCE and its breakdown products at this location are indicative of TCE and its breakdown products migrating in a dissolved (i.e., aqueous) phase. The aqueous concentrations of TCE and its breakdown products at this location are orders of magnitude below the solubility limits for these compounds.
- No DNAPL was found immediately below the former UST area (WS-13 location, about 450 ft. upgradient of WS-11-125). Aqueous concentrations of TCE and its breakdown products are higher in the WS-13 wells. DCE concentrations in the Gasco DNAPL are not likely representative of a TCE-related DNAPL, but may represent a co-solving of DCE from the aqueous plume.

Please call either of us at (971) 544-2139 if you have questions or comments.

Sincerely,

Maul Foster & Alongi, Inc.

James G.D. Peale, RG
Senior Hydrogeologist

Thomas L Foster for
James J. Maul
Principal Hydrogeologist

cc: Tom McCue; Siltronic
Chris Reive; Jordan Schrader
Alan Gladstone; Davis Rothwell Mullin Earle & Xochihua, P.C.

Attachments:
Tables 1 – 5 Analytical Results
Attachment 1 – Boring Log
Attachment 2 – Data QC Review and Laboratory Analytical Reports

Table 1
DNAPL Analysis
Hydrocarbon Fuel Fingerprint (8015M)
WS-11-125
Siltronic Corporation
Portland, OR

Analyte	Method Reporting Limit	Units	Result
Automatic Transmission Fluid	25,000	mg/kg	ND
Hydraulic Oil	25,000	mg/kg	ND
Gasoline	10,000	mg/kg	ND
Mineral Spirits	10,000	mg/kg	ND
Kerosene	25,000	mg/kg	ND
Diesel(1)	25,000	mg/kg	593,000
Oil(1)	50,000	mg/kg	180,000

Notes:
mg/kg - milligrams per kilogram
ND - Not detected above the Method Reporting Limit
(1) These results were quantified as diesel and oil based on carbon ranges; however, the chromatograms do not match typical petroleum refined products.

Table 2

DNAPL Analysis
Semivolatile Organic Compounds by GC/MS (8270D)
WS-11-125
Siltronic Corporation
Portland, OR

Analyte	Method Reporting Limit	Units	Result
1,2,4-Trichlorobenzene	667	µg/kg	ND
1,2-Dichlorobenzene	667	µg/kg	ND
1,3-Dichlorobenzene	667	µg/kg	ND
1,4-Dichlorobenzene	667	µg/kg	ND
2,4,5-Trichlorophenol	3,330	µg/kg	ND
2,4,6-Trichlorophenol	3,330	µg/kg	ND
2,4-Dichlorophenol	2,000	µg/kg	ND
2,4-Dimethylphenol	2,000	µg/kg	ND
2,4-Dinitrophenol	3,330	µg/kg	ND
2,4-Dinitrotoluene	3,330	µg/kg	ND
2,6-Dinitrotoluene	3,330	µg/kg	ND
2-Chloronaphthalene	667	µg/kg	ND
2-Chlorophenol	667	µg/kg	ND
2-Methylnaphthalene	66,700	µg/kg	ND
2-Methylphenol	1,330	µg/kg	ND
2-Nitroaniline	3,330	µg/kg	ND
2-Nitrophenol	3,330	µg/kg	ND
3,3-Dichlorobenzidine	3,330	µg/kg	ND
3-&4-Methylphenol	3,330	µg/kg	ND
3-Nitroaniline	3,330	µg/kg	ND
4,6-Dinitro-2-methylphenol	3,330	µg/kg	ND
4-Bromophenyl phenyl ether	667	µg/kg	ND
4-Chloro-3-methylphenol	1,330	µg/kg	ND
4-Chloroaniline	2,000	µg/kg	ND
4-Chlorophenyl phenyl ether	667	µg/kg	ND
4-Nitroaniline	3,330	µg/kg	ND
4-Nitrophenol	3,330	µg/kg	ND
Acenaphthene	6,670	µg/kg	7,160
Acenaphthylene	6,670	µg/kg	ND
Anthracene	6,670	µg/kg	ND
Benz(a)anthracene	6,670	µg/kg	ND
Benzo(a)pyrene	6,670	µg/kg	ND
Benzo(b)fluoranthene	6,670	µg/kg	ND
Benzo(g,h,I)perylene	667	µg/kg	ND
Benzo(k)fluoranthene	667	µg/kg	694
Benzoic acid	6,670	µg/kg	ND
Benzyl alcohol	3,330	µg/kg	ND
Bis(2-chloroethoxy)methane	667	µg/kg	ND
Bis(2-chloroethyl)ether	1,330	µg/kg	ND
Bis(2-chloroisopropyl)ether	667	µg/kg	ND
Bis(2-ethylhexyl)phthalate	667	µg/kg	ND
Butyl benzyl phthalate	667	µg/kg	ND
Carbazole	6,670	µg/kg	ND
Chrysene	6,670	µg/kg	ND

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Table 2

DNAPL Analysis
Semivolatile Organic Compounds by GC/MS (8270D)
WS-11-125
Siltronic Corporation
Portland, OR

Analyte	Method Reporting Limit	Units	Result
Di-n-butylphthalate	667	µg/kg	ND
Di-n-octyl phthalate	667	µg/kg	ND
Dibenz(a,h)anthracene	667	µg/kg	ND
Dibenzofuran	667	µg/kg	ND
Diethylphthalate	667	µg/kg	ND
Dimethylphthalate	667	µg/kg	ND
Fluoranthene	6,670	µg/kg	7,100
Fluorene	6,670	µg/kg	ND
Hexachlorobenzene	667	µg/kg	ND
Hexachlorobutadiene	1,330	µg/kg	ND
Hexachlorocyclopentadiene	3,330	µg/kg	ND
Hexachloroethane	1,330	µg/kg	ND
Indeno(1,2,3-cd)pyrene	667	µg/kg	ND
Isophorone	667	µg/kg	ND
N-Nitrosodi-n-propylamine	1,330	µg/kg	ND
N-Nitrosodimethylamine	667	µg/kg	ND
N-Nitrosodiphenylamine	667	µg/kg	ND
Naphthalene(1)	66,700	µg/kg	68,000
Nitrobenzene	667	µg/kg	ND
Pentachlorophenol	3,330	µg/kg	ND
Phenanthrene	66,700	µg/kg	ND
Phenol	1,330	µg/kg	ND
Pyrene	6,670	µg/kg	9,120

Notes:
µg/kg - micrograms per kilogram
ND - Not detected above the Method Reporting Limit
(1) This naphthalene concentration is biased low due to losses that occur during extraction. The concentration obtained using Method 8260 is a more representative result.

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Table 3

DNAPL Analysis
Polycyclic Aromatic Hydrocarbons by GC/MS (8270 SIM)
WS-11-125
Siltronic Corporation
Portland, OR

Analyte	Method Reporting Limit	Units	Result
Benz(a)anthracene	667	µg/kg	1,780
Benzo(a)pyrene	667	µg/kg	1,800
Benzo(b)fluoranthene	667	µg/kg	1,680
Benzo(g,h,i)perylene	667	µg/kg	1,090
Benzo(k)fluoranthene	667	µg/kg	ND
Chrysene	667	µg/kg	1,890
Dibenz(a,h)anthracene	667	µg/kg	ND
Fluoranthene	667	µg/kg	6,810
Fluorene	667	µg/kg	4,790
Indeno(1,2,3-cd)pyrene	667	µg/kg	810
Naphthalene(1)	6,670	µg/kg	57,600
Phenanthrene	667	µg/kg	18,300
Pyrene	667	µg/kg	9,530

Notes:
µg/kg - micrograms per kilogram
ND - Not detected above the Method Reporting Limit
(1) This naphthalene concentration is biased low due to losses that occur during extraction. The concentration obtained using Method 8260 is a more representative result.

Table 4
DNAPL Analysis
Volatile Organic Compounds by GC/MS (8260B)
WS-11-125
Siltronic Corporation
Portland, OR

Analyte	Method Reporting Limit	Units	Result
1,1,1,2-Tetrachloroethane	50,000	µg/kg	ND
1,1,1-Trichloroethane	50,000	µg/kg	ND
1,1,2,2-Tetrachloroethane	50,000	µg/kg	ND
1,1,2-Trichloroethane	50,000	µg/kg	ND
1,1-Dichloroethane	50,000	µg/kg	ND
1,1-Dichloroethene	50,000	µg/kg	ND
1,1-Dichloropropene	50,000	µg/kg	ND
1,2,3-Trichlorobenzene	50,000	µg/kg	ND
1,2,3-Trichloropropane	50,000	µg/kg	ND
1,2,4-Trichlorobenzene	50,000	µg/kg	ND
1,2,4-Trimethylbenzene	50,000	µg/kg	188,000
1,2-Dibromo-3-chloropropane	50,000	µg/kg	ND
1,2-Dibromoethane	50,000	µg/kg	ND
1,2-Dichlorobenzene	50,000	µg/kg	ND
1,2-Dichloroethane	50,000	µg/kg	ND
1,2-Dichloropropane	50,000	µg/kg	ND
1,3,5-Trimethylbenzene	50,000	µg/kg	54,200
1,3-Dichlorobenzene	50,000	µg/kg	ND
1,3-Dichloropropane	50,000	µg/kg	ND
1,4-Dichlorobenzene	50,000	µg/kg	ND
2,2-Dichloropropane	50,000	µg/kg	ND
2-Butanone	200,000	µg/kg	ND
2-Chlorotoluene	50,000	µg/kg	ND
2-Hexanone	100,000	µg/kg	ND
4-Chlorotoluene	50,000	µg/kg	ND
4-Isopropyltoluene	50,000	µg/kg	ND
4-Methyl-2-pentanone	200,000	µg/kg	ND
Acetone	500,000	µg/kg	ND
Benzene	50,000	µg/kg	118,000
Bromobenzene	50,000	µg/kg	ND
Bromochloromethane	50,000	µg/kg	ND
Bromodichloromethane	50,000	µg/kg	ND
Bromoform	50,000	µg/kg	ND
Bromomethane	50,000	µg/kg	ND
Carbon disulfide	50,000	µg/kg	ND
Carbon tetrachloride	50,000	µg/kg	ND
Chlorobenzene	50,000	µg/kg	ND
Chloroethane	50,000	µg/kg	ND
Chloroform	50,000	µg/kg	ND
Chloromethane	50,000	µg/kg	ND
cis-1,2-Dichloroethene	50,000	µg/kg	75,200
cis-1,3-Dichloropropene	50,000	µg/kg	ND
Dibromochloromethane	50,000	µg/kg	ND
Dibromomethane	50,000	µg/kg	ND

SCOEPA00012551

Table 4
DNAPL Analysis
Volatile Organic Compounds by GC/MS (8260B)
WS-11-125
Siltronic Corporation
Portland, OR

Analyte	Method Reporting Limit	Units	Result
Dichlorodifluoromethane	50,000	µg/kg	ND
Ethylbenzene	50,000	µg/kg	379,000
Hexachlorobutadiene	50,000	µg/kg	ND
Isopropylbenzene	50,000	µg/kg	ND
m,p-Xylene	100,000	µg/kg	290,000
Methyl tert-butyl ether	50,000	µg/kg	ND
Methylene chloride	250,000	µg/kg	ND
n-Butylbenzene	50,000	µg/kg	ND
n-Propylbenzene	50,000	µg/kg	ND
Naphthalene	5,000,000	µg/kg	5,520,000
o-Xylene	50,000	µg/kg	158,000
sec-Butylbenzene	50,000	µg/kg	ND
Styrene	50,000	µg/kg	ND
tert-Butylbenzene	50,000	µg/kg	ND
Tetrachloroethene	50,000	µg/kg	ND
Toluene	50,000	µg/kg	82,000
trans-1,2-Dichloroethene	50,000	µg/kg	ND
trans-1,3-Dichloropropene	50,000	µg/kg	ND
Trichloroethene	50,000	µg/kg	ND
Trichlorofluoromethane	50,000	µg/kg	ND
Vinyl chloride	50,000	µg/kg	ND

Notes:
µg/kg - micrograms per kilogram
ND - Not detected above the Method Reporting Limit

SCOEPA00012552

Table 5
DNAPL Analysis
pH and Specific Gravity
WS-11-125
Siltronic Corporation
Portland, OR

Parameter	Units	Result
pH	--	7.93
Specific Gravity	g/cc	1.09

Notes:
-- Standard pH units
g/cc - grams per cubic centimeter

Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8128.01.06	WS-11	1 of 11

Project Name	Wacker Siltronic Corporation	TOC Elevation (feet above MSL)	31.8500
Project Location	7200 Northwest Front Avenue, Portland Oregon 97210	Surface Elevation (feet above MSL)	31.9350
Start/End Date	9/21/03 to 10/3/03	Northing	7624628.3
Driller/Equipment	Prosonic Corporation/Rotosonic	Easting	705147.0
Geologist/Engineer	Tony Silva	Hole Depth	207.0-feet
Sample Method	4x6 Core Barrel	Outer Hole Diam	9.0/6.0-inch

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
1			100%	CB		PID = 0.0			0.0 to 0.5 feet: TOPSOIL, GRAVELLY SILT (ML); grayish brown; 20% fines, non plastic; 30% gravel, medium, subangular; 50% organic debris, rootlets, woody debris; moist.
									0.5 to 1.5 feet: SANDY GRAVEL (GP); brownish-gray; 40% sand, fine to medium; 60% gravel, fine, subangular to subrounded; dry. (Fill)
2									1.5 to 7.0 feet: SAND (SP); light brown; 95% sand, medium; 5% gravels, fine to medium, subrounded; moist. (Fill)
3						PID = 0.0			
4			100%	CB					
5						PID = 0.0			
6									
7			100%	CB					7.0 to 12.0 feet: SAND (SP); dark brown; 100% sand, fine to medium; trace fines and gravels; moist. (Fill)
8						PID = 0.0			
9									
10						PID = 0.0			
11									
12						PID = 0.0			12.0 to 16.0 feet: WOOD; core of wood; staining at upper end of wood; naphthalene or petroleum like odor. (Fill)
13									
14									
15						PID = 0.0			
16			100%	CB					16.0 to 17.0 feet: SAND (SP); dark brown; 100% sand, fine to medium; trace fines and gravels; moist. Possibly drilling sluff from trying to clean out the hole from the wood. (Fill)
17									17.0 to 18.0 feet: WOOD; core of wood; staining at upper end of wood; naphthalene or petroleum like odor. (Fill)
18			100%	CB		PID = 0.0			18.0 to 19.0 feet: SAND (SP); light brown, moist; 100% sand, fine to medium; trace fines and gravels; moist. (Fill)
19									19.0 to 21.0 feet: SANDY SILT (ML-SM); light gray; 50% fines, non plastic; 50% sand, fine to medium; dry. Brittle, breaks apart in flakes. (Fill)
20						PID = 0.0			

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ **Approximate water level observed prior to well development.**

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Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8128.01.06	WS-11	2 of 11

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
21						PID = 0.0			21.0 to 27.0 feet: SAND (SP); reddish-brown; 90% sand, fine to medium; 10% gravel, fine to medium, subrounded; dry to moist. (Fill)
22									
23						PID = 0.0 PID = 0.0			@ 22.5 feet: 0.2-foot layer color change to light gray. Steel debris, possibly steel shackle from a padlock.
24						PID = 0.0			
25									
26									
27			90%	CB		PID = 0.0			27.0 to 28.0 feet: NO RECOVERY.
28	▽								28.0 to 31.5 feet: SAND (SP); dark gray; 95% sand, fine to medium; 5% gravels, subrounded; wet. (Fill)
29						PID = 0.0			
30									
31									
32						PID = 13.5			31.5 to 37.0 feet: SILTY SAND to SANDY SILT (SM-ML); dark gray; 50% fines, non plastic; 50% sand, fine; organic debris, roots; moist to wet.
33						PID = 7.0			@ 31.5 feet: 0.2-foot thick layer of staining, sheen. Petroleum like odor.
34									
35						PID = 0.0			
36									
37			90%	CB		PID = 0.0			37.0 to 38.0 feet: NO RECOVERY.
38									38.0 to 41.0 feet: SANDY SILT (ML); dark gray; 60% fines, non plastic; 40% sand, fine; organic debris, wood, roots; wet.
39									
40						PID = 0.0			
41									41.0 to 47.0 feet: SILTY SAND (SM); dark gray; 25% fines, non plastic; 75% sand, fine to medium; organic debris, roots, woody debris; wet. Faint petroleum-like odor.
42									

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ **Approximate water level observed prior to well development.**

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Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8128.01.06	WS-11	3 of 11

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
43									
44									
45						PID = 0.0			
46									
47			100%	CB		PID = 0.0			47.0 to 50.0 feet: SILTY SAND (SM); dark gray; 40% fines, non plastic; 60% sand, fine to medium; micaceous; organic debris; wet.
48									
49									
50						PID = 0.0			50.0 to 53.5 feet: SAND with SILT (SP-SM); dark gray; 15% fines, non plastic; 85% sand, fine to medium; micaceous; wet.
51									
52						PID = 0.0			
53									
54						PID = 0.0			53.5 to 54.0 feet: SILT (ML); dark gray; 95% fines, low to medium plasticity; 5% sand, fine; sand in pockets; micaceous; organic debris.
55									54.0 to 57.0 feet: SAND with SILT (SP-SM); dark gray; 15% fines, non plastic; 85% sand, fine to medium; micaceous; wet.
56									
57			100%	CB		PID = 0.0			57.0 to 58.0 feet: SILTY SAND (SM); dark gray; 20% fines, non plastic; 80% sand, fine to medium; micaceous; organic debris; wet.
58									58.0 to 59.0 feet: SILT (ML); dark gray; 100% fines, medium plasticity, trace fine sand in pockets; micaceous; organic debris, roots; wet.
59						PID = 0.0			59.0 to 60.0 feet: SAND with SILT (SP-SM); dark gray; 15% fines, non plastic; 85% sand, fine to medium; micaceous; wet.
60						PID = 0.0			60.0 to 64.0 feet: SILTY SAND (SM); dark gray; 20% fines, non plastic; 80% sand, fine to medium, micaceous; organic debris; wet.
61									
62			100%	CB		PID = 0.0			
63						PID = 0.0			
64									64.0 to 67.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium; micaceous, coarse mica flakes; wet.
65									

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ ***Approximate water level observed prior to well development.***

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Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8128.01.06	WS-11	4 of 11

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
						PID = 0.0			
66									
67									
			100%	CB		PID = 0.0			67.0 to 67.5 feet: NO RECOVERY; sluff.
68						PID = 0.0			67.5 to 72.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine; micaceous; organic debris, roots; moist to wet.
69									
70				GW		WS11-W-72.0 PID = 0.0			@ 70.0 feet: 0.2-foot layer of silt with organic debris.
71									
72			80%	CB		PID = 0.0			72.0 to 75.0 feet: NO RECOVERY; sluff.
73									
74									
75									75.0 to 78.0 feet: SILTY SAND (SM); dark gray; 20% fines, non plastic; 80% sand, fine to medium; micaceous; wet.
76									
77									
78						PID = 0.0			78.0 to 82.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet.
79									
80						PID = 0.0			
81									
82						PID = 0.0			82.0 to 83.0 feet: SILT (ML); dark gray; 95% fines, non plastic; 5% sand, fine, sand in pockets; micaceous; organic debris, roots; moist.
83									83.0 to 84.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine; micaceous; organic debris; wet.
84									84.0 to 85.5 feet: SILTY SAND (SM); dark gray; 20% fines, non plastic; 80% sand, fine to medium; micaceous; wet.
85				GW		WS11-W-87.0 PID = 0.0			
86									85.5 to 86.0 feet: SILT (ML); dark gray; 85% fines, non plastic; 15% sand, fine, sand in pockets; micaceous; moist.
87									86.0 to 87.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 90% sand, fine; 5% organic debris, woody debris; micaceous; wet.
			100%	CB		PID = 0.0			87.0 to 87.5 feet: SAND (SP); dark gray; 5% fines, non plastic; 95%

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ **Approximate water level observed prior to well development.**

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Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8128.01.06	WS-11	5 of 11

Depth (feet, BGS)	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Soil Description
							sand, fine; micaceous; wet.
88					PID = 0.0		87.5 to 88.0 feet: SILT with SAND (ML); dark gray; 70% fines, non plastic; 30% sand, fine to medium; micaceous; organic debris; moist to wet.
89							88.0 to 92.5 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet.
90					PID = 0.0		
91							
92							
93							92.5 to 94.5 feet: SILT (ML); dark gray; 90% fines, medium plasticity; 10% sand, fine to medium, sand in pockets; micaceous; organic debris; wet.
94							
95					PID = 1.5		94.5 to 98.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine; micaceous; wet.
96							
97					PID = 1.5		
98							98.0 to 102.0 feet: SAND with SILT (SP-SM); dark gray; 15% fines, non plastic; 85% sand, fine to medium; micaceous; wet. Fines occur in nodules, up to 0.5-inches in diameter.
99							
100			GW		WS11-W-102.0		
101					PID = 4.5		
102		100%	CB		PID = 13.6		102.0 to 107.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, red and green lithics; micaceous; wet.
103					PID = 0.0		
104							
105					PID = 0.0		@ 105.0 feet: 0.2-foot layer of SILT (ML); dark gray; 90% fines, 10% sand, fine, sand in pockets; wet.
106							@ 105.5 feet: 0.2-foot layer of SILT (ML); dark gray; 90% fines, 10% sand, fine, sand in pockets; wet.
107		90%	CB		PID = 0.0		107.0 to 108.0 feet: NO RECOVERY.
108					PID = 3.0		108.0 to 112.0 feet: SILT (ML); dark gray to greenish-gray; 100% fines, low to medium plasticity; micaceous; organic debris, roots, leaves; wet.
109							Visible sheen on water in soil core bag.
110							

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ ***Approximate water level observed prior to well development.***

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Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.06	WS-11	6 of 11

Depth (feet, BGS)	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
					PID = 3.1			
111								
112								112.0 to 118.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, red and green lithics; micaceous; wet.
113					PID = 0.0			
114								
115			GW		WS11-W-117.0 WS11-W-DUP			
116					PID = 3.1			@ 116.0 feet: 0.1-foot layer of SILT (ML).
117		100%	CB		PID = 3.1			
118					PID = 6.2			118.0 to 118.5 feet: SILTY SAND (SM); dark gray; 20% fines, non plastic; 80% sand, fine to medium; wet. Strong odor, visible sheen on soil.
119								118.5 to 119.5 feet: SILT (ML); dark gray; 95% fines, low to medium plasticity; 5% sand, fine to medium; wet. Faint odor.
120					PID = 0.0			119.5 to 119.7 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, red and green lithics; micaceous; wet.
121								119.7 to 120.0 feet: SILT (ML); dark gray; 95% fines, low to medium plasticity; 5% sand, fine to medium; micaceous; wet.
								120.0 to 122.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, red and green lithics; micaceous; wet.
122								122.0 to 123.0 feet: SILT (ML); dark gray; 95% fines, low to medium plasticity; 5% sand, fine to medium; micaceous; wet.
123					PID = 0.0			123.0 to 127.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, red and green lithics; micaceous; wet.
124								
125					PID = 0.0			
126								
127		100%	CB		PID = 0.0			127.0 to 128.0 feet: SILTY SAND (SM); dark gray; 20% fines, non plastic; 80% sand, fine to medium, red and green lithics; wet.
128								128.0 to 132.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, red and green lithics; micaceous; wet.
129								
130			GW		WS11-W-132.0 PID = 0.0			@ 130.0 feet: 0.3-foot layer of SILT (ML); dark gray; organic debris.
131								
132		100%	CB		PID = 0.0			132.0 to 137.0 feet: SAND (SP); dark gray with white speckles, salt

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ **Approximate water level observed prior to well development.**

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Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8128.01.06	WS-11	7 of 11

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
133						PID = 0.0			and pepper look; 5% fines, non plastic; 95% sand, medium; micaceous; wet.
134									
135						PID = 0.0			
136									
137			70%	CB		PID = 0.0			137.0 to 140.0 feet: NO RECOVERY.
138									
139									
140						PID = 0.0			140.0 to 146.5 feet: SAND (SP); dark gray with white speckles, salt and pepper look; 5% fines, non plastic; 95% sand, medium, dark green and red lithics; micaceous; wet.
141									
142									
143						PID = 0.0			
144									
145				GW		WS11-W-147.0			
146						PID = 0.0			
147			100%	CB		PID = 0.0			146.5 to 147.0 feet: SILT (ML); dark gray; 95% fines, low to medium plasticity; 5% sand, fine to medium, sand in pockets; micaceous; wet.
148						PID = 0.0			147.0 to 150.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, medium, dark green and red lithics; micaceous; wet.
149									
150						PID = 0.0			150.0 to 152.0 feet: SILT with SAND (ML); dark gray; 70% fines, low to medium plasticity; 30% sand, fine to medium, sand in pockets; micaceous; organic debris; wet.
151									
152									152.0 to 153.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, medium, dark green and red lithics; micaceous; wet.
153						PID = 0.0			153.0 to 153.5 feet: SILT with SAND (ML); dark gray; 70% fines, low to medium plasticity; 30% sand, fine to medium, sand in pockets; micaceous; organic debris; wet.
154									153.5 to 157 feet: SAND with SILT (SP-SM); dark gray; 15% fines, non plastic; 85% sand, fine to medium, red and green lithics; organic debris; wet. Fines occur in chunks or balls.
155									

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ **Approximate water level observed prior to well development.**

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Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.06	WS-11	8 of 11

Depth (feet, BGS)	Well Details	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
						PID = 0.0			
156									
157			100%	CB		PID = 0.0			@ 157.0 feet: 0.2-foot layer of SILT (ML). 157.2 to 160.0 feet: SAND (SP); dark gray with white speckles, salt and pepper look; 5% fines, non plastic; 95% sand, medium, green and red lithics; wet.
158									
159									
160						PID = 0.0			160.0 to 161.0 feet: SILT with SAND (ML); dark gray; 70% fines, low to medium plasticity; 30% sand, fine to medium; wet.
161									161.0 to 164.0 feet: SAND (SP); dark gray with white speckles, salt and pepper look; 5% fines, non plastic; 95% sand, medium, green and red lithics; wet.
162									@162.0 feet: 0.3-foot layer of SILT (ML).
163						PID = 0.0			@162.8 feet: 0.3-foot layer of SILT (ML).
164									164.0 to 165.0 feet: SILT (ML); dark gray to greenish-gray; 90% fines, low to medium plasticity; 10% sand, fine, sand in pockets; organic debris; wet.
165				GW		WS11-W-167.0 PID = 0.0			165.0 to 165.5 feet: SANDY SILT (ML); dark gray to greenish gray; 60% fines, non plastic; 40% sand, fine; wet.
166									165.5 to 167.0 feet: SAND (SP); dark gray with white speckles, salt and pepper look; 5% fines, non plastic; 95% sand, medium, green and red lithics; wet.
167			80%	CB		PID = 0.0			167.0 to 169.0 feet: NO RECOVERY.
168									
169									169.0 to 170.5 feet: SAND (SP); dark gray with white speckles, salt and pepper look; 5% fines, non plastic; 95% sand, fine, green and red lithics; wet.
170						PID = 0.0			
171									170.5 to 171 feet: SILTY SAND (SM); dark gray; 20% fines, low plasticity; 80% sand, fine; wet. 171.0 to 174.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, dark green and red lithics; wet.
172									
173						PID = 0.0			
174									174.0 to 174.5 feet: SILT (ML); dark gray to greenish-gray; 90% fines, medium plasticity; 10% sand, fine, sand in pockets; wet.
175						PID = 0.0			174.5 to 179.0 feet: SAND (SP); dark gray with white speckles, salt and pepper look; 5% fines, non plastic; 95% sand, fine to medium, green and red lithics; wet.
176									
177			100%	CB		PID = 0.0			

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ ***Approximate water level observed prior to well development.***

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Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8128.01.06	WS-11	9 of 11

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
178						PID = 0.0			
179									179.0 to 182.0 feet: SAND (SP); dark gray with white speckles, salt and pepper look; 100% sand, medium, green and red lithics; wet.
180				GW		WS11-W-182.0 PID = 0.0			
181									
182			100%	CB		PID = 0.0			182.0 to 187.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine, red lithics; wet.
183						PID = 0.0			
184									
185						PID = 0.0			
186									
187			90%	CB		PID = 0.0			187.0 to 188.0 feet: NO RECOVERY.
188									188.0 to 195.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine, red lithics; wet.
189									
190						PID = 0.0			
191									
192									
193						PID = 0.0			
194									
195				GW		WS11-W-197.0 PID = 0.0			195.0 to 195.5 feet: SILT (ML); dark gray to greenish-gray; 95% fines, low plasticity; 5% sand, fine, sand in pockets; organic debris, roots, leaves; wet.
196									195.5 to 201.0 feet: SAND (SP); dark gray; 5% fines, non plastic; 95% sand, fine to medium, red lithics; wet.
197			40%	CB		PID = 0.0			
198									
199									
200									

NOTES: 1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.

▽ **Approximate water level observed prior to well development.**

GBLWC W:\GINT\GINTW\PROJECTS\8128-01\WS10-13.GPJ 3/17/04

Maul Foster & Alongi, Inc.	Geologic Borehole Log/Well Construction		
	Project Number	Well Number	Sheet
	8128.01.06	WS-11	10 of 11

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
						PID = 0.0			
201									201.0 to 204.5 feet: SILTY GRAVEL (GM); dark gray; 15% fines, non plastic; 85% gravel, fine to coarse, subrounded to rounded; wet.
202						PID = 0.0			
203									
204				GW		WS11-206.0			
205									204.5 to 207.0 feet: BASALT; light gray to dark gray; moist to wet; bedrock. (Columbia River Basalt Group) Significant increase in resistance, drilling hardness.
206									
207									

Total Depth = 207.0 feet below ground surface.

WS11 Completion Details

Oregon Water Resources Department Well Start Card Number: W147655
Oregon Water Resources Department Well Identification Number: L67076

Boring:
0.0 to 58.0 feet bgs: 9-inch temporary, threaded steel, isolation casing.
0.0 to 137.0 feet bgs: 8-inch temporary, threaded steel, isolation casing.
0.0 to 58.0 feet bgs: 7-inch temporary, threaded steel, isolation casing.
0.0 to 207.0 feet bgs: 6-inch temporary, threaded steel, isolation casing.
0.0 to 207.0 feet bgs: 4x6-inch core barrel sampler.

0.0 to 1.5 feet bgs: flush mount vault and cement seal.
1.5 to 5.0 feet bgs: 3/8-inch Baroid bentonite chips hydrated with potable water.
5.0 to 102.0 feet bgs: bentonite grout slurry, 10.0 pounds per gallon.
102.0 to 104.0 feet bgs: non-acetone coated, 3/8-inch bentonite chips hydrated with potable water.
104.0 to 106.0 feet bgs: 20x40 washed Colorado silica sand, secondary filter pack.
106.0 to 124.0 feet bgs: 10x20 washed Colorado silica sand, primary filter pack.
124.0 to 126.0 feet bgs: non-acetone coated, 3/8-inch bentonite chips hydrated with potable water.
126.0 to 139.0 feet bgs: bentonite grout slurry, 10.3 pounds per gallon.
139.0 to 140.0 feet bgs: non-acetone coated, 3/8-inch bentonite chips hydrated with potable water.
140.0 to 142.0 feet bgs: 20x40 washed Colorado silica sand, secondary filter pack.
142.0 to 161.0 feet bgs: 10x20 washed Colorado silica sand, primary filter pack.
161.0 to 207.0 feet bgs: non-acetone coated, 3/8-inch bentonite chips hydrated with potable water.

NOTES: *1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.*

Approximate water level observed prior to well development.

GBLWC W:\GINTW\PROJECTS\8128-01\WS10-13.GPJ 3/17/04

Maul Foster & Alongi, Inc.	Geologic Borehole Log/Well Construction		
	Project Number **8128.01.06**	Well Number **WS-11**	Sheet **11 of 11**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description

Well WS11-125:
0.0 to 109.0 feet bgs: 2-inch diameter, schedule 40 PVC blank riser pipe.
109.0 to 124.0 feet bgs: 2-inch diameter, stainless steel wire wrapped screen, 0.010-slot.
124.0 to 125.0 feet bgs: 2-inch diameter, stainless steel sump.

Well WS11-161:
0.0 to 145.0 feet bgs: 2-inch diameter, schedule 40 PVC blank riser pipe.
145.0 to 160.0 feet bgs: 2-inch diameter, stainless steel wire wrapped screen, 0.010-slot.
160.0 to 161.0 feet bgs: 2-inch diameter, stainless steel sump.

NOTES: *1. CB = 4x6-inch core barrel soil sampler. 2. PID = Photo ionization detector, soil head space reading in parts per million. 3. GW = groundwater sample, dashed graphic indicates approximate screened interval. 4. bgs = below ground surface. 5. PVC = poly vinyl chloride.*

▽ ***Approximate water level observed prior to well development.***

GBLWC W:\GINT\GINTW\PROJECTS\8128-01\WS10-13.GPJ 3/17/04

DATA QUALITY ASSURANCE/QUALITY CONTROL REVIEW

WACKER SILTRONIC CORPORATION
JANUARY 2004
8128.01.06

This report reviews the analytical results for one product sample collected by the Maul Foster & Alongi, Inc. (MFA) project team on the Wacker Siltronic Corporation site in Portland, Oregon. The samples were collected in January 2004.

Specialty Analytical (SA), in Tualatin, Oregon performed the analyses. SA report number 0402023 was reviewed. The analyses performed are listed below.

Analysis	Reference
Volatile Organic Compounds (VOCs)	USEPA 8260B
Semivolatile Organic Compounds (SVOCs)	USEPA 8270D
Polynuclear Aromatic Hydrocarbons (PAHs)	USEPA 8270-SIM
Hydrocarbon Fuel Fingerprint	USEPA 8015M
Specific Gravity	ASTM D1298
Corrosivity by pH	USEPA 9045B

USEPA = U.S. Environmental Protection Agency
SIM = Selected Ion Monitoring
ASTM = American Society for Testing and Materials

DATA QUALIFICATIONS

Analytical results were evaluated according to applicable portions of USAEPA procedures (USEPA, 1994a, 1999), and appropriate laboratory and method-specific guidelines (SA, 2003; USEPA, 1986; ASTM, 2003).

The data are considered acceptable for their intended use, with the appropriate data qualifiers assigned.

Holding Times, Preservation, and Sample Storage

Holding Times

Extractions and analyses were performed within the recommended holding time criteria.

Preservation and Sample Storage

The samples were preserved and stored appropriately.

Blanks

Method Blanks

Laboratory method blank analyses were performed at the required frequencies. No target analytes were detected above the SA method reporting limits (MRLs).

Trip Blanks

Trip blanks were not submitted for this sampling event.

Equipment Rinsate Blanks

Rinsate blanks were not submitted for this sampling event. The sample was collected using dedicated sampling equipment.

Surrogate Recovery Results

The samples were spiked with surrogate compounds to evaluate laboratory performance on individual samples. The reviewer took no action based on minor surrogate outliers or surrogate percent recoveries that were outside of acceptance limits due to dilutions necessary to quantify high concentrations of target analytes present in the samples.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Results

MS/MSD results are used to evaluate laboratory precision and accuracy. All MS/MSD samples were extracted and analyzed at the required frequency. The percent recovery result for toluene were significantly outside laboratory acceptance limits in the MS and MSD due to the analyte concentration in the sample being higher than the added spike concentration, preventing accurate evaluation of the spike recoveries. Percent recoveries for chlorobenzene and trichloroethene in the MS and chlorobenzene in the MSD were outside laboratory exceptance limits; but the outliers were minor.

The reviewer took no action based on MS/MSD outliers, as all other Batch QC was within acceptance limits. Remaining recoveries were within acceptance limits for percent recovery and relative percent differences (RPDs).

Laboratory Control Sample (LCS) Results

An LCS is spiked with target analytes to provide information on laboratory accuracy. The LCS samples were extracted and analyzed at the required frequency. All LCS analytes were within acceptance limits for percent recovery.

Method Reporting Limits

SA used routine MRLs for non-detect results with the exception of samples requiring dilutions due to high analyte concentrations and/or matrix interferences.

Data Package

The data package was reviewed for transcription errors, omissions, or anomalies. None were found.

REFERENCES

Specialty Analytical (SA) 2003. *Quality Assurance Manual.* Specialty Analytical, Tualatin, Oregon.

USEPA (United States Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA-530/SW-846. September (update 1, July 1992; update 2a, August 1993; update 2, September 1994; update 2b, January 1995).

ASTM (American Society for Testing and Materials). 2003. *Annual Book of ASTM Standards.* American Society for Testing and Materials. Section 11: Water and Environmental Technology. May 2003.

USEPA (U.S. Environmental Protection Agency). 1994a. *USEPA contract laboratory program, national functional guidelines for inorganics data review.* Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. EPA 540/R-94/013. February.

USEPA (United States Environmental Protection Agency). 1999. *USEPA Contract Laboratory Program, National Functional Guidelines for Organics Data Review.* Office of Emergency and Remedial Response, U.S. Environmental Protection Agency. EPA 540/R-99/008. October.

Specialty Analytical **Date:** *23-Feb-04*

CLIENT: Maul, Foster & Alongi
Project: Wacker Siltronics / 8128.01.06
Lab Order: 0402023

CASE NARRATIVE

Specialty Analytical Sample No. 0402023-01 was analyzed per 8015 Fuel Fingerprint, to identify and quantify the fuel products present.

The chromatogram showed the presence of Flame Ionization Detector (FID) responding compounds, indicating the presence of hydrocarbons. The product covered regulatory ranges for Diesel Range Organics (DRO) and Oil Range Organics (ORO), represented by C12-C24 for DRO, and C24-C40 for ORO.

Oil Range contamination present appears to be primarily from the DRO product present. No discrete Oil-type products were present (ie, Motor Oil, Hydraulic Oil, etc.).

Diesel Range Organics that were found are not matched by any distillate fuel type represented in Specialty Analytical's fuel identification library. The product does not appear to be consistent with a distillate fuel (refined product). The hydrocarbon pattern expressed on the chromatogram appears to be an un-refined product type, falling primarily in the Diesel Range Organics boiling range, with some percentage falling into the Oil Range Organics boiling point range.

The product analyzed does not appear to be Diesel #1, Diesel #2, Light Industrial Diesel, Kerosene, or other distillate product. The aggregate of large, single component peaks suggest a non-refined product of unknown type, falling primarily in the DRO range. It is not consistent with Bunker Fuels, Fuel Oils, or other semi-defined oil products. Its source is unidentifiable at this time.

SCOEPA00012569

Specialty Analytical

Date: *23-Feb-04*

CLIENT:	Maul, Foster & Alongi	**ClientSampleID:**	WS11-125-N
LabOrder:	0402023	**CollectionDate:**	1/28/2004
Project:	Wacker Siltronics / 8128.01.06		
LabID:	0402023-01	**Matrix:**	PRODUCT

Analyses	Result	Limit	Qual	Units	DF	DateAnalyzed
HYDROCARBONFUELFINGERPRINT		**8015M**				Analyst: **btf**
AutomatricTransFluid	ND	25000		mg/Kg	50	2/9/2004
HydraulicOil	ND	25000		mg/Kg	50	2/9/2004
Gasoline	ND	10000		mg/Kg	50	2/9/2004
MineralSpirits	ND	10000		mg/Kg	50	2/9/2004
Kerosene	ND	25000		mg/Kg	50	2/9/2004
Diesel	593000	25000	CN	mg/Kg	50	2/9/2004
Oil	180000	50000		mg/Kg	50	2/9/2004
Surr: o-Terphenyl	660	50-150	S,D	%REC	50	2/9/2004
SEMIVOLATILEORGANICSBYGC/MS		**SW8270D**				Analyst: **bda**
1,2,4-Trichlorobenzene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
1,2-Dichlorobenzene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
1,3-Dichlorobenzene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
1,4-Dichlorobenzene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
2,4,5-Trichlorophenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
2,4,6-Trichlorophenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
2,4-Dichlorophenol	ND	2000		µg/Kg	10	2/20/2004 12:20:00PM
2,4-Dimethylphenol	ND	2000		µg/Kg	10	2/20/2004 12:20:00PM
2,4-Dinitrophenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
2,4-Dinitrotoluene	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
2,6-Dinitrotoluene	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
2-Chloronaphthalene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
2-Chlorophenol	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
2-Methylnaphthalene	ND	66700		µg/Kg	1000	2/20/2004 11:53:00AM
2-Methylphenol	ND	1330		µg/Kg	10	2/20/2004 12:20:00PM
2-Nitroaniline	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
2-Nitrophenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
3,3-Dichlorobenzidine	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
3-&4-Methylphenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
3-Nitroaniline	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
4,6-Dinitro-2-methylphenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
4-Bromophenylphenylether	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
4-Chloro-3-methylphenol	ND	1330		µg/Kg	10	2/20/2004 12:20:00PM
4-Chloroaniline	ND	2000		µg/Kg	10	2/20/2004 12:20:00PM
4-Chlorophenylphenylether	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
4-Nitroaniline	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
4-Nitrophenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
Acenaphthene	7160	6670		µg/Kg	100	2/20/2004 12:48:00PM
Acenaphthylene	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM
Anthracene	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM
Benz(a)anthracene	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM

SCOEPA00012570

Specialty Analytical

Date: *23-Feb-04*

CLIENT:	Maul, Foster & Alongi	**ClientSampleID:**	WS11-125-N
LabOrder:	0402023	**CollectionDate:**	1/28/2004
Project:	Wacker Siltronics / 8128.01.06		
LabID:	0402023-01	**Matrix:**	PRODUCT

Analyses	Result	Limit	Qual	Units	DF	DateAnalyzed
SEMIVOLATILEORGANICSBYGC/MS		**SW8270D**				Analyst: **bda**
Benzo(a)pyrene	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM
Benzo(b)fluoranthene	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM
Benzo(g,h,i)perylene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Benzo(k)fluoranthene	694	667		µg/Kg	10	2/20/2004 12:20:00PM
Benzoic Acid	ND	6670		µg/Kg	10	2/20/2004 12:20:00PM
Benzyl Alcohol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
Bis(2-chloroethoxy)methane	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Bis(2-chloroethyl)ether	ND	1330		µg/Kg	10	2/20/2004 12:20:00PM
Bis(2-chloroisopropyl)ether	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Bis(2-ethylhexyl)phthalate	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Butyl benzyl phthalate	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Carbazole	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM
Chrysene	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM
Di-n-butylphthalate	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Di-n-octyl phthalate	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Dibenz(a,h)anthracene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Dibenzofuran	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Diethyl phthalate	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Dimethylphthalate	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Fluoranthene	7100	6670		µg/Kg	100	2/20/2004 12:48:00PM
Fluorene	ND	6670		µg/Kg	100	2/20/2004 12:48:00PM
Hexachlorobenzene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Hexachlorobutadiene	ND	1330		µg/Kg	10	2/20/2004 12:20:00PM
Hexachlorocyclopentadiene	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
Hexachloroethane	ND	1330		µg/Kg	10	2/20/2004 12:20:00PM
Indeno(1,2,3-cd)pyrene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Isophorone	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
N-Nitrosodi-n-propylamine	ND	1330		µg/Kg	10	2/20/2004 12:20:00PM
N-Nitrosodimethylamine	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
N-Nitrosodiphenylamine	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Naphthalene	68000	66700		µg/Kg	1000	2/20/2004 11:53:00AM
Nitrobenzene	ND	667		µg/Kg	10	2/20/2004 12:20:00PM
Pentachlorophenol	ND	3330		µg/Kg	10	2/20/2004 12:20:00PM
Phenanthrene	ND	66700		µg/Kg	1000	2/20/2004 11:53:00AM
Phenol	ND	1330		µg/Kg	10	2/20/2004 12:20:00PM
Pyrene	9120	6670		µg/Kg	100	2/20/2004 12:48:00PM
PAH'SBYGC/MS-OARSIM		**8270SIM**				Analyst: **bda**
Acenaphthene	6140	667		µg/Kg	100	2/9/2004 4:04:00PM
Acenaphthylene	1860	667		µg/Kg	100	2/9/2004 4:04:00PM
Anthracene	3760	667		µg/Kg	100	2/9/2004 4:04:00PM

SCOEPA00012571

Specialty Analytical

Date: *23-Feb-04*

CLIENT:	Maul, Foster & Alongi	**ClientSampleID:**	WS11-125-N
LabOrder:	0402023	**CollectionDate:**	1/28/2004
Project:	Wacker Siltronics / 8128.01.06		
LabID:	0402023-01	**Matrix:**	PRODUCT

Analyses	Result	Limit	Qual	Units	DF	DateAnalyzed
PAH'SBYGC/MS-OARSIM		**8270SIM**				Analyst: **bda**
Benz(a)anthracene	1780	667		µg/Kg	100	2/9/20044:04:00PM
Benzo(a)pyrene	1800	667		µg/Kg	100	2/9/20044:04:00PM
Benzo(b)fluoranthene	1680	667		µg/Kg	100	2/9/20044:04:00PM
Benzo(g,h,i)perylene	1090	667		µg/Kg	100	2/9/20044:04:00PM
Benzo(k)fluoranthene	ND	667		µg/Kg	100	2/9/20044:04:00PM
Chrysene	1890	667		µg/Kg	100	2/9/20044:04:00PM
Dibenz(a,h)anthracene	ND	667		µg/Kg	100	2/9/20044:04:00PM
Fluoranthene	6810	667		µg/Kg	100	2/9/20044:04:00PM
Fluorene	4790	667		µg/Kg	100	2/9/20044:04:00PM
Indeno(1,2,3-cd)pyrene	810	667		µg/Kg	100	2/9/20044:04:00PM
Naphthalene	57600	6670		µg/Kg	1000	2/9/20044:36:00PM
Phenanthrene	18300	667		µg/Kg	100	2/9/20044:04:00PM
Pyrene	9530	667		µg/Kg	100	2/9/20044:04:00PM
Surr:2-Fluorobiphenyl	1490	42.6-128	S	%REC	100	2/9/20044:04:00PM
Surr:Nitrobenzene-d5	1440	21.7-155	S	%REC	100	2/9/20044:04:00PM
Surr:p-Terphenyl-d14	1680	44.9-155	S	%REC	100	2/9/20044:04:00PM
VOLATILESBYGC/MS		**SW8260B**				Analyst: **skc**
1,1,1,2-Tetrachloroethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,1,1-Trichloroethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,1,2,2-Tetrachloroethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,1,2-Trichloroethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,1-Dichloroethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,1-Dichloroethene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,1-Dichloropropene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2,3-Trichlorobenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2,3-Trichloropropane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2,4-Trichlorobenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2,4-Trimethylbenzene	188000	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2-Dibromo-3-chloropropane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2-Dibromoethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2-Dichlorobenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2-Dichloroethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,2-Dichloropropane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,3,5-Trimethylbenzene	54200	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,3-Dichlorobenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,3-Dichloropropane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
1,4-Dichlorobenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
2,2-Dichloropropane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
2-Butanone	ND	200000		µg/Kg	5000	2/10/2004 6:20:00 AM
2-Chlorotoluene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM

SCOEPA00012572

Specialty Analytical

Date: *23-Feb-04*

CLIENT:	Maul, Foster & Alongi	**ClientSampleID:**	WS11-125-N
LabOrder:	0402023	**CollectionDate:**	1/28/2004
Project:	Wacker Siltronics / 8128.01.06		
LabID:	0402023-01	**Matrix:**	PRODUCT

Analyses	Result	Limit	Qual	Units	DF	DateAnalyzed
VOLATILESBYGC/MS		**SW8260B**				Analyst: **skc**
2-Hexanone	ND	100000		µg/Kg	5000	2/10/2004 6:20:00 AM
4-Chlorotoluene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
4-Isopropyltoluene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
4-Methyl-2-pentanone	ND	200000		µg/Kg	5000	2/10/2004 6:20:00 AM
Acetone	ND	500000		µg/Kg	5000	2/10/2004 6:20:00 AM
Benzene	118000	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Bromobenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Bromochloromethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Bromodichloromethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Bromoform	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Bromomethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Carbondisulfide	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Carbontetrachloride	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Chlorobenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Chloroethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Chloroform	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Chloromethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
cis-1,2-Dichloroethene	75200	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
cis-1,3-Dichloropropene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Dibromochloromethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Dibromomethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Dichlorodifluoromethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Ethylbenzene	379000	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Hexachlorobutadiene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Isopropylbenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
m,p-Xylene	290000	100000		µg/Kg	5000	2/10/2004 6:20:00 AM
Methyl tert-butyl ether	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Methylenechloride	ND	250000		µg/Kg	5000	2/10/2004 6:20:00 AM
n-Butylbenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
n-Propylbenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Naphthalene	5520000	5000000		µg/Kg	500000	2/11/2004 11:01:00 PM
o-Xylene	158000	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
sec-Butylbenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Styrene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
tert-Butylbenzene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Tetrachloroethene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Toluene	82000	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
trans-1,2-Dichloroethene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
trans-1,3-Dichloropropene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Trichloroethene	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Trichlorofluoromethane	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM

SCOEPA00012573

Specialty Analytical

Date: *23-Feb-04*

CLIENT:	Maul, Foster & Alongi	**ClientSampleID:**	WS11-125-N
LabOrder:	0402023	**CollectionDate:**	1/28/2004
Project:	Wacker Siltronics / 8128.01.06		
LabID:	0402023-01	**Matrix:**	PRODUCT

Analyses	Result	Limit	Qual	Units	DF	DateAnalyzed
VOLATILESBYGC/MS		**SW8260B**				Analyst: **skc**
Vinyl chloride	ND	50000		µg/Kg	5000	2/10/2004 6:20:00 AM
Surr: 1,2-Dichloroethane-d4	93.7	71.5-112		%REC	5000	2/10/2004 6:20:00 AM
Surr: 4-Bromofluorobenzene	138	75.7-122	S	%REC	5000	2/10/2004 6:20:00 AM
Surr: Dibromofluoromethane	127	64.3-124	S	%REC	5000	2/10/2004 6:20:00 AM
Surr: Toluene-d8	106	74.9-120		%REC	5000	2/10/2004 6:20:00 AM
CORROSIVITYBYPH		**SW9045B**				Analyst: **das**
pH	7.93	1.00		pHUnits	1	2/11/2004
SPECIFICGRAVITY		**D1298**				Analyst: **skc**
Specific Gravity	1.09			g/cc	1	2/13/2004

SCOEPA00012574

Specialty Analytical

Date: *23-Feb-04*

CLIENT:	Maul, Foster & Alongi	**ClientSampleID:**	WS12-125-N
LabOrder:	0402023	**CollectionDate:**	1/28/2004
Project:	Wacker Siltronics / 8128.01.06		
LabID:	0402023-02	**Matrix:**	PRODUCT

Analyses	Result	Limit	Qual	Units	DF	DateAnalyzed
HOLDPERCLIENTREQUEST		**PERCLIENT**				Analyst: **nne**
Hold	Hold			Date	1	2/11/2004

SCOEPA00012575

SpecialtyAnalytical

Date: *23-Feb-04*

CLIENT: Maul, Foster & Alongi
WorkOrder: 0402023
Project: WackerSiltronics/8128.01.06

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015FF_S

Sample ID **MBLK** SampType: **MBLK** TestCode: **8015FF_S** Units: **mg/Kg** Prep Date: **2/6/2004** Run ID: **GC-M_040209A**
Client ID: **ZZZZZ** Batch ID: **10436** TestNo: **8015M** Analysis Date: **2/9/2004** SeqNo: **238616**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Automatric Trans Fluid	ND	50.0									
Hydraulic Oil	ND	50.0									
Gasoline	ND	20.0									
Mineral Spirits	ND	20.0									
Kerosene	ND	50.0									
Diesel	ND	50.0									
Oil	ND	100									
Surr: o-Terphenyl	96.2	1.00	100	0	96.2	50	150	0	0		

Sample ID **LCS** SampType: **LCS** TestCode: **8015FF_S** Units: **mg/Kg** Prep Date: **2/6/2004** Run ID: **GC-M_040209A**
Client ID: **ZZZZZ** Batch ID: **10436** TestNo: **8015M** Analysis Date: **2/9/2004** SeqNo: **238617**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	208	50.0	250	0	83.2	69.7	116	0	0		

Sample ID **CCV** SampType: **CCV** TestCode: **8015FF_S** Units: **mg/Kg** Prep Date: **2/6/2004** Run ID: **GC-M_040209A**
Client ID: **ZZZZZ** Batch ID: **10436** TestNo: **8015M** Analysis Date: **2/9/2004** SeqNo: **238618**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diesel	917.6	50.0	998	0	91.9	85	115	0	0		
Oil	537.7	100	500.5	0	107	85	115	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blanl

CLIENT: Maul, Foster & Alongi
WorkOrder: 0402023
Project: WackerSiltronics/8128.01.06

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	**MB**	SampType:	**MBLK**	TestCode:	**8260_S**	Units:	**µg/Kg**	Prep Date:	**2/9/2004**	Run ID:	**5973J_040209A**
Client ID:	**ZZZZZ**	Batch ID:	**10465**	TestNo:	**SW8260B**			Analysis Date:	**2/10/2004**	SeqNo:	**239265**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ND	10.0									
1,1,1-Trichloroethane	ND	10.0									
1,1,2,2-Tetrachloroethane	ND	10.0									
1,1,2-Trichloroethane	ND	10.0									
1,1-Dichloroethane	ND	10.0									
1,1-Dichloroethene	ND	10.0									
1,1-Dichloropropene	ND	10.0									
1,2,3-Trichlorobenzene	ND	10.0									
1,2,3-Trichloropropane	ND	10.0									
1,2,4-Trichlorobenzene	ND	10.0									
1,2,4-Trimethylbenzene	ND	10.0									
1,2-Dibromo-3-chloropropane	ND	10.0									
1,2-Dibromoethane	ND	10.0									
1,2-Dichlorobenzene	ND	10.0									
1,2-Dichloroethane	ND	10.0									
1,2-Dichloropropane	ND	10.0									
1,3,5-Trimethylbenzene	ND	10.0									
1,3-Dichlorobenzene	ND	10.0									
1,3-Dichloropropane	ND	10.0									
1,4-Dichlorobenzene	ND	10.0									
2,2-Dichloropropane	ND	10.0									
2-Butanone	ND	40.0									
2-Chlorotoluene	ND	10.0									
2-Hexanone	ND	20.0									
4-Chlorotoluene	ND	10.0									
4-Isopropyltoluene	ND	10.0									
4-Methyl-2-pentanone	ND	40.0									
Acetone	ND	100									
Benzene	ND	10.0									
Bromobenzene	ND	10.0									
Bromochloromethane	ND	10.0									

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blanl

CLIENT: Maul, Foster & Alongi
WorkOrder: 0402023
Project: WackerSiltronics/8128.01.06

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID	MB	SampType:	MBLK	TestCode:	8260_S	Units:	µg/Kg	Prep Date:	2/9/2004	Run ID:	5973J_040209A
Client ID:	ZZZZZ	Batch ID:	10465	TestNo:	SW8260B			Analysis Date:	2/10/2004	SeqNo:	239265

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Bromodichloromethane	ND	10.0									
Bromoform	ND	10.0									
Bromomethane	ND	10.0									
Carbon disulfide	ND	10.0									
Carbon tetrachloride	ND	10.0									
Chlorobenzene	ND	10.0									
Chloroethane	ND	10.0									
Chloroform	ND	10.0									
Chloromethane	ND	10.0									
cis-1,2-Dichloroethene	ND	10.0									
cis-1,3-Dichloropropene	ND	10.0									
Dibromochloromethane	ND	10.0									
Dibromomethane	ND	10.0									
Dichlorodifluoromethane	ND	10.0									
Ethylbenzene	ND	10.0									
Hexachlorobutadiene	ND	10.0									
Isopropylbenzene	ND	10.0									
m,p-Xylene	ND	20.0									
Methyl tert-butyl ether	ND	10.0									
Methylene chloride	ND	50.0									
n-Butylbenzene	ND	10.0									
n-Propylbenzene	ND	10.0									
Naphthalene	ND	10.0									
o-Xylene	ND	10.0									
sec-Butylbenzene	ND	10.0									
Styrene	ND	10.0									
tert-Butylbenzene	ND	10.0									
Tetrachloroethene	ND	10.0									
Toluene	ND	10.0									
trans-1,2-Dichloroethene	ND	10.0									
trans-1,3-Dichloropropene	ND	10.0									

Qualifiers: ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blanl

CLIENT: Maul, Foster & Alongi
WorkOrder: 0402023
Project: WackerSiltronics/8128.01.06

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID **MB** SampType: **MBLK** TestCode: **8260_S** Units: **µg/Kg** Prep Date: **2/9/2004** Run ID: **5973J_040209A**
Client ID: **ZZZZZ** Batch ID: **10465** TestNo: **SW8260B** Analysis Date: **2/10/2004** SeqNo: **239265**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Trichloroethene	ND	10.0									
Trichlorofluoromethane	ND	10.0									
Vinyl chloride	ND	10.0									
Surr: 1,2-Dichloroethane-d4	93.24	1.00	100	0	93.2	71.5	112	0	0		
Surr: 4-Bromofluorobenzene	130.7	1.00	100	0	131	75.7	122	0	0		S
Surr: Dibromofluoromethane	114.1	1.00	100	0	114	64.3	124	0	0		
Surr: Toluene-d8	122.5	1.00	100	0	122	74.9	120	0	0		S

Sample ID **LCS** SampType: **LCS** TestCode: **8260_S** Units: **µg/Kg** Prep Date: **2/9/2004** Run ID: **5973J_040209A**
Client ID: **ZZZZZ** Batch ID: **10465** TestNo: **SW8260B** Analysis Date: **2/10/2004** SeqNo: **239264**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	102.6	10.0	80	0	128	65.4	133	0	0		
Benzene	97.02	10.0	80	0	121	78	123	0	0		
Chlorobenzene	97.42	10.0	80	0	122	79.5	125	0	0		
Toluene	90.39	10.0	80	0	113	77.5	132	0	0		
Trichloroethene	88.93	10.0	80	0	111	72.4	124	0	0		

Sample ID **0401115-04AMS** SampType: **MS** TestCode: **8260_S** Units: **µg/Kg** Prep Date: **2/9/2004** Run ID: **5973J_040209A**
Client ID: **ZZZZZ** Batch ID: **10465** TestNo: **SW8260B** Analysis Date: **2/11/2004** SeqNo: **239270**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	37.65	10.0	40	0	94.1	69.2	158	0	0		
Benzene	30.51	10.0	40	0	76.3	71.7	147	0	0		
Chlorobenzene	33.6	10.0	40	0	84	85.6	148	0	0		S
Toluene	80.6	10.0	40	90.05	-23.6	75.8	153	0	0		S
Trichloroethene	28.6	10.0	40	0	71.5	77.1	138	0	0		S

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blanl
J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits

SCOEPA00012579

CLIENT: Maul, Foster & Alongi
WorkOrder: 0402023
Project: WackerSiltronics/8128.01.06

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260_S

Sample ID **0401115-04AMSD** SampType: **MSD** TestCode: **8260_S** Units: **µg/Kg** Prep Date: **2/9/2004** Run ID: **5973J_040209A**
Client ID: **ZZZZZ** Batch ID: **10465** TestNo: **SW8260B** Analysis Date: **2/11/2004** SeqNo: **239271**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	37.99	10.0	40	0	95	69.2	158	37.65	0.899	20	
Benzene	30.35	10.0	40	0	75.9	71.7	147	30.51	0.526	20	
Chlorobenzene	33.83	10.0	40	0	84.6	85.6	148	33.6	0.682	20	S
Toluene	98.79	10.0	40	90.05	21.8	75.8	153	80.6	20.3	20	SR
Trichloroethene	34.3	10.0	40	0	85.8	77.1	138	28.6	18.1	20	

Sample ID **CCV** SampType: **CCV** TestCode: **8260_S** Units: **µg/Kg** Prep Date: **2/9/2004** Run ID: **5973J_040209A**
Client ID: **ZZZZZ** Batch ID: **10465** TestNo: **SW8260B** Analysis Date: **2/10/2004** SeqNo: **239263**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	48.87	10.0	50	0	97.7	80	120	0	0		
1,2-Dichloropropane	47.46	10.0	50	0	94.9	80	120	0	0		
Chloroform	55.19	10.0	50	0	110	80	120	0	0		
Ethylbenzene	52.77	10.0	50	0	106	80	120	0	0		
Toluene	51.03	10.0	50	0	102	80	120	0	0		
Vinyl chloride	55.55	10.0	50	0	111	80	120	0	0		

Sample ID **CCV** SampType: **CCV** TestCode: **8260_S** Units: **µg/Kg** Prep Date: **2/9/2004** Run ID: **5973J_040209A**
Client ID: **ZZZZZ** Batch ID: **10465** TestNo: **SW8260B** Analysis Date: **2/11/2004** SeqNo: **239267**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1-Dichloroethene	46.19	10.0	50	0	92.4	80	120	0	0		
1,2-Dichloropropane	48.08	10.0	50	0	96.2	80	120	0	0		
Chloroform	47.52	10.0	50	0	95	80	120	0	0		
Ethylbenzene	46.13	10.0	50	0	92.3	80	120	0	0		
Toluene	43.68	10.0	50	0	87.4	80	120	0	0		
Vinyl chloride	58.65	10.0	50	0	117	80	120	0	0		

Qualifiers: ND - Not Detected at the Reporting Limit; S - Spike Recovery outside accepted recovery limits; B - Analyte detected in the associated Method Blanl
J - Analyte detected below quantitation limits; R - RPD outside accepted recovery limits

SCOEPA00012580

CLIENT: Maul, Foster & Alongi
WorkOrder: 0402023
Project: WackerSiltronics/8128.01.06

ANALYTICAL QC SUMMARY REPORT

TestCode: PH_S

Sample ID	**0402044-01ADUP**	SampType:	**DUP**	TestCode:	**PH_S**	Units:	**pH Units**	Prep Date:				Run ID:	**PH ACCUMET_040211A**
Client ID:	**ZZZZZ**	Batch ID:	**R29068**	TestNo:	**SW9045B**			Analysis Date:	**2/11/2004**			SeqNo:	**239068**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
pH	12.28	1.00	0	0	0	0	0	12.33	0.406	20	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blanl

SCOEPA00012581

CLIENT: Maul, Foster & Alongi
WorkOrder: 0402023
Project: WackerSiltronics/8128.01.06

ANALYTICAL QC SUMMARY REPORT

TestCode: SPECGRAV

Sample ID **0402023-01ADUP** SampType: **DUP** TestCode: **SPECGRAV** Units: **g/cc** Prep Date: Run ID: **WETCHEM_040213C**
Client ID: **WS11-125-N** Batch ID: **R29133** TestNo: **D1298** Analysis Date: **2/13/2004** SeqNo: **239770**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Specific Gravity	1.09	0	0	0	0	0	0	1.085	0.441	20	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blanl

SCOEPA00012582

LETTER OF TRANSMITTAL

TO:

Jordan Schrader, P.C. PO Box 230669 Portland, OR 97281	Date:	March 5, 2004
	Job No:	0-61M-10703-0/Task 43
	Attn:	Christopher Reive
	RE:	RP - Portland Site

WE ARE SENDING YOU: ☐ Attached ☒ Under Separate Cover via US Mail

Copies	Dated	Description
1	2/17/04	Final Post-Characterization Groundwater Monitoring Plan

THESE ARE TRANSMITTED as checked below:

☐ For Review ☐ For Approval ☒ For Your Use ☐ As Requested

REMARKS:

AMEC Earth & Environmental, Inc.
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel +1 (503) 639-3400
Fax +1 (503) 620-7892

amec

FINAL POST-CHARACTERIZATION GROUNDWATER MONITORING PLAN RP - PORTLAND SITE

February 17, 2004

Submitted to:

Oregon Department of Environmental Quality
2020 S.W. 4th Ave.
Portland, Oregon 97201

Submitted for:

SLLI
One Copely Parkway, Suite 309
Morrisville, North Carolina 27560

Submitted by:

AMEC Earth & Environmental, Inc.
7376 S.W. Durham Road
Portland, Oregon 97224

0-61M-10703-0/Task 43

February 17, 2004

0-61M-10703-0/Task 43

Tom Roick
Cleanup & Portland Harbor
Oregon Department of Environmental Quality
2020 S.W. 4th Avenue
Portland, Oregon 97201

Dear Mr. Roick:

Re: Final Post-Characterization Groundwater Monitoring Plan
RP - Portland Site

On behalf of SLLI, AMEC Earth & Environmental, Inc. (AMEC) is submitting to the Oregon Department of Environmental Quality (DEQ) the Final Post-Characterization Groundwater Monitoring Plan (PCGMP). This Final PCGMP incorporates comments received from DEQ in its letter dated October 1, 2003, and discussion between SLLI, DEQ, and AMEC on December 11, 2003.

Water level measurement and groundwater sampling locations and analytical methods for annual groundwater monitoring and sampling events are identified in this PCGMP. Groundwater monitoring field activities are expected to start during the Spring 2004. A Draft Field Sampling Plan for these activities is included with the PCGMP as Appendix A.

If you have any questions, please call Roger Gresh at (503) 639-3400.

Sincerely,

AMEC Earth & Environmental, Inc.

REGISTERED PROFESSIONAL GEOLOGIST
JOE M. FASSIO
#G1214
GEOLOGIST

Joe Fassio, R.G.
Geologist

Roger T. Gresh, P.G.
Project Manager

Attachments: Final Post-Characterization Groundwater Monitoring Plan

LG/lp

c: R. Ferguson, SLLI
J. Benedict, CHBH&L

AMEC Earth & Environmental, Inc.
7376 SW Durham Road
Portland, Oregon
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List of Appendices

Appendix A Final Post-Characterization Groundwater Monitoring Field Sampling Plan

SCOEPA00012589

1.0 INTRODUCTION

This Final Post-Characterization Groundwater Monitoring Plan (PCGMP) addresses the groundwater monitoring and sampling field activities that will be completed at the Rhône-Poulenc (RP) Portland Site following the completion of the Final Groundwater Characterization Report (GCR) (AMEC, 2003a). Groundwater characterization for the purposes of the Remedial Investigation (RI) is complete with the exception of the natural attenuation evaluation, as presented in the GCR. The Oregon Department of Environmental Quality (DEQ) requested a groundwater monitoring plan, as identified in DEQ's January 28, 2003 letter response to the Draft GCR. The Draft Extended Groundwater Characterization Plan (EGCP) (AMEC 2001) and the GCR (AMEC, 2003a) were considered when developing this plan.

The PCGMP identifies the monitoring wells to be included in the post-characterization groundwater monitoring events, outlines the laboratory methods to be used for analysis of groundwater samples, and describes the data quality objectives (DQOs) for the post-characterization groundwater monitoring events. Annual sampling of two City of Portland (City) outfalls to the Willamette River is also provided in this plan.

2.0 DATA QUALITY OBJECTIVES

Groundwater characterization DQOs for the RI have been satisfied with the exception of natural attenuation parameters as discussed in the GCR and DEQ's January 28, 2003 letter response to the Draft GCR. The groundwater characterization DQOs that have been met include those designed to provide information for:

- Characterizing nature and extent of the RP preliminary constituents of potential concern (PCOPCs) in groundwater;
- Conducting the human health risk assessment (HHRA);
- Conducting the ecological risk assessment (ERA);
- Conducting the groundwater hot spot assessment; and
- Conducting the groundwater transport evaluation (GTE).

The DQOs for the groundwater and outfall discharge data to be collected under the PCGMP are to provide additional information for:

- Evaluating the changes in groundwater chemistry due to natural attenuation;
- Providing additional chemical analytical and hydrogeologic data for the feasibility study;

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- Evaluating further the potential for chemical constituent migration to receptors;
- Evaluating the quality of and potential temporal changes in non-stormwater discharge from City Outfall 22B and Outfall 22C during the dry season; and
- Confirming the stability of the chemical distribution in groundwater.

The purpose of the PCGMP is to define the necessary groundwater monitoring wells and analytical methods required to satisfy these DQOs. The DQOs and need for continued groundwater monitoring will be evaluated after two sampling events.

3.0 GROUNDWATER MONITORING

An extensive groundwater monitoring well network has been installed at the RP Site. The monitoring wells have been installed for multiple purposes including evaluation of the nature and extent of groundwater potentially impacted by PCOPCs from the former RP facility. The monitoring wells proposed for the PCGMP represent distinct portions of the groundwater flow system and constituent distribution (both PCOPCs and natural attenuation parameters), including:

- Upgradient monitoring wells relatively unaffected by industrial activities;
- On-property monitoring wells (Insecticide [IA], Herbicide [HA], and Lake area [LA] wells);
- Intermediate downgradient monitoring wells (wells located to the north of the RP property and south of the river front); and
- Distal downgradient monitoring wells (wells located near the Willamette River).

The selection of the monitoring wells proposed for the PCGMP was based on the DQOs listed above and the distribution of constituents documented in the GCR. The monitoring well clusters along the groundwater flow path with historical natural attenuation results were given preference during the selection process. Although PCOPCs were detected historically at monitoring wells located along the edge of the constituent plume (including monitoring wells W-03, W-04, W-15, and W-16), these monitoring wells were not selected for continued groundwater monitoring, as any changes in groundwater chemistry are not expected to be significant and would not be likely to have a potential effect on receptors. Monitoring wells have been selected from all three investigative zones, as defined in the GCR as Fill/Shallow Alluvium, Alluvium, and Basalt Zones. The monitoring well selection process is summarized below by chemical constituent group.

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Volatile Organic Compounds (VOCs): Some VOC constituents have been detected along the general direction of groundwater flow from the northwest portion of the HA towards the location of the distal downgradient monitoring wells (AMEC 2003a). Concentrations of VOCs generally increase with depth to the north of the southern portion of the LA. As such, representative alluvial and basalt well clusters have been selected to the north of the LA along the length of the VOC plume and near West Doane Lake and North Doane Lake.

Phenolic Constituents: The lateral extent of the detected phenolic constituents decreases with depth and is limited to the northern HA and the southern portion of the LA (AMEC 2003a). Monitoring wells selected for analysis of phenolic constituents are limited to representative wells in this area completed in each of the three investigation zones along the groundwater flow path.

Herbicides: Silvex concentrations appear to follow the general groundwater flow path to the distal downgradient wells (AMEC 2003a). As with the VOCs, Silvex concentrations increase with depth in the northern LA and further downgradient. Detections of 2,4-D, 2,4-DB, 2,4,5-T and bromoxynil appear to be localized to the RP property and generally do not extend north of the LA. Representative monitoring wells completed in each of the investigation zones were selected from the LA and HA for herbicide analysis. Representative monitoring wells in each investigation zone have been selected to the north of LA along the length of the herbicide constituent plume and near West and North Doane Lakes.

Dioxins/Furans: Representative wells in all the investigation zones have been selected from the LA and HA and representative deep alluvial and basalt wells have been selected to the north of the LA and near West and North Doane Lakes.

Pesticides: The distribution of pesticides in groundwater appears to be very limited in vertical and lateral extent and generally localized to the IA (AMEC 2003a). Pesticide constituents are relatively immobile and have not been detected downgradient of the IA and the southeastern corner of the Metro property. Because these constituents are not likely to migrate in groundwater or show a significant short-term temporal change due to natural attenuation, one shallow monitoring well (MW-10-24) was selected as being representative of pesticides in this area.

Metals: The distribution of dissolved metals in groundwater does not appear to follow any specific trend and concentrations vary greatly between sampling events (AMEC 2003a). Metals historically detected in distal downgradient monitoring wells may be related to fill material and are not likely associated with RP constituents in groundwater. These distal downgradient monitoring wells, including RP-02-31, W-11-I,

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W-19-I, and RP-01-31, were not selected for metals analysis as part of the PCGMP. Dissolved arsenic has been detected upgradient of the RP property, southwest of St. Helens Road, suggesting naturally occurring arsenic in groundwater. Metals analysis will continue for upgradient wells (W-18 well cluster) screened within the deep alluvial and basalt zones to provide additional local background concentration for arsenic in groundwater. Historically, background concentrations in the shallow and deep alluvial zones in the W-18 well cluster have been similar, so sampling at both alluvium wells has not been proposed.

The groundwater monitoring will be conducted annually during the spring season. The groundwater monitoring wells proposed for the PCGMP and analytical methods for the post-characterization events are listed in Table 2-1 and shown on Figure 2-1 of the attached Post-Characterization Groundwater Monitoring Field Sampling Plan (Post-Characterization FSP) (Appendix A). In addition, groundwater monitoring wells proposed for groundwater elevation and NAPL thickness measurements are included in Table 2-1 and Figure 2-1.

The Post-Characterization FSP (Appendix A) provides detailed information on sampling activities and field procedures, including proper documentation procedures, sample collection and labeling, QA/QC protocol, and sample and waste handling standard operating procedures (SOPs). Documentation of the groundwater sampling activities will include the use of field logbooks and completion of appropriate field forms, including the Groundwater Field Sampling Form and chain-of-custody documentation, as specified in the attached Post-Characterization FSP (Appendix A). A technical memorandum will be submitted to DEQ following completion of each annual field event.

4.0 CITY OUTFALL NON-STORMWATER DISCHARGE SAMPLING

Two City stormwater outfalls are located in the vicinity of the RP Site, City Outfalls 22B and 22C. The locations of the outfalls are shown on Figure 2-2 of the attached FSP (Appendix A).

Non-stormwater discharge from each of these two outfalls will be sampled annually during the summer or fall (dry season) to determine whether RP-related constituents are present in the discharge, and to allow evaluation of changes in concentrations over time. As specified in the FSP (Appendix A), water samples collected from these outfalls will be analyzed by the analytical methods listed in Table 2-1.

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REFERENCES

AMEC, 2001. *Draft Extended Groundwater Characterization Plan, RPAC - Portland* Site, prepared for Aventis CropScience, prepared by AMEC Earth & Environmental, submitted to Oregon Department of Environmental Quality, March 2, 2001.

AMEC, 2003a. *Final Groundwater Characterization Report, RPAC - Portland Site*, prepared by AMEC Earth & Environmental, submitted to Oregon Department of Environmental Quality, March 28, 2003.

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LIMITATIONS

This report was prepared exclusively for SLLI by AMEC Earth & Environmental, Inc. The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by SLLI only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

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APPENDIX A

Post-Characterization Groundwater Monitoring
Field Sampling Plan

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FINAL POST-CHARACTERIZATION GROUNDWATER MONITORING FIELD SAMPLING PLAN RP - PORTLAND SITE

February 17, 2004

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SOP - 3: Decontamination Procedure

SOP - 4: Field Measurement of Groundwater Parameters

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SOP - 13: Waste Management Procedures

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Surface Water and Outfall Sampling Worksheet Form

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1.0 INTRODUCTION

On behalf of SLLI, this Final Post-Characterization Groundwater Monitoring Field Sampling Plan (Post-Characterization FSP) addresses the groundwater monitoring and sampling field activities that will be completed at the Rhône-Poulenc (RP) Portland Site following the completion of the Final Groundwater Characterization Report (GCR) (AMEC 2003a). When developing the Post-Characterization FSP, AMEC considered the following:

- The Consent Order (the Order) between the Oregon Department of Environmental Quality (DEQ) and RP dated July 8, 1999;
- The March 30, 2001 Final Project Management Plan (AMEC 2001b);
- The Draft Extended Groundwater Characterization Plan (EGCP) (AMEC 2001a);
- Final Focused Spring 2002 Groundwater Characterization Field Sampling Plan (AMEC 2002a), dated March 8, 2002;
- DEQ correspondence dated January 28, 2003, regarding the Draft Groundwater Characterization Report - Rhône-Poulenc Site;
- The GCR dated March 28, 2003;
- DEQ correspondence dated October 1, 2003, with comments on the Draft Post-Characterization FSP; and
- Discussions with DEQ during a December 11, 2003 meeting.

The Post-Characterization FSP outlines the procedures, sample handling, field measurements, analytical methods, documentation, decontamination procedures, and investigation derived waste (IDW) handling practices for groundwater sampling activities following the completion of the GCR and until the completion of the Draft RI Report for the RP Site. The work will be conducted according to procedures outlined in the site-specific Revised Quality Assurance Project Plan (QAPP) (AMEC 2001b) dated June 13, 2001, the Draft QAPP Addendum No. 1 (AMEC 2002c), and the Site-Specific Health and Safety Plan (HASP) (AMEC 2003b) dated July 2003, and subsequent addenda and updates, as appropriate.

1.1 Scope and Objectives

The Data Quality Objectives (DQOs) for the groundwater data collected during the Post-Characterization Groundwater Monitoring events are discussed in Section 2.0 of the Post-Characterization Groundwater Monitoring Plan (AMEC 2003b). The scope of tasks covered by this FSP includes:

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Annual groundwater monitoring well sampling and analysis;

- Annual groundwater and surface water elevation determination; and
- Annual non-stormwater discharge outfall sampling.

This FSP addresses the methodologies and other objectives for the activities discussed above as they relate to the following RP areas and off-site properties:

- RP Herbicide Area (HA);
- RP Insecticide Area (IA);
- RP Lake Area (LA);
- ATOFINA Chemicals, Inc. Property;
- Gould Electronics Property;
- Burlington Northern and Santa Fe Railway Company Property;
- Wacker Siltronic Corporation (Wacker) Property;
- ESCO Corporation (ESCO) Property;
- Metro Property;
- Schnitzer Investment Corp. Property;
- Kinder Morgan Property; and
- City of Portland Properties.

Monitoring of wells on off-site properties is subject to compliance with existing access agreements with and approval from these property owners.

1.2 Project Organization and Responsibilities

The field team will consist of a Field Manager and necessary field personnel to implement this field sampling program. The Field Manager will maintain or delegate responsibility for the logistical requirements of the sampling effort, including but not limited to:

- Event scheduling, coordination between AMEC staff, AMEC subcontractors, and representatives of off-site property owners;
- Delivery and shipping of sample containers and coolers;
- Quality assurance checking of sampling technique, documentation, and other paperwork completed by sampling crews;

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- Distribution and proper use of personal protective equipment (PPE) as required by the HASP;
- Ensuring that daily health and safety meetings for field staff take place;
- Sample management and handling activities occurring at the Site; and
- Handling IDW.

The Assistant Project Manager will be responsible for implementation of internal quality assurance (QA) checks on field procedures. The QA checks will include field procedures and health and safety reviews, to be performed by appropriate and qualified AMEC personnel not directly involved in field activities. The QA checks will include an unscheduled field visit and observation of procedures during some field events.

The current key AMEC personnel are:

Project Manager:	Roger Gresh
Assistant Project Manager:	Scott Kranz
Field Manager:	Joe Fassio

2.0 FIELD SAMPLING PLAN TASKS

2.1 Water Level Measurements

Water level measurements will be collected and used to evaluate the general direction of groundwater flow, vertical hydraulic gradients, other hydraulic characteristics of the hydrogeologic units, and the hydraulic relationships between outfall discharge and groundwater.

Groundwater elevations and non-aqueous phase liquid (NAPL) thickness measurements will be collected from 123 existing monitoring wells. Surface water elevations will be collected at three staff gauges in North Doane Lake, West Doane Lake, and the Northwest Drainage Pond. The water level and NAPL thickness measurement locations are listed on Table 2-1.

2.2 Groundwater Sampling

Groundwater samples will be collected and submitted for selected chemical analytical testing from existing monitoring wells, as described in Table 2-1. The locations of the monitoring wells are depicted on Figure 2-1. Groundwater sampling will occur at 33 existing monitoring wells.

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2.3 City Outfall Non-Stormwater Discharge Sampling

Two City of Portland (City) stormwater outfalls are located in the vicinity of the RP Site: City Outfalls 22B and 22C. These outfalls are shown on Figure 2-2. Non-stormwater discharge from each of these two outfalls will be sampled on an annual basis during the summer or fall (dry season) to determine whether RP-related constituents are present in the discharge. The outfall discharge sampling may occur independent from groundwater monitoring events, when no precipitation has occurred for at least 72 hours prior to sampling and when the ephemeral creek flowing into the Northwest Drainage Pond is dry.

2.4 Analytical Testing

Standard EPA and DEQ analytical test methods will be used for all groundwater and outfall discharge sample analysis. The specific analytical methods for groundwater samples collected at the monitoring wells and the outfall samples are summarized in Table 2-1. Under this Post-Characterization FSP, chemical analyses will not be conducted on NAPL samples or groundwater samples collected from monitoring wells where NAPL was detected, except possibly in locations determined critical, and only under specific direction of the Project Manager.

The physical properties of groundwater will be measured at all monitoring wells where groundwater samples are collected, including:

- Temperature;
- pH;
- Specific conductance;
- Dissolved oxygen (DO);
- Oxidation-reduction potential (ORP); and
- Turbidity.

Natural attenuation parameters will be collected at 29 monitoring wells during the Post-Characterization Groundwater Monitoring events. These monitoring wells are listed in Table 2-1 and Figure 2-1 depicts the locations of the monitoring wells. Groundwater samples will be collected and analyzed for the following natural attenuation parameters:

- Ferrous iron (field measurement);
- Microbial enumerations (total heterotrophic plate count, diesel degrading bacteria);

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- Nutrients (soluble ammonia, nitrate, nitrite, and orthophosphate);
- Total organic carbon (TOC);
- Biological oxygen demand (BOD);
- Chemical oxygen demand (COD);
- Chloride;
- Sulfate;
- Sulfide;
- Total alkalinity;
- Major cations (aluminum, calcium, iron, magnesium, manganese, potassium, sodium);
- Total petroleum hydrocarbons as diesel (using method NWTPH-Dx); and
- Methane.

For the same monitoring wells selected for analysis of total metals, SLLI may elect to collect and analyze groundwater samples for dissolved metals.

All samples will be collected and submitted to the contract laboratories following the procedures described in this Post-Characterization FSP, the Project QAPP, and QAPP Addendum.

3.0 GROUNDWATER MONITORING AND OUTFALL SAMPLING PROCEDURES

Detailed descriptions of the groundwater and outfall discharge sampling procedures are specified and documented in the appropriate Standard Operating Procedures (SOPs) found in Appendix A of this FSP. Field Quality Control (QC) includes standardization protocol such that all field data are reported in an identical manner regardless of the site, sample location, or operator. The data are entered into the project database and then electronic and original field sheet data are compared to assure consistency and accuracy.

3.1 Water Level Measurements

Methodology for water level and NAPL thickness measurements will follow the procedures outlined in SOP - 1, Methodology for Water Level Determination (Appendix A). Water level measurements and NAPL thicknesses will be collected before the groundwater samples are collected. It is anticipated that it will take 1.5 days to

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complete these measurements. Table 2-1 lists the wells currently proposed for groundwater elevation and NAPL thickness measurements.

Prior to collection of groundwater elevation measurements (and NAPL thickness measurements, if present) at the RP Site monitoring wells, the groundwater extraction system will be deactivated for at least 48 hours.

An electronic water level probe will be used to measure the groundwater levels and well total depths. If evidence of NAPL is seen on the probe upon retrieval from the total well depth, the presence and approximate thickness of NAPL will be confirmed using an interface probe or disposable bailer. An interface probe will also be used to check for NAPL at monitoring wells where NAPL was detected in year 2000 through 2002 groundwater characterization events, or during recent NAPL monitoring events. A bailer will be used to confirm the presence of NAPL if it is detected with and interface probe. The water level and/or interface probe will be decontaminated between measurements according to procedures in Section 3.7 of this FSP, SOP - 1, and SOP - 3 (Appendix A).

3.2 Groundwater Sampling Methodologies

Methodology for groundwater sampling will follow the procedures outlined in SOP - 2, Methodology for Groundwater Sampling (Appendix A). The groundwater samples will be collected with low flow sampling methodologies, when possible, using a submersible pump with chemically inert components. If the groundwater recharge to the well is very slow or the groundwater column in the well is insufficient to allow the submersible pump to operate, the well will be purged and sampled using a bailer or peristaltic pump. Three casing volumes will be purged from the well if a bailer is used for sampling, unless the well is purged dry first. Disposable vinyl or polyethylene tubing will be used for purging and sampling with the submersible and peristaltic pumps. The pump or tubing intake will be placed approximately at the mid-point of the saturated screen interval of the well. To ensure stability for a representative groundwater sample, field parameters including temperature, pH, specific conductance, DO, and ORP, will in most cases, be measured using a flow-through cell (flow cell) while purging. Field measurement collection methods are discussed in Section 3.5 and SOP - 4 (Appendix A). The sample tubing and disposable bailers, if used, will be disposed of as IDW after sampling and will not be reused for sampling another monitoring well.

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3.3 City Outfall Non-Stormwater Discharge Sampling

Two City stormwater outfalls are located in the vicinity of the RP Site: City Outfalls 22B and 22C. Sampling of non-stormwater discharge from these outfalls will be conducted, as discussed below. Discharge samples will undergo field observation and laboratory testing. These samples will be collected from each outfall near the Willamette River bank. The outfall discharge sample locations are shown on Figure 2-2 and proposed sampling designations with analyte list are summarized in Table 2-1.

Non-stormwater discharge will be sampled from each of these two outfalls during the summer or fall (dry season) to eliminate the influence of storm water on results. Samples will be collected directly in laboratory-provided sampling containers when possible, or (as necessary) disposable or decontaminated equipment may be used to collect the discharge and immediately transfer it into the appropriate sample containers. Sample containers will be labeled following the appropriate sample labeling procedure described in Section 3.4. Field documentation for each sample location will include completion of the appropriate field sampling form and a chain-of-custody documentation form. Additional samples for QA/QC that will be collected include a field duplicate sample, laboratory QC samples (MS/MSD), and a trip blank as described in Section 3.4.1.

Sampling equipment (if any non-disposable equipment is used) will be decontaminated following sample collection at each location, according to the appropriate decontamination procedures (SOP - 3, Appendix A). Waste generated during the sampling procedure will be handled in accordance with the waste handling procedures described herein (SOP - 13, Appendix A).

3.4 Sample Designation and Handling

Groundwater sample handling and designation procedures were developed to provide sufficient project-specific QA and QC measures. Specific QA/QC procedures are described in this section and in SOP - 1, SOP - 2, SOP - 4, and SOP - 11 including:

- QC sample collection requirements;
- Sample container requirements and preservation;
- Sample documentation and handling; and
- Chain-of-custody.

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3.4.1 QC Sample Collection Requirements

A variety of QC samples are required in order to assess performance of the project team in collection and performance of the laboratories conducting the analysis of the groundwater samples. QC samples required for this sampling and analysis program include:

Field Duplicate Samples:	One duplicate per 20 requests for each analytical procedure, with a minimum of one per procedure (with the exception of most natural attenuation parameters).
Interlaboratory Split Samples:	One split sample per 20 requests for each analytical procedure, with a minimum of one per procedure (with the exception of most natural attenuation parameters and outfall samples).
Performance Evaluation Samples:	Minimum of one per event (with the exception of outfall samples).
Rinsate Blanks:	One rinsate blank per 20 samples when disposable or dedicated sampling equipment is used (including disposable tubing with a submersible pump).
Trip Blanks:	One trip blank per cooler containing vials for volatile organic compound (VOC) analysis.
Laboratory QC Samples:	One laboratory QC sample per 20 requests for each analytical procedure, with a minimum of one per procedure (with the exception of most natural attenuation parameters).

Field duplicates are replicate samples collected at the same location during the same sampling session (roughly at the same time) and submitted in blind form to the contract laboratory. Field duplicates provide an indication of the reproducibility of the sampling and analysis procedures for a given sample matrix, including heterogeneity of the sample itself. Field duplicate samples will be collected by alternating between the sample and the replicate as each bottle is filled. The field duplicates will be collected in the same container types and handled and analyzed in the same manner as all other groundwater samples.

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Interlaboratory split samples are field duplicates that are shipped to both the primary laboratory and a QC laboratory. They are collected in a manner identical to that described for field duplicates.

Performance evaluation (PE) samples are certified reference materials that contain analytes of concern for the project, and are submitted to the laboratory in blind form as a check on laboratory procedures. The PE samples are purchased from an accredited supplier in whole volume form, and are packaged in the same bottle types used for field samples. Each bottle contains analytes for a single analytical procedure, so individual bottles will be labeled correctly, and submitted for the appropriate analysis.

A rinsate blank serves as an indicator of potential contamination resulting from inadequate decontamination of sampling equipment. Deionized water or distilled deionized water is passed through (or across) the sampling equipment after the decontamination procedure is complete, and collected in the same containers as the field samples.

A trip blank is a container filled by the laboratory with analyte free water and never opened in the field. It is used to assess possible contamination during transport and storage of sample containers. Trip blanks and associated sample containers should remain in the same cooler the laboratory shipped them in or in the on-site refrigerator and not be intermingled with bottles from different batches. The trip blank will be kept with samples planned for VOC analysis and will be analyzed for VOCs only.

Laboratory QC samples are field samples that are designated for laboratory QC procedures such as duplicate analysis or matrix spike analysis. Extra volume must be collected for laboratory QC samples to ensure the laboratory has sufficient volume to perform all required analyses. QC sample volume requirements are listed in Table 3-1.

3.4.2 Sample Containers

The contract laboratory will supply pre-cleaned, certified bottles appropriate for the required analysis. Sample container quality protocols will be strictly enforced and assured by the laboratory. The laboratory shall retain certificates of analysis from each lot of bottles for a period of at least five years. Bottles supplied by the laboratory shall contain any required chemical preservative, except when necessary to field preserve. Field preservation will be conducted under specific direction from the laboratory. Sample containers will be kept closed until used. Required sample containers, preservation, and holding time requirements for this project are described in Table 3-1.

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3.4.3 Sample Preservation and Holding Times

Field personnel will verify that the correct laboratory-supplied bottles are used for each sample and labeled with the corresponding intended analysis.

All water samples will be placed in a cooler with blue ice or double-bagged wet ice immediately after collection. The target temperature for the cooler is 4°C or less. Water samples will be transported to the contract laboratory as soon as possible after collection. This will allow rapid transfer of the water samples into controlled, refrigerated storage, and allow the contract laboratory adequate time to meet required analytical holding times as described in Table 3-1. A temperature blank, when provided by the laboratory with the sample bottles, will be included in each cooler so the laboratory can verify sample temperature upon receipt.

3.4.4 Sample Storage, Packaging, and Transport

Sample Storage

All samples will be in possession of an AMEC field representative or designated AMEC staff member at all times until custody is relinquished to the laboratory (in person or through shipment), or until the samples are placed in a secure storage location. Samples will be placed into metal or plastic picnic coolers at a target temperature of 4°C, or in a refrigerator designated for sample storage. Ice will be added, as necessary, to maintain the target temperature.

Sample Packaging

Samples will be transported in the same coolers used for sample storage. Each cooler or daily set of coolers will be accompanied by a chain-of-custody form. The chain-of-custody form will be completed, sealed in a Ziploc® bag to prevent damage to the document, and taped to the top of the cooler (or one of the coolers if there are multiple coolers for a sample set). Each cooler will then be sealed with signed, self-adhesive chain-of-custody seals prior to transport.

Sample Transport

Sample coolers will be placed into the back of a field vehicle for transport to the contract laboratory or to the AMEC office. All samples collected for VOC analysis will be transported in the same cooler with the trip blank.

Individual glass sample containers will be wrapped in bubble wrap bags or placed in closed-cell foam packaging. Samples with numerous aliquots per sample set will be

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placed in resealable bags to help keep sets together. Plastic sample containers will be placed in resealable bags, but not bubble wrap.

Samples designated to be analyzed at out-of-area laboratories will be repackaged (as necessary) at the AMEC office for shipping. Bubble wrap and foam may be used to help prevent sample breakage during shipping. Samples will be packed into coolers with blue ice and labeled appropriately for shipping. Common carriers may be used for shipping. A chain-of-custody form will accompany all coolers during shipment. Although common carriers do not typically sign chain-of-custody forms, the receipt for shipment will be retained as evidence of sample transport.

3.5 Field Measurements

Measurements collected in the field will include, but not be limited to, depth to water, depth to bottom of well, depth to NAPL (as appropriate), ferrous iron concentration, and groundwater physical parameters including: temperature, pH, specific conductance, DO, ORP, and turbidity. Records of standard preparation and instrument calibration data shall be maintained. The field logbook shall include at a minimum, the date and time of calibration, the initials of the personnel performing the calibrations, and concentration the equipment was calibrated against. The methodology for water level determination is provided in SOP - 1, the field measurement of groundwater parameters is described in SOP - 4, and the field measurement for outfall discharge parameters, which would apply to outfall sampling, is described in SOP - 11 (Appendix A).

3.6 Documentation

Verifiable sample custody is of primary importance during field and laboratory procedures. Such practices ensure all samples have been properly acquired, preserved, and identified. This information will be collected in a variety of formats that will all be specific to the function they perform in the sampling procedure (e.g., field logbooks, groundwater sampling forms, sample labels, chain-of-custody forms). Accurate sampling records create a complete record of all field procedures, including circumstances of collection and integrity of the given sample. This will also allow for detailed tracking of all samples from collection through transport and laboratory analysis. This will also facilitate the import of field data and laboratory analyses into the database system. The following information outlines specific procedures that will be implemented during field water sampling activities.

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3.6.1 Field Logbooks

Field logbooks will be the main source of field documentation for all field activities. The books will be permanently bound, with waterproof pages, chosen for their secure binding and durability in adverse field conditions. All pages will be numbered consecutively. All pages will remain intact and no page will be removed for any reason. Notes will be taken in indelible, waterproof, blue, or black ink. The front and inside of each field logbook will be marked with the project name, number, logbook number and AMEC's address and phone number. A new book will be started for each annual sampling event. The field logbooks will be stored in the project files when not in use and upon completion of each sampling event.

The first entry at the beginning of each day will include the date and time, project number, names of all field personnel on-site (including subcontractors and the company for which they work), weather conditions, and the purpose of fieldwork. Each subsequent page will be started with the project number and the date. The bottom of each page will have the date and the initials of all personnel entering information onto that page. Any remaining unused lines will be crossed through. Errors will not be erased. All errors will have a single strikethrough with an initial and date next to the strikethrough and the subsequent change made.

Information included in the field logbooks may include, but not be limited to, the following items:

- Reasons for collecting samples (e.g., annual sampling event).
- Field observations relevant to the sampling event, including weather (wind direction and approximate speed, air temperature, sky cover) and any events that may have occurred previous to sampling which may influence the integrity or the representative nature of the sample.
- Observations of site activities not covered under regular activities, including presence of persons on-site not related to the sampling activities (subcontractors, DEQ, and others), and actions by those people affecting task performance.
- Sketches of relevant information.
- Information relevant to a change in scope or change in Post-Characterization FSP procedure, with documentation of subsequent AMEC and/or SLLI approval.
- Type and/or level of health and safety equipment used.
- References to information on other field forms, such as the Groundwater Sampling Field Form (discussed below).

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All information compiled in the field logbook, will be written legibly in language that is clear and concise, without interpretation.

3.6.2 Water Level and NAPL Thickness Measurement Form

A separate Groundwater Level and NAPL Thickness Measurement Form will be used to record water levels, NAPL thicknesses, well total depth, and date and time of measurement (Appendix B). Staff gauge outfall discharge levels, as appropriate, will also be entered on this form. Errors will not be erased. All errors will have a single strikethrough with an initial and date next to the strikethrough and the subsequent change made.

3.6.3 Groundwater Sampling Field Form

A separate and complete Groundwater Sampling Field Form (GSF) will be created for each monitoring well sampled (Appendix B). Errors will not be erased. All errors will have a single strikethrough with an initial and date next to the strikethrough and the subsequent change made. Information collected during sampling will be marked on the GSF in addition to notes taken in the field logbook.

Information may include, but will not be limited to:

- Date and time of sampling for each sample, including time of well purging, field sample collection, and laboratory sample collection;
- Well identification;
- Sample identification or naming system, including each unique sample name/number;
- Method of sampling, including procedures and equipment, as well as any variance from the methods in this FSP;
- Volume of sample collected per sample container, type of sample container, and number of aliquots per sample;
- Sample preservation techniques and analyses requested;
- Results of field measurements (e.g., headspace readings, temperature);
- Information relevant to quality control (e.g., sampling discrepancies or difficulties, unexpected conditions, abnormal sampling procedures);
- Weather conditions;
- Depth to water and depth to bottom including depth to water measurements made while purging and sampling;

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- Purge method, time, and volume;
- Field sampling methods and instruments;
- Laboratory samples collected;
- Waste disposal method; and
- Decontamination method.

The fields within the form will help ensure that pertinent information will be documented appropriately.

3.6.4 Surface Water and Outfall Sampling Worksheet Forms

A separate and complete Surface Water and Outfall Sampling Worksheet form (Appendix B) will be filled out for both outfall water sample locations. Errors will not be erased. All errors will have a single strikethrough with an initial and date next to the strikethrough and the subsequent change made. Information collected during sampling will be marked on the form, in addition to notes taken in the field logbook.

Information may include, but will not be limited to:

- Date and time of sampling for each sample, field sample collection, and laboratory sample collection;
- Sample media type and description of sample location;
- Sample identification or naming system, including each unique sample name/number;
- Method of sampling, including procedures and equipment, as well as any variance from the methods in this Post-Characterization FSP;
- Volume of sample collected per sample container, type of sample container, and number of aliquots per sample;
- Sample preservation techniques and analyses requested;
- Results of field measurements (e.g., pH, temperature, etc.);
- Information relevant to quality control (e.g., sampling discrepancies or difficulties; unexpected conditions or abnormal sampling procedures);
- Weather conditions;
- Laboratory samples collected, specifically sample identification and QA/QC samples identification, if applicable;
- Waste disposal method; and

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- Decontamination method.

The fields within the form will help ensure that pertinent information will be documented appropriately.

3.6.5 Sample Designation and Labeling

The purpose of sample designation and labeling is to enable discrete sample tracking. Each sample will be given a discrete sample identification number (ID). All samples will be tracked on the GSF and Surface Water and Outfall Sampling Worksheet forms (Appendix B) by location name and sample ID. Each sample ID will be designated by the following identification system:

- Each sample location or well will have a three-digit number that will be in sequence with the previous sample collected. For example, a water sample collected from MW-11 would have a sample ID of 001. The next sample collected from MW-8 would be designated as 002 and so on.
- A QA/QC designation will be assigned to the sample as follows:

  -01 Primary Sample

  -02 Field Duplicate

  -03 Trip Blank

  -04 Rinsate Sample

  -05 PE Sample

  -06 Interlaboratory Duplicate

For example, a primary sample collected from MW-8 would be designed 002-01 and the field duplicate also collected from MW-8 would be assigned a sample ID of 002-02. A rinsate sample collected after sampling MW-8 would have a sample ID of 002-04.

No indication of QA/QC designation will be provided to the laboratory, with the exception of additional quantities of sample for the laboratory matrix spike (MS) and matrix spike duplicate (MSD). The sample location or well number will not be recorded on the sample label or chain-of-custody form. The sample containers designated for MS and MSD analysis will be labeled with the same modifier as the primary sample (-01). However, on the chain-of-custody form the primary sample associated with the MS/MSD bottles will be identified. This will assist the laboratory in reporting MS/MSD results as associated with the correct primary field sample results.

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Sample labels will be preprinted with project name and number. Items including sample ID, date and time of collection, and sample collector will be indicated on the sample label and will be filled out in the field. In addition, the analysis method and/or analyte(s) will be specified on the label for each container.

3.6.6 Chain-of-Custody Procedures

The chain-of-custody is an integral component of the sampling process as it stands as a permanent record of sample holding and shipment. Sample custody is documented from collection through transport, analysis, and reporting.

Samples will remain in the custody of field personnel or appropriate AMEC staff until submitted to the laboratory. The corresponding chain-of-custody form is in plain view at all times, in physical possession, or in a locked location where no tampering will occur. The chain-of-custody form will be cross-checked for errors and signed. Any errors will not be erased, but will have a single strikethrough, with the change dated and initialed.

All samples will be hand-delivered to a laboratory representative or shipped according to the procedures described in Section 3.4.4.3. Coolers with their respective chain-of-custody form(s) will be checked into the laboratory by a laboratory representative, and the chain-of-custody form will be signed and dated appropriately. The field representative or AMEC staff member will retain one copy of the signed chain-of-custody form for the project files. The laboratory representative will verify cooler temperature, sample designation, and other relevant sample conditions. The original chain-of-custody form or a photocopy will be returned to the Project Manager with the analytical results to go into the project files.

3.7 Decontamination

All equipment used to collect down-hole measurements that may come into contact with sample water (e.g., water level probe) will be decontaminated between each use. This will not be the case for disposable equipment (e.g., bailers and sample tubing). Decontamination procedures will help to eliminate cross-contamination between samples, a situation that leads to analytical results that may misrepresent the natural subsurface conditions. Equipment will be decontaminated as follows:

- Soap wash (dilute solution of Alconox or equivalent in potable water solution);
- Potable water rinse;
- Solvent rinse (methanol or similar solvent); and

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- Rinse with distilled or deionized water.

Further details regarding decontamination procedures are provided as SOP - 3 in Appendix A.

4.0 WASTE DISPOSAL AND HANDLING PROCEDURES

All IDW generated during the investigation will be handled in such a way as to prevent or minimize the potential for the spread of contamination, the creation of a sanitary hazard, or visual degradation of the Site through the spread of litter. The IDW will remain under the control of SLLI and its contractor at all times during its generation, containerization, and transport to the RP facility for consolidation and shipment.

Wastes generated during conduct of the field investigations covered by this Post-Characterization FSP will include purge water, decontamination fluids, personal protective equipment, disposable sampling equipment, and miscellaneous solid waste. Waste will be handled according to procedures specified in SOP - 13, Waste Handling and Disposal Procedure (Appendix A).

SCOEPA00012616

REFERENCES

AMEC 2001a. *Draft Extended Groundwater Characterization Plan (EGCP) RPAC - Portland Site,* prepared for Aventis CropScience, prepared by AMEC Earth & Environmental, submitted to Oregon Department of Environmental Quality, March 2, 2001.

AMEC, 2001b. *Final Project Management Plan RPAC - Portland Site*, prepared for Aventis CropScience, prepared by AMEC Earth & Environmental, submitted to Oregon Department of Environmental Quality, March 30, 2001.

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AMEC, 2002a. *Final Focused Spring 2002 Groundwater Characterization Field Sampling Plan RPAC - Portland Site*, prepared by AMEC Earth & Environmental, submitted to Oregon Department of Environmental Quality, March 8, 2002

AMEC, 2002c. *Draft Quality Assurance Project Plan Addendum No. 1, Remaining Remedial Investigation Surface and Sediment Data Collection RPAC - Portland Site*, prepared by AMEC Earth & Environmental, submitted to Oregon Department of Environmental Quality, August 1, 2002.

AMEC, 2003a. *Final Groundwater Characterization Report RPAC - Portland Site*, prepared by AMEC Earth & Environmental, submitted to Oregon Department of Environmental Quality, March 28, 2003.

AMEC, 2003b. *Site-Specific Health and Safety Plan, RP - Portland Site*, prepared by AMEC Earth & Environmental, Inc. submitted to Oregon Department of Environmental Quality, July 25, 2003.

AMEC, 2004. *Final Post-Characterization Groundwater Monitoring Plan, RP - Portland Site,* prepared by AMEC Earth & Environmental, Inc. submitted to Oregon Department of Environmental Quality, February 17, 2004.

Oregon Department of Environmental Quality (DEQ), 1999. *Remedial Investigation Work Plan Rhône-Poulenc AG Company Portland, Oregon*, prepared for Oregon Department of Environmental Quality, prepared by Ecology and Environment, Inc., April 1999.

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LIMITATIONS

This report was prepared exclusively for SLLI by AMEC Earth & Environmental, Inc. The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used by SLLI only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

SCOEPA00012618

TABLES

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TABLE 2-1
Proposed Sampling Locations and Analytical Methods
Post-Characterization Groundwater Monitoring
RP - Portland Site

Location		Measurement and Sampling Requirements										Data Quality Objective
Monitoring Well	Property Owner	Water Level Measurement	NAPL Measurement if Present	VOCs by EPA 8260B	Phenols by EPA 8270C	Herbicides by EPA 8151A	Dioxins/ Furans by EPA 8290 for Groundwater and EPA 1613B for Outfall	Metals by EPA 6010/6020 and 7470A for Groundwater and 200.7/200.8 and 1631 for Outfall	Pesticides by EPA 8081A	PAHs by 8270C-SIM	Natural Attenuation	
AL2-17	SLLI	X	X									
AL2-32	SLLI	X	X	X	X	X	X	X			X	FS,N
AL2-46	SLLI	X	X	X	X	X	X				X	FS,N
AL4-47	SLLI	X	X									
AL5-19	SLLI	X	X									
AL5-35	SLLI	X	X									
AL5-62	SLLI	X	X									
AL6-96	SLLI	X	X	X		X	X				X	N,M
ASW-01A	Metro	X	X									
ASW-04	Metro	X	X									
ASW-05	Metro	X	X									
ASW-06	Metro	X	X									
ASW-08	Metro	X	X									
BST2W-61	SLLI	X	X	X	X	X					X	FS,N
BST5W-74	SLLI	X	X									
BTB-4A-84	SLLI	X	X									
BTB-4B-25	SLLI	X	X									
BTB-4B-55	SLLI	X	X									
KM-MW-2	Kinder Morgan	X	X									
KM-MW-5	Kinder Morgan	X	X									
MW-01-26	SLLI	X	X									
MW-01-41	SLLI	X	X									
MW-01-56	SLLI	X	X									
MW-01-76	SLLI	X	X									
MW-02-26	SLLI	X	X									
MW-02-46	SLLI	X	X									
MW-02-62	SLLI	X	X									
MW-03-27	SLLI	X	X									
MW-03-49	SLLI	X	X									
MW-03-68	SLLI	X	X									
MW-03-81	Wacker	X	X	X		X		X			X	M,N
MW-03-I	Wacker	X	X	X		X		X			X	M,N
MW-03-S	Wacker	X	X									

TABLE 2-1
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Post-Characterization Groundwater Monitoring
RP - Portland Site

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Monitoring Well	Property Owner	Water Level Measurement	NAPL Measurement if Present	VOCs by EPA 8260B	Phenols by EPA 8270C	Herbicides by EPA 8151A	Dioxins/ Furans by EPA 8290 for Groundwater and EPA 1613B for Outfall	Metals by EPA 6010/6020 and 7470A for Groundwater and 200.7/200.8 and 1631 for Outfall	Pesticides by EPA 8081A	PAHs by 8270C-SIM	Natural Attenuation	
MW-04-27	SLLI	X	X									
MW-04-47	SLLI	X	X									
MW-04-63	SLLI	X	X									
MW-05-24	SLLI	X	X	X	X	X					X	FS,N
MW-05-34	SLLI	X	X	X	X	X					X	FS,N
MW-05-52	SLLI	X	X	X	X	X	X				X	FS,N
MW-05-70	SLLI	X	X	X		X	X				X	FS,N
MW-06-S	Wacker	X	X									
MW-07-S	Wacker	X	X									
MW-08-27	SLLI	X	X									
MW-08-46	SLLI	X	X									
MW-08-64	SLLI	X	X									
MW-09-23	SLLI	X	X									
MW-09-42	SLLI	X	X									
MW-09-58	SLLI	X	X									
MW-09-80	SLLI	X	X									
MW-10-24	SLLI	X	X					X	X		X	FS,N
MW-10-44	SLLI	X	X									
MW-10-57	SLLI	X	X									
MW-11-24	SLLI	X	X									
MW-11-37	SLLI	X	X									
MW-11-56	SLLI	X	X									
MW-11-79	SLLI	X	X									
MW-12-27	SLLI	X	X									
MW-12-41	SLLI	X	X									
MW-12-59	SLLI	X	X									
MW-12-79	SLLI	X	X									

TABLE 2-1
Proposed Sampling Locations and Analytical Methods
Post-Characterization Groundwater Monitoring
RP - Portland Site

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Monitoring Well	Property Owner	Water Level Measurement	NAPL Measurement if Present	VOCs by EPA 8260B	Phenols by EPA 8270C	Herbicides by EPA 8151A	Dioxins/ Furans by EPA 8290 for Groundwater and EPA 1613B for Outfall	Metals by EPA 6010/6020 and 7470A for Groundwater and 200.7/200.8 and 1631 for Outfall	Pesticides by EPA 8081A	PAHs by 8270C-SIM	Natural Attenuation	
P-07	SLLI	X	X									
P-10	SLLI	X	X									
P-11	SLLI	X	X									
PP-08	SLLI	X	X									
PP-11	SLLI	X	X									
PZ-02-40	Portland	X	X									
PZ-1-11	SLLI	X	X									
RP-01-31	BN/SF	X	X	X		X					X	N,M
RP-01-51	BN/SF	X	X	X		X	X				X	N,M
RP-01-65	BN/SF	X	X	X		X	X				X	N,M
RP-02-31	Atofina	X	X									
RP-02-49	Atofina	X	X									
RP-02-66	Atofina	X	X	X		X	X	X			X	M,N
RP-03-30R	BN/SF	X	X	X			X			X		M,FS
RP-03-52R	BN/SF	X	X	X		X	X			X		M,FS
RP-04-16	SLLI	X	X	X	X	X	X				X	N,M,FS
RP-04-41	SLLI	X	X	X	X	X	X				X	N,M,FS
RP-05-16	SLLI	X	X									
RP-06-30	BN/SF	X	X									
RP-06-87	BN/SF	X	X	X		X		X			X	M,N
RP-07-30	Wacker	X	X							X		M,N
RP-07-55	Wacker	X	X							X		M,N
RP-07-84	Wacker	X	X	X		X	X	X		X	X	N,M
RP-07-119	Wacker	X	X	X		X	X	X		X	X	N,M
RPW-02	SLLI	X	X									
RPW-03	SLLI	X	X									
RPW-05	SLLI	X	X									
W-03-D	Gould	X	X									
W-03-I	Gould	X	X									
W-03-S	Gould	X	X									

TABLE 2-1
Proposed Sampling Locations and Analytical Methods
Post-Characterization Groundwater Monitoring
RP - Portland Site

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Monitoring Well	Property Owner	Water Level Measurement	NAPL Measurement if Present	VOCs by EPA 8260B	Phenols by EPA 8270C	Herbicides by EPA 8151A	Dioxins/ Furans by EPA 8290 for Groundwater and EPA 1613B for Outfall	Metals by EPA 6010/6020 and 7470A for Groundwater and 200.7/200.8 and 1631 for Outfall	Pesticides by EPA 8081A	PAHs by 8270C-SIM	Natural Attenuation	
W-04-89	Gould	X	X									
W-04-I	Gould	X	X									
W-04-S	Gould	X	X									
W-06-B	SLLI	X	X									
W-06-D	SLLI	X	X									
W-06-S	SLLI	X	X									
W-08	SLLI	X	X									
W-08-26	SLLI	X	X									
W-08-74	SLLI	X	X									
W-09	SLLI	X	X									
W-09-116	SLLI	X	X	X		X	X				X	N,M
W-09-86	SLLI	X	X									
W-10	Portland	X	X									
W-11-B	ESCO	X	X	X		X	X				X	N,M
W-11-D	ESCO	X	X	X		X	X				X	N,M
W-11-I	ESCO	X	X	X		X					X	N,M
W-11-S	ESCO	X	X	X		X					X	N,M
W-12-D	ESCO	X	X									
W-12-I	ESCO	X	X									
W-12-S	ESCO	X	X									
W-15-D	Metro	X	X									
W-15-I	Metro	X	X									
W-15-S	Metro	X	X									
W-16-31	Schnitzer	X	X									
W-16-D	Schnitzer	X	X									
W-16-I	Schnitzer	X	X									
W-16-S	Schnitzer	X	X									
W-18-D	PGE	X	X					X			X	N,FS
W-18-I	PGE	X	X					X			X	N,FS
W-18-S	PGE	X	X									
W-19-D	Atofina	X	X	X		X					X	N,M
W-19-I	Atofina	X	X	X		X					X	N,M
W-19-S	Atofina	X	X									

TABLE 2-1
Proposed Sampling Locations and Analytical Methods
Post-Characterization Groundwater Monitoring
RP - Portland Site

Location		Measurement and Sampling Requirements										Data Quality Objective
Monitoring Well	Property Owner	Water Level Measurement	NAPL Measurement if Present	VOCs by EPA 8260B	Phenols by EPA 8270C	Herbicides by EPA 8151A	Dioxins/ Furans by EPA 8290 for Groundwater and EPA 1613B for Outfall	Metals by EPA 6010/6020 and 7470A for Groundwater and 200.7/200.8 and 1631 for Outfall	Pesticides by EPA 8081A	PAHs by 8270C-SIM	Natural Attenuation	
SG-NDL	BN/SF	X										
SG-NDP	Wacker	X										
SG-WDL	BN/SF	X										
City Outfalls 22B and 22C - Nonstormwater Dry Season Sampling Only												
CO-22B-01 *	N/A	N/A	N/A	X	X	X	X	X	X	X		M
CO-22C-01 *	N/A	N/A	N/A	X	X	X	X	X	X	X		M

DQO **Data Quality Objectives**

N Changes in groundwater chemistry, natural attenuation.

M Potential migration of constituents offsite or to receptors.

FS Possible data requirements for feasibility study.

Notes:

NAPL Non-aqueous-phase liquid VOCs Volatile organic compounds

PAHs Polynuclear aromatic hydrocarbons EPA Environmental Protection Agency

* Outfall samples will also be analyzed for total suspended solids (TSS), petroleum hydrocarbons by NWTPH-Dx, Alkalinity by USEPA Method 310.0, Anions by USEPA 300.0, pH by USEPA Method 150.1, and Hardness by Calculation Method No. SM2340B.

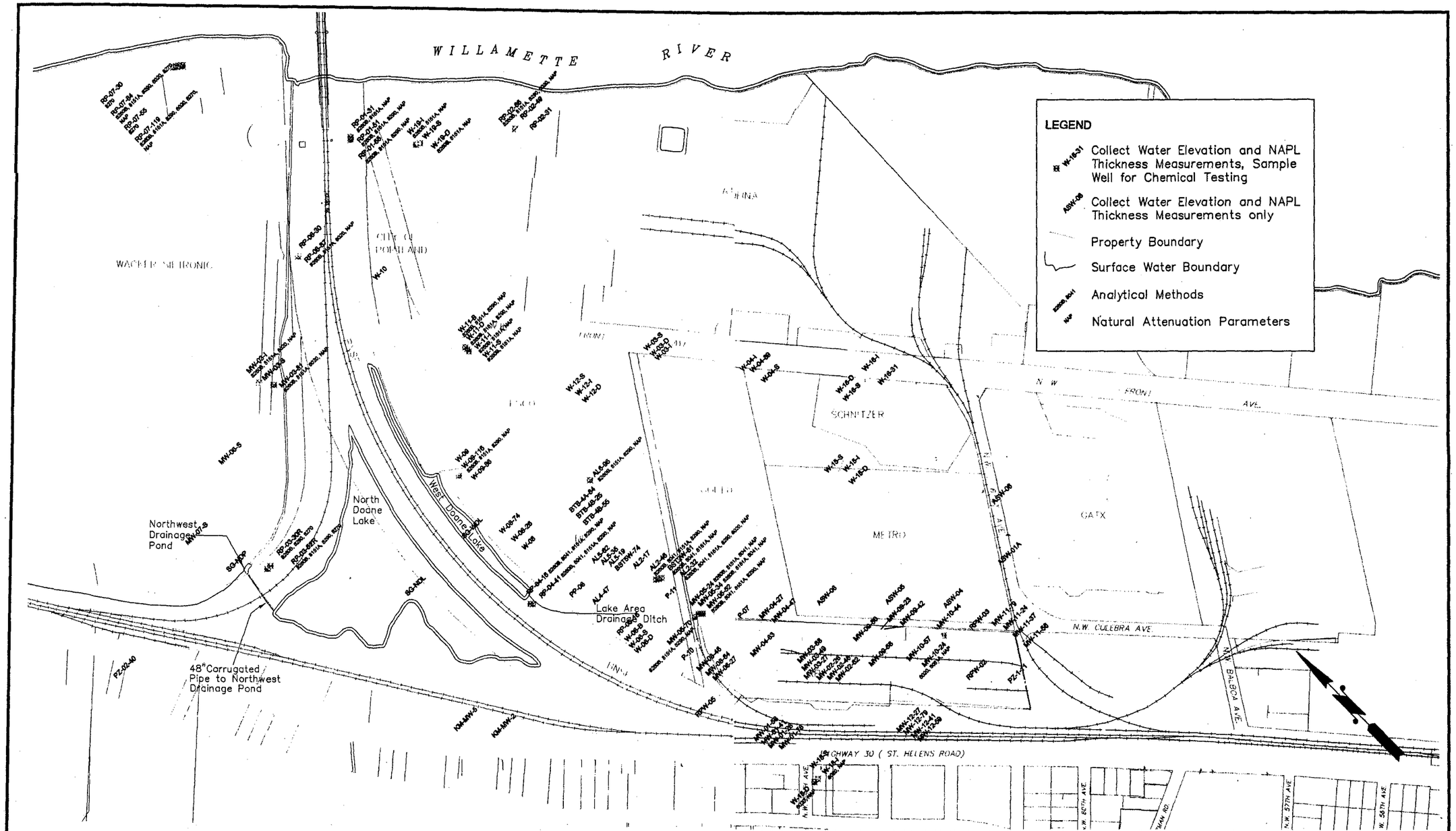
TABLE 3-1
Laboratory Container, Preservation, and Holding Times
Post-Characterization Groundwater Monitoring and Outfall Sampling Events
RP - Portland Site

Method	Analysis	Container	Preservation	Holding Time
EPA 8270C-SIM	Polynuclear Aromatic Hydrocarbons (PAHs)	2 - 1 L Amber Glass Bottles 4 - 1 L Bottles for Lab QC	4°C	7/40 days[1]
EPA 8270C	Semi-Volatile Compounds including Phenols	2 - 1 L Amber Glass Bottles 4 - 1 L Bottles for Lab QC	4°C	28/40 days[1]
EPA 8081A	Organochlorine Pesticides and Low-Level Extraction	3 - 1 L Amber Glass Bottles 4 - 1 L Bottles for Lab QC	4°C	7/40 days[1]
EPA 8151A	Chlorinated Herbicides	2 - 1 L Amber Glass Bottles 4 - 1 L Bottles for Lab QC	4°C	7/40 days[1]
EPA 8290 Groundwater	Dioxins/Furans	2 - 1 L Amber Glass Bottles 4 - 1 L Bottles for Lab QC	4°C	28/40 days[1]
EPA 1613B Outfall Sample	Dioxins/Furans	2 - 1 L Amber Glass Bottles 4 - 1 L Bottles for Lab QC	4°C	28/40 days[1]
EPA 8260B	Volatile Organic Compounds (VOC)[2]	4 - 40 mL Glass Vials 8 - 40 ml Glass Vials for Lab QC	4°C, HCl to pH < 2 (no headspace)	14 days
EPA 6010A/6020 7470A Groundwater	Total Recoverable Metals Total Recoverable Mercury	1 - 500 or 250 mL HDPE	Cool 4°C, HNO3 to pH <2	180 days 28 days
EPA 200.7/200.8 and 1631 Outfall	Total Recoverable Metals Total Recoverable Mercury	1 - 500 or 250 mL HDPE	Cool 4°C, HNO3 to pH <2	180 days 28 days
EPA 6010A/6020 7470A	Dissolved Metals Dissolved Mercury	1 - 500 or 250 mL HDPE	Field Filter, HNO3 to pH <2, Cool, 4°C	180 days 28 days
EPA 310.1	Alkalinity	250 mL HDPE*	4°C	14 days
EPA 300.0	Anions - Chloride, Nitrate, Nitrite, Sulfate, Orthophosphate	1 L HDPE*	4°C	2 days[3] 28 days[4]
EPA 350.3 EPA 376.2	Ammonia, TKN Sulfide	250 mL HDPE** 500 mL HDPE	4°C, H_2SO_4 to pH < 2 4°C, ZnAc and NaOH to pH > 9	28 days 7 days
EPA 415.2	Total Organic Carbon	250 mL HDPE**	4°C, H_2SO_4 to pH < 2	28 days
GC/FID-RSK 175	Methane	4 - 40 mL Glass Vials 6 - 40 mL Glass Vials for Lab QC	4°C, HCl to pH < 2	7 days
EPA 410.4	Chemical Oxygen Demand (COD)	125 mL HDPE**	4°C, H_2SO_4 to pH < 2	28 days
EPA 405.1	Biological Oxygen Demand (BOD)	1 L HDPE	4°C	2 days
NWTPH-DX	Diesel Fuel Quantification	2 - 1 L Amber Glass Bottle 4 - 1 L Bottles for Lab QC	4°C, HCl to pH < 2	14/40 days[1]
SM 9215[5]	Total Heterotrophic Plate Count, Diesel Degrading Bacteria	125 mL plastic Sterile Collection Vessel	4°C, $Na_2S_2O_3$	1 day
USEPA 160.2	Total Suspended Solids (TSS)	1-1 LHDPE	4°C	7 days
USEPA 150.1	pH	1-1 LHDPE	4°C	Immediately

[1] Days to extraction/days to analysis.
[2] To include isobutyl alcohol.
[3] Nitrate, Nitrite, Orthophosphate.
[4] Chloride, Sulfate.
[5] Diesel degrading bacteria are determined using a modified procedure.
* Alkalinity and anions can be run from same container.
** Ammonia, total organic carbon, and COD can be run from same container.

FIGURES

SCOEPA00012626



amec

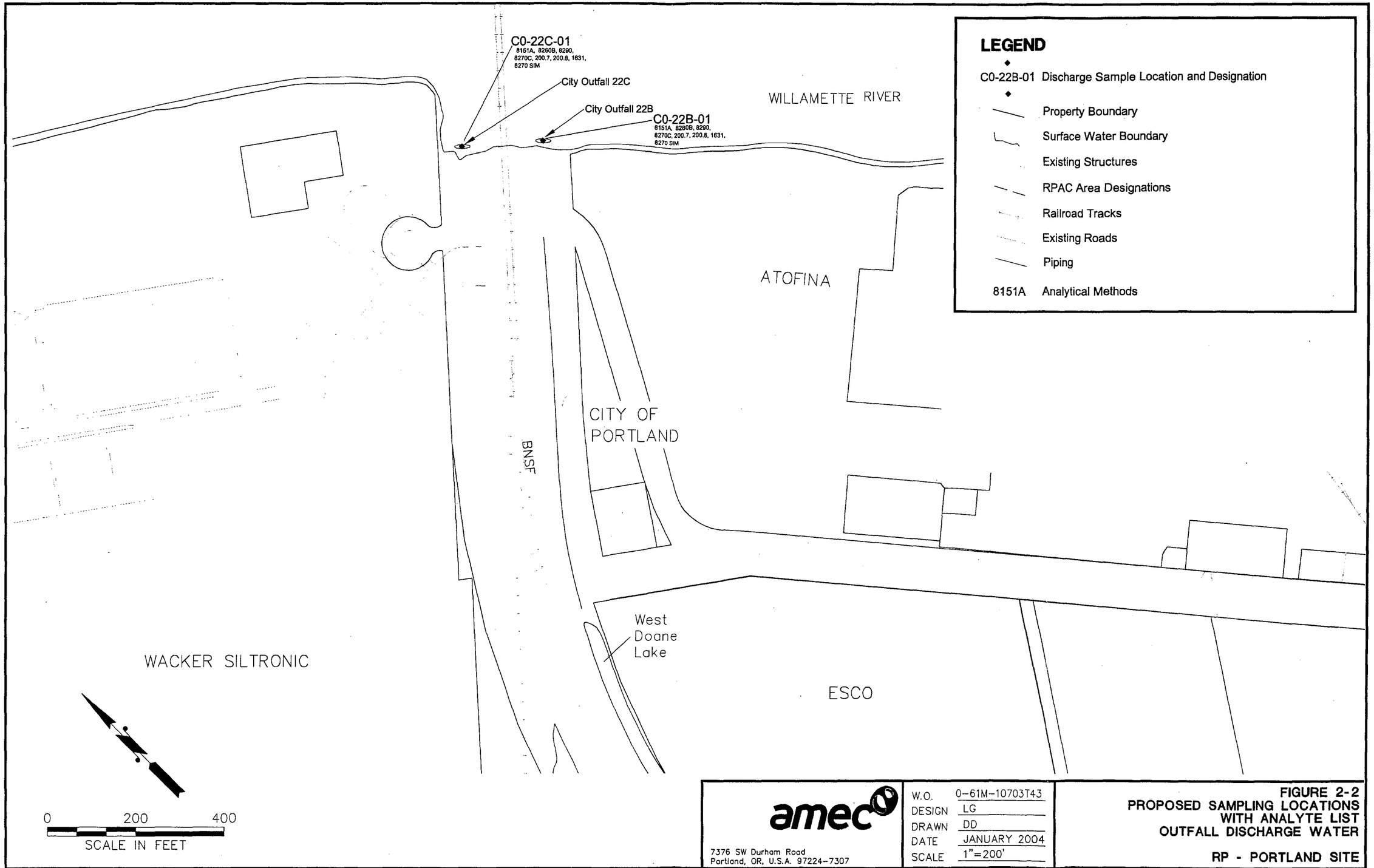
7376 SW Durham Road
Portland, OR, U.S.A. 97224

W.O.	0-61M-107030T43
DESIGN	LG
DRAWN	DD
DATE	JANUARY 2004
SCALE	1"=350'

FIGURE 2-1
PROPOSED POST-CHARACTERIZATION GROUNDWATER SAMPLING AND MEASUREMENT LOCATIONS

RP - PORTLAND SITE

AMEC DRAWING NO. K:\10000\10700\10703\Task 43 Groundwater Monitoring\2002 Spring Event\FSP\FIG_2-1_0104.DWG



amec

7376 SW Durham Road
Portland, OR, U.S.A. 97224-7307

W.O.	0-61M-10703T43
DESIGN	LG
DRAWN	DD
DATE	JANUARY 2004
SCALE	1"=200'

FIGURE 2-2
PROPOSED SAMPLING LOCATIONS WITH ANALYTE LIST OUTFALL DISCHARGE WATER

RP - PORTLAND SITE

AMEC DRAWING NO. K:\10000\10700\10703\Task 43 Groundwater Monitoring\2002 Spring Event\FSP\FIG_2-2_0104.dwg

correspondence
out
make new file
that's billable

APPENDIX A-1

Standard Operating Procedures

SOP - 1: Methodology for Water Level Determination

SOP - 2: Methodology for Groundwater Sampling

SOP - 3: Decontamination Procedure

SOP - 4: Field Measurement of Groundwater Parameters

SOP - 11: Field Parameter Measurement for Outfall Discharge Sampling

SOP - 13: Waste Management Procedures

NOTE: STRANGE
PAGINATION IS
AS IN ORIGINAL

RP - PORTLAND SITE
SOP - 1
METHODOLOGY FOR WATER LEVEL DETERMINATION

1.0 PURPOSE

Depth to water measurements are used to compute groundwater elevations. Water levels may be collected manually with an electronic water level probe or automatically with a pressure transducer and associated datalogger. This standard operating procedure (SOP) is specific to manual water level determination. Manual water level readings are the most common type of water level determination. Generally, this method is used if continuous water level data are not required, and at wells where non-aqueous phase liquid (NAPL) is suspected or present.

2.0 EQUIPMENT LIST

1) Photo-ionization detector (PID) for environmental sites
2) Well lock keys
3) Blank Water Level and NAPL Thickness Measurement Form, other site-specific form, and/or field logbook with indelible pens
4) Electronic water level probe
5) If NAPL is expected, interface probe and check-valve Teflon bailer with new cord
6) Knife or scissors
7) Decontamination equipment (see SOP - 3 Decontamination Procedure and sampling plan for additional site-specific requirements)
8) Site map and site health and safety plan (HASP)
9) PPE appropriate for site (see HASP if applicable)

3.0 PROCEDURE

Depth to groundwater and total well depth measurements will be made with an electronic well sounding (water level) probe. This probe is capable of measuring the depth from the top of the well casing to the nearest 0.01 foot.

1) Measurements are taken from cleanest to most heavily impacted wells, based on historic data where available.
2) Check well for security damage or evidence of tampering and record pertinent observations. Note any maintenance tasks that should be completed, such as well cap or padlock replacement.

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RP - PORTLAND SITE
SOP - 2
METHODOLOGY FOR GROUNDWATER SAMPLING

1.0 PURPOSE

Groundwater samples are collected from monitoring wells for analysis of physical and chemical parameters, either using field observations and portable equipment or using off-Site laboratory analytical methods. Monitoring wells are purged or mircro-purged prior to sample collection to ensure that water sampled is representative of the formation. The procedures in this standard operating procedure (SOP) are specific to standard monitoring wells with a single slotted interval. This method can be used when using bailers, dedicated pumps or portable pumps.

2.0 EQUIPMENT LIST

1) Well lock keys
2) Groundwater Sampling Field Form, other appropriate Site-specific form(s), and field logbook with indelible pens
3) Electronic water level probe or interface probe
4) If dense non-aqueous phase liquid (DNAPL) is potentially present, interface probe and check-valve Teflon® bailer with new cord
5) Knife or scissors
6) Decontamination equipment (see RP SOP - 3 Decontamination Procedure, and sampling plan for additional Site-specific requirements)
7) Site map and Site health and safety plan (HASP), if applicable
8) PPE appropriate for Site (see HASP if applicable)
9) Submersible pump or bailer (for monitoring wells without dedicated pumps), and associated pump equipment (controller, connectors, power cord, etc.)
10) Compressed gas source or generator, air compressor, and fuel (if dual valve pump is used)
11) Disposable discharge tubing, if necessary
12) Field water quality monitoring equipment (see RP SOP - 4 Field Measurement of Groundwater Parameters) and flow-through cell, if appropriate
13) Buckets or other containers for purged water
14) Sample containers, labels, packaging material

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minimum capability of the pump, which should be between 0.1 and 0.4 liters per minute (l/min). Do not allow the water level to fall below the pump intake or the pump may overheat.

7) During well purging, monitor the field parameters every three to five minutes. Purging is considered complete and sampling may begin when the field parameters have stabilized for three consecutive readings (taken at three to five minute intervals). These readings should be within the following limits:

Temperature:	3%
Conductance:	3%
pH:	+/- 0.1 pH units
DO	10% (or measurement <1 milligrams per lliter (mg/L)
ORP	+/- 10 millivolts

8) If after 30 minutes of purging indicator parameters have not stabilized, purging will be discontinued, and sample collection will proceed.

9) The water sample must be collected before the water passes through the flow cell. Disconnect the influent tubing from the flow cell and directly fill the sample containers. Turbidity of the sample water will be measured using field instruments prior to sample collection and upon obvious visual changes in turbidity during sample collection. Groundwater samples for dissolved metals analysis will be field-filtered with a 0.45-micron filter by placing the filter directly on the end of the discharge hose from the submersible or peristaltic pump. Alternatively, water will initially be collected in a poly bottle and then filtered using a peristaltic pump into the bottles that contain preservative. If multiple analytical tests are to be performed, collect samples in order of decreasing sensitivity to handling-introduced bias (i.e., VOCs, semivolatiles, and metals). Water should be directed down the inside walls of the bottles to minimize aeration.

10) All the sample bottles will be properly labeled, protected from breakage, placed in storage bags, and placed in a cooler on ice and packed for transport to the laboratory. Samples will be shipped to the laboratory within 48 hours of collection.

11) Discard the dedicated tubing as Investigation Derived Waste (IDW) after sampling.

12) Before securing the well, measure and record the water level.

13) Decontamination of sampling equipment is addressed in SOP - 3 Decontamination Procedure.

14) All field observations made, and data generated in conjunction with the sample collection, will be entered on a well-specific Groundwater Sampling Field Form (see Appendix B), dated, and signed by the field personnel.

15) Complete the chain-of-custody documentation after samples are collected, and before moving to the next well.

SCOEPA00012634

with a 0.45-micron filter. Water will initially be collected in a poly bottle, and then it will be filtered using a peristaltic pump into the bottles that contain preservative. Alternatively, the filter may be placed directly on the end of the discharge hose from the submersible pump, if used. If the well is purged dry, a sample will be collected as soon as adequate water has returned to the well to make sampling feasible. If multiple analytical tests are to be performed, collect samples in order of decreasing sensitivity to handling-introduced bias (i.e., VOCs, semivolatiles, and metals). A low-turbulence discharge device will be used to elute VOC samples from bailer into sample container. Water should be directed down the inside walls of the bottles to minimize aeration.

9) All the sample bottles will be properly labeled, protected from breakage, placed in storage bags, and placed in a cooler on ice and packed for transport to the laboratory. Samples will be shipped to the laboratory within 48 hours of collection.

10) Discard the dedicated tubing as IDW after sampling.

11) Before securing the well, measure and record the water level.

12) Decontamination of sampling equipment is addressed in SOP - 3 Decontamination Procedure.

13) All field observations made and data generated in conjunction with the sample collection will be entered on a well-specific Groundwater Sampling Field Form, dated, and signed by the field personnel.

14) Complete the chain-of-custody documentation after samples are collected, and before moving to the next well.

Well purge water will be stored in an appropriately labeled poly tank and transported from the generation point to the RP wastewater treatment system for discharge in accordance with the NPDES permit dated September 15, 2003. This will occur on the day of generation. The quantity of water discharged to the RP wastewater treatment system will be recorded on the 90-Day Investigation Derived Waste Log.

SCOEPA00012635

RP - PORTLAND SITE
SOP - 3
DECONTAMINATION PROCEDURE

1.0 PURPOSE

Decontamination of non-disposable equipment is performed at sites where environmental contamination is known or suspected. This is done to minimize the potential for cross-contamination between sampling locations (potentially resulting in unrepresentative samples and/or causing the spread of contamination) and also to protect human health and safety.

2.0 EQUIPMENT LIST

1) Deionized water
2) Plastic buckets
3) Spray bottles
4) Disposable rags or paper towels
5) Alconox, methanol, hexane
6) Potable water (can be replaced by deionized water)
7) Site map and site health and safety plan (HASP)
8) PPE appropriate for site (see HASP if applicable)

3.0 PROCEDURE

Sampling equipment (e.g., water samplers, flow cells, pumps, water level meter, etc.) will be decontaminated as follows:

1) Soap wash (dilute solution of Alconox or equivalent in potable water solution);
2) Potable water rinse;
3) Solvent rinse (methanol, hexane, or similar); and
4) Distilled/deionized water rinse.

If non-aqueous-phase liquid (NAPL) is encountered, probes and sounding tape will be wiped with a solvent-soaked towel during retrieval, and the equipment will be decontaminated with a solvent rinse as described above. For locations with NAPL or suspected NAPL, the sampling equipment used will be washed with hexane prior to the soap wash.

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RP - PORTLAND SITE
SOP - 4
FIELD MEASUREMENT OF GROUNDWATER PARAMETERS

1.0 PURPOSE

Measurements of pH, oxidation-reduction potential (ORP), air and water temperature, conductivity, tubidity, ferrous iron, and dissolved oxygen concentrations will be obtained with calibrated instruments at all sample sites prior to sample collection.

2.0 EQUIPMENT LIST

1) Portable, battery-powered multiprobe equipment (e.g., YSI 650 MDS or YSI 610) with calibration solutions and instructions
2) Ferrous iron field test kit, stocked with reagents
3) Turbidity meter
4) Appropriate field forms for recording readings and/or field logbook with indelible pens
5) Knife or scissors
6) Decontamination equipment (see SOP - 3 Decontamination Procedure and sampling plan for additional site-specific requirements)
7) Site map and site health and safety plan (HASP), if applicable
8) PPE appropriate for site (see HASP if applicable)

3.0 PROCEDURE

Procedures for collection of specific field parameters are provided in the sections below.

Temperature, pH, Specific Conductance, DO, and ORP

Field measurements for temperature, pH, specific conductance, dissolved oxygen (DO), and ORP will be measured with portable, battery-powered instruments (e.g., YSI 650 MDS or YSI 610 D multiprobes). Procedures for calibration and measurements are outlined in the user manuals included with these instruments. At a minimum, these instruments will be calibrated once each day before sampling activities begin.

Turbidity

Turbidity will be measured once per well immediately prior to filling sample bottles, and upon obvious visual changes in turbidity during sample collection. Turbidity will be measured using appropriate portable, battery-powered field equipment and results will

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RP - PORTLAND SITE
SOP - 11
FIELD PARAMETER MEASUREMENT FOR SURFACE WATER AND OUTFALL DISCHARGE SAMPLING

1.0 PURPOSE

Measurements of pH, oxidation-reduction potential (ORP), air and water temperature, conductivity, tubidity, and dissolved oxygen (DO) concentrations will be obtained with calibrated instruments at all sample sites prior to sample collection. At some locations ferrous iron also may be included.

2.0 EQUIPMENT LIST

1) Portable, battery-powered multiprobe equipment (e.g., YSI 650 MDS or YSI 610) with calibration solutions and instructions
2) Turbidity meter
3) Ferrous iron field test kit, stocked with reagents
4) Appropriate field forms for recording readings and/or field logbook with indelible pens
5) Knife or scissors
6) Decontamination equipment (see SOP - 3 Decontamination Procedure and sampling plan for additional site-specific requirements)
7) Site map and site health and safety plan (HASP), if applicable
8) PPE appropriate for site (see HASP if applicable)

3.0 PROCEDURE

Procedures for collection of specific field parameters are provided in the sections below.

Temperature, pH, Specific Conductance, DO, and ORP

Field measurements for temperature, pH, specific conductance, DO, and ORP will be measured with portable, battery-powered instruments (e.g., YSI 650 MDS or YSI 610 D multiprobes). Procedures for calibration and measurements are outlined in the user manuals included with these instruments. At a minimum, these instruments will be calibrated each day before sampling activities begin. If possible, these field parameters will be measured directly by lowering the probe into the water body at the

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RP - PORTLAND SITE
SOP - 13
WASTE MANAGEMENT PROCEDURES

1.0 PURPOSE

To promote proper and consistent handling, storage, and disposal of waste generated during field investigations to prevent or minimize the potential for the spread of contamination, creation of sanitary hazards, or visual degradation of the RP site through the spread of litter.

2.0 EQUIPMENT LIST

1) Site health and safety plan (HASP), including site map
2) Personal Protective Equipment (PPE) appropriate for site (see HASP)
3) 90-Day Investigation Derived Waste Log form (attached)
4) Daily Water Disposal Log form (attached)
5) Field logbook
6) Waste labels
7) Indelible pens
8) Heavy duty plastic sacks
9) Portable water storage tank
10) Department of Transportation (DOT) approved removable head 55-gallon steel drums
11) As appropriate for work involving non-aqueous phase liquid (NAPL), on-site chemical-resistant container with secondary containment (e.g., 30-gallon, Teflon-bonded, hard-top steel drum with volumetric gauge contained with secondary containment and cover, and large dedicated funnel)
12) As appropriate for work involving NAPL, portable chemical-resistant container with secondary containment (e.g., 3-gallon Teflon-bonded steel container within 5-gallon bucket)
13) As appropriate for oversight of waste transport, manifest forms (hazardous and/or non-hazardous)

3.0 PROCEDURES

Wastes generated during field investigations may include decontamination water, PPE, disposable sampling equipment, NAPL, and/or other hazardous and non-hazardous

SCOEPA00012639

Collection, Documentation, and Storage of NAPL or NAPL/Fluid Mixtures

NAPL and NAPL/fluid mixtures generated during field events where NAPL is intentionally removed from wells will be placed in a portable, chemical-resistant container with secondary containment for transportation from the well to the RP waste storage facility. The contents of the portable container will be transferred to a stationary chemical-resistant container with secondary containment by discharging the fluid through a dedicated, industrial-sized funnel with a flip-top reclosable lid to eliminate splashing and spills. Appropriate PPE, consistent with or more protective than that used for NAPL collection, will be worn during transfer of NAPL from the portable container to the stationary container. Transport of NAPL from the collection site and transfer into the stationary container will occur on the day of generation.

The total quantity of NAPL and NAPL/fluid mixture removed, expected to be quarts per well, during each day will be recorded on the 90-Day Investigation Derived Waste Log (attached).

Temporary Container Labelling

All containers of waste generated during field investigations will be labeled with information appropriate for accurate tracking and identification of the containers and their contents. The labels will be waterproof markings or adhesive labels applied on both sides and the lids of each 55-gallon drum or container.

Drums will be labeled with the following information:

RP ACTIVITY (i.e., RI/FS) WASTE TYPE (i.e., Investigation-Derived Waste (IDW))

HOLD FOR ANALYSIS

DATE FIRST ACCUMULATED (example: March 18, 2002)

STATION IDENTIFIER (example: NDL-102-S)

TYPE OF WASTE/MEDIA (example: disposable poly-sleeve/soil)

Each container will be assigned a unique identification number and will be logged onto the 90-Day Investigation Derived Waste Log, attached. Wastes will be categorized and containerized based on media type and waste stream. Following waste determination, these temporary markings will be removed and each container will be labeled with an appropriate hazardous or non-hazardous waste label.

SCOEPA00012640

DAILY WATER DISPOSAL LOG
RI/FS
RP - Portland Site

Date	Area/Location(s)		Type of Waste	Activity Description	Volume Generated/Transferred* (Give Units of Measure)
Example: 4/22/2002	*LA*	*RP-04-16*	*Purge Water*	*Fall 2001 GW*	*15 gallons*

Notes:

LA = Lake Area
IA = Insecticide Area
HA = Herbicide Area
NRA = Non-RP Area

APPENDIX A-2

Forms

Water Level and NAPL Thickness Measurement Form

Groundwater Sampling Field Form

Surface Water and Outfall Sampling Worksheet Form

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(SIC) STRANGE
PAGINATION

Water Level and NAPL Thickness Measurement Form
RP - Portland

Monitoring Well	%LEL		PID (ppm)		Depth to Water Level (TOC-ft)	Observation of LNAPL or Sheen Detected	Depth to LNAPL (TOC-ft)	LNAPL Thickness (ft)	Total Depth (TOC-ft)	Observation of DNAPL	Depth to DNAPL (TOC-ft)	DNAPL Thickness (ft)	Date and Time of Measurement	Recorded by
	Back-ground	In Well Casing	Back-ground	In Well Casing										
AL2-17														
AL2-32														
AL2-46														
AL4-47														
AL5-19														
AL5-35														
AL5-62														
AL6-96														
ASW-01A														
ASW-04														
ASW-05														
ASW-06														
ASW-08														
BST2W-61														
BST5W-74														
BTB-4A-84														
BTB-4B-25														
BTB-4B-55														
KM-MW-2														
KM-MW-5														

Water Level and NAPL Thickness Measurement Form
RP - Portland

Monitoring Well	%LEL		PID (ppm)		Depth to Water Level (TOC-ft)	Observation of LNAPL or Sheen Detected	Depth to LNAPL (TOC-ft)	LNAPL Thickness (ft)	Total Depth (TOC-ft)	Observation of DNAPL	Depth to DNAPL (TOC-ft)	DNAPL Thickness (ft)	Date and Time of Measurement	Recorded by
	Back-ground	In Well Casing	Back-ground	In Well Casing										
MW-07-S														
MW-08-27														
MW-08-46														
MW-08-64														
MW-09-23														
MW-09-42														
MW-09-58														
MW-09-80														
MW-10-24														
MW-10-44														
MW-10-57														
MW-11-24														
MW-11-37														
MW-11-56														
MW-11-79														
MW-12-27														
MW-12-41														
MW-12-59														
MW-12-79														
P-07														
P-10														
P-11														

Water Level and NAPL Thickness Measurement Form
RP - Portland

Monitoring Well	%LEL		PID (ppm)		Depth to Water Level (TOC-ft)	Observation of LNAPL or Sheen Detected	Depth to LNAPL (TOC-ft)	LNAPL Thickness (ft)	Total Depth (TOC-ft)	Observation of DNAPL	Depth to DNAPL (TOC-ft)	DNAPL Thickness (ft)	Date and Time of Measurement	Recorded by
	Back-ground	In Well Casing	Back-ground	In Well Casing										
W-03-D														
W-03-I														
W-03-S														
W-04-89														
W-04-I														
W-04-S														
W-06-D														
W-06-B														
W-06-S														
W-08-26														
W-08														
W-08-74														
W-09														
W-09-86														
W-09-116														
W-10														
W-11-B														
W-11-D														
W-11-I														
W-11-S														
W-12-D														
W-12-I														
W-12-S														

amec	AMEC Earth & Environmental, Inc. GROUNDWATER SAMPLING FIELD FORM	Project Name: Project #: Monitoring/Sampling Date:

Monitoring Well ID:	Field Personnel:	
Start Time:	Weather Conditions:	Approx. Air Temp (F):

INITIAL WELL DATA & WELL PURGING INFORMATION

PID (ppm) Background: In well Casing:	PID Calibration Standard:
%LEL Background: In well Casing:	PID Calibration Date:
Date/Time of Measurement: /	Depth to Water Measuring Technique:
Depth Well Bottom (TOC - ft.):	Detection Method of Free Product:
Depth to Water Level (TOC - ft.):	Conversions Factors (casing dia. = gallons/linear ft.) Circle One
Depth to Free Product (TOC - ft.):	0.75" = 0.02 1" = 0.04 2" = 0.17 3" = 0.37
Calculated Column Height (ft.):	4" = 0.66 6" = 1.47 8" = 2.61 12" = 5.88
Casing Diameter (in.):	Three Well Purge Volumes (gallons) = 3 x _____ = _____
Quantity of Free Product Collected (gal.):	Method of Collecting Free Product:
Obsevation of sheen or LNAPL:	Observation of DNAPL:

Casing Volumes (#)	Volume Purged (liters)	Water Temperature (degree C)	Water pH (S.U.)	Specific Conductivity (ms)	Turbidity (NTUs)	Dissolved Oxygen (mg/L)	ORP (mV)	Time (0:00 - 23:59)

Total Purged =	Purge Pumping Rate (approx. L/m):	Well Yield: High / Moderate / Low
Purge Method (circle one): PVC Bailer / Poly Bailer / SS Bailer / Peristalic Pump / Grunfos Pump / Other =		
Ferrous Iron (ppm):	Decontamination Method:	
Instrument Type & Number:	Water Disposal:	
Instrument Calibration Date & Time:	Approx. Pump/Intake Depth:	

WELL CONDITION

Casing (circle one): Stainless Steel Carbon Steel PVC Other:	
Casing Condition: OK / NA / Needs Repairs / Repaired	Lock Condition: OK / NA / Needs Repairs / Replaced
Cap Condition: OK / NA / Needs Repairs / Repaired	Inner Casing Condition: OK / NA / Needs Repairs / Repaired
Paint Condition: OK / NA / Needs Repairs / Repaired	Monument Condition: OK / NA / Needs Repairs / Repaired
Recommended Well Repairs:	

SAMPLING INFORMATION / DATA

Date Sampled:	QA/QC Sample (circle one): YES / NO	Water Chemistry Sample: YES / NO
Time Sampled:	Sampling Method (circle one): SS Bailer Poly Bailer Grunfos Pump	
Chain-of-Custody #s:	Teflon Bailer Peristaltic Pump Other:	

Sample ID	Bottles (total)	Bottles (size)	Preservative	Destination Laboratory	Sample Transporter	Analytical Parameters

All samples were immediately placed into a cooler and packed with ice or "Blue Ice", unless otherwise noted: YES / NO

Field Observations/Notes of Sampling Event: _____

CERTIFICATION STATEMENT

By signing below, the listed AMEC sampler states that the information provided on this page is accurate.

Sampler (Print): Sampler Signature: Date Signed:

SURFACE WATER AND OUTFALL SAMPLING WORKSHEET

SAMPLE LOCATION: _____ DATE: _____ START TIME: _____
PERSONNEL: _____ WEATHER: _____

OBSERVATIONS/FIELD MEASUREMENTS

MEASUREMENT TYPE	VALUE / UNITS	INSTRUMENT	COMMENTS
AIR TEMP (°C)			
WATER TEMPERATURE (°C)			
SAMPLE DEPTH (TWC)			
pH			
ORP			
CONDUCTIVITY			
TURBIDITY			
FERROUS IRON			
DISSOLVED OXYGEN			
OBSERVATION OF CONTAMINATION			

(TWC=Thickness of Water Column in Feet)

ADDITIONAL COMMENTS/OBSERVATIONS (TOPOGRAPHY, CHANNELIZATION, SURFACE WATER FLOW, DEBRIS. GPS OR SURVEY LOCATION)

_____
_____
_____
_____
_____

SAMPLE COLLECTION

SAMPLE NUMBER: _____ QA/QC SAMPLE NUMBER: _____ SAMPLE TIME: _____

SAMPLE COMMENTS: _____

LABORATORY (1)		COC #	
LABORATORY (2)		COC #	
LABORATORY (3)		COC #	
LABORATORY (4)		COC #	

PARAMETER(S)	PRESERVATION/ SIZE	NUMBER/VOLUME	LABORATORY #	ICED (Y/N)	COMMENTS
Organochlorine Pesticides and low-level extraction by USEPA Method 8081A	2 - 1 L Amber Glass Bottles/ Cool to 4°C				
Volatile Organic Compounds (VOCs) by USEPA Method 8260B	4 – 40 mL Glass Vials/ HCl to pH < 2, Cool to 4°C (no headspace)				
Chlorinated Herbicides by USEPA Method 8151A	2 - 1 L Amber Glass Bottles/ Cool to 4°C				
Semi-Volatile Organic Compounds (SVOCs) including phenols by USEPA Method 8270C	2 – 1 L Amber Glass Bottles/ Cool to 4 °C				
Target Analyte List (TAL) Metals by USEPA Methods 200.7, 200.8, and 1631	1 – 500 or 250 mL HDPE/ HNO_3 to pH < 2, Cool to 4°C				
Dioxins/Furans by USEPA Method 1613B	2 - 1 L Amber Glass Bottles/ Cool to 4°C				
Alkalinity by USEPA Method 310.1	1 L HDPE*/ Cool to 4°C				
Anions (Chloride, Nitrate, Nitrite, Orthophosphate, and Sulfate) by USEPA 300.0					
Total Suspended Solids (TSS) by USEPA Method 160.2					
pH by USEPA Method 150.1					
Hardness by Calculation (Standard Methods for the Examination of Water and Wastewater Method No. SM2340B)	Calculation, based on Metals Analysis	NA	NA	NA	NA

SOP - 3: DECONTAMINATION PROCEDURES FOLLOWED? YES/NO
QA/QC SAMPLE COLI DESCRIBE: _____
CHAIN OF CUSTODY COMPLETED? YES / NO
WASTE DISPOSAL METHOD: _____

SAMPLE METHOD USED: _____
SAMPLE TYPE (IE: Grab, Split, etc.) _____
INSTRUMENT CALIBRATION: (Date/Time) _____
CALIBRATION STANDARD: _____

ADDITIONAL COMMENTS

_____
_____
_____

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DATE: March 10, 2004

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Jordan Schrader
2 Centerpointe Drive, 6th Floor
Lake Oswego, OR 97035

RE: Wacker Siltronic

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December 9, 2003

Mr. Matt McClincy
Department of Environmental Quality
Northwest Region
2020 S.W. Fourth Ave., Suite 400
Portland, Oregon 97201-4987

Dear Mr. McClincy:

Enclosed are five copies of the Phase II Stage 1 & 2 In-River Groundwater and Sediment Investigation report. This report summarizes the Stage 1 work that was conducted from our docks during June of 2002, and the Stage 2 work that was conducted from a barge during February and March of 2003. A copy of this report has been sent directly to Tara Martich at EPA.

If you have any questions, please feel free to contact me at 503-225-7210.

Sincerely,
ATOFINA Chemicals, Inc.

Larry D. Patterson

Larry D. Patterson
Environmental Manager

P:vmon

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ATOFINA

DEC 0 9 2003

PHASE II STAGE 1 & 2 IN-RIVER GROUNDWATER AND SEDIMENT INVESTIGATION

Prepared for

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
COIs	chemicals of interest
CPD	City of Portland datum (benchmark #2529)
DDT	dichlorodiphenyltrichloroethane
DEQ	Oregon Department of Environmental Quality
DGPS	differential global positioning system
DNAPL	dense nonaqueous-phase liquid
DO	dissolved oxygen
Eh	oxidation-reduction potential
EPA	United States Environmental Protection Agency
FSP	field sampling plan
HSP	health and safety plan
ID	inside diameter
MCB	monochlorobenzene
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MPR	manufacturing process residue
mV	millivolts
NAPL	nonaqueous-phase liquid
OD	outside diameter
OVM	organic vapor meter
QAPP	quality assurance project plan
RI	remedial investigation
TLC	thin-layer chromatography
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
VOC	volatile organic compound

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1. INTRODUCTION

This report presents the results of the Phase II Stage 1 and 2 in-river groundwater and sediment investigation offshore of the ATOFINA Chemicals, Inc. (ATOFINA) facility in Portland, Oregon. The Stage 1 investigation was conducted to characterize the nature and extent of chemicals of interest (COIs) in groundwater and sediments that are downgradient of the existing monitoring well network on the upland portion of the site. This work was designed to obtain an understanding of the potential transport and fate of COIs along pathways downgradient of the former Acid Plant, and to use those data as part of the criteria for choosing borehole locations for the Stage 2 investigation. The primary objective of the Phase II Stage 2 investigation was to develop additional information on hydrolithologic units, concentrations of COIs, and potential pathways in affected sediment areas to address source control issues at the site. The combined data from the Phase II Stage 1 and 2 investigations will be used to identify the need for additional source control measures at the site. Ongoing and recently completed remedial activities at the ATOFINA site include the completion of the uplands remedial investigation, the completion of two phases of upland soil removal, and bench- and field-scale pilot studies for the in-situ treatment of monochlorobenzene (MCB), perchlorate, and hexavalent chromium. The results of these ongoing studies will be used along with the data from this report to assess further source control evaluation alternatives.

The Phase II Stage 1 investigation was conducted at the site from June 3-12, 2002. The work was conducted in general accordance with a work plan submitted by ATOFINA to the Oregon Department of Environmental Quality (DEQ) on May 10, 2002 (ATOFINA 2002a), as modified according to DEQ comments and ATOFINA responses in letters dated May 29, 2002 and May 31, 2002, respectively. The preliminary findings of the Stage 1 investigation were reported in an August 23, 2002 letter to DEQ. A total of seven boreholes were advanced during the Stage 1 investigation.

The Phase II Stage 2 investigation was conducted at the site from February 17 through March 10, 2003. The work was conducted in general accordance with a work plan submitted by ATOFINA to DEQ on August 23, 2002 (ATOFINA 2002c) as modified according to letters dated September 20, 2002 (DEQ 2002b), September 24, 2002 (EPA 2002), October 25, 2002 (DEQ 2002c), November 14, 2002 (ATOFINA 2002d), and November 25, 2002 (DEQ 2002d). A total of 18 boreholes were advanced during the Stage 2 investigation.

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2. PHASE II STAGE 1 AND 2 INVESTIGATION RESULTS

A total of seven boreholes were advanced from Docks 1 and 2 during the Stage 1 investigation (Figure 1). The only significant deviation from the work plan was that a groundwater sample was not collected from borehole WB-6. A groundwater sample was not collected from this borehole because of time constraints resulting from the slow hydraulic ram on the modified Geoprobe® unit that was used to advance this borehole. The tool assembly had to be removed from the conductor casing using the hydraulic ram because the Geoprobe® unit was not equipped with a winch.

A total of 18 boreholes were advanced during the Stage 2 investigation within a 400 ft by 1,000 ft area in the vicinity of Docks 1 and 2 (Figure 1). Two of these boreholes (WB-24 and WB-25) were unplanned and were added to the scope of the investigation at the end of the planned field program to further delineate the distribution of COIs on the landward side of the docks. There were no other significant deviations from the work plan.

2.1 FIELD METHODS

The field methods employed during the Stage 1 investigation differed from those used in the Stage 2 investigation and are presented separately below.

2.1.1 Stage 1 Investigation Methods

A total of seven boreholes (WB-1 through WB-7) were advanced using direct-push techniques from Docks 1 and 2. Boreholes WB-1 through WB-5 were advanced using a standard Geoprobe® push-probe rig. Borehole WB-6 was advanced using a smaller Geoprobe® push-probe unit attached to the bed of a standard pick-up truck because of a structural weight-load limitation on that portion of the dock. Borehole WB-7 was advanced on a narrow walkway on Dock 1 using a portable tripod Geoprobe® unit. The field methods described below apply to all three Geoprobe® units employed during the Stage 1 work.

Two sets of conductor casing were set at each borehole location to ensure alignment and advancement of the borehole in its proper location. One conductor casing was used to advance a borehole for sediment sampling; the other conductor casing was used to collect groundwater samples. Sediment samples were collected using a square aluminum sediment sampler (2.5 in. square by 3.5 ft long) for the shallowest interval and Geoprobe® Macrocore samplers (2 in. diameter by 4 ft long) with new acetate liners for each sample interval collected from the deeper sediments.

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Sediments were continuously sampled for lithologic description and field screening. Where possible, sediments were composited over approximate 2-ft intervals and field screened for volatile organic compounds (VOCs) using an organic vapor monitor (OVM), for nonaqueous-phase liquid (NAPL) using Sudan IV® hydrophobic dye, and for dichlorodiphenyltrichloroethane (DDT) using thin-layer chromatography (TLC) methods. If there was sufficient recovery, sediment samples were collected from each 2-ft interval and archived frozen at an analytical laboratory for possible future analysis.

Groundwater samples were collected from one or more discrete intervals at each borehole station (except WB-6, as discussed above) to provide further data on the vertical distribution of MCB and DDT and its metabolites in groundwater. Following termination of the sediment borehole at each location, the Geoprobe® unit was moved over a short distance (1-2 ft) and the second borehole was advanced to collect the groundwater samples. At each borehole, the shallower grab groundwater sample was obtained by advancing the drill bit to the bottom of the first target interval and then retracting the sheath to expose the 4-ft long stainless-steel Geoprobe® screen. Prior to sampling, groundwater and river water levels were measured with an electronic water level meter relative to the dock surface to an accuracy of 0.01 ft. Groundwater and river levels were measured inside and just outside the push-probe rods, respectively, until the readings had stabilized. After sample collection, the tool assembly was removed and decontaminated, and the borehole was advanced to the bottom of the second target interval, if applicable, and the groundwater sampling process was repeated. The target depth for the groundwater samples was determined from the lithologic information collected from the first borehole in each pair and was selected in an attempt to target physically distinct groundwater intervals. Field parameters (i.e., temperature, pH, dissolved oxygen [DO], oxidation-reduction potential [Eh], and specific conductance) were measured during purging. One groundwater sample was collected from each target depth for field screening (OVM headspace monitoring) and for laboratory analysis for VOCs by U. S. Environmental Protection Agency (EPA) Method 8260B and for organochlorine pesticides by EPA Method 8081A. Once the groundwater sampling was completed, the sediment and groundwater boreholes were abandoned with bentonite grout.

The horizontal location and elevation of the top of each Geoprobe® borehole was surveyed to within 0.1 ft and 0.01 ft accuracy, respectively, by a public land surveyor licensed in the state of Oregon. All work was conducted in general accordance with the detailed field and laboratory procedures outlined in the field sampling plan (FSP; Appendix A), the quality assurance project plan (QAPP; Appendix B), and the health and safety plan (HSP; Appendix C) of the Elf Atochem Acid Plant Area Remedial Investigation and Feasibility Study Work Plan (Exponent 1998).

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2.1.2 Stage 2 Investigation Methods

A total of 18 sediment boreholes (WB-8 through WB-25) were advanced using a Geoprobe® push-probe rig mounted on a barge. The barge platform had a moon hole in the approximate center of the barge through which tooling was advanced to collect sediment and groundwater samples. Some boreholes were advanced with the Geoprobe® rig mounted at the back of the barge so the boreholes could be advanced in shallow water and other limited access areas. The barge and Geoprobe® rig were positioned over each target location utilizing a small tugboat or aluminum boat and were guided to the location using a differential global positioning system (DGPS). Once positioned over the target location, the barge spuds were gradually advanced into the sediments to provide a stable drilling platform.

Two sets of conductor casing were set at each borehole location to ensure alignment and advancement of the borehole in its proper location. One conductor casing was used to advance a borehole for sediment sampling; the other conductor casing was used to collect groundwater samples.

Once the conductor casing (5-in. diameter) was set, a combination of square sediment samplers (2-1/2-in. square by 3.5 ft long), split spoon samplers (3-in. diameter by 5 ft long), and Geoprobe® Macrocore samplers with sand catchers (2-in. diameter sampler by 4 ft long) were used to continuously collect the sediment samples for visual examination, logging, and field screening. The shallowest sediment samples were collected using a square aluminum sediment sampler (2.5 in. square by 3.5 ft long). Subsequent samples were collected using the 5 ft long split-spoon sampler. The conductor casing (dual tube casing) and the 5 ft long sampler were advanced with direct-push techniques. The conductor casing was advanced simultaneously with the sampler to each target sampling interval, effectively casing off the previously sampled sediment interval. Upon driving the dual tube system at 5 ft intervals within the sediment, the inner string of sampling equipment was retrieved. The dual tube method was employed until there was insufficient sample recovery or until the pressure required to drive the dual tubes was beyond the capabilities of the push-probe rig (i.e., refusal). At that point, a Geoprobe® Macrocore sampler with new acetate liners for each sample interval was employed to advance the borehole to the target depth (refusal).

Sediments were continuously sampled for lithologic description and field screening. Where possible, sediments were composited over approximate 2 ft intervals and field screened for VOCs using an OVM, for NAPL using Sudan IV® hydrophobic dye, and for DDT using TLC methods. If there was sufficient recovery, sediment samples were collected from each 2 ft interval and selected samples were analyzed for organochlorine pesticides by EPA Method 8081A. The sediment samples that were not analyzed were sent to the analytical laboratory to be archived frozen for possible future analysis.

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Groundwater samples were collected from each Geoprobe® borehole in which ample penetration of the sediments could be achieved (i.e., a minimum of 4 ft), with the exception of borehole WB-24, which was advanced only for the purpose of collecting sediment samples. Groundwater samples were collected from each borehole with the exception of borehole WB-17, where only 2.2 ft of sediment was encountered prior to sampler refusal on basalt. Prior to sampling, groundwater and river water levels were measured with an electronic water level meter relative to the barge deck surface to an accuracy of 0.01 ft. Groundwater and river levels were measured inside and just outside the push-probe rods, respectively, until the readings had stabilized.

The groundwater sampling procedure employed in the Stage 2 boreholes was the same as that used in the Stage 1 boreholes. Each groundwater sample was analyzed for VOCs by EPA Method 8260B, for organochlorine pesticides by EPA Method 8081A, and for perchlorate by EPA Method 314.0. Once the groundwater sampling was completed, the sediment and groundwater boreholes were abandoned with bentonite grout.

The horizontal location of each Geoprobe® borehole was surveyed to within an approximate 1 meter accuracy using a DGPS unit. The elevation of each borehole (i.e., mudline) was measured by using a laser level to determine the elevation of the barge deck relative to arbitrary benchmarks located on platforms beneath Docks 1 and 2. Periodic measurements were made throughout each day to monitor river stage changes. Based on this information, adjustments were made to the sediment and groundwater sample depth intervals to compensate for river stage changes. The elevations of the arbitrary benchmarks on the platforms beneath the docks were measured relative to two permanent onsite monitoring wells using the laser level. The accuracy of the elevations, relative to two existing monitoring wells, is $\pm$ 0.1 ft. Further error may have been introduced to the elevation estimate as a result of the difficulty in assessing the top of the soft mudline in some areas and also because of fluctuations in the river surface from tidal influences. For these reasons, the mudline elevations are assumed to be accurate to $\pm$ 1 ft.

All work was conducted in general accordance with the detailed field and laboratory procedures outlined in the FSP (Appendix A), the QAPP (Appendix B), and the HSP (Appendix C) of the Elf Atochem Acid Plant Area Remedial Investigation and Feasibility Study Work Plan (Exponent 1998).

2.2 HYDROSTRATIGRAPHY

Geoprobe® boreholes WB-1 through WB-25 were advanced during the Phase II Stage 1 and 2 investigations (Figure 1). Borehole logs are presented in Appendix A.

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The total depth of borehole penetration ranged from approximately 2 (WB-17) to 43 (WB-4) ft below mudline (Table 1). Sediments were thickest on the landward side of Docks 1 and 2. The mudline elevation generally decreases eastward, as shown on the bathymetric map (Figure 2). The top of the mudline was encountered at elevations ranging from 7.6 ft City of Portland datum (CPD; corresponds to mean sea level) at borehole WB-1 on Dock 2 to -38.9 ft CPD at borehole WB-22, the eastern-most borehole (Table 1; Figure 2).

The top of the underlying basalt surface was encountered in 20 boreholes at elevations ranging from -14.3 (WB-2) to -43.1 (WB-21) ft CPD (Table 1). The basalt surface generally slopes to the east (Figure 3). There is an apparent high spot (i.e., mound) on the basalt surface around borehole WB-2. There are also two apparent troughs in the basalt surface. One trough is centered on Dock 1 and the other is just south of Dock 2, near borehole WB-14. The troughs may be erosional features produced by streams that previously flowed into the ancestral Willamette River at these locations.

Cross-sections in the vicinity of the Phase II boreholes are presented in Figures 4a through 9b. The sediments above the basalt become finer-grained and sand horizons are of more limited vertical extent farther from the shoreline (Figures 5a and 9a). The sediment thickness also thins away from the shoreline (in an eastward direction). The increased thickness of sediments on the landward side of the docks is likely a result of increased deposition because of the sheltering effect of the docks. In general, the sediments observed during the Phase II investigation represent a fining upward sequence (i.e., coarser sediments at the bottom and finer sediments at the top of the sequence) and become thinner toward the east.

Thin (i.e., less than 1 ft thick) sand and silt layers were observed in a number of the boreholes and are shown on the cross-sections. Based on the available data, many of these layers appear to be discontinuous. Some of these layers appear to dip to the east, consistent with the slope of the basalt surface. As discussed in Section 3, some of these horizons may be important controls on the migration pathways of COIs.

2.3 SEDIMENT RESULTS

Sediment sampling was attempted continuously in each borehole and sample recovery ranged from excellent (100 percent) to poor (0 percent), but generally was good to excellent. Sediment samples were screened for VOCs with an OVM and via obvious odor, for NAPL using hydrophobic dye and visual observations, and for DDT by TLC. None of the Stage 1 sediment samples was analyzed for pesticides. Selected sediment samples from the Stage 2 boreholes were submitted to a laboratory for analysis of organochlorine pesticides by EPA Method 8081A. The remaining sediment samples from the Phase II investigation were archived at the laboratory for possible future analysis.

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2.3.1 VOC Field Screening

Field screening results for VOCs are presented in Table 2. The OVM used to screen the Phase II sediment samples for VOCs was calibrated with an isobutylene calibration standard; therefore, the reported OVM measurements are indicators of relative VOC concentrations but not specifically MCB concentrations.

OVM measurements were generally at background or low levels (i.e., less than 100 ppm) except in boreholes WB-5, WB-6, WB-10, WB-11, and WB-24. In borehole WB-5, the highest OVM measurement of 280 ppm was recorded at an elevation of -23.5 to -25.5 ft CPD. The highest OVM measurements in borehole WB-6 were 3,000 and 1,400 ppm at elevations of -22.4 to -24.4 ft and -28.4 to -30.4 ft CPD, respectively. In borehole WB-10, the highest OVM measurements of 120 ppm, 2,300 ppm, and 270 ppm were recorded at elevations of -18.0 to -19.0, -19.0 to -21.0 ft, and 21.0 to -23.0 ft CPD, respectively. The OVM readings throughout the remainder of boreholes WB-6 and WB-10 were at low or background levels. The highest OVM measurements in borehole WB-11 were 110 ppm and 1,200 ppm at elevations of -10.6 to -14.6 ft and -14.6 to -16.6 ft CPD, respectively. The OVM readings throughout the remainder of the WB-11 borehole were at low levels. In borehole WB-24, the highest OVM measurements were 320 ppm and 340 ppm at elevations of -10.0 to -12.0 and -12.0 to -14.0 ft CPD, respectively. The OVM readings were at low levels below these intervals; however, sediment samples were not collected above an elevation of -10.0 ft CPD (the mudline elevation was approximately 0.5 ft CPD). The OVM readings were generally consistent with organic odors noted by field personnel during the Phase II investigation.

The only sediment sample in the Stage 1 and 2 investigations exhibiting a positive response to the Sudan IV® field screening for NAPL was the sediment sample collected at an elevation of -12.5 to -14.4 ft CPD from borehole WB-6. However, this response may have been attributable to petroleum hydrocarbons rather than MCB, based on visual evidence and low OVM measurements. Residual NAPL of an uncertain origin was observed by visual inspection of the sample in borehole WB-6 collected at an elevation of -22.4 to -24.4 ft CPD. Residual NAPL was not detected with the Sudan IV® field screening of this sample, although there was limited sample available for screening. An approximate 0.1 ft thickness of sediment with visual evidence of residual NAPL characteristic of DDT manufacturing process residue (MPR) was observed in this sample interval, which also exhibited a high OVM measurement (3,000 mg/kg).

2.3.2 DDT Field Screening and Analytical Results

Each sediment sample collected from the Stage 1 and 2 investigations was screened for DDT by TLC. Field screening and analytical results for DDT are presented in Table 2.

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Profiles of DDT concentrations in sediments are shown in Figure 10. Laboratory reports are presented in Appendix B.

2.3.2.1 Stage 1 and 2 Field Screening Results

None of the TLC DDT results exceeded 250 mg/kg in the Stage 1 boreholes. A horizon with elevated DDT concentrations was identified using TLC screening in boreholes WB-1, WB-3, and WB-4 at 4-8 ft below mudline (-10.3 to 3.6 ft CPD). The highest DDT concentration by TLC (250 mg/kg) was measured in borehole WB-5 at 1.8 to 3.8 ft below mudline (-14.0 to -16.0 ft CPD). No DDT was detected above 50 mg/kg in boreholes WB-2, WB-6, and WB-7.

In the Stage 2 boreholes, TLC DDT results exceeded 50 mg/kg in WB-8, WB-9, WB-10, WB-24, and WB-25. These boreholes are all located to the landward side of Dock 1. The higher concentrations of DDT (i.e., at or above 200 mg/kg) were observed in boreholes WB-9, WB-10, WB-24, and WB-25 at depths ranging from approximately 7 to 17 ft below mudline (-3 to -17 ft CPD). Selected sediment samples from the Stage 2 investigation were analyzed for pesticides and the results are presented in the following section.

2.3.2.2 Stage 2 Analytical Results

The DDT sediment concentrations are presented in Table 3 and in Figures 11 and 12 for surface and deeper sediments, respectively. Figure 12 also presents the data collected from the OSS shallow sediment samples in 1999 (Exponent 1999). Profiles of DDT concentrations in sediments are shown in Figure 10. In general, there is a reasonable correlation between the TLC and laboratory analyses for DDT, given the limitations with TLC methods (i.e., detection limit of 50 mg/kg and maximum detectable concentration of 500 mg/kg).

All surface sediment samples from the Stage 2 investigation were analyzed for DDT by EPA Method 8081A, except the samples collected from boreholes WB-22, WB-23, and WB-24. The surface sediment sample intervals varied based on recovery from 1.4 to 4.3 ft below mudline (if recovery was poor, the sample was composited over a larger interval). DDT concentrations greater than 1,000 μg/kg in surface sediments are generally confined to the landward side of the docks, except for the sample collected from borehole WB-17 (6,100 μg/kg). The highest DDT concentrations are found in the vicinity of Dock 1 and at the south end of Dock 2 (specifically borehole WB-13). Surface sediment DDT concentrations generally decrease to the east beyond the docks.

The highest DDT concentrations (i.e., greater than 100,000 μg/kg) in subsurface sediments were generally found 7 to 14.5 feet below mudline (elevations ranging from -4 to -17 ft CPD). These higher DDT concentrations were all found on the landward side of Dock 1

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(boreholes WB-8, WB-9, WB-11, and WB-24). The highest DDT concentration (4,500,000 μg/kg) was found in borehole WB-9 at 8.0 to 10.0 ft below mudline (-2.9 to -4.9 ft CPD). Other DDT concentrations greater than 1,000 μg/kg were found in boreholes WB-10 (15,000 μg/kg and 19,000 μg/kg at 7.0 to 9.0 ft [-11.0 to -13.0 ft CPD] and 15.0 to 17.0 ft [-19.0 to -21.0 ft CPD] below mudline, respectively) and WB-18 (17,000 μg/kg from 6.0 to 8.0 ft below mudline [-4.5 to -6.5 ft CPD]). DDT concentrations were below 1,000 μg/kg in deeper sediments collected from boreholes WB-12, WB-13, WB-14, WB-15, WB-16, WB-17, WB-19, WB-20, WB-21, WB-22, WB-23, and WB-25.

2.4 GROUNDWATER RESULTS

Groundwater grab samples were collected at one or more depth intervals within each borehole, with the exception of boreholes WB-6 (groundwater sample in this area was collected from adjacent borehole WB-10), WB-17 (insufficient sediment thickness), and WB-24 (added to investigation as a sediment borehole only). Each groundwater sample was analyzed for VOCs by EPA Method 8260B, and for organochlorine pesticides by EPA Method 8081A. Selected groundwater samples were analyzed for conventional parameters (i.e., cations and anions). Stage 2 groundwater samples were also analyzed for perchlorate by EPA Method 314.0.

Relative surface water and groundwater level measurements were collected at each screened interval prior to groundwater sample collection (Table 1). The results of these measurements indicate that the potentiometric surface of groundwater in sediments is generally higher than the river level (typical head difference ranged between 0.1 and 1.0 ft). Some of the measurements, however, indicated a potentiometric surface of groundwater in sediments lower than the river level. The surface water potentiometric surface differences should be interpreted with caution because the groundwater levels were measured from temporary monitoring points and water levels may not represent a static equilibrated groundwater surface.

Groundwater field parameter results are presented in Table 4. Groundwater with the highest specific conductance was found in boreholes WB-4, WB-5, WB-8, WB-9, WB-10, WB-12, and WB-23, which are generally located downgradient of the salt pads on the southern portion of the ATOFINA facility. The pH values in groundwater ranged from acidic (5.25 in WB-7) to slightly alkaline (7.67 in the shallow interval from WB-3). Temperatures ranged from 5.15 (deep interval collected from WB-18) to 26.2 (deep interval from WB-5) degrees Celsius. The generally higher temperature of the Stage 1 groundwater samples may be attributable to warmer ambient air conditions during this portion of the investigation. Dissolved oxygen ranged from 0.760 (deep interval from WB-23) to 13.1 (deep interval from WB-4) mg/L and redox potential ranged from -166

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millivolts (mV) (deep interval from WB-4) to 271 mV (deep interval from WB-10). Dissolved oxygen concentrations were generally lower in the deeper intervals.

Conventional parameter analytical results (Table 4) indicate that groundwater samples collected from the Stage 1 and 2 boreholes have higher cation and anion concentrations than the water sample collected from the Willamette River, confirming that groundwater in sediments beneath the river has a chemical signature that is distinct from Willamette River water. Elevated sodium and chloride concentrations were detected in groundwater samples collected from boreholes WB-9 and WB-10, which are located downgradient of the salt pads on the southern portion of the ATOFINA facility. This finding is consistent with high specific conductance measurements collected from boreholes in this area.

2.4.1 MCB and DDT

Groundwater sample analytical results for MCB and DDT are summarized in Tables 5 and 6, respectively, and are posted in Figures 13 and 14, respectively. The MCB and DDT concentrations in groundwater are also posted on the cross-sections (Figures 4a through 9b). A groundwater sample was not collected from WB-6; however, groundwater samples were collected from adjacent borehole WB-10, which generally represents the groundwater quality in this area.

The correlation between MCB and DDT concentrations in groundwater is generally good (compare Figures 13 and 14). The highest concentration of MCB in groundwater (64,000 μg/L) was detected in borehole WB-10 at a screened interval elevation of -18.0 to -22.0 CPD. This interval also had the highest DDT groundwater concentration (1,900 μg/L). The higher concentrations of MCB and DDT (greater than 1,000 μg/L and 10 μg/L, respectively) were confined to the landward side of Docks 1 and 2. The MCB and DDT concentrations outside of the docks were substantially lower than those on the landward side of the docks. MCB and DDT concentrations were lower than 250 μg/L and 2.5 μg/L, respectively, in all groundwater samples collected outside Docks 1 and 2.

2.4.2 Perchlorate

Groundwater samples collected from the Stage 2 boreholes were analyzed for perchlorate (Table 7 and Figure 15). Perchlorate was detected in groundwater samples collected from six boreholes in two general areas. The highest perchlorate concentrations were observed in the deeper sample intervals in the vicinity of the southern portion of Dock 1. In this area, perchlorate was detected in groundwater samples collected from boreholes WB-8, WB-12, and WB-23. The highest perchlorate concentration was detected in borehole WB-23 at 370,000 μg/L (screened interval elevation of -27.8 to -31.8 ft CPD). The highest concentrations in boreholes WB-8 and WB-23 were detected in the deep groundwater sample intervals.

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Perchlorate was also detected at low concentrations (below 250 μg/L) in groundwater samples collected from boreholes WB-16, WB-18, and WB-20 in the vicinity of Dock 2.

2.5 QUALITY ASSURANCE/QUALITY CONTROL

The data validation reports summarize the results of the data quality review conducted for this investigation. Data validation qualifiers were assigned to selected results, as required by Functional Guidelines (US EPA 1994, 1999), because of exceedances of project or laboratory quality control criteria. Selected results were qualified as undetected (assigned a *U* qualifier) because of the detection of target analytes in associated laboratory or field blanks. Selected results were qualified as estimated (assigned a *J* qualifier) because of the exceedance of laboratory control limits for matrix spike results, surrogate recoveries, calibration verification, and other laboratory quality control samples. Selected results were rejected (assigned an *R* qualifier) because of quality control exceedances for instrument calibration. The data validation reports provide a summary of the qualifiers assigned and the rationale for the assignment of each data validation qualifier. The data validation reports for the Phase II data have been submitted to DEQ separately.

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3. ANALYSIS OF PHASE II RESULTS

The following section presents an analysis of the Phase II Stage 1 and 2 investigation results in relation to the soil and groundwater results from the upland remedial investigation. Shallow sediment data collected in January 1999 (Exponent 1999) are included in the analysis because they provide additional data between the Phase II boreholes.

3.1 POTENTIAL SOURCES AND TRANSPORT PATHWAYS

This section discusses the potential sources and transport pathways that are inferred from the analysis of the upland groundwater and soil data and Phase II investigation groundwater and sediment data.

3.1.1 MCB in Groundwater

The highest MCB concentrations in sediment groundwater are located east and southeast of the former Acid Plant area, in an area generally confined to the landward side of Docks 1 and 2 (Figure 11). The MCB sediment groundwater concentrations are generally consistent with concentrations of MCB in upland groundwater immediately downgradient from the Acid Plant. The MCB concentrations in monitoring wells MWA-9i, MWA-10i, and MWA-17si are all of the same order-of-magnitude as the highest concentration measured in borehole WB-10 during the Phase II investigation.

Based on data from the upland groundwater monitoring well network, the groundwater gradients and groundwater flow directions in both the shallow and intermediate groundwater zones are generally along a line from the Acid Plant toward Dock 2. Even though the MCB plume extends in that direction in the nearshore sediments, higher concentrations of MCB were measured in sediment groundwater south and east of the Acid Plant area (Figure 11). The highest MCB concentration detected in sediment groundwater (64,000 μg/L) during the Phase II investigation was found in borehole WB-10 (adjacent to WB-6 on Dock 1) at a screened interval elevation of -18.0 to -22.0 ft CPD. In addition, residual NAPL was observed at only one location, borehole WB-6 at -24.3 to -24.4 ft CPD, near borehole WB-10.

These data suggest that MCB has been transported in groundwater from the Acid Plant area into the nearshore sediments adjacent to the Acid Plant area of the ATOFINA Portland Plant. Furthermore, the highest MCB concentrations in sediment groundwater appear to be related to stratigraphically controlled flow of historical discharges of MPR fluids into the former MPR pond and trench in the form of a dense non-aqueous phase

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liquid (DNAPL). The DNAPL fluids likely migrated along more permeable sand beds within the finer-grained and less permeable sediments that slope to the southeast and generally emulate the slope of the basalt surface in the nearshore area.

3.1.2 DDT in Groundwater

There is a close correlation between MCB and DDT concentrations in groundwater both in the upland areas and in sediments (Figures 11 and 14). In selected samples, DDT concentrations in sediment groundwater are up to two orders-of-magnitude more than the aqueous solubility of DDT. Note, however, that because the groundwater samples were collected using the Geoprobe® temporary well screen that the introduction of fine suspended particulate matter could add a high-bias to the measured groundwater DDT concentrations. In general, the areas with exceedances of the aqueous solubility of DDT are collocated with areas of higher MCB concentrations, indicating a likely cosolvent relationship between DDT and MCB. The highest DDT concentration in sediment groundwater (1,900 μg/L) was measured at WB-10 at -18.0 to -22.0 ft CPD.

These data suggest that groundwater DDT concentrations generally covary with MCB concentrations because of the cosolvent relationship between MCB and DDT.

3.1.3 Perchlorate in Groundwater

The highest perchlorate concentrations in sediment groundwater are measured in boreholes immediately south and east of Dock 1 (Figure 15). The highest perchlorate groundwater concentrations (on the order of 160,000 to 370,000 μg/L) were measured in boreholes WB-12 (screened interval elevation of -37.9 to -41.9 ft CPD) and WB-23 (screened interval elevation of -27.8 to -31.8 ft CPD). Perchlorate was detected at 3,800 μg/L in borehole WB-8 at a screened interval elevation of -30.9 to -34.9 ft CPD. Lower concentrations of perchlorate were also detected in groundwater from boreholes WB-16, WB-18, and WB-20 in the vicinity of Dock 2.

Perchlorate concentrations in sediment groundwater are consistent with perchlorate measured in groundwater samples from upland monitoring wells. The highest concentrations of perchlorate are found in shallow groundwater zone monitoring wells in the Chlorate area (Figure 15). Perchlorate concentrations in groundwater from monitoring wells MWA-25 and MWA-27 range from 200,000 to 300,000 μg/L. Perchlorate concentrations attenuate 2 to 3 orders-of-magnitude in a hydraulically downgradient direction in the shallow groundwater zone. The highest perchlorate concentration in the intermediate groundwater zone is found in well MWA-32i (on the order of 200,000 μg/L), located immediately adjacent to well MWA-30 (on the order of 10,000 μg/L).

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These data suggest that perchlorate is being transported from the Chlorate area downgradient to deeper groundwater intervals in the nearshore sediment area around Dock 1.

3.1.4 DDT in Sediments

DDT concentrations greater than 1,000 μg/kg in surface sediments are generally confined to the landward side of Docks 1 and 2 (except for an area just east of Dock 2; Figure 12). The highest DDT concentrations are found in the vicinity of Dock 1 (at WB-8) and in the southern portion of Dock 2 (near WB-13). DDT concentrations generally decrease to the east beyond the docks (Figure 12). The highest DDT concentration measured in surface sediments during the Phase II investigation was 34,000 μg/kg in the 0 to 4.3 ft surface interval at WB-8. The highest surface sediment DDT concentration measured during the 1999 RI sampling was 81,000 μg/kg at OSS002, which is located on the landward side of Dock 2.

The highest concentrations of DDT in deeper sediments are found on the landward side of Dock 1 in the vicinity of borehole WB-9 (Figure 13). The highest concentration of DDT in subsurface sediment is 4,500,000 μg/kg at 8 to 10 ft below mudline at WB-9. The DDT concentration in the shallowest interval (0 to 4 ft below mudline) from the same borehole was over two orders of magnitude lower (12,000 μg/kg). DDT concentrations of 3,500,000 μg/kg and 920,000 μg/kg were measured in WB-24 (10.6 to 12.6 ft below mudline) and WB-8 (6.8 to 9.3 ft below mudline), respectively.

These data suggest that the highest DDT concentrations in subsurface sediments are most likely the result of historical discharges from a temporary MPR discharge pipe that was located along the shoreline in the vicinity of borehole WB-9. DDT discharged from that pipe may have been deposited on the sediment surface and then buried by subsequent sediment deposition. Although there are no bathymetric data available from the time that discharge occurred, there is reason to believe that considerable sediment deposition may have occurred in this area. The shoreline inshore of the area between Docks 1 and 2 has been extended out into the river with fill during the intervening years, and some shoaling may have occurred in the vicinity of the boreholes with high subsurface DDT concentrations. The presence of the docks may tend to shelter this area, allowing greater deposition and accumulation of suspended river sediments. The hypothesized source of these high DDT concentrations in sediments well below the present mudline is further supported by the fact that the elevated DDT sediment concentrations in this area are not associated with elevated MCB concentrations in groundwater, indicating that they are not related to the transport of DDT in groundwater and are not related to the MCB groundwater plume emanating from the former Acid Plant area of the site.

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3.2 DATA USABILITY FOR SOURCE CONTROL EVALUATION

This section summarizes the usability of the existing data set with respect to evaluation of potential source control measures at the site.

3.2.1 MCB and DDT in Groundwater

The existing MCB and DDT groundwater data are sufficient to evaluate source control measures in nearshore sediments. The existing data indicate that MCB and DDT in sediment groundwater are likely associated with the advective movement of MCB and DDT in groundwater from the uplands Acid Plant area of the site. Some of the areas with higher MCB and DDT concentrations may be related to the historical migration of MCB in the MPR from the former MPR pond and trench.

3.2.2 Perchlorate in Groundwater

The perchlorate concentrations in sediment groundwater in the vicinity of Dock 1 are consistent with perchlorate concentrations measured in shallow and intermediate groundwater on the upland portion of the site. The existing data indicate that perchlorate in sediment groundwater is likely associated with the advective movement of perchlorate in groundwater from the uplands Chlorate area.

3.2.3 MCB in Sediments

The existing MCB sediment data adequately characterize the sediments for potential source control measures appropriate for the site. The only visual evidence of residual NAPL characteristic of DDT MPR was from a very thin zone (0.1 ft thickness) in borehole WB-6. Although the sediment from the interval containing that thin zone did not yield a positive response in the Sudan IV® field screening for NAPL, there was limited sample available for screening. That sample interval did, however, have a high OVM measurement (3,000 ppm). MCB was found only in the dissolved phase in groundwater in the remainder of the Phase II boreholes.

MCB that is derived from residual NAPL beneath the MPR pond has been well characterized in upland soils in the former Acid Plant area and enough data are available to evaluate potential source control measures.

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4. SUMMARY AND CONCLUSIONS

The results of the Phase II Investigation indicate that sediments and groundwater in the vicinity of Docks 1 and 2 have been affected by the migration of MCB, DDT, and perchlorate via historical MPR discharges or by groundwater migration. Sediments in the nearshore area are primarily fine-grained silts and clays with minor sand horizons. The sediments are underlain by basalt bedrock at depths of greater than 40 ft below mudline nearshore to less than 3 ft below mudline toward the river channel. The top of the underlying basalt surface generally slopes to the east. Thin sand beds are sometimes present and apparently dip to the east and may control the migration of COIs in groundwater in some locations.

Concentrations of MCB and DDT greater than 1,000 μg/L and 10 μg/L, respectively, in sediment groundwater are confined to the landward side of Docks 1 and 2. The MCB and DDT concentrations outside of the docks were substantially lower than those on the landward side of the docks. In groundwater samples collected outside Docks 1 and 2, MCB and DDT concentrations were all lower than 250 μg/L and 2.5 μg/L, respectively. The correlation between MCB and DDT concentrations in sediment groundwater is generally good, indicating a likely cosolvent relationship between these constituents. MCB and DDT in sediment groundwater are likely associated with the advective movement of MCB and DDT in groundwater from the uplands Acid Plant area of the site; however, in some areas MCB and DDT concentrations may also be from the dissolution of MCB that historically migrated from the former MPR pond and trench into the nearshore sediments. The existing MCB and DDT groundwater data are sufficient for evaluating potential source control measures.

Perchlorate concentrations greater than 1,000 μg/L were found in sediment groundwater in the vicinity of the southern portion of Dock 1. The existing data indicate that perchlorate in sediment groundwater is likely associated with the advective movement of perchlorate from the uplands Chlorate area.

In surface sediments, DDT concentrations greater than 1,000 μg/kg in surface sediments are generally confined to the landward side of the docks. The highest DDT concentrations are found in the vicinity of Dock 1 (at borehole WB-8) and inshore of the south end of Dock 2 (near borehole WB-13). DDT concentrations generally decrease to the east beyond the docks. The highest DDT concentrations (i.e., greater than 100,000 μg/kg) were found in deeper sediments from 7 to 14.5 feet below mudline on the landward side of Dock 1. The areas of highest sediment DDT concentrations appear to be associated with temporary MPR discharges from a pipe that was located along the shoreline in the vicinity of borehole WB-9. The bulk of the buried DDT mass appears to be associated

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with discharges that occurred for a brief period of time more than 50 years ago. A very small portion of the DDT sediment mass may be associated with the ongoing cosolvent migration of MCB and DDT (as summarized above). The existing data set adequately characterizes the DDT in surface and subsurface sediments for the purpose of evaluating potential source control measures that may be appropriate for the area between Docks 1 and 2.

Ongoing and recently completed remedial activities at the ATOFINA site include the completion of the uplands remedial investigation, the completion of two phases of upland soil removal, and bench- and field-scale pilot studies for the in-situ treatment of MCB, perchlorate, and hexavalent chromium. The results of these ongoing studies will be used along with the data from this report to assess further source control evaluation alternatives.

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Tables

Table 1. Station coordinates and borehole elevation data for the Stage 1 and 2 boreholes

										Shallow Groundwater Sample Interval			
Borehole I.D.	Start Date	Latitude	Longitude	Barge Deck or Dock Elevation (ft)	Mudline Elevation (ft)	Basalt Elevation (ft)	Sediment Thickness (ft)	Upper Elevation (ft)	Lower Elevation (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Ground-water elevation (ft)	River elevation (ft)
WB-1	6/3/02	45° 34' 19.4"	122° 44' 37.36"	36.6	7.6	-19.4	27.0	3.6	-0.4	4.0	8.0	12.1	11.8
WB-2	6/4/02	45° 34' 19.6"	122° 44' 36.9"	36.7	3.4	-14.3	17.7	-0.3	-4.3	3.7	7.7	12.3	12.2
WB-3	6/5/02	45° 34' 20"	122° 44' 36.5"	36.7	-2.3	-17.8	15.5	-5.3	-9.3	3.0	7.0	12.9	12.7
WB-4	6/6/02	45° 34' 14.9"	122° 44' 30.48"	36.3	6.6	-36.2	42.8	2.3	-1.7	4.3	8.3	12.5	12.5
WB-5	6/11/02	45° 34' 15.7"	122° 44' 29.8"	36.5	-12.2	-33.7	21.5	-17.5	-21.5	5.3	9.3	12.0	11.5
WB-6	6/7/02	45° 34' 16.5"	122° 44' 30.7"	36.6	-12.5	--	--	--	--	--	--	--	--
WB-7	6/11/02	45° 34' 17.46"	122° 44' 31.82"	37.1	-13.1	--	--	-23.9	-27.9	10.8	14.8	13.0	12.7
WB-8	2/28/03	45° 34' 15.72313"	122° 44' 30.91913"	8.6	2.9	-34.9	37.8	-7.4	-11.4	10.3	14.3	8.6	7.4
WB-9	3/4/03	45° 34' 16.01279"	122° 44' 32.21358"	10.1	5.1	-29.7	34.8	-9.9	-13.9	15.0	19.0	9.6	8.3
WB-10	3/5/03	45° 34' 16.33975"	122° 44' 31.04529"	10.0	-4.0	-32.2	28.2	-18.0	-22.0	14.0	18.0	10.1	8.8
WB-11	3/6/03	45° 34' 17.40241"	122° 44' 32.92170"	9.4	-2.1	-24.2	22.1	-13.6	-17.6	11.5	15.5	7.6	8.2
WB-12	2/19/03	45° 34' 15.80398"	122° 44' 28.21504"	10.1	-32.9	--	--	-37.9	-41.9	5.0	9.0	8.6	7.7
WB-13	2/26/03	45° 34' 18.50116"	122° 44' 35.07325"	8.8	0.8	-19.8	20.6	-4.2	-8.2	5.0	9.0	7.8	7.6
WB-14	2/27/03	45° 34' 18.90736"	122° 44' 34.52794"	8.5	-6.5	-28.5	22.0	-10.5	-14.5	4.0	8.0	7.5	7.2
WB-15	2/17/03	45° 34' 17.465"	122° 44' 30.036"	8.5	-35.5	-41.0	5.5	-36.8	-40.8	1.3	5.3	3.7 [b]	2.5 [b]
WB-16	2/19/03	45° 34' 19.05831"	122° 44' 32.77159"	11.5	-27.1	-31.9	4.8	-30.5	-31.5	3.4	4.4	10.9	9.0
WB-17	2/27/03	45° 34' 20.13637"	122° 44' 34.18409"	8.8	-25.2	-27.3	2.1	--	--	--	--	--	--
WB-18	2/25/03	45° 34' 21.21688"	122° 44' 38.47890"	9.5	1.5	-20.1	21.6	-3.5	-7.5	5.0	9.0	8.9	8.2
WB-19	2/24/03	45° 34' 21.36651"	122° 44' 35.97411"	9.9	-24.2	-28.2	4.0	-27.1	-28.1	2.9	3.9	10.3	7.4
WB-20	2/24/03	45° 34' 20.80447"	122° 44' 33.03850"	9.6	-36.9	-41.4	4.5	-39.4	-41.4	2.5	4.5	8.1	7.2
WB-21	2/20/03	45° 34' 18.09158"	122° 44' 29.44381"	10.3	-34.9	-43.1	8.2	-39.2	-43.2	4.3	8.3	9.2	8.0
WB-22	2/21/03	45° 34' 20.31419"	122° 44' 30.04633"	11.6	-38.9	--	--	-42.4	-46.4	3.5	7.5	9.9	9.2
WB-23	2/18/03	45° 34' 14.41471"	122° 44' 28.14914"	10.2	-11.2	-31.8	20.6	-14.8	-18.8	3.6	7.6	8.0	7.8
WB-24	3/7/03	45° 34' 16.70581"	122° 44' 32.59989"	10.0	0.6	--	--	--	--	--	--	--	--
WB-25	3/7/03	45° 34' 18.15890"	122° 44' 33.56621"	9.9	-4.4	-25.7	21.3	-16.1	-20.1	11.7	15.7	8.7	8.7

Table 1 (con't)

	Deep Groundwater Sample Interval						Additional Groundwater Sample Interval					
Borehole I.D.	Upper Elevation (ft)	Lower Elevation (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Ground-water elevation (ft)	River elevation (ft)	Upper Elevation (ft)	Lower Elevation (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Ground-water elevation (ft)	River elevation (ft)
WB-1	-11.4	-15.4	19.0	23.0	11.9	11.8	--	--	--	--	--	--
WB-2	-8.3	-12.3	11.7	15.7	8.4 [a]	12.2	--	--	--	--	--	--
WB-3	-13.3	-17.3	11.0	15.0	14.2	14.0	--	--	--	--	--	--
WB-4	-10.7	-14.7	17.3	21.3	12.7	12.5	-23.7	-27.7	30.3	34.3	12.5	12.5
WB-5	-27.5	-31.5	15.3	19.3	3.0 [a]	11.5	--	--	--	--	--	--
WB-6	--	--	--	--	--	--	--	--	--	--	--	--
WB-7	--	--	--	--	--	--	--	--	--	--	--	--
WB-8	-30.9	-34.9	33.8	37.8	7.1	7.3	--	--	--	--	--	--
WB-9	-25.9	-29.9	31.0	35.0	9.1	8.2	--	--	--	--	--	--
WB-10	-28.0	-32.0	24.0	28.0	8.9	8.9	--	--	--	--	--	--
WB-11	-21.6	-24.1	19.5	22.0	7.6	8.2	--	--	--	--	--	--
WB-12	--	--	--	--	--	--	--	--	--	--	--	--
WB-13	-15.7	-19.7	16.5	20.5	7.9	7.4	--	--	--	--	--	--
WB-14	-23.5	-27.5	17.0	21.0	7.7	7.2	--	--	--	--	--	--
WB-15	--	--	--	--	--	--	--	--	--	--	--	--
WB-16	--	--	--	--	--	--	--	--	--	--	--	--
WB-17	--	--	--	--	--	--	--	--	--	--	--	--
WB-18	-16.0	-20.0	17.5	21.5	9.0	8.2	--	--	--	--	--	--
WB-19	--	--	--	--	--	--	--	--	--	--	--	--
WB-20	--	--	--	--	--	--	--	--	--	--	--	--
WB-21	--	--	--	--	--	--	--	--	--	--	--	--
WB-22	--	--	--	--	--	--	--	--	--	--	--	--
WB-23	-27.8	-31.8	16.6	20.6	8.5	7.9	--	--	--	--	--	--
WB-24	--	--	--	--	--	--	--	--	--	--	--	--
WB-25	-24.1	-26.1	19.7	21.7	8.4	8.7	--	--	--	--	--	--

Note: -- not measured or data not available.

Note: Barge deck or dock elevation represents the initial elevation from which all relative borehole depths were measured. Groundwater samples were not collected from all boreholes. Some boreholes had only one groundwater sample interval. Vertical reference datum for elevations is City of Portland Datum, unless otherwise noted.

[a]The measured groundwater elevation may not represent a stabilized reading and therefore no intrepretation of potentiometric surface should be made using this measurement.

[b]Vertical reference datum was the Geoprobe rods rather than the City of Portland Datum

Table 2. Field screening results and analytical results for select pesticides in sediments from Stage 1 and 2 boreholes.

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (μg/kg)	4,4'-DDE (8081A) (μg/kg)	4,4'-DDT (8081A) (μg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1711	WB-1	6/3/2002	29–33	0.0	4.0	7.6	3.6	0	-	--	--	--	50 *U*
SO1712	WB-1	6/3/2002	33–37	4.0	8.0	3.6	-0.4	34	-	--	--	--	150
SO1713	WB-1	6/3/2002	37–39	8.0	10.0	-0.4	-2.4	86	-	--	--	--	50 *U*
SO1714	WB-1	6/3/2002	42–44	13.0	15.0	-5.4	-7.4	3.4	-	--	--	--	50 *U*
SO1715	WB-1	6/3/2002	44–46	15.0	17.0	-7.4	-9.4	3.4	-	--	--	--	50 *U*
SO1716	WB-1	6/3/2002	46–48	17.0	19.0	-9.4	-11.4	0	-	--	--	--	50 *U*
SO1717	WB-1	6/3/2002	48–50	19.0	21.0	-11.4	-13.4	0	-	--	--	--	50 *U*
SO1718	WB-1	6/3/2002	50–52	21.0	23.0	-13.4	-15.4	1.7	-	--	--	--	50 *U*
SO1719	WB-1	6/3/2002	52–54	23.0	25.0	-15.4	-17.4	1.7	-	--	--	--	50 *U*
SO1720	WB-1	6/3/2002	54–56	25.0	27.0	-17.4	-19.4	1.7	-	--	--	--	50 *U*
SO1721	WB-2	6/4/2002	33.3–35	0.0	1.7	3.4	1.7	8.1	-	--	--	--	50 *U*
SO1721Z	WB-2	6/4/2002	35–37	1.7	3.7	1.7	-0.3	0	-	--	--	--	50 *U*
SO1722	WB-2	6/4/2002	37–39	3.7	5.7	-0.3	-2.3	0	-	--	--	--	50 *U*
SO1723	WB-2	6/4/2002	39–41	5.7	7.7	-2.3	-4.3	0	-	--	--	--	50 *U*
SO1724	WB-2	6/4/2002	41–43	7.7	9.7	-4.3	-6.3	8.1	-	--	--	--	50 *U*
SO1725	WB-2	6/4/2002	43–45	9.7	11.7	-6.3	-8.3	16	-	--	--	--	50 *U*
SO1726	WB-2	6/4/2002	45–47	11.7	13.7	-8.3	-10.3	56	-	--	--	--	50 *U*
SO1727	WB-2	6/4/2002	47–49	13.7	15.7	-10.3	-12.3	15	-	--	--	--	50 *U*
SO1728	WB-2	6/4/2002	49–51	15.7	17.7	-12.3	-14.3	0	-	--	--	--	50 *U*
SO1729	WB-3	6/5/2002	39–41	0.0	2.0	-2.3	-4.3	2.8	-	--	--	--	50 *U*
SO1730	WB-3	6/5/2002	41–43	2.0	4.0	-4.3	-6.3	4.7	-	--	--	--	50 *U*
SO1731	WB-3	6/5/2002	45–47	6.0	8.0	-8.3	-10.3	2.8	-	--	--	--	100
SO1732	WB-3	6/5/2002	47–49	8.0	10.0	-10.3	-12.3	4.7	-	--	--	--	50 *U*
SO1733	WB-3	6/5/2002	49–51	10.0	12.0	-12.3	-14.3	4.7	-	--	--	--	50 *U*
SO1734	WB-3	6/5/2002	51–53	12.0	14.0	-14.3	-16.3	2.8	-	--	--	--	50 *U*
SO1734A	WB-3 (dup)	6/5/2002	51–53	12.0	14.0	-14.3	-16.3	NA	NA	--	--	--	50 *U*
SO1735	WB-3	6/5/2002	53–54.5	14.0	15.5	-16.3	-17.8	2.8	-	--	--	--	50 *U*
SO1736	WB-4	6/6/2002	29.7–32	0.0	2.3	6.6	4.3	7.3	-	--	--	--	50 *U*
SO1737	WB-4	6/6/2002	32–34	2.3	4.3	4.3	2.3	11	-	--	--	--	50 *U*
SO1738	WB-4	6/6/2002	34–36	4.3	6.3	2.3	0.3	7.3	-	--	--	--	200
SO1739	WB-4	6/6/2002	36–38	6.3	8.3	0.3	-1.7	3.5	-	--	--	--	50 *U*
SO1740	WB-4	6/6/2002	38–40	8.3	10.3	-1.7	-3.7	5.4	-	--	--	--	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (μg/kg)	4,4'-DDE (8081A) (μg/kg)	4,4'-DDT (8081A) (μg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1741	WB-4	6/6/2002	40–42	10.3	12.3	-3.7	-5.7	5.4	-	--	--	--	50 *U*
SO1742	WB-4	6/6/2002	42–44	12.3	14.3	-5.7	-7.7	5.4	-	--	--	--	50 *U*
SO1743	WB-4	6/6/2002	44–46	14.3	16.3	-7.7	-9.7	5.4	-	--	--	--	50 *U*
SO1744	WB-4	6/6/2002	46–48	16.3	18.3	-9.7	-11.7	0	-	--	--	--	50 *U*
SO1745	WB-4	6/6/2002	48–50	18.3	20.3	-11.7	-13.7	1.8	-	--	--	--	50 *U*
SO1746	WB-4	6/6/2002	52–54	22.3	24.3	-15.7	-17.7	3.6	-	--	--	--	50 *U*
SO1747	WB-4	6/6/2002	54–56	24.3	26.3	-17.7	-19.7	5.4	-	--	--	--	50 *U*
SO1748	WB-4	6/6/2002	56–58	26.3	28.3	-19.7	-21.7	3.6	-	--	--	--	50 *U*
SO1749	WB-4	6/6/2002	58–60	28.3	30.3	-21.7	-23.7	3.6	-	--	--	--	50 *U*
SO1750	WB-4	6/6/2002	60–62	30.3	32.3	-23.7	-25.7	1.8	-	--	--	--	50 *U*
SO1751	WB-4	6/6/2002	62–64	32.3	34.3	-25.7	-27.7	3.6	-	--	--	--	50 *U*
SO1757	WB-4	6/10/2002	64–66	34.3	36.3	-27.7	-29.7	1.7	-	--	--	--	50 *U*
SO1758	WB-4	6/10/2002	66–68	36.3	38.3	-29.7	-31.7	0	-	--	--	--	50 *U*
SO1759	WB-4	6/10/2002	68–70	38.3	40.3	-31.7	-33.7	0	-	--	--	--	50 *U*
SO1760	WB-4	6/10/2002	70–72.5	40.3	42.8	-33.7	-36.2	0	-	--	--	--	50 *U*
SO1775	WB-5	6/11/2002	48.7–50.5	0.0	1.8	-12.2	-14.0	5.4	-	--	--	--	50 *U*
SO1775A	WB-5 (dup)	6/11/2002	48.7–50.5	0.0	1.8	-12.2	-14.0	NA	NA	--	--	--	50 *U*
SO1776	WB-5	6/11/2002	50.5–52.5	1.8	3.8	-14.0	-16.0	16	-	--	--	--	250
SO1777	WB-5	6/11/2002	60–62	11.3	13.3	-23.5	-25.5	280	-	--	--	--	150
SO1778	WB-5	6/11/2002	62–64	13.3	15.3	-25.5	-27.5	7.2	-	--	--	--	50 *U*
SO1779	WB-5	6/11/2002	64–66	15.3	17.3	-27.5	-29.5	3.6	-	--	--	--	50 *U*
SO1780	WB-5	6/11/2002	66–68	17.3	19.3	-29.5	-31.5	1.8	-	--	--	--	50 *U*
SO1781	WB-5	6/11/2002	68–70	19.3	21.3	-31.5	-33.5	5.4	-	--	--	--	50 *U*
SO1752	WB-6	6/7/2002	49.1–51	0.0	1.9	-12.5	-14.4	7.1	+[d]	--	--	--	50
SO1752A	WB-6 (dup)	6/7/2002	49.1–51	0.0	1.9	-12.5	-14.4	NA	NA	--	--	--	50
SO1753	WB-6	6/7/2002	51–53	1.9	3.9	-14.4	-16.4	8.9	-	--	--	--	50 *U*
SO1753A	WB-6 (dup)	6/7/2002	51–53	1.9	3.9	-14.4	-16.4	NA	NA	--	--	--	50 *U*
SO1754	WB-6	6/7/2002	55–59	5.9	9.9	-18.4	-22.4	310	-	--	--	--	50
SO1755	WB-6	6/7/2002	59–61	9.9	11.9	-22.4	-24.4	3,000	-[d]	--	--	--	50
SO1756	WB-6	6/7/2002	63–67	13.9	17.9	-26.4	-30.4	1,400	-	--	--	--	50
SO1761	WB-7	6/11/2002	50.2–52	0.0	1.8	-13.1	-14.9	3.6	-	--	--	--	50 *U*
SO1762	WB-7	6/11/2002	52–54	1.8	3.8	-14.9	-16.9	13	-	--	--	--	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (μg/kg)	4,4'-DDE (8081A) (μg/kg)	4,4'-DDT (8081A) (μg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1763	WB-7	6/11/2002	54–56	3.8	5.8	-16.9	-18.9	120	+[d]	--	--	--	50 *U*
SO1764	WB-7	6/11/2002	56–58	5.8	7.8	-18.9	-20.9	56	-	--	--	--	50 *U*
SO1765	WB-7	6/11/2002	58–60	7.8	9.8	-20.9	-22.9	64	-	--	--	--	50 *U*
SO1766	WB-7	6/11/2002	61–63	10.8	12.8	-23.9	-25.9	57	-	--	--	--	50 *U*
SO1767	WB-7	6/11/2002	63–65	12.8	14.8	-25.9	-27.9	54	-	--	--	--	50 *U*
SO1915	WB-8	2/28/2003	5.7-10	0.0	4.3	2.9	-1.4	6.2	-	3,800	570 *J*	34,000	50 *U*
SO1916	WB-8	2/28/2003	10-12.5	4.3	6.8	-1.4	-3.9	12.0	-	--	--	--	50
SO1916D	WB-8 (dup)	2/28/2003	10-12.5	4.3	6.8	-1.4	-3.9	NA	NA	--	--	--	50
SO1917	WB-8	2/28/2003	12.5-15	6.8	9.3	-3.9	-6.4	12.0	-	470,000	9,000	920,000	100
SO1917D	WB-8 (dup)	2/28/2003	12.5-15	6.8	9.3	-3.9	-6.4	NA	NA	--	--	--	100
SO1918	WB-8	2/28/2003	15-17.5	9.3	11.8	-6.4	-8.9	15.5	-	--	--	--	50 *U*
SO1919	WB-8	2/28/2003	20-22	14.3	16.3	-11.4	-13.4	7.0	-	95	7.1 *U*	330	50 *U*
SO1920	WB-8	2/28/2003	22-24	16.3	18.3	-13.4	-15.4	5.4	-	--	--	--	50 *U*
SO1921	WB-8	2/28/2003	24-26	18.3	20.3	-15.4	-17.4	4.5	-	--	--	--	50 *U*
SO1922	WB-8	2/28/2003	26-28	20.3	22.3	-17.4	-19.4	6.2	-	--	--	--	50 *U*
SO1923	WB-8	2/28/2003	28-30	22.3	24.3	-19.4	-21.4	5.4	-	--	--	--	50 *U*
SO1924	WB-8	2/28/2003	30-32	24.3	26.3	-21.4	-23.4	5.4	-	--	--	--	50 *U*
SO1925	WB-8	2/28/2003	32-34	26.3	28.3	-23.4	-25.4	6.4	-	--	--	--	50 *U*
SO1926	WB-8	2/28/2003	34-36	28.3	30.3	-25.4	-27.4	7.0	-	--	--	--	50 *U*
SO1927	WB-8	2/28/2003	36-38	30.3	32.3	-27.4	-29.4	5.4	-	--	--	--	50 *U*
SO1928	WB-8	2/28/2003	38-40	32.3	34.3	-29.4	-31.4	7.0	-	--	--	--	50 *U*
SO1929	WB-8	2/28/2003	40-42	34.3	36.3	-31.4	-33.4	5.4	-	26	7.0 *U*	17	50 *U*
SO1930	WB-8	2/28/2003	42-43.8	36.3	38.1	-33.4	-35.2	2.0	-	--	--	--	50 *U*
SO1931	WB-9	3/4/2003	5-9	0.0	4.0	5.1	1.1	0.0	-	1,900	730	12,000	50 *U*
SO1932	WB-9	3/4/2003	9-11	4.0	6.0	1.1	-0.9	0.9	-	--	--	--	50 *U*
SO1933	WB-9	3/4/2003	11-13	6.0	8.0	-0.9	-2.9	3.4	-	--	--	--	50
SO1934	WB-9	3/4/2003	13-15	8.0	10.0	-2.9	-4.9	3.5	-	240,000	24,000	4,500,000	500
SO1934D	WB-9 (dup)	3/4/2003	13-15	8.0	10.0	-2.9	-4.9	NA	NA	--	--	--	500
SO1935	WB-9	3/4/2003	15-17	10.0	12.0	-4.9	-6.9	6.1	-	--	--	--	200
SO1936	WB-9	3/4/2003	17-19	12.0	14.0	-6.9	-8.9	0.0	-	--	--	--	50
SO1936D	WB-9 (dup)	3/4/2003	17-19	12.0	14.0	-6.9	-8.9	NA	NA	--	--	--	50
SO1937	WB-9	3/4/2003	21-23	16.0	18.0	-10.9	-12.9	0.0	-	--	--	--	50
SO1938	WB-9	3/4/2003	23-25	18.0	20.0	-12.9	-14.9	0.1	-	130 *U*	130 *U*	1,900	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (µg/kg)	4,4'-DDE (8081A) (µg/kg)	4,4'-DDT (8081A) (µg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1939	WB-9	3/4/2003	25-27	20.0	22.0	-14.9	-16.9	0.4	-	--	--	--	50 *U*
SO1940	WB-9	3/4/2003	27-29	22.0	24.0	-16.9	-18.9	0.0	-	--	--	--	50 *U*
SO1941	WB-9	3/4/2003	29-31	24.0	26.0	-18.9	-20.9	0.0	-	--	--	--	50 *U*
SO1942	WB-9	3/4/2003	31-33	26.0	28.0	-20.9	-22.9	0.0	-	--	--	--	50 *U*
SO1943	WB-9	3/4/2003	33-35	28.0	30.0	-22.9	-24.9	0.0	-	--	--	--	50 *U*
SO1944	WB-9	3/4/2003	35-37	30.0	32.0	-24.9	-26.9	0.0	-	--	--	--	50 *U*
SO1945	WB-9	3/4/2003	37-39	32.0	34.0	-26.9	-28.9	0.0	-	20	6.6 *U*	240	50 *U*
SO1946	WB-9	3/4/2003	39-40.3	34.0	35.3	-28.9	-30.2	0.0	-	--	--	--	50 *U*
SO1947	WB-10	3/5/2003	14-16	0.0	2.0	-4.0	-6.0	4.8	-	950 *J*	160	4,000	50 *U*
SO1948	WB-10 (dup)	3/5/2003	14-16	0.0	2.0	-4.0	-6.0	NA	NA	830 *J*	190	4,000	--
SO1949	WB-10	3/5/2003	16-17.5	2.0	3.5	-6.0	-7.5	5.9	-	--	--	--	50
SO1950	WB-10	3/5/2003	17.5-19	3.5	5.0	-7.5	-9.0	8.0	-	--	--	--	150
SO1951	WB-10	3/5/2003	19-21	5.0	7.0	-9.0	-11.0	12.1	-	--	--	--	50
SO1952	WB-10	3/5/2003	21-23	7.0	9.0	-11.0	-13.0	8.0	-	4,600	660 *J*	15,000	200
SO1953	WB-10	3/5/2003	23-26	9.0	12.0	-13.0	-16.0	6.7	-	--	--	--	50
SO1954	WB-10	3/5/2003	26-28	12.0	14.0	-16.0	-18.0	32.2	-	--	--	--	50
SO1955	WB-10	3/5/2003	28-29	14.0	15.0	-18.0	-19.0	117	-	--	--	--	100
SO1956	WB-10	3/5/2003	29-31	15.0	17.0	-19.0	-21.0	2280	-	640,000	4,300 *U*	19,000	50
SO1956D	WB-10 (dup)	3/5/2003	29-31	15.0	17.0	-19.0	-21.0	NA	NA	--	--	--	50
SO1957	WB-10	3/5/2003	31-33	17.0	19.0	-21.0	-23.0	271	-	--	--	--	50
SO1958	WB-10	3/5/2003	33-35	19.0	21.0	-23.0	-25.0	24.3	-	--	--	--	50
SO1959	WB-10	3/5/2003	35-37	21.0	23.0	-25.0	-27.0	8.9	-	--	--	--	50 *U*
SO1960	WB-10	3/5/2003	37-39	23.0	25.0	-27.0	-29.0	5.8	-	--	--	--	50 *U*
SO1961	WB-10	3/5/2003	39-41	25.0	27.0	-29.0	-31.0	3.5	-	28	6.6 *U*	6.6 *U*	50 *U*
SO1962	WB-10	3/5/2003	41-42.7	27.0	28.7	-31.0	-32.7	1.1	-	--	--	--	50 *U*
SO1963	WB-11	3/6/2003	11.5-13.5	0.0	2.0	-2.1	-4.1	4.4	-	1,300 *J*	400 *J*	3,500 *J*	50 *U*
SO1964	WB-11	3/6/2003	13.5-15	2.0	3.5	-4.1	-5.6	3.7	-	--	--	--	50
SO1965	WB-11	3/6/2003	15-20	3.5	8.5	-5.6	-10.6	14.8	-	--	--	--	50
SO1966	WB-11	3/6/2003	20-24	8.5	12.5	-10.6	-14.6	109	-	--	--	--	50
SO1967	WB-11	3/6/2003	24-26	12.5	14.5	-14.6	-16.6	1230	-	690,000	5,700 *U*	110,000	50
SO1968	WB-11	3/6/2003	26-28	14.5	16.5	-16.6	-18.6	78.5	-	--	--	--	50
SO1969	WB-11	3/6/2003	28-30	16.5	18.5	-18.6	-20.6	12.8	-	--	--	--	50 *U*
SO1970	WB-11	3/6/2003	30-32	18.5	20.5	-20.6	-22.6	21.4	-	--	--	--	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (µg/kg)	4,4'-DDE (8081A) (µg/kg)	4,4'-DDT (8081A) (µg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1971	WB-11	3/6/2003	32-33.8	20.5	22.3	-22.6	-24.4	13.5	-	36	6.4 *U*	6.4 *U*	50 *U*
SO1870	WB-12	2/19/2003	43-44.5	0.0	1.5	-32.9	-34.4	2.1	-	42 *J*	25 *J*	100 *J*	50 *U*
SO1871	WB-12	2/19/2003	44.5-46.5	1.5	3.5	-34.4	-36.4	0.7	-	--	--	--	50 *U*
SO1872	WB-12	2/19/2003	46.5-48	3.5	5.0	-36.4	-37.9	2.2	-	--	--	--	50 *U*
SO1896	WB-13	2/26/2003	8-11.5	0.0	3.5	0.8	-2.7	3.2	-	8,200	780	26,000	50 *U*
SO1897	WB-13	2/26/2003	11-13	3.0	5.0	-2.2	-4.2	7.4	-	--	--	--	50 *U*
SO1898	WB-13	2/26/2003	13-15	5.0	7.0	-4.2	-6.2	5.7	-	--	--	--	50 *U*
SO1899	WB-13	2/26/2003	15-20	7.0	12.0	-6.2	-11.2	6.5	-	--	--	--	50
SO1900	WB-13	2/26/2003	20-22.5	12.0	14.5	-11.2	-13.7	12.3	-	--	--	--	50
SO1901	WB-13	2/26/2003	22.5-25	14.5	17.0	-13.7	-16.2	25.5	-	460	75 *U*	610	50
SO1902	WB-13	2/26/2003	25-27.5	17.0	19.5	-16.2	-18.7	28.8	-	--	--	--	50 *U*
SO1903	WB-13	2/26/2003	27.5-28.5	19.5	20.5	-18.7	-19.7	16.4	-	--	--	--	50 *U*
SO1906	WB-14	2/27/2003	15-17	0.0	2.0	-6.5	-8.5	13.8	-	810	150 *J*	1,400	50 *U*
SO1907	WB-14	2/27/2003	17-19	2.0	4.0	-8.5	-10.5	16.2	-	--	--	--	50 *U*
SO1908	WB-14	2/27/2003	19-20	4.0	5.0	-10.5	-11.5	14.6	-	--	--	--	50 *U*
SO1909	WB-14	2/27/2003	20-25	5.0	10.0	-11.5	-16.5	8.9	-	--	--	--	50 *U*
SO1910	WB-14	2/27/2003	25-27.5	10.0	12.5	-16.5	-19.0	14.6	-	--	--	--	50 *U*
SO1911	WB-14	2/27/2003	27.5-31	12.5	16.0	-19.0	-22.5	18.7	-	--	--	--	50 *U*
SO1912	WB-14	2/27/2003	31-33	16.0	18.0	-22.5	-24.5	--	-	6.9 *U*	6.9 *U*	6.9 *U*	50 *U*
SO1913	WB-14	2/27/2003	33-35	18.0	20.0	-24.5	-26.5	--	-	--	--	--	50 *U*
SO1914	WB-14	2/27/2003	35-37	20.0	22.0	-26.5	-28.5	--	-	--	--	--	50 *U*
SO1850	WB-15	2/17/2003	44-46	0.0	2.0	-35.5	-37.5	0	-	80 *J*	25 *J*	290 *J*	50 *U*
SO1851	WB-15	2/17/2003	46-47	2.0	3.0	-37.5	-38.5	0	-	--	--	--	50 *U*
SO1852	WB-15	2/17/2003	47-49	3.0	5.0	-38.5	-40.5	0	-	--	--	--	50 *U*
SO1853	WB-15	2/17/2003	49-49.5	5.0	5.5	-40.5	-41.0	3.0	-	--	--	--	50 *U*
SO1854	WB-15	2/17/2003	49.5-50	5.5	6.0	-41.0	-41.5	0	-	--	--	--	50 *U*
SO1867	WB-16	2/19/2003	38.6-40.5	0.0	1.9	-27.1	-29.0	8.1	-	39 *J*	11 *UJ*	130 *J*	50 *U*
SO1868	WB-16	2/19/2003	40.5-43.3	1.9	4.7	-29.0	-31.8	11.8	-	--	--	--	50 *U*
SO1904	WB-17	2/27/2003	34-36	0.0	2.0	-25.2	-27.2	7.3	-	320 *J*	92 *U*	6,100	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (μg/kg)	4,4'-DDE (8081A) (μg/kg)	4,4'-DDT (8081A) (μg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1905	WB-17	2/27/2003	36-36.2	2.0	2.2	-27.2	-27.4	13.0	-	--	--	--	50 *U*
SO1888	WB-18	2/25/2003	8-10	0.0	2.0	1.5	-0.5	5.1	-	1,200	350	8,000	50 *U*
SO1889	WB-18	2/25/2003	12-14	4.0	6.0	-2.5	-4.5	5.1	-	--	--	--	50 *U*
SO1890	WB-18	2/25/2003	14-16	6.0	8.0	-4.5	-6.5	9.3	-	3,600	650 *J*	17,000	50
SO1890D	WB-18 (dup)	2/25/2003	14-16	6.0	8.0	-4.5	-6.5	NA	NA	--	--	--	50
SO1891	WB-18	2/25/2003	16-18	8.0	10.0	-6.5	-8.5	5.1	-	--	--	--	50
SO1892	WB-18	2/25/2003	18-20	10.0	12.0	-8.5	-10.5	6.7	-	--	--	--	50
SO1893	WB-18	2/25/2003	20-24	12.0	16.0	-10.5	-14.5	5.9	-	--	--	--	50 *U*
SO1894	WB-18	2/25/2003	24-28	16.0	20.0	-14.5	-18.5	6.7	-	220	6.5 *U*	150	50 *U*
SO1895	WB-18	2/25/2003	28-29.7	20.0	21.7	-18.5	-20.2	6.7	-	--	--	--	50 *U*
SO1885	WB-19	2/24/2003	34.1-35.5	0.0	1.4	-24.2	-25.6	3.6	-	310	100	620	50 *U*
SO1886	WB-19	2/24/2003	35.5-37	1.4	2.9	-25.6	-27.1	4.5	-	--	--	--	50 *U*
SO1887	WB-19	2/24/2003	37-38	2.9	3.9	-27.1	-28.1	5.4	-	--	--	--	50 *U*
SO1882	WB-20	2/24/2003	46.5-48.5	0.0	2.0	-36.9	-38.9	1.7	-	24 *J*	11 *UJ*	67 *J*	50 *U*
SO1883	WB-20	2/24/2003	48.5-51	2.0	4.5	-38.9	-41.4	3.5	-	--	--	--	50 *U*
SO1884	WB-20	2/24/2003	51-51.9	4.5	5.4	-41.4	-42.3	3.5	-	--	--	--	50 *U*
SO1873	WB-21	2/20/2003	45.2-47	0.0	1.8	-34.9	-36.7	2.6	-	29 *J*	9.1 *UJ*	37 *J*	50 *U*
SO1874	WB-21	2/20/2003	47-49	1.8	3.8	-36.7	-38.7	2.6	-	--	--	--	50 *U*
SO1875	WB-21	2/20/2003	49-51	3.8	5.8	-38.7	-40.7	4.7	-	--	--	--	50 *U*
SO1876	WB-21	2/20/2003	51-52.3	5.8	7.1	-40.7	-42.0	4.0	-	--	--	--	50 *U*
SO1877	WB-22	2/21/2003	50.5-52	0.0	1.5	-38.9	-40.4	6.3[f]	-	--	--	--	50 *U*
SO1878	WB-22	2/21/2003	52-54	1.5	3.5	-40.4	-42.4	5.3[f]	-	--	--	--	50 *U*
SO1879	WB-22	2/21/2003	54-55.8	3.5	5.3	-42.4	-44.2	5.3[f]	-	14 *U*	8.1	15 *U*	50 *U*
SO1880	WB-22	2/21/2003	56-60	5.5	9.5	-44.4	-48.4	6.3[f]	-	--	--	--	50 *U*
SO1881	WB-22	2/21/2003	60-62.5	9.5	12.0	-48.4	-50.9	6.3[f]	-	--	--	--	50 *U*
SO1855	WB-23	2/18/2003	21.4-23	0.0	1.6	-11.2	-12.8	1.0	-	--	--	--	50 *U*
SO1856	WB-23	2/18/2003	23-25	1.6	3.6	-12.8	-14.8	1.0	-	--	--	--	50 *U*
SO1857	WB-23	2/18/2003	25-29	3.6	7.6	-14.8	-18.8	1.0	-	--	--	--	50 *U*
SO1858	WB-23	2/18/2003	26-28	4.6	6.6	-15.8	-17.8	1.7	-	230	21 *U*	450	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (μg/kg)	4,4'-DDE (8081A) (μg/kg)	4,4'-DDT (8081A) (μg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1859	WB-23	2/18/2003	28-30	6.6	8.6	-17.8	-19.8	2.7	-	--	--	--	50 *U*
SO1860	WB-23	2/18/2003	30-32	8.6	10.6	-19.8	-21.8	2.7	-	--	--	--	50 *U*
SO1861	WB-23	2/18/2003	32-34	10.6	12.6	-21.8	-23.8	2.7	-	--	--	--	50 *U*
SO1862	WB-23	2/18/2003	34-36	12.6	14.6	-23.8	-25.8	2.7	-	--	--	--	50 *U*
SO1863	WB-23	2/18/2003	36-38	14.6	16.6	-25.8	-27.8	2.4	-	--	--	--	50 *U*
SO1864	WB-23	2/18/2003	38-40	16.6	18.6	-27.8	-29.8	2.4	-	11 *U*	6.7 *U*	6.7 *U*	50 *U*
SO1865	WB-23	2/18/2003	40-42	18.6	20.6	-29.8	-31.8	2.0	-	--	--	--	50 *U*
SO1972	WB-24	3/7/2003	20-22	10.6	12.6	-10.0	-12.0	316	-	130,000	13,000	3,500,000	250
SO1973	WB-24	3/7/2003	22-24	12.6	14.6	-12.0	-14.0	337	-	--	--	--	200
SO1974	WB-24	3/7/2003	24-26	14.6	16.6	-14.0	-16.0	23.9	-	--	--	--	200
SO1975	WB-24	3/7/2003	26-28	16.6	18.6	-16.0	-18.0	9.5	-	89 *J*	6.9 *U*	27,000	50 *U*
SO1976	WB-24	3/7/2003	28-30	18.6	20.6	-18.0	-20.0	4.2	-	--	--	--	50 *U*
SO1977	WB-24	3/7/2003	30-32	20.6	22.6	-20.0	-22.0	10.5	-	--	--	--	50 *U*
SO1978	WB-25	3/7/2003	14.3-16	0.0	1.7	-4.4	-6.1	1.5	-	--	--	--	50
SO1979	WB-25 (dup)	3/7/2003	14.3-16	0.0	1.7	-4.4	-6.1	NA	NA	350 *J*	110 *UJ*	1,200 *J*	--
SO1980	WB-25	3/7/2003	16-18	1.7	3.7	-6.1	-8.1	0.0	-	--	--	--	50
SO1981	WB-25	3/7/2003	18-20	3.7	5.7	-8.1	-10.1	0.2	-	--	--	--	50
SO1982	WB-25	3/7/2003	20-25	5.7	10.7	-10.1	-15.1	0.1	-	--	--	--	100
SO1983	WB-25	3/7/2003	25-27	10.7	12.7	-15.1	-17.1	1.0	-	10	7.4 *U*	24	200
SO1984	WB-25	3/7/2003	27-29	12.7	14.7	-17.1	-19.1	1.0	-	--	--	--	50 *U*
SO1985	WB-25	3/7/2003	29-31	14.7	16.7	-19.1	-21.1	8.5	-	7.1 *U*	7.1 *U*	11	50 *U*
SO1985DUP	WB-25 (dup)	3/7/2003	29-31	14.7	16.7	-19.1	-21.1	NA	NA	6.9 *U*	6.9 *U*	14	--
SO1986	WB-25	3/10/2003	31-32.5	16.7	18.2	-21.1	-22.6	4.4	-	--	--	--	50 *U*
SO1987	WB-25	3/10/2003	32.5-34.5	18.2	20.2	-22.6	-24.6	0.0	-	--	--	--	50 *U*
SO1988	WB-25	3/10/2003	34.5-36	20.2	21.7	-24.6	-26.1	0.0	-	6.2 *U*	6.2 *U*	6.2 *U*	50 *U*

Notes on following page

Table 2. (cont.)

Note: -- not analyzed
- negative hydrophobic dye screening result
NA - not applicable
OVM - organic vapor monitor
PID - photoionization detector
TLC - thin layer chromatography
U - undetected at detection limit shown
J - estimated

[a] All depths for WB-1 to WB-7 measured from dock surface. All depths for WB-8 to WB-25 measured from barge deck.
[b] Vertical reference datum is City of Portland Benchmark
[c] A negative indicates that nonaqueous phase liquids (NAPLs) were not present and a positive indicates the presence of NAPLs.
[d] NAPL detection is attributed to an organic compound other than monochlorobenzene, perhaps petroleum hydrocarbons based on visual evidence and OVM measurements.
[e] Limited sample was available for hydrophobic dye screening from this interval. NAPL was not detected with hydrophobic dye; however, residual NAPL characteristic of DDT manufacturing process residue was visually observed in a sample from a depth of 60.9-61 ft below the dock surface.
[f] OVM measurement taken in office laboratory within 3 hours of borehole completion.

Table 3. Pesticide results for sediment samples from the Stage 2 boreholes.

			WB-8	WB-8	WB-8	WB-8	WB-9	WB-9	WB-9	WB-9
			2/28/2003	2/28/2003	2/28/2003	2/28/2003	3/4/2003	3/4/2003	3/4/2003	3/4/2003
			SO1915	SO1917	SO1919	SO1929	SO1931	SO1934	SO1938	SO1945
	Depth below mudline (ft)		0.0 to 4.3	6.8 to 9.3	14.3 to 16.3	34.3 to 36.3	0.0 to 4.0	8.0 to 10.0	18.0 to 20.0	32.0 to 34.0
	Elevation (ft CPD)		2.9 to -1.4	-3.9 to -6.4	-11.4 to -13.4	-31.4 to -33.4	5.1 to 1.1	-2.9 to -4.9	-12.9 to -14.9	-26.9 to -28.9
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	3,800	470,000	95	26	1,900	240,000	130 *U*	20
4,4'-DDE	8081A	µg/kg	570 *J*	9,000	7.1 *U*	7.0 *U*	730	24,000	130 *U*	6.6 *U*
4,4'-DDT	8081A	µg/kg	34,000	920,000	330	17	12,000	4,500,000	1,900	240
Aldrin	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,800 *U*	130 *U*	6.6 *U*
alpha-Chlordane	8081A	µg/kg	120 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
alpha-Endosulfan	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
beta-Endosulfan	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *UJ*	38,000 *U*	130 *U*	6.6 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Dieldrin	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Endosulfan sulfate	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Endrin	8081A	µg/kg	70 *UJ*	80 *U*	7.1 *U*	7.0 *U*	64 *UJ*	22,000 *U*	130 *U*	6.6 *U*
Endrin aldehyde	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *UJ*	1,400 *U*	130 *U*	6.6 *U*
Endrin ketone	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
gamma-Chlordane	8081A	µg/kg	70 *U*	93 *U*	7.1 *U*	7.0 *U*	170 *J*	1,400 *U*	130 *U*	6.6 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	76 *U*	80 *U*	7.1 *U*	7.0 *U*	110 *U*	1,400 *U*	130 *U*	6.6 *U*
Heptachlor	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Heptachlor epoxide	8081A	µg/kg	70 *U*	83 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Methoxychlor	8081A	µg/kg	70 *UJ*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Toxaphene	8081A	µg/kg	15,000 *U*	22,000 *U*	430 *U*	350 *U*	3,900 *U*	110,000 *U*	6,500 *U*	970 *U*

Table 3. (cont.)

			WB-10	WB-10 (dup)	WB-10	WB-10	WB-10	WB-11	WB-11	WB-11
			3/5/2003	3/5/2003	3/5/2003	3/5/2003	3/5/2003	3/6/2003	3/6/2003	3/6/2003
			SO1947	SO1948	SO1952	SO1956	SO1961	SO1963	SO1967	SO1971
	Depth below mudline (ft)		0.0 to 2.0	0.0 to 2.0	7.0 to 9.0	15.0 to 17.0	25.0 to 27.0	0.0 to 2.0	12.5 to 14.5	20.5 to 22.3
	Elevation (ft CPD)		-4.0 to -6.0	-4.0 to -6.0	-11.0 to -13.0	-19.0 to -21.0	-29.0 to -31.0	-2.1 to -4.1	-14.6 to -16.6	-22.6 to -24.4
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	950 *J*	830 *J*	4,600	640,000	28	1,300 *J*	690,000	36
4,4'-DDE	8081A	µg/kg	160	190	660 *J*	4,300 *U*	6.6 *U*	400 *J*	5,700 *U*	6.4 *U*
4,4'-DDT	8081A	µg/kg	4,000	4,000	15,000	19,000	6.6 *U*	3,500 *J*	110,000	6.4 *U*
Aldrin	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
alpha-Chlordane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
alpha-Endosulfan	8081A	µg/kg	94 *U*	95 *U*	180 *U*	270 *U*	6.6 *U*	97 *U*	310 *U*	6.4 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.6 *U*
beta-Endosulfan	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Dieldrin	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Endosulfan sulfate	8081A	µg/kg	94 *U*	100	180 *U*	170 *U*	6.6 *U*	290	190 *U*	6.4 *U*
Endrin	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Endrin aldehyde	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Endrin ketone	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	120	190 *U*	6.4 *U*
gamma-Chlordane	8081A	µg/kg	140 *J*	150 *U*	180 *U*	440 *U*	6.6 *U*	370 *U*	440 *U*	6.4 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Heptachlor	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Heptachlor epoxide	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	110	190 *U*	6.4 *U*
Methoxychlor	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Toxaphene	8081A	µg/kg	5,500 *U*	5,000 *U*	17,000 *U*	13,000 *U*	430 *U*	9,200 *U*	9,200 *U*	320 *U*

Table 3. (cont.)

			WB-12	WB-13	WB-13	WB-14	WB-14	WB-15	WB-16	WB-17
			2/19/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003	2/19/2003	2/27/2003
			SO1870	SO1896	SO1901	SO1906	SO1912	SO1850	SO1867	SO1904
	Depth below mudline (ft)		0.0 to 1.5	0.0 to 3.5	14.5 to 17.0	0.0 to 2.0	16.0 to 18.0	0.0 to 2.0	0.0 to 1.9	0.0 to 2.0
	Elevation (ft CPD)		-32.9 to -34.4	0.8 to -2.7	-13.7 to -16.2	-6.5 to -8.5	-22.5 to -24.5	-35.5 to -37.5	-27.1 to -29.0	-25.2 to -27.2
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	42 *J*	8,200	460	810	6.9 *U*	80 *J*	39 *J*	320 *J*
4,4'-DDE	8081A	µg/kg	25 *J*	780	75 *U*	150 *J*	6.9 *U*	25 *J*	11 *UJ*	92 *U*
4,4'-DDT	8081A	µg/kg	100 *J*	26,000	610	1,400	6.9 *U*	290 *J*	130 *J*	6,100
Aldrin	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
alpha-Chlordane	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
alpha-Endosulfan	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	76 *U*	120	97 *U*	240 *U*	11 *UJ*	11 *UJ*	92 *U*
beta-Endosulfan	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	77	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Dieldrin	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endosulfan sulfate	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endrin	8081A	µg/kg	11 *UJ*	93 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endrin aldehyde	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endrin ketone	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
gamma-Chlordane	8081A	µg/kg	11 *UJ*	110 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Heptachlor	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Heptachlor epoxide	8081A	µg/kg	11 *UJ*	89	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Methoxychlor	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Toxaphene	8081A	µg/kg	530 *UJ*	7,800 *U*	3,800 *U*	4,900 *U*	350 *U*	530 *UJ*	570 *UJ*	4,600 *U*

Table 3. (cont.)

			WB-18	WB-18	WB-18	WB-19	WB-20	WB-21	WB-22	WB-23
			2/25/2003	2/25/2003	2/25/2003	2/24/2003	2/24/2003	2/20/2003	2/21/2003	2/18/2003
			SO1888	SO1890	SO1894	SO1885	SO1882	SO1873	SO1879	SO1858
	Depth below mudline (ft)		0.0 to 2.0	6.0 to 8.0	16.0 to 20.0	0.0 to 1.4	0.0 to 2.0	0.0 to 1.8	3.5 to 5.3	4.6 to 6.6
	Elevation (ft CPD)		1.5 to -0.5	-4.5 to -6.5	-14.5 to -18.5	-24.2 to -25.6	-36.9 to -38.9	-34.9 to -36.7	-42.4 to -44.2	-15.8 to -17.8
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	1,200	3,600	220	310	24 *J*	29 *J*	14 *U*	230
4,4'-DDE	8081A	µg/kg	350	650 *J*	6.5 *U*	100	11 *UJ*	9.1 *UJ*	8.1	21 *U*
4,4'-DDT	8081A	µg/kg	8,000	17,000	150	620	67 *J*	37 *J*	15 *U*	450
Aldrin	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
alpha-Chlordane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
alpha-Endosulfan	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
beta-Endosulfan	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	120	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Dieldrin	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endosulfan sulfate	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endrin	8081A	µg/kg	190 *J*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endrin aldehyde	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endrin ketone	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
gamma-Chlordane	8081A	µg/kg	410 *J*	190 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Heptachlor	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Heptachlor epoxide	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Methoxychlor	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Toxaphene	8081A	µg/kg	17,000 *U*	22,000 *U*	330 *U*	4,400 *U*	520 *UJ*	460 *UJ*	360 *U*	400 *U*

Table 3. (cont.)

			WB-23	WB-24	WB-24	WB-25	WB-25	WB-25	WB-25 (dup)	WB-25
			2/18/2003	3/7/2003	3/7/2003	3/7/2003	3/7/2003	3/7/2003	3/7/2003	3/10/2003
			SO1864	SO1972	SO1975	SO1979	SO1983	SO1985	SO1985DUP	SO1988
	Depth below mudline (ft)		16.6 to 18.6	10.6 to 12.6	16.6 to 18.6	0.0 to 1.7	10.7 to 12.7	14.7 to 16.7	14.7 to 16.7	20.2 to 21.7
	Elevation (ft CPD)		-27.8 to -29.8	-10.0 to -12.0	-16.0 to -18.0	-4.4 to -6.1	-15.1 to -17.1	-19.1 to -21.1	-19.1 to -21.1	-24.6 to -26.1
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	11 *U*	130,000	89 *J*	350 *J*	10	7.1 *U*	6.9 *U*	6.2 *U*
4,4'-DDE	8081A	µg/kg	6.7 *U*	13,000	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
4,4'-DDT	8081A	µg/kg	6.7 *U*	3,500,000	27,000	1,200 *J*	24	11	14	6.2 *U*
Aldrin	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
alpha-Chlordane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
alpha-Endosulfan	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	230 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
beta-Endosulfan	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Dieldrin	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endosulfan sulfate	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	130 *J*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endrin	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endrin aldehyde	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endrin ketone	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
gamma-Chlordane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	160 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Heptachlor	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Heptachlor epoxide	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Methoxychlor	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Toxaphene	8081A	µg/kg	340 *U*	90,000 *U*	350 *U*	5,500 *UJ*	710 *U*	360 *U*	350 *U*	310 *U*

Note: *J* - estimated
U - undetected at detection limit shown
CPD - City of Portland Datum

Table 4. Cation, anion, and field parameter results for groundwater samples from the Stage 1 and 2 boreholes and Willamette River water.

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202
	Depth below mudline (ft)		4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0
	Elevation (ft CPD)		3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	150	86	140	120	1300	40	26
Magnesium	6010B	mg/L	130	59	130	74	530	19	12
Potassium	6010B	mg/L	23	15	11	13	20	4 *U*	4 *U*
Sodium	6010B	mg/L	140	1,200	240	190	41	110	68
Anions									
Bicarbonate	2320B	mg/L	69	550	420	380	750	140	120
Sulfate	300.0	mg/L	25	100	5.8	4.1	3.0	4.4	4.2
Total alkalinity	310.1	mg/L	--	--	--	--	--	--	--
Total chloride	300.0	mg/L	130	1,500	570	500	11	920 *J*	340 *J*
Field Parameters									
Conductivity	SOP	μS/cm	619	4,910	2,960	2,340	4,830	7,770	7,770
Dissolved oxygen	SOP	mg/L	10.4	10.0	10.7	9.86	9.34	2.52	2.52
Oxidation Reduction Potential	SOP	mV	--	--	--	--	247	2.00	2.00
pH	SOP	pH	5.27	6.76	6.90	6.23	7.67	7.15	7.15
Temperature	SOP	degC	15.3	16.4	22.9	20.8	20.3	14.1	14.1
Turbidity	SOP	NTU	--	--	--	--	--	--	--

Table 4. (cont.)

			WB-4	WB-4	WB-4	WB-5	WB-5	WB-7	WB-8
			6/10/2002	6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003
			GW06100201	GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301
	Depth below mudline (ft)		8.3 to 4.3	17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3
	Elevation (ft CPD)		2.3 to -1.7	-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	--	--	--	--	--	--	--
Magnesium	6010B	mg/L	--	--	--	--	--	--	--
Potassium	6010B	mg/L	--	--	--	--	--	--	--
Sodium	6010B	mg/L	--	--	--	--	--	--	--
Anions									
Bicarbonate	2320B	mg/L	--	--	--	--	--	--	--
Sulfate	300.0	mg/L	--	--	--	--	--	--	--
Total alkalinity	310.1	mg/L	--	--	--	--	--	--	--
Total chloride	300.0	mg/L	--	--	--	--	--	--	--
Field Parameters									
Conductivity	SOP	μS/cm	12,500	18,600	55,400	3,020	50,200	3,540	5,260
Dissolved oxygen	SOP	mg/L	11.4	12.4	13.1	8.78	8.36	8.87	2.07
Oxidation Reduction Potential	SOP	mV	36.0	42.0	–166	35.0	–91.0	141	200
pH	SOP	pH	7.03	6.65	6.28	6.43	6.26	5.25	6.34
Temperature	SOP	degC	16.5	20.0	21.8	23.4	26.2	20.6	8.59
Turbidity	SOP	NTU	--	--	--	--	--	--	999

Table 4. (cont.)

Chemical	Method	Units	WB-8	WB-9	WB-9	WB-10	WB-10	WB-10 (dup)	WB-11
			2/28/2003	3/4/2003	3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003
			GW02280302	GW03040301	GW03040302	GW03050302	GW03060301	GW03060302	GW03070302
		Depth below mudline (ft)	33.8 to 37.8	15.0 to 19.0	31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5
		Elevation (ft CPD)	-30.9 to -34.9	-9.9 to -13.9	-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6
Cations									
Calcium	6010B	mg/L	--	200	2,000	810	550	540	--
Magnesium	6010B	mg/L	--	66	270	600	190	180	--
Potassium	6010B	mg/L	--	19	85	28	62	60	--
Sodium	6010B	mg/L	--	4,200	8,800	2,100	8,200	8,300	--
Anions									
Bicarbonate	2320B	mg/L	--	710	2.0 *U*	540	650	640	--
Sulfate	300.0	mg/L	--	160	1,600	3,200	260	260	--
Total alkalinity	310.1	mg/L	--	710	2.0 *U*	540	650	640	--
Total chloride	300.0	mg/L	--	5,300	13,000	3,800	8,400	12,000	--
Field Parameters									
Conductivity	SOP	μS/cm	91,400	23,700	55,500	19,000	50,700	--	1,670
Dissolved oxygen	SOP	mg/L	1.08	1.60	1.91	3.39	1.72	--	3.74
Oxidation Reduction Potential	SOP	mV	2.88	78.0	124	29.0	271	--	192
pH	SOP	pH	5.56	6.70	3.85 [a]	5.53	5.59	--	6.61
Temperature	SOP	degC	8.07	8.67	9.14	10.9	7.09	--	6.58
Turbidity	SOP	NTU	184	162	262	314	40.9	--	311

Table 4. (cont.)

			WB-11	WB-12	WB-13	WB-13	WB-14	WB-14	WB-15
			3/7/2003	2/20/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003
			GW03070301	GW02200301	GW02260303	GW02260304	GW02270301	GW02270302	GW02170301
	Depth below mudline (ft)		19.5 to 22.0	5.0 to 9.0	5.0 to 9.0	16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3
	Elevation (ft CPD)		-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2	-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	--	--	--	--	--	--	60
Magnesium	6010B	mg/L	--	--	--	--	--	--	23
Potassium	6010B	mg/L	--	--	--	--	--	--	3.8
Sodium	6010B	mg/L	--	--	--	--	--	--	440
Anions									
Bicarbonate	2320B	mg/L	--	--	--	--	--	--	83
Sulfate	300.0	mg/L	--	--	--	--	--	--	22
Total alkalinity	310.1	mg/L	--	--	--	--	--	--	83
Total chloride	300.0	mg/L	--	--	--	--	--	--	530 *J*
Field Parameters									
Conductivity	SOP	μS/cm	5,580	99,900	3,660	11,400	213	10,900	1,520
Dissolved oxygen	SOP	mg/L	3.08	1.39	6.23	1.68	6.07	1.06	9.08
Oxidation Reduction Potential	SOP	mV	212	9.00	96.0	152	190	142	-2.00
pH	SOP	pH	5.60	5.54	6.97	6.48	5.86	6.03	6.96
Temperature	SOP	degC	5.34	9.50	11.2	11.2	12.7	14.5	8.50
Turbidity	SOP	NTU	26.1	140	590	57.6	82.7	62.3	379

Table 4. (cont.)

			WB-16	WB-18	WB-18	WB-19	WB-20	WB-21	WB-22
			2/19/2003	2/25/2003	2/26/2003	2/25/2003	2/24/2003	2/20/2003	2/21/2003
			GW02190301	GW02250302	GW02260301	GW02250301	GW02240301	GW02200302	GW02210301
	Depth below mudline (ft)		3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9	2.5 to 4.5	4.3 to 8.3	3.5 to 7.5
	Elevation (ft CPD)		-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1	-39.4 to -41.4	-39.2 to -43.2	-42.4 to -46.4
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	--	--	--	--	18	--	33
Magnesium	6010B	mg/L	--	--	--	--	8.3	--	14
Potassium	6010B	mg/L	--	--	--	--	2.1	--	2.6 *J*
Sodium	6010B	mg/L	--	--	--	--	21	--	23
Anions									
Bicarbonate	2320B	mg/L	--	--	--	--	38	--	100
Sulfate	300.0	mg/L	--	--	--	--	11	--	16
Total alkalinity	310.1	mg/L	--	--	--	--	38	--	100
Total chloride	300.0	mg/L	--	--	--	--	56	--	56
Field Parameters									
Conductivity	SOP	μS/cm	237	470	16,100	191	278	1,640	530
Dissolved oxygen	SOP	mg/L	6.55	8.50	1.04	4.07	6.86	3.76	2.42
Oxidation Reduction Potential	SOP	mV	9.00	4.00	171	9.00	7.00	-4.00	-2.00
pH	SOP	pH	5.85	6.58	6.66	5.49	5.83	6.09	6.15
Temperature	SOP	degC	9.70	8.75	5.15	6.83	8.26	9.30	11.5
Turbidity	SOP	NTU	319	192	580	86.5	24.6	244	442

Table 4. (cont.)

			WB-23	WB-23	WB-25	WB-25	WL-RIVER
			2/18/2003	2/18/2003	3/10/2003	3/10/2003	2/24/2003
			GW02180301	GW02180302	GW03100301	GW03100302	GW02240302
	Depth below mudline (ft)		3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7	--
	Elevation (ft CPD)		-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1	--
Chemical	Method	Units					
Cations							
Calcium	6010B	mg/L	--	--	--	--	7.4
Magnesium	6010B	mg/L	--	--	--	--	2.5
Potassium	6010B	mg/L	--	--	--	--	2 *U*
Sodium	6010B	mg/L	--	--	--	--	5
Anions							
Bicarbonate	2320B	mg/L	--	--	--	--	24
Sulfate	300.0	mg/L	--	--	--	--	3.6
Total alkalinity	310.1	mg/L	--	--	--	--	24
Total chloride	300.0	mg/L	--	--	--	--	3.2
Field Parameters							
Conductivity	SOP	μS/cm	2,710	52,900	4,370	7,480	106
Dissolved oxygen	SOP	mg/L	5.57	0.760	2.88	1.75	12.5
Oxidation Reduction Potential	SOP	mV	5.00	4.00	158	44.0	3.00
pH	SOP	pH	6.32	6.19	5.76	5.86	7.20
Temperature	SOP	degC	10.2	11.8	13.6	16.3	7.56
Turbidity	SOP	NTU	272	999	221	462	10.0

Note: -- not analyzed or measured
J - estimated
U - undetected at detection limit shown
SOP - standard operating procedure as outlined in *Elf Atochem Acid Plant Area Remedial Investigation and Feasibility Study Work Plan* (Exponent 1998).
CPD - City of Portland Datum
[a] - pH value may have been collected prior to stabilization.

Table 5. Volatile organic compound results for groundwater samples from the Stage 1 and 2 boreholes

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202
Depth below mudline (ft)			4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0
Elevation (ft CPD)			3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,1-Trichloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2-Trichloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethane	8260B	µg/L	13 *U*	1.3	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloropropene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,2,3-Trichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	50 *UR*	2.0 *UR*	10 *UR*	4.0 *UR*	2.0 *UR*	2.0 *UR*	2.0 *UR*
1,2-Dibromoethane	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dichlorobenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
1,2-Dichloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2-Dichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,3-Dichlorobenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
1,3-Dichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,4-Dichlorobenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
2,2-Dichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
2-Butanone	8260B	µg/L	500 *UR*	20 *UR*	100 *UR*	40 *UR*	20 *UR*	20 *UR*	20 *UR*
2-Chlorotoluene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
2-Hexanone	8260B	µg/L	500 *U*	20 *U*	100 *U*	40 *U*	20 *U*	20 *U*	20 *U*
4-Chlorotoluene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
4-Isopropyltoluene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
4-Methyl-2-pentanone	8260B	µg/L	500 *UR*	20 *UR*	100 *UR*	40 *UR*	20 *UR*	20 *UR*	20 *UR*
Acetone	8260B	µg/L	500 *UR*	20 *UR*	100 *UR*	40 *UR*	20 *UR*	20 *UR*	20 *UR*
Benzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
Bromobenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
Bromochloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromodichloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromoform	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromomethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202
	Depth below mudline (ft)		4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0
	Elevation (ft CPD)		3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Carbon tetrachloride	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chlorobenzene	8260B	µg/L	980	13	240	47	1.8 *J*	70	100
Chloroethane	8260B	µg/L	13 *UR*	0.50 *UR*	2.5 *UR*	1.0 *UR*	0.50 *UR*	0.50 *UR*	0.50 *UR*
Chloroform	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,2-Dichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromochloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromomethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dichlorodifluoromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Ethylbenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
Hexachlorobutadiene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Isopropylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
meta & *para* Xylenes	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
Methylene chloride	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Naphthalene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.9 *J*	2.0 *U*	2.0 *U*
n-Butylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
n-Propylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
ortho-Xylene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.5 *UJ*	0.5 *U*	0.5 *U*
sec-Butylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
Styrene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
tert-Butylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
Tetrachloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Toluene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
trans-1,2-Dichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Trichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Trichlorofluoromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Vinyl chloride	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-4	WB-4	WB-4	WB-5	WB-5	WB-7	WB-8
			6/10/2002	6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003
			GW06100201	GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301
Depth below mudline (ft)			8.3 to 4.3	17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3
Elevation (ft CPD)			2.3 to -1.7	-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1-Dichloroethane	8260B	µg/L	0.77	0.59	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *UJ*	2.0 *UJ*	4.0 *UJ*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	10 *U*	1.0 *U*	50 *U*	5.0 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
2-Butanone	8260B	µg/L	20 *UR*	20 *UR*	40 *UR*	200 *U*	20 *U*	1,000 *U*	200 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
2-Hexanone	8260B	µg/L	20 *U*	20 *U*	40 *U*	200 *U*	20 *U*	1,000 *U*	200 *UR*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	20 *UR*	40 *UR*	200 *U*	20 *U*	1,000 *U*	200 *UR*
Acetone	8260B	µg/L	20 *UR*	20 *UR*	40 *UR*	200 *UR*	20 *UR*	1,000 *UR*	200 *UR*
Benzene	8260B	µg/L	0.68	0.50 *U*	1.0 *U*	5.0 *U*	0.59	25 *U*	5.0 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Bromodichloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	4.2	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Bromoform	8260B	µg/L	0.50 *U*	0.56	7.5	10.0 *U*	1.0 *U*	50 *U*	5.0 *U*
Bromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *UJ*	0.50 *UJ*	25 *UJ*	5.0 *U*

Table 5. (cont.)

			WB-4	WB-4	WB-4	WB-5	WB-5	WB-7	WB-8
			6/10/2002	6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003
			GW06100201	GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301
	Depth below mudline (ft)		8.3 to 4.3	17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3
	Elevation (ft CPD)		2.3 to -1.7	-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	10 *U*	1.0 *U*	50 *U*	5.0 *U*
Chlorobenzene	8260B	µg/L	47	1.4	3.1	2,200	38 *J*	18,000	2,800
Chloroethane	8260B	µg/L	0.50 *UR*	0.50 *UR*	1.0 *UR*	5.0 *U*	0.50 *U*	140	5.0 *U*
Chloroform	8260B	µg/L	0.50 *U*	12	270	5.0 *U*	6.4	54	5.0 *U*
Chloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.84	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Dibromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	3.5	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Dibromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.9	10 *U*	1.0 *U*	50 *U*	5.0 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Methylene chloride	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Naphthalene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
ortho-Xylene	8260B	µg/L	0.5 *U*	0.5 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Styrene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Tetrachloroethene	8260B	µg/L	1.5	0.89	1.0	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Toluene	8260B	µg/L	0.54	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*

Table 5. (cont.)

			WB-8	WB-9	WB-9	WB-10	WB-10	WB-10 (dup)	WB-11
			2/28/2003	3/4/2003	3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003
			GW02280302	GW03040301	GW03040302	GW03050302	GW03060301	GW03060302	GW03070302
	Depth below mudline (ft)		33.8 to 37.8	15.0 to 19.0	31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5
	Elevation (ft CPD)		-30.9 to -34.9	-9.9 to -13.9	-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1-Dichloroethane	8260B	µg/L	0.54	13 *U*	5.0 *U*	5.0 *J*	1.4	2.5 *U*	50 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	20 *U*	5.0 *U*	10 *U*	200 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	110	5.0 *U*	15 *J*	1.3 *U*	2.5 *U*	50 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	41 *J*	1.3 *U*	2.5 *U*	50 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	1.0 *J*	1.3 *U*	2.5 *U*	50 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	150	5.0 *U*	49 *J*	1.3 *U*	2.5 *U*	50 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
2-Butanone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	260 *J*	50 *UR*	100 *UR*	2,000 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
2-Hexanone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	200 *UR*	50 *UR*	100 *UR*	2,000 *U*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	20 *UR*	50 *UR*	100 *UR*	2,000 *UR*
Acetone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	1,300 *J*	50 *UR*	100 *UR*	2,000 *UR*
Benzene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	52 *J*	1.3 *U*	2.5 *U*	50 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Bromodichloromethane	8260B	µg/L	13	13 *U*	5.0 *U*	0.50 *U*	2.6	2.7	50 *U*
Bromoform	8260B	µg/L	13	13 *U*	5.0 *U*	5.0 *U*	1.5	2.5 *U*	50 *U*
Bromomethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *UJ*

Table 5. (cont.)

			WB-8	WB-9	WB-9	WB-10	WB-10	WB-10 (dup)	WB-11
			2/28/2003	3/4/2003	3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003
			GW02280302	GW03040301	GW03040302	GW03050302	GW03060301	GW03060302	GW03070302
	Depth below mudline (ft)		33.8 to 37.8	15.0 to 19.0	31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5
	Elevation (ft CPD)		-30.9 to -34.9	-9.9 to -13.9	-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	13 *J*	1.3 *U*	2.5 *U*	50 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Chlorobenzene	8260B	µg/L	28	12,000	2,800	64,000	1,200	1,100	32,000
Chloroethane	8260B	µg/L	0.50 *U*	57	5.0 *U*	96 *J*	1.6	2.5 *U*	50 *U*
Chloroform	8260B	µg/L	490	150	25	38 *J*	120	130	50 *U*
Chloromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	8.6 *J*	1.3	2.5 *U*	50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Dibromochloromethane	8260B	µg/L	5.7	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Dibromomethane	8260B	µg/L	1.5	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	20 *U*	5.0 *U*	10 *U*	200 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Methylene chloride	8260B	µg/L	2.7	50 *U*	20 *U*	75 *J*	5.0 *U*	10 *U*	200 *U*
Naphthalene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	59 *J*	5.0 *U*	10 *U*	200 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
ortho-Xylene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Styrene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Tetrachloroethene	8260B	µg/L	1.4	13 *U*	5.5	23 *J*	6.5	6.7	50 *U*
Toluene	8260B	µg/L	7.0	19 *U*	5.0 *U*	380 *J*	2.0 *U*	2.5 *U*	50 *U*
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	55	5.0 *U*	16 *J*	5.1	5.5	50 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	23	5.0 *U*	5.8 *J*	1.3 *U*	2.5 *U*	50 *U*

Table 5. (cont.)

			WB-11	WB-12	WB-13	WB-13	WB-14	WB-14	WB-15
			3/7/2003	2/20/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003
			GW03070301	GW02200301	GW02260303	GW02260304	GW02270301	GW02270302	GW02170301
	Depth below mudline (ft)		19.5 to 22.0	5.0 to 9.0	5.0 to 9.0	16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3
	Elevation (ft CPD)		-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2	-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1,1-Trichloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1,2-Trichloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1-Dichloroethane	8260B	µg/L	50 *U*	1.5	0.98	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1-Dichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1-Dichloropropene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2,3-Trichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2-Dibromoethane	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2-Dichlorobenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2-Dichloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2-Dichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,3-Dichlorobenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,3-Dichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,4-Dichlorobenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
2,2-Dichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
2-Butanone	8260B	µg/L	2,000 *UR*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *UR*
2-Chlorotoluene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
2-Hexanone	8260B	µg/L	2,000 *U*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *U*
4-Chlorotoluene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
4-Isopropyltoluene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
4-Methyl-2-pentanone	8260B	µg/L	2,000 *UR*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *UR*
Acetone	8260B	µg/L	2,000 *UR*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *UR*
Benzene	8260B	µg/L	50 *U*	0.92	1.6	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromobenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Bromochloromethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromodichloromethane	8260B	µg/L	50 *U*	6.7	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromoform	8260B	µg/L	50 *U*	9.9	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromomethane	8260B	µg/L	50 *UJ*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*

Table 5. (cont.)

			WB-11	WB-12	WB-13	WB-13	WB-14	WB-14	WB-15
			3/7/2003	2/20/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003
			GW03070301	GW02200301	GW02260303	GW02260304	GW02270301	GW02270302	GW02170301
	Depth below mudline (ft)		19.5 to 22.0	5.0 to 9.0	5.0 to 9.0	16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3
	Elevation (ft CPD)		-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2	-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Carbon tetrachloride	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Chlorobenzene	8260B	µg/L	23,000	11	23	12,000	4.2	9,300	210
Chloroethane	8260B	µg/L	50 *U*	0.95	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *UR*
Chloroform	8260B	µg/L	85 *U*	430	0.50 *U*	25 *U*	0.50 *U*	13 *U*	2.2
Chloromethane	8260B	µg/L	50 *U*	1.5	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *UJ*
cis-1,2-Dichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Dibromochloromethane	8260B	µg/L	50 *U*	3.3	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Dibromomethane	8260B	µg/L	50 *U*	1.4	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Dichlorodifluoromethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *UJ*
Ethylbenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Hexachlorobutadiene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Isopropylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
meta & para Xylenes	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Methylene chloride	8260B	µg/L	200 *U*	2.6	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Naphthalene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
n-Butylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
n-Propylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
ortho-Xylene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
sec-Butylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Styrene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
tert-Butylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Tetrachloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	400	0.86	250	0.50 *U*
Toluene	8260B	µg/L	50 *U*	1.0	1.1	25 *U*	1.7	13 *U*	1.7
trans-1,2-Dichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Trichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25	0.50 *U*	190	0.50 *U*
Trichlorofluoromethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Vinyl chloride	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*

Table 5. (cont.)

			WB-16	WB-18	WB-18	WB-19	WB-20	WB-21
			2/19/2003	2/25/2003	2/26/2003	2/25/2003	2/24/2003	2/20/2003
			GW02190301	GW02250302	GW02260301	GW02250301	GW02240301	GW02200302
	Depth below mudline (ft)		3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9	2.5 to 4.5	4.3 to 8.3
	Elevation (ft CPD)		-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1	-39.4 to -41.4	-39.2 to -43.2
Chemical	Method	Units						
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	2.1	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.85	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
2-Butanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
2-Hexanone	8260B	µg/L	20 *U*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
Acetone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
Benzene	8260B	µg/L	0.50 *U*	0.72	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromodichloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromoform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-16	WB-18	WB-18	WB-19	WB-20	WB-21
			2/19/2003	2/25/2003	2/26/2003	2/25/2003	2/24/2003	2/20/2003
			GW02190301	GW02250302	GW02260301	GW02250301	GW02240301	GW02200302
	Depth below mudline (ft)		3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9	2.5 to 4.5	4.3 to 8.3
	Elevation (ft CPD)		-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1	-39.4 to -41.4	-39.2 to -43.2
Chemical	Method	Units						
Carbon disulfide	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chlorobenzene	8260B	µg/L	20	2.3	0.50 *U*	0.50 *U*	79	220
Chloroethane	8260B	µg/L	0.50 *UR*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chloroform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chloromethane	8260B	µg/L	0.50 *UJ*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.4	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *UJ*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Methylene chloride	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Naphthalene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
ortho-Xylene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Styrene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Tetrachloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Toluene	8260B	µg/L	6.4	31 *U*	7.1 *U*	6.4 *U*	1.5 *U*	2.1
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.2	0.50 *U*	0.50 *U*	0.50 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.59	0.50 *U*	0.50 *U*	0.50 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-21 (dup)	WB-22	WB-23	WB-23	WB-25	WB-25
			2/20/2003	2/21/2003	2/18/2003	2/18/2003	3/10/2003	3/10/2003
			GW02200303	GW02210301	GW02180301	GW02180302	GW03100301	GW03100302
		Depth below mudline (ft)	4.3 to 8.3	3.5 to 7.5	3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7
		Elevation (ft CPD)	-39.2 to -43.2	-42.4 to -46.4	-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1
Chemical	Method	Units						
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	2.2	25 *U*	25 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
2-Butanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	40 *UR*	1,000 *UR*	1,000 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
2-Hexanone	8260B	µg/L	20 *UR*	20 *UR*	20 *U*	40 *U*	1,000 *U*	1,000 *U*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	40 *UR*	1,000 *UR*	1,000 *UR*
Acetone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	40 *UR*	1,000 *UR*	1,000 *UR*
Benzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Bromodichloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	5.5	25 *U*	25 *U*
Bromoform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	5.1	25 *U*	25 *U*
Bromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *UJ*	25 *UJ*

Table 5. (cont.)

			WB-21 (dup)	WB-22	WB-23	WB-23	WB-25	WB-25
			2/20/2003	2/21/2003	2/18/2003	2/18/2003	3/10/2003	3/10/2003
			GW02200303	GW02210301	GW02180301	GW02180302	GW03100301	GW03100302
	Depth below mudline (ft)		4.3 to 8.3	3.5 to 7.5	3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7
	Elevation (ft CPD)		-39.2 to -43.2	-42.4 to -46.4	-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1
Chemical	Method	Units						
Carbon disulfide	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Chlorobenzene	8260B	µg/L	190	100 *J*	0.50 *U*	2.9	16,000	16,000
Chloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *UR*	1.0 *UR*	25 *U*	25 *U*
Chloroform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	610	25 *U*	25 *U*
Chloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *UJ*	1.0 *UJ*	25 *U*	25 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	57	25 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Dibromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	3.2	25 *U*	25 *U*
Dibromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.4	25 *U*	25 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *UJ*	1.0 *U*	25 *U*	25 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Methylene chloride	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Naphthalene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
ortho-Xylene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Styrene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Tetrachloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Toluene	8260B	µg/L	2.2	4.7	3.2	2.5	25 *U*	25 *U*
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	45	25 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*

Note: *J* - estimated
R - rejected
U - undetected at detection limit shown
CPD - City of Portland Datum

Table 6. Pesticide results for groundwater samples from the Stage 1 and 2 boreholes

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)	WB-4
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002	6/10/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202	GW06100201
	Depth below mudline (ft)		4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0	4.3 to 8.3
	Elevation (ft CPD)		3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3	2.3 to -1.7
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	15 *J*	1.6 *J*	6.0 *J*	0.78 *J*	1.0 *J*	0.86 *J*	1.6 *J*	5.3 *J*
4,4'-DDE	8081A	µg/L	0.41 *J*	0.018 *J*	0.25 *J*	0.016 *J*	0.10	0.031 *J*	0.056 *J*	0.11 *J*
4,4'-DDT	8081A	µg/L	34 *J*	0.44	29 *J*	0.14	0.17	0.24	0.27	6.5 *J*
Aldrin	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.017 *UR*
alpha-Chlordane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
alpha-Endosulfan	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.054 *UR*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.37 *UR*
beta-Endosulfan	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.088 *UR*
beta-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
delta-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.015 *UR*
Dieldrin	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endosulfan sulfate	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endrin	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endrin aldehyde	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endrin ketone	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
gamma-Chlordane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.099 *UR*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Heptachlor	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *UR*
Heptachlor epoxide	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Methoxychlor	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Toxaphene	8081A	µg/L	0.50 *UJ*	0.50 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.48 *UR*

Table 6. (cont.)

			WB-4	WB-4	WB-5	WB-5	WB-7	WB-8	WB-8	WB-9
			6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003	2/28/2003	3/4/2003
			GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301	GW02280302	GW03040301
	Depth below mudline (ft)		17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3	33.8 to 37.8	15.0 to 19.0
	Elevation (ft CPD)		-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4	-30.9 to -34.9	-9.9 to -13.9
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	0.38 *J*	0.83 *J*	22 *J*	5 *J*	78 *J*	14	12	72 *J*
4,4'-DDE	8081A	µg/L	0.020 *J*	0.042 *J*	0.55 *J*	0.22 *J*	0.40 *J*	0.097 *U*	0.44 *J*	1.2 *J*
4,4'-DDT	8081A	µg/L	0.69 *J*	2.0 *J*	26 *J*	65 *J*	66 *J*	10	17	68 *U*
Aldrin	8081A	µg/L	0.0098 *UR*	0.027 *UR*	0.0098 *UJ*	0.0098 *UJ*	0.0098 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
alpha-Chlordane	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.011 *UJ*	0.011 *UJ*	0.011 *UJ*	0.097 *U*	0.096 *U*	1.4
alpha-Endosulfan	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0066 *UJ*	0.0066 *UJ*	0.0066 *UJ*	0.097 *U*	0.096 *U*	0.23 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.017 *UR*	0.055 *UR*	0.0051 *UJ*	0.0051 *UJ*	0.0051 *UJ*	0.097 *U*	0.50 *U*	0.53 *U*
beta-Endosulfan	8081A	µg/L	0.012 *UR*	0.020 *UR*	0.0072 *UJ*	0.0072 *UJ*	0.0072 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.017 *UJ*	0.017 *UJ*	0.017 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0020 *UJ*	0.0020 *UJ*	0.0020 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Dieldrin	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0048 *UJ*	0.0048 *UJ*	0.0048 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Endosulfan sulfate	8081A	µg/L	0.0098 *UR*	0.013 *UR*	0.0051 *UJ*	0.0051 *UJ*	0.0051 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Endrin	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0089 *UJ*	0.0089 *UJ*	0.0089 *UJ*	0.34 *U*	0.096 *U*	0.098 *U*
Endrin aldehyde	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0047 *UJ*	0.0047 *UJ*	0.0047 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Endrin ketone	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0020 *UJ*	0.0020 *UJ*	0.0020 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
gamma-Chlordane	8081A	µg/L	0.0098 *UR*	0.013 *UR*	0.0053 *UJ*	0.0053 *UJ*	0.0053 *UJ*	0.097 *U*	0.096 *U*	0.14 *U*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.12 *UR*	0.037 *UR*	0.0034 *UJ*	0.0034 *UJ*	0.0034 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Heptachlor	8081A	µg/L	0.014 *UR*	0.026 *UR*	0.0020 *UJ*	0.0020 *UJ*	0.0020 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Heptachlor epoxide	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0031 *UJ*	0.0031 *UJ*	0.0031 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Methoxychlor	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0043 *UR*	0.0043 *UR*	0.0043 *UR*	0.097 *U*	0.096 *U*	0.098 *U*
Toxaphene	8081A	µg/L	0.49 *UR*	0.58 *UR*	0.50 *UJ*	0.50 *UJ*	0.50 *UJ*	4.9 *U*	9.2 *U*	4.9 *U*

Table 6. (cont.)

			WB-9	WB-10	WB-10	WB-10 (dup)	WB-11	WB-11	WB-12	WB-13
			3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003	3/7/2003	2/20/2003	2/26/2003
			GW03040302	GW03050302	GW03060301	GW03060302	GW03070302	GW03070301	GW02200301	GW02260303
	Depth below mudline (ft)		31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5	19.5 to 22.0	5.0 to 9.0	5.0 to 9.0
	Elevation (ft CPD)		-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6	-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	2.2	710	0.20 *U*	0.25 *U*	91	3.5	0.13	0.60
4,4'-DDE	8081A	µg/L	0.16	13	0.0098 *U*	0.0098 *U*	1.5 *J*	0.077 *J*	0.098 *U*	0.0097 *U*
4,4'-DDT	8081A	µg/L	17	1,900	0.21 *U*	0.33 *U*	130	1.1 *J*	0.26	0.49 *J*
Aldrin	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.11 *J*	0.098 *U*	0.0097 *U*
alpha-Chlordane	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
alpha-Endosulfan	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.85 *U*	1.2 *U*	0.028 *U*	0.018 *U*	0.011 *U*	5.9 *U*	0.098 *U*	0.052 *U*
beta-Endosulfan	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.015 *U*	0.19 *J*	0.0097 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.18 *J*	0.98 *U*	0.012 *U*	0.0098 *U*	0.011 *U*	0.028 *U*	0.098 *U*	0.0097 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.019	0.098 *U*	0.0097 *U*
Dieldrin	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Endosulfan sulfate	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.073 *U*	0.018 *U*	0.098 *U*	0.0097 *U*
Endrin	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.014 *U*	0.098 *U*	0.0097 *U*
Endrin aldehyde	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Endrin ketone	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
gamma-Chlordane	8081A	µg/L	0.098 *U*	1.4 *U*	0.0098 *U*	0.0098 *U*	0.097 *U*	0.014 *U*	0.098 *U*	0.0097 *U*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.038 *J*	0.024	0.098 *U*	0.0097 *U*
Heptachlor	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Heptachlor epoxide	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.019 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Methoxychlor	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.012 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Toxaphene	8081A	µg/L	4.9 *U*	250 *U*	0.49 *U*	0.49 *U*	5.6 *U*	2.2 *U*	4.9 *U*	0.49 *U*

Table 6. (cont.)

			WB-13	WB-14	WB-14	WB-15	WB-16	WB-18	WB-18	WB-19
			2/26/2003	2/27/2003	2/27/2003	2/17/2003	2/19/2003	2/25/2003	2/26/2003	2/25/2003
			GW02260304	GW02270301	GW02270302	GW02170301	GW02190301	GW02250302	GW02260301	GW02250301
	Depth below mudline (ft)		16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3	3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9
	Elevation (ft CPD)		-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8	-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	0.12	20	0.097 *U*	2.0	0.033	0.16	0.30	0.0097 *U*
4,4'-DDE	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
4,4'-DDT	8081A	µg/L	0.18 *U*	23	0.097 *U*	1.3	0.030 *U*	0.51	0.13	0.0097 *U*
Aldrin	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
alpha-Chlordane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
alpha-Endosulfan	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	14 *U*	0.28 *U*	3.3 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
beta-Endosulfan	8081A	µg/L	0.11 *U*	0.098 *U*	0.097 *U*	0.27 *U*	0.045 *U*	0.16	0.038 *J*	0.025 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.022 *U*	0.0097 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Dieldrin	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endosulfan sulfate	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endrin	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endrin aldehyde	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endrin ketone	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.019
gamma-Chlordane	8081A	µg/L	0.099 *U*	0.26 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Heptachlor	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Heptachlor epoxide	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Methoxychlor	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Toxaphene	8081A	µg/L	5.0 *U*	20 *U*	4.9 *U*	26 *U*	0.49 *U*	4.9 *U*	0.52 *U*	0.49 *U*

Table 6. (cont.)

			WB-20	WB-21	WB-21 (dup)	WB-22	WB-23	WB-23	WB-25	WB-25
			2/24/2003	2/20/2003	2/20/2003	2/21/2003	2/18/2003	2/18/2003	3/10/2003	3/10/2003
			GW02240301	GW02200302	GW02200303	GW02210301	GW02180301	GW02180302	GW03100301	GW03100302
	Depth below mudline (ft)		2.5 to 4.5	4.3 to 8.3	4.3 to 8.3	3.5 to 7.5	3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7
	Elevation (ft CPD)		-39.4 to -41.4	-39.2 to -43.2	-39.2 to -43.2	-42.4 to -46.4	-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	0.010 *U*	0.011	0.013	0.0098 *U*	0.13	0.098 *U*	0.42	4.5
4,4'-DDE	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.053 *J*	0.098 *U*	0.017	0.055 *U*
4,4'-DDT	8081A	µg/L	0.010 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.15	0.098 *U*	0.28 *J*	3.6
Aldrin	8081A	µg/L	0.010 *U*	0.010	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.034 *U*	0.036 *U*
alpha-Chlordane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.018 *U*
alpha-Endosulfan	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.018 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.012 *U*	0.0099 *U*
beta-Endosulfan	8081A	µg/L	0.022 *U*	0.013 *U*	0.013 *U*	0.016 *U*	0.067 *U*	0.098 *U*	0.074 *U*	0.12 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.013 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.019 *J*	0.0099 *U*
Dieldrin	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Endosulfan sulfate	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.017
Endrin	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.013 *U*
Endrin aldehyde	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Endrin ketone	8081A	µg/L	0.031	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
gamma-Chlordane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.025 *UJ*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.028	0.044 *J*
Heptachlor	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Heptachlor epoxide	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Methoxychlor	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.030 *U*
Toxaphene	8081A	µg/L	0.51 *U*	0.49 *U*	0.49 *U*	0.49 *U*	1.3 *U*	4.9 *U*	0.75 *U*	3.9 *U*

Note: Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

J - estimated

R - rejected

U - undetected at detection limit shown

CPD - City of Portland Datum

Table 7. Perchlorate results for groundwater samples from the Stage 2 boreholes

Sample number	Survey station	Date	Depth Below Mudline (ft)	Elevation (ft CPD)	Perchlorate (µg/L)
GW02280301	WB-8	2/28/2003	10.3 to 14.3	-7.4 to -11.4	65 *J*
GW02280302	WB-8	2/28/2003	33.8 to 37.8	-30.9 to -34.9	3,800
GW03040301	WB-9	3/4/2003	15.0 to 19.0	-9.9 to -13.9	800 *U*
GW03040302	WB-9	3/4/2003	31.0 to 35.0	-25.9 to -29.9	400 *U*
GW03050302	WB-10	3/5/2003	14.0 to 18.0	-18.0 to -22.0	40,000 *U*
GW03060301	WB-10	3/6/2003	24.0 to 28.0	-28.0 to -32.0	1,000 *U*
GW03060302	WB-10 (dup)	3/6/2003	24.0 to 28.0	-28.0 to -32.0	1,000 *U*
GW03070302	WB-11	3/7/2003	11.5 to 15.5	-13.6 to -17.6	1,000 *U*
GW03070301	WB-11	3/7/2003	19.5 to 22.0	-21.6 to -24.1	1,000 *U*
GW02200301	WB-12	2/20/2003	5.0 to 9.0	-37.9 to -41.9	160,000 *J*
GW02260303	WB-13	2/26/2003	5.0 to 9.0	-4.2 to -8.2	20 *U*
GW02260304	WB-13	2/26/2003	16.5 to 20.5	-15.7 to -19.7	80 *U*
GW02270301	WB-14	2/27/2003	4.0 to 8.0	-10.5 to -14.5	4.0 *U*
GW02270302	WB-14	2/27/2003	17.0 to 21.0	-23.5 to -27.5	80 *U*
GW02170301	WB-15	2/17/2003	1.3 to 5.3	-36.8 to -40.8	40 *U*
GW02190301	WB-16	2/19/2003	3.4 to 4.4	-30.5 to -31.5	6.6
GW02250302	WB-18	2/25/2003	5.0 to 9.0	-3.5 to -7.5	81 *J*
GW02260301	WB-18	2/26/2003	17.5 to 21.5	-16.0 to -20.0	8.0 *U*
GW02250301	WB-19	2/25/2003	2.9 to 3.9	-27.1 to -28.1	4.0 *U*
GW02240301	WB-20	2/24/2003	2.5 to 4.5	-39.4 to -41.4	210 *J*
GW02200302	WB-21	2/20/2003	4.3 to 8.3	-39.2 to -43.2	200 *U*
GW02200303	WB-21 (dup)	2/20/2003	4.3 to 8.3	-39.2 to -43.2	200 *UJ*
GW02210301	WB-22	2/21/2003	3.5 to 7.5	-42.4 to -46.4	20 *U*
GW02180301	WB-23	2/18/2003	3.6 to 7.6	-14.8 to -18.8	11 *J*
GW02180302	WB-23	2/18/2003	16.6 to 20.6	-27.8 to -31.8	370,000
GW03100301	WB-25	3/10/2003	11.7 to 15.7	-16.1 to -20.1	1,000 *U*
GW03100302	WB-25	3/10/2003	19.7 to 21.7	-24.1 to -26.1	1,000 *U*

Note: *J* - estimated
U - undetected at detection limit shown
µg/L - micrograms per liter
CPD - City of Portland Datum

Figures

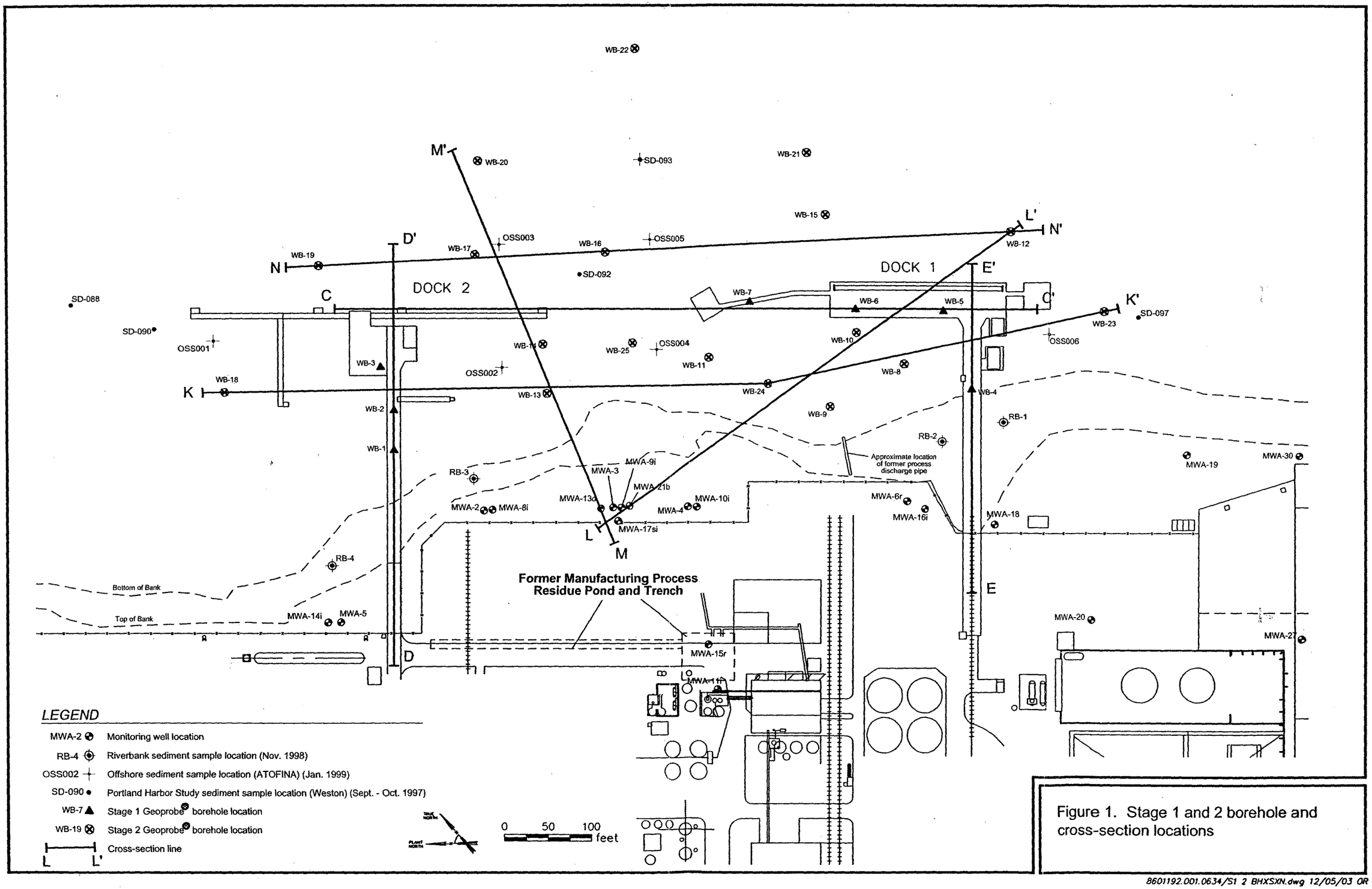


Figure 1. Stage 1 and 2 borehole and cross-section locations

8601192.001.0634/S1 2 BHXSXN.dwg 12/05/03 OR

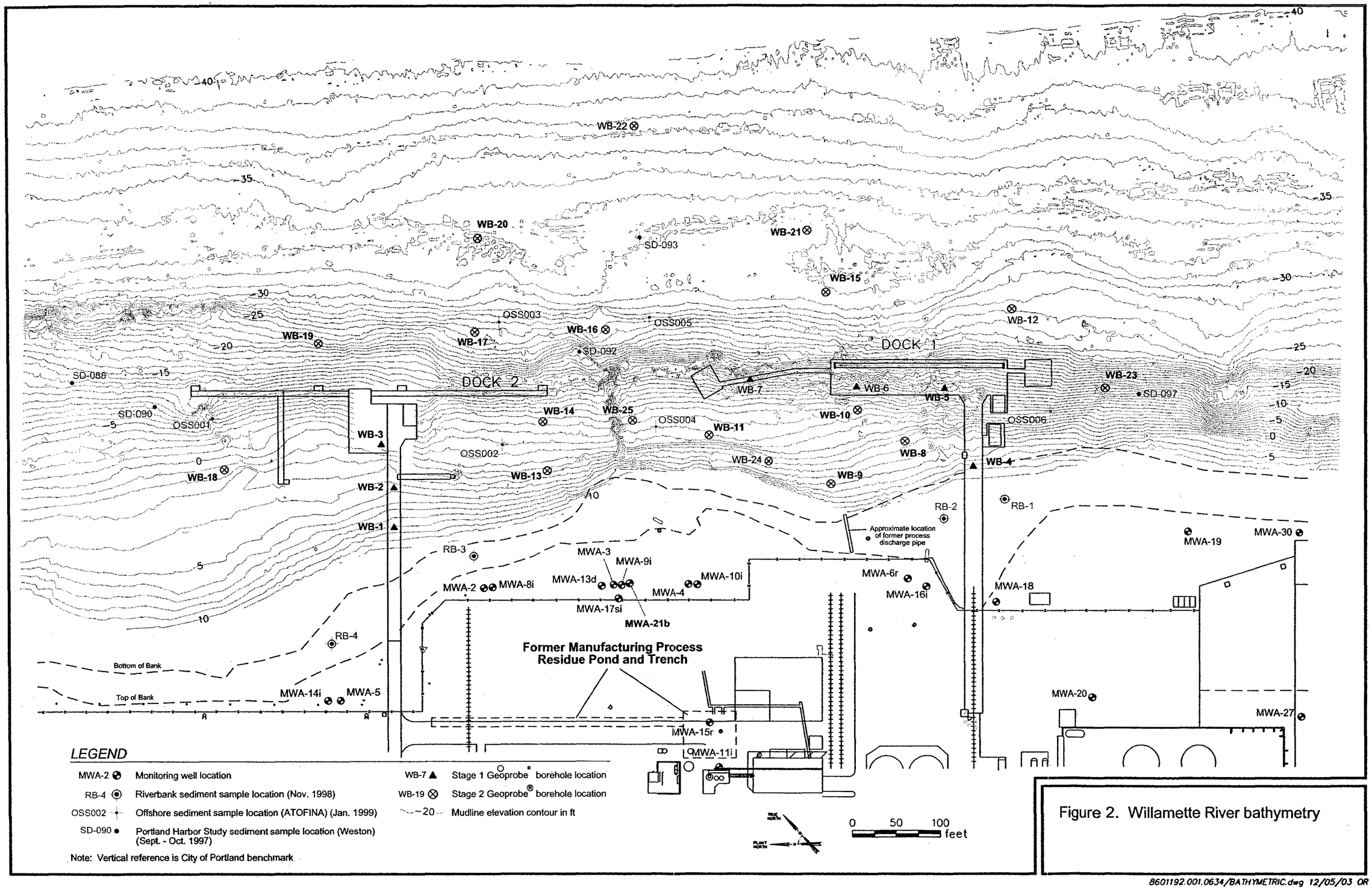


Figure 2. Willamette River bathymetry

8601192.001.0634/BATHYMETRIC.dwg 12/05/03 QR

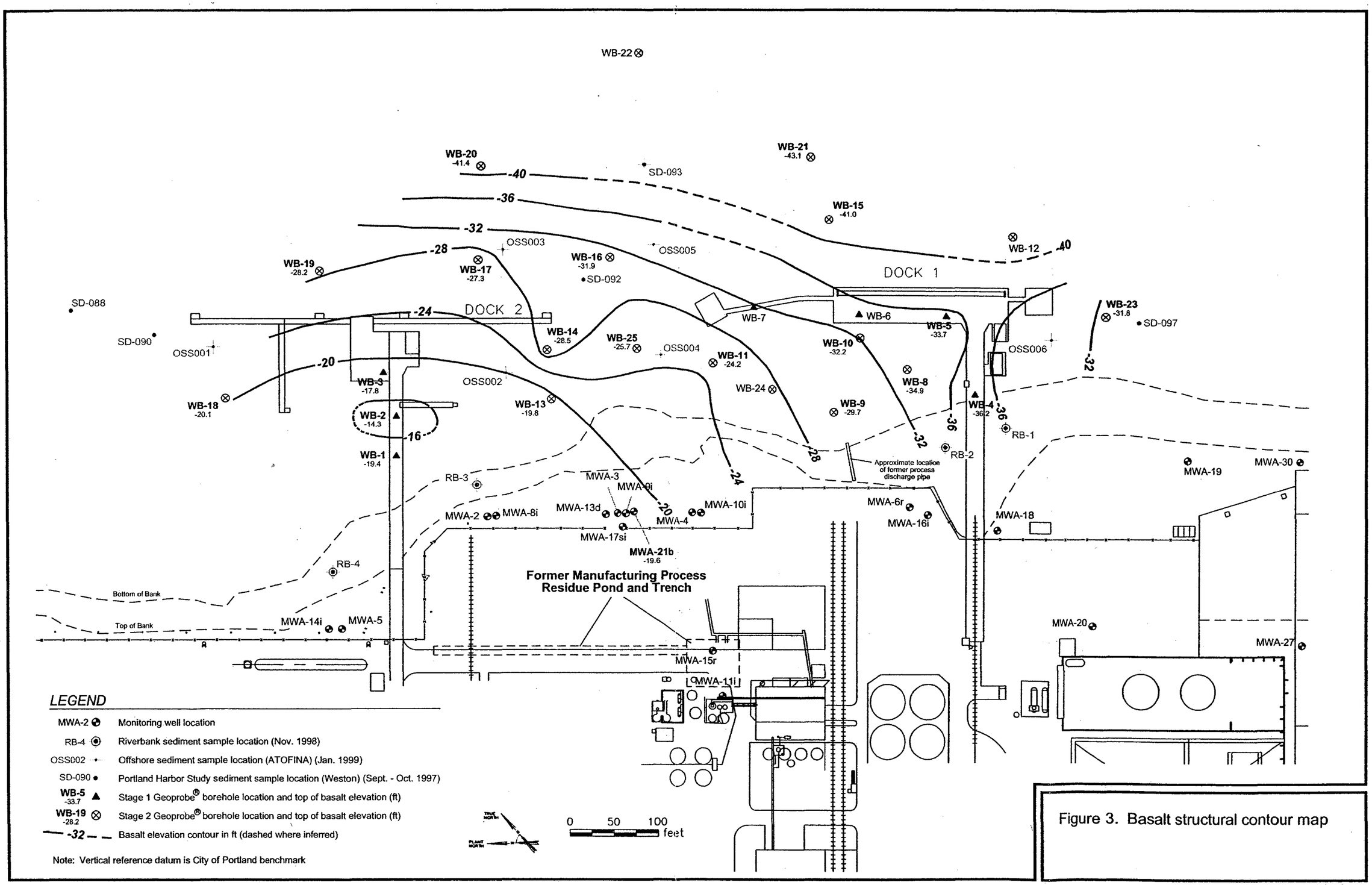
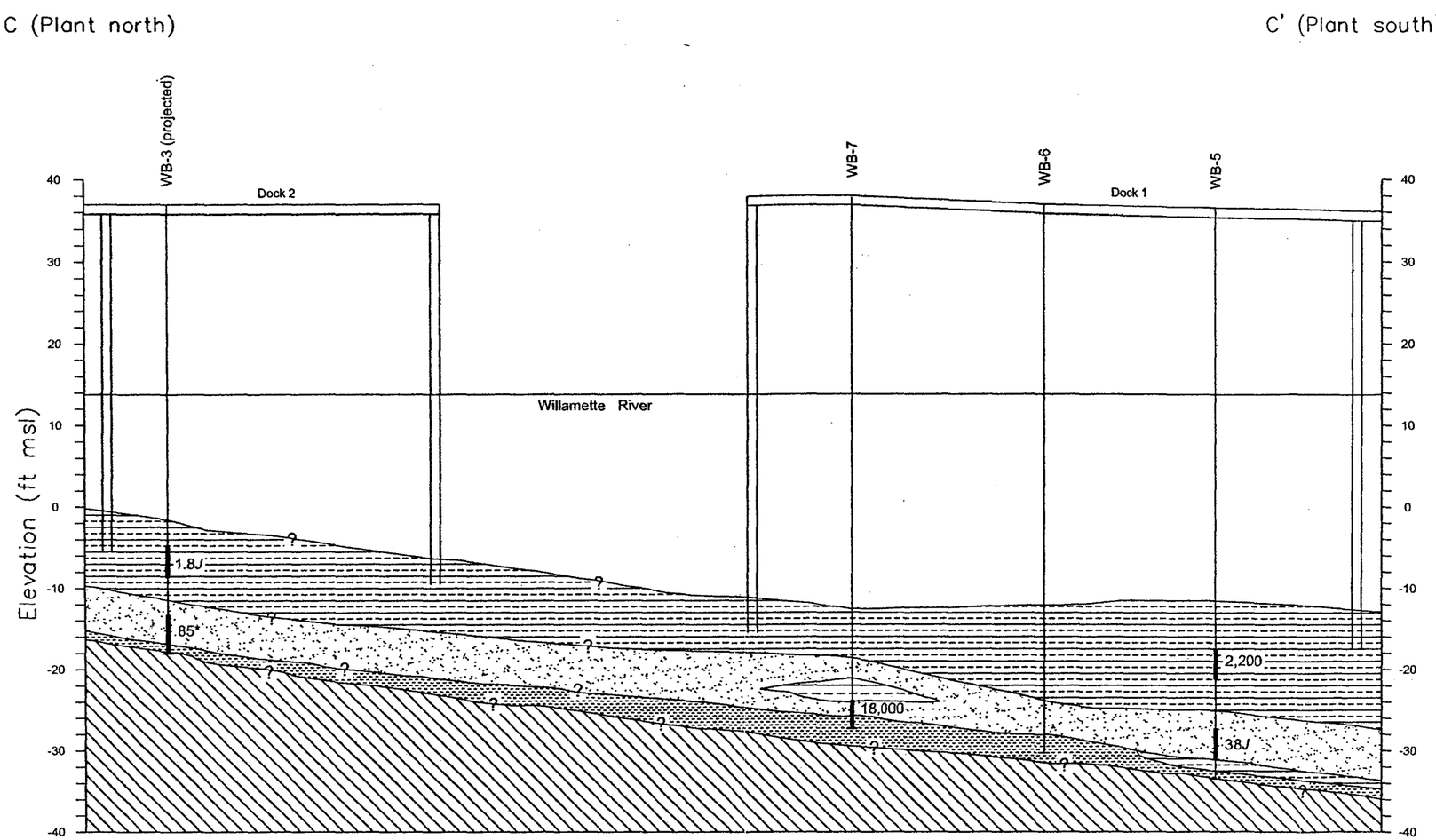


Figure 3. Basalt structural contour map

8601192.001.0634/BASALT.dwg 12/08/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt
- WB-3 — Geoprobe® boring number
- Boring with grab groundwater sample interval
- Inferred soil or geologic contact (queried where uncertain)
- J - Estimated
- * - Average of sample and sample duplicate

0 80 feet

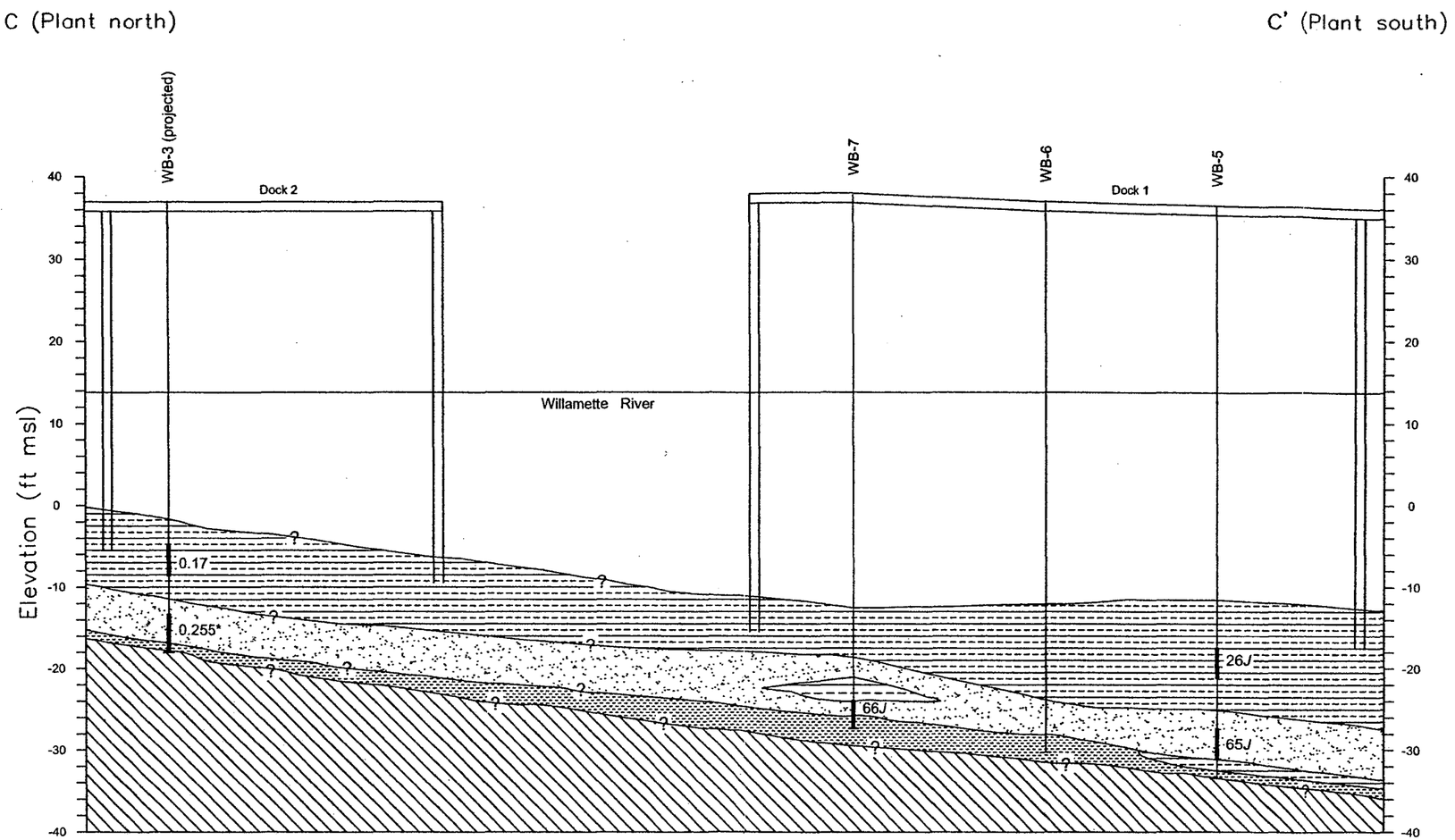
Note: Vertical scale exaggerated 5x

Note: All concentrations are in micrograms per liter (μg/L).
Chlorobenzene concentrations are from grab groundwater samples collected in June 2002.

Exponent

Figure 4a. Cross-section C-C' with chlorobenzene concentrations in groundwater

8601192.001.0634\C-C' Chlor.dwg 11/18/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number

Boring with grab groundwater sample interval

Inferred soil or geologic contact (queried where uncertain)

J - Estimated

* - Average of sample and sample duplicate

0 80 feet

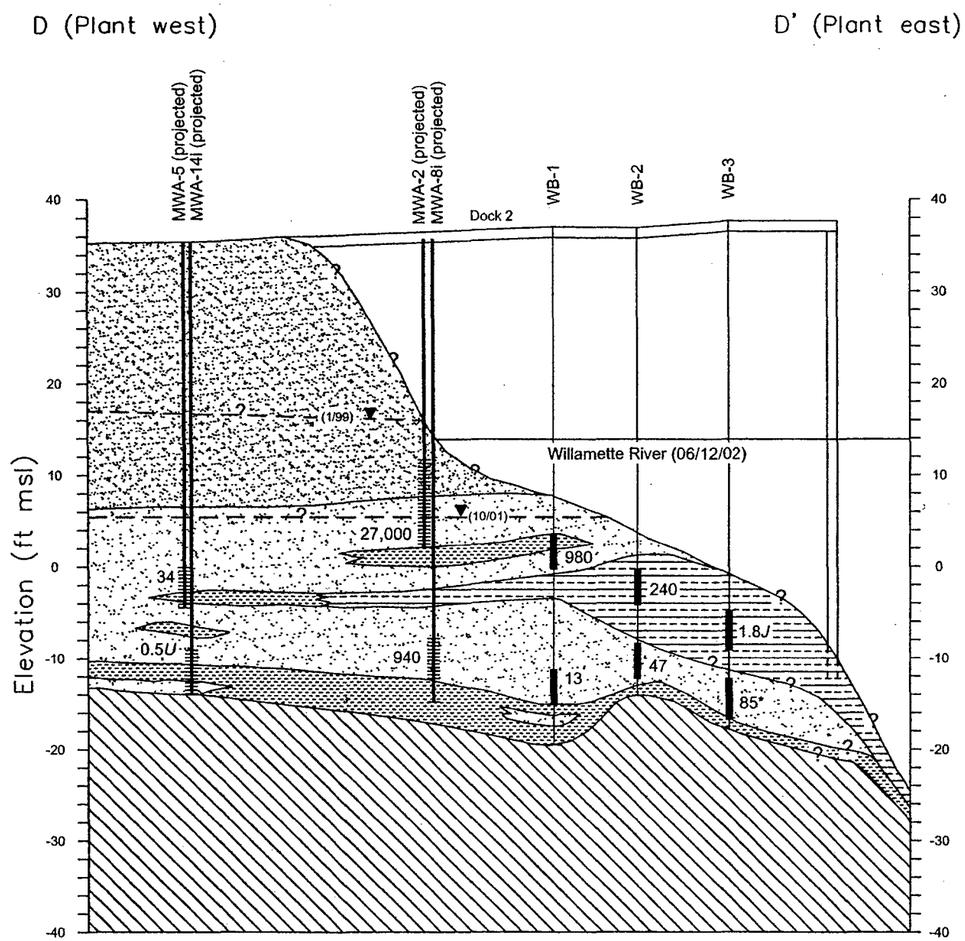
Note: Vertical scale exaggerated 5x

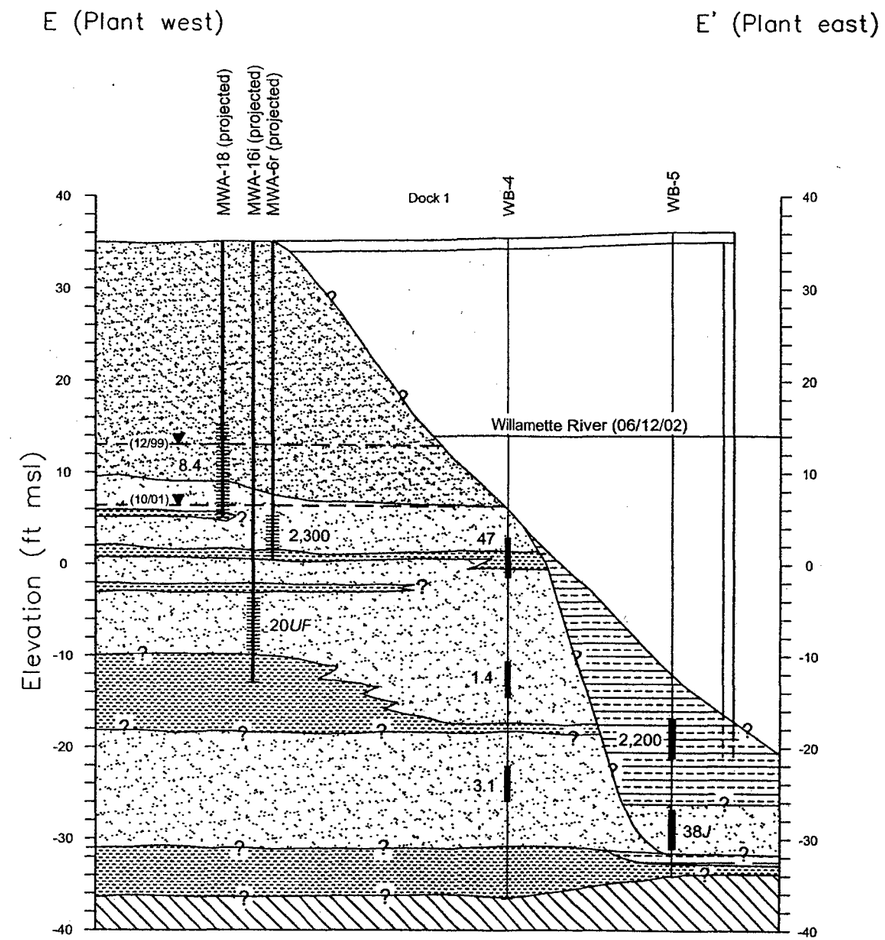
Note: All concentrations are in micrograms per liter (μg/L)
DDT concentrations are from grab groundwater samples collected in June 2002.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 4b. Cross-section C-C' with DDT concentrations in groundwater

8601192.001.0634\C-C' DDT.dwg 12/05/03 OR





LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number
MWA-1 — Well number
Cased interval
Screen interval

Shallow zone groundwater surface (approximate)
Inferred soil or geologic contact (queried where uncertain)
Boring with grab groundwater sample interval

F - Field quality control sample (blanks or reference materials) criteria not met
J - Estimated
U - Undetected at detection limit shown
* - Average of sample and sample duplicate

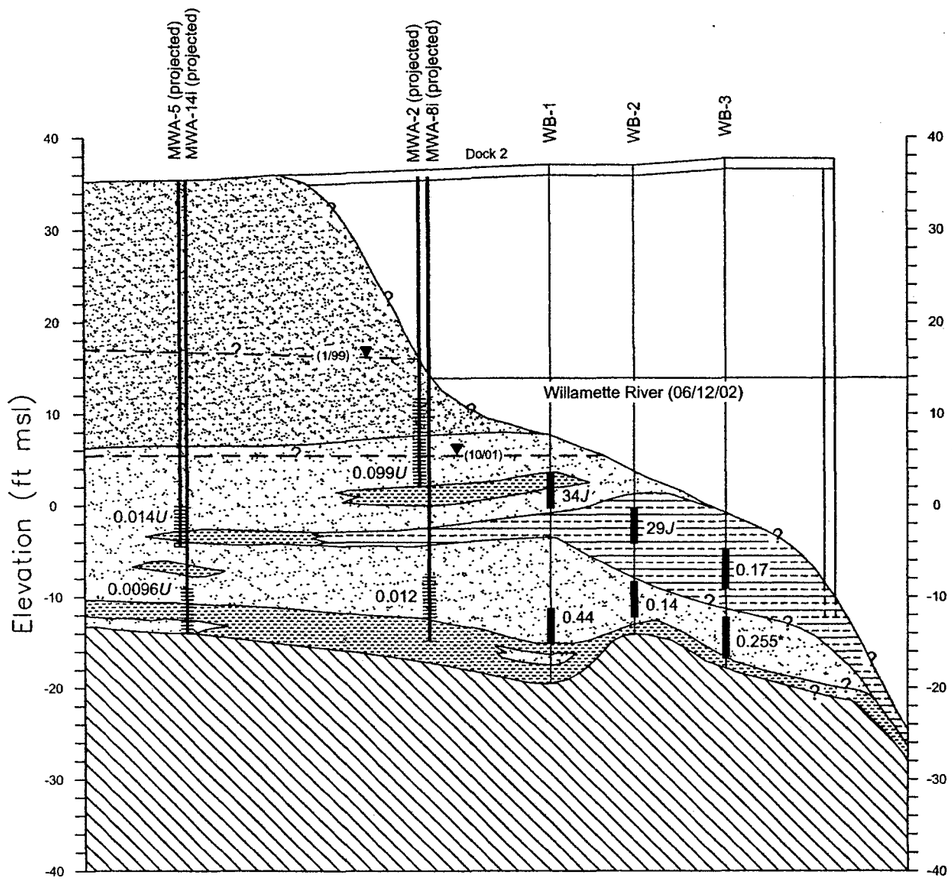
0 80 feet
Note: Vertical scale exaggerated 5x

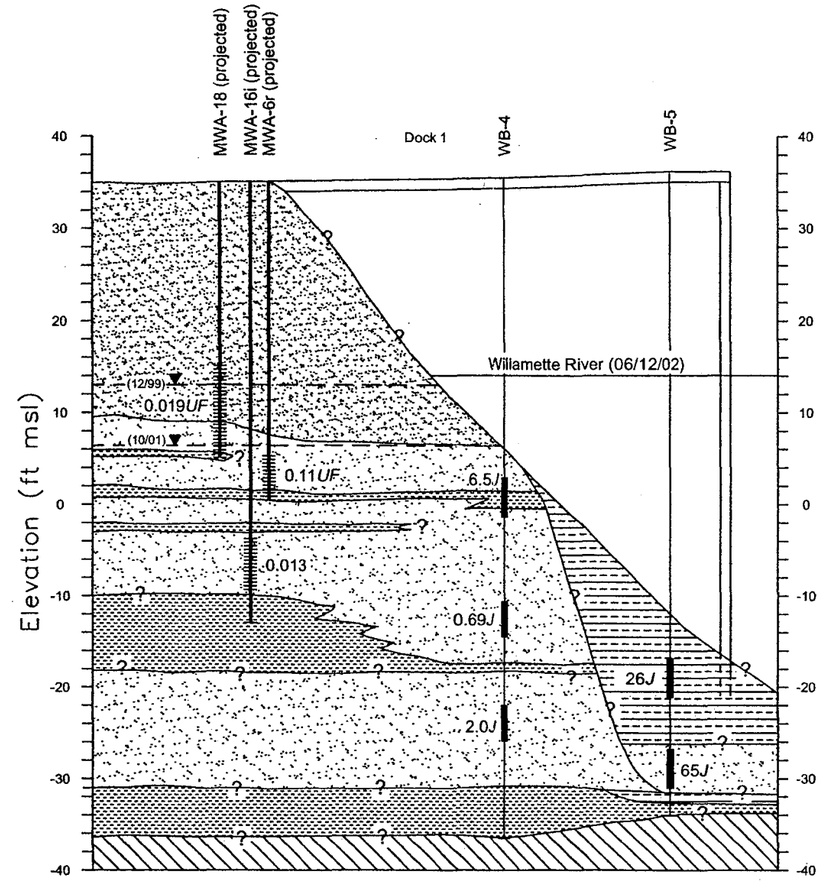
Note: All concentrations are in micrograms per liter (µg/L).
Chlorobenzene concentration data in monitoring wells are from April 2002; Geoprobe® boring data are from June 2002.

Exponent

Figure 5a. Cross-sections D-D' and E-E' with chlorobenzene concentrations in groundwater

8601192.001.0634\DD/EE.dwg 12/05/03 OR





LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number
MWA-1 — Well number
Cased interval
Screen interval

Shallow zone groundwater surface (approximate)
Inferred soil or geologic contact (queried where uncertain)
Boring with grab groundwater sample interval

F - Field quality control sample (blanks or reference materials) criteria not met
J - Estimated
U - Undetected at detection limt shown
* - Average of sample and sample duplicate

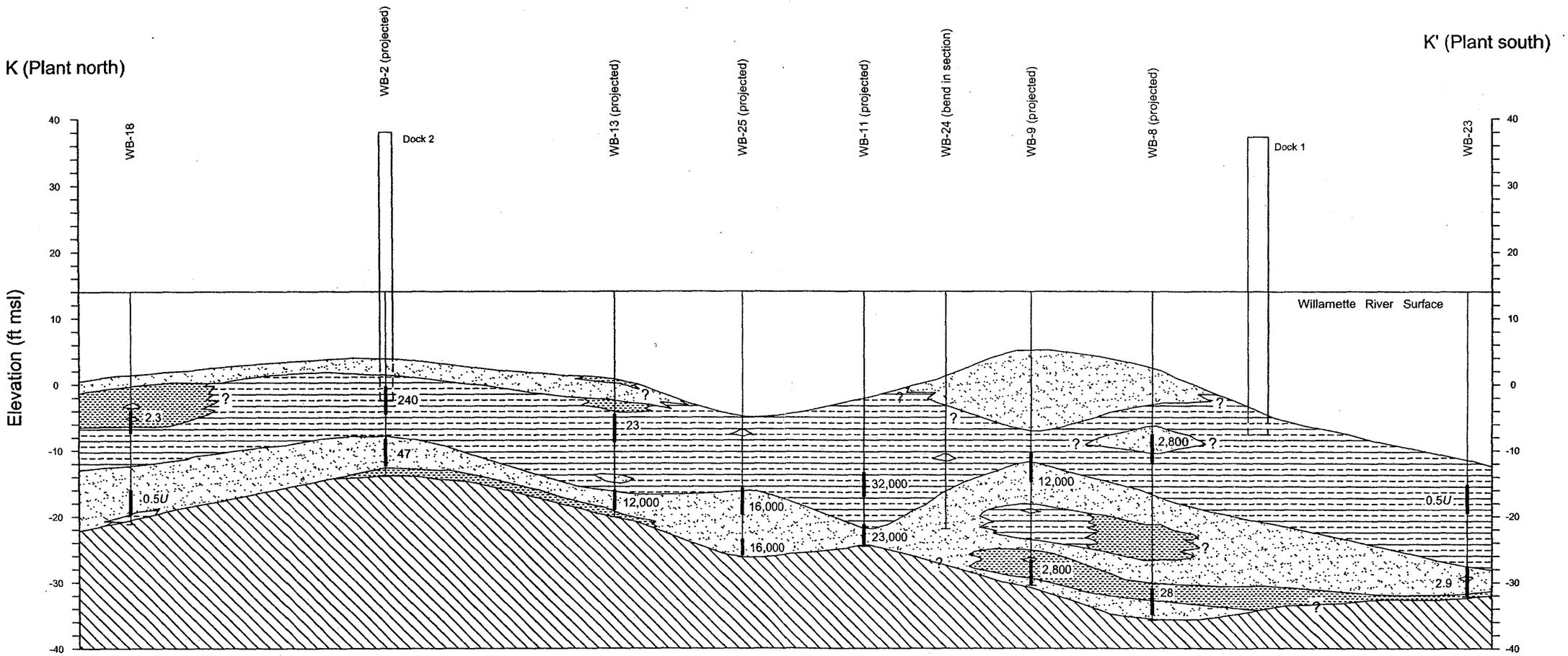
0 80 feet
Note: Vertical scale exaggerated 5x

Note: All concentrations are in micrograms per liter (μg/L).
DDT concentration data in monitoring wells are from April 2002; Geoprobe® boring data are from June 2002.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 5b. Cross-sections D-D' and E-E' with DDT concentrations in groundwater

8601192.001.0634\DD and EE.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number

Boring with grab groundwater sample interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
J Estimated
U Undetected at detection limit shown

0 80 feet

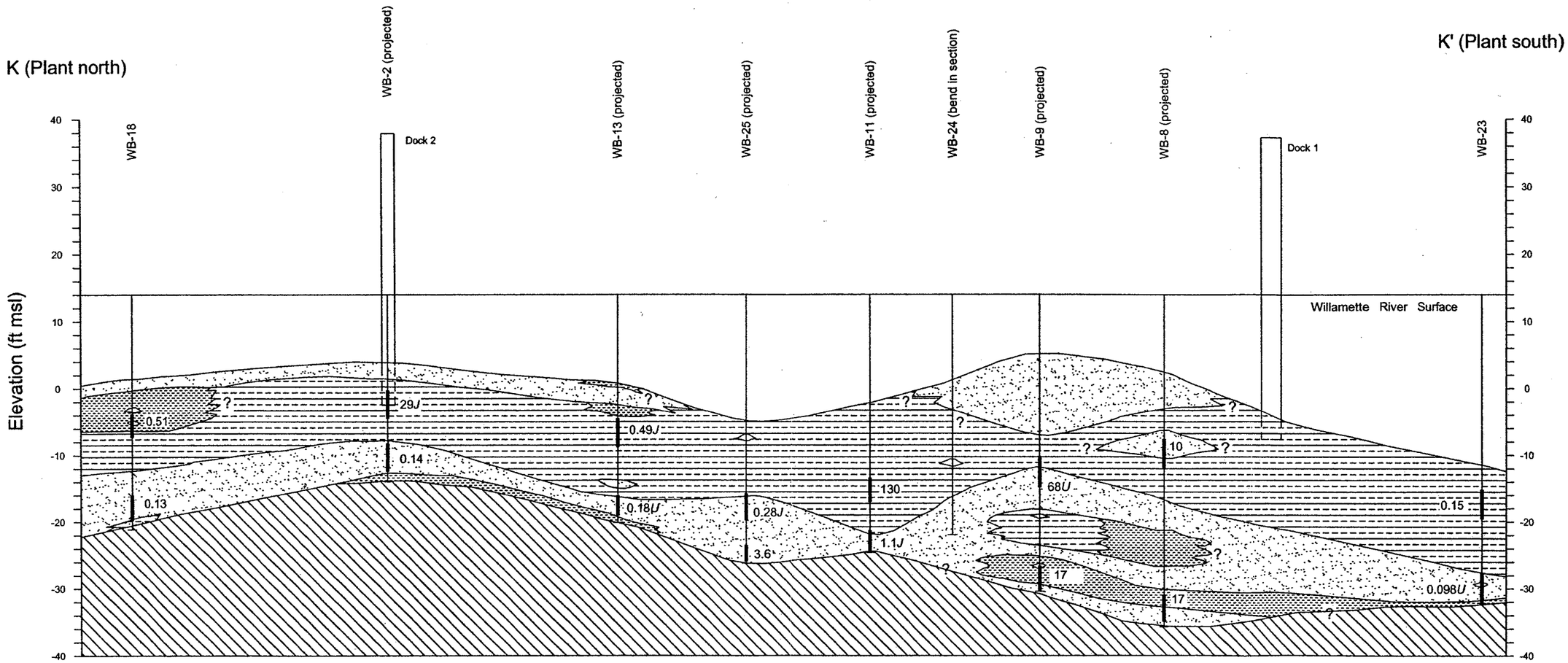
Note: Vertical scale exaggerated 5x

Notes: Stratigraphy in portions of WB-8, WB-9 and WB-25 consists of interlayered silts and sands. Contacts on cross-section are interpretive.
All concentrations are in micrograms per liter (µg/L). Chlorobenzene concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.

Exponent

Figure 6a. Cross-section K-K' with chlorobenzene concentrations in groundwater

8601192.001.0634\K-K' CHLOR.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number

Boring with grab groundwater sample interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
J Estimated
U Undetected at detection limit shown

0 — 80 feet

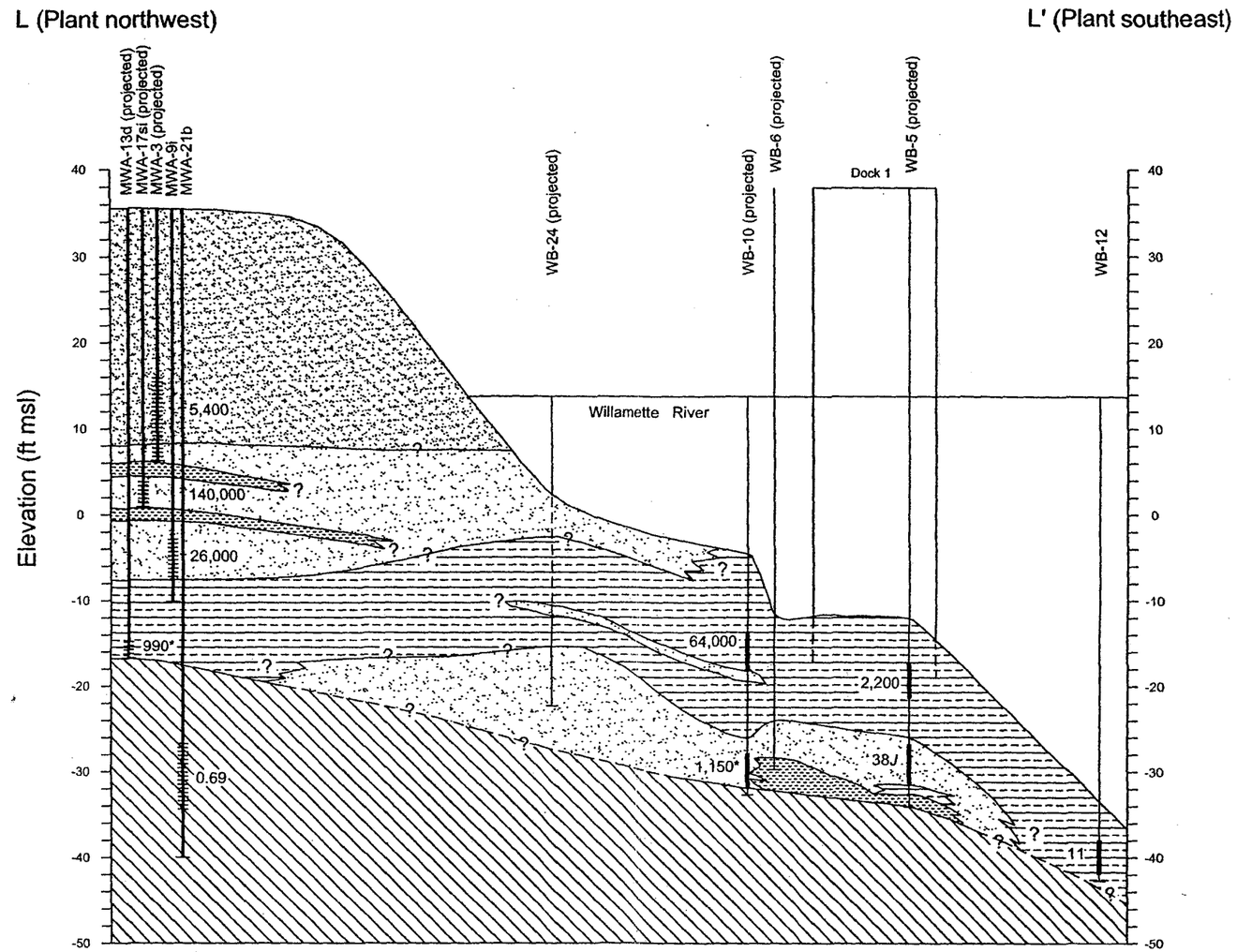
Note: Vertical scale exaggerated 5x

Notes: Stratigraphy in portions of WB-8, WB-9 and WB-25 consists of interlayered silts and sands. Contacts on cross-section are interpretive. All concentrations are in micrograms per liter (μg/L). DDT concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 6b. Cross-section K-K' with DDT concentrations in groundwater

8601192.001.0634\K-K' DDT.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate

J Estimated

0 80 feet

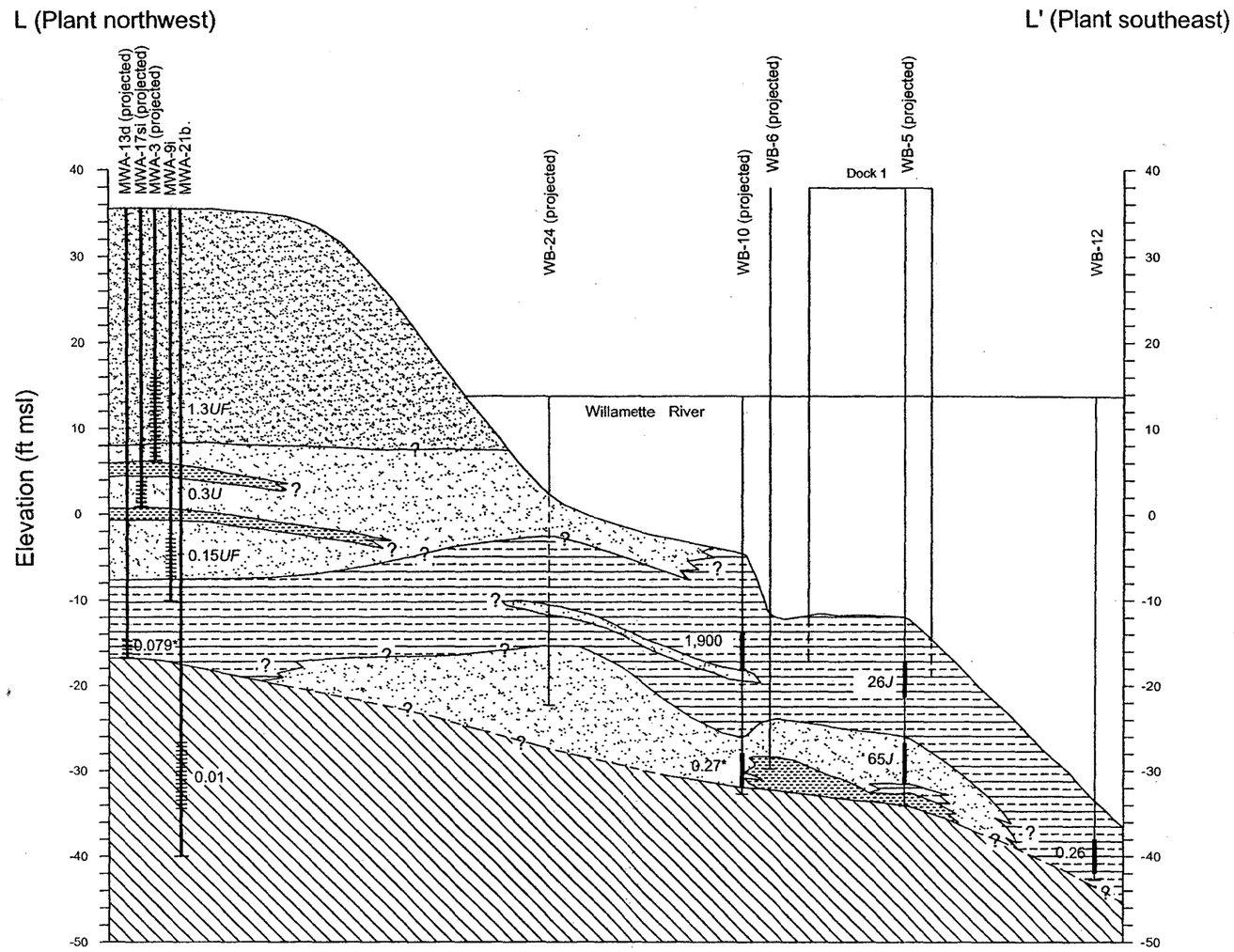
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (µg/L). Chlorobenzene concentrations are from grab groundwater samples collected in June 2002 and February-March 2003. Chlorobenzene concentrations in monitoring wells are from April 2002.

Exponent

Figure 7a. Cross-section L-L' with chlorobenzene concentrations in groundwater

8601192.001.0634\L-L' CHLOR.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
F Field quality control sample (blanks or reference materials) criteria not met
J Estimated
U Undetected at detection limit shown

0 — 80 feet

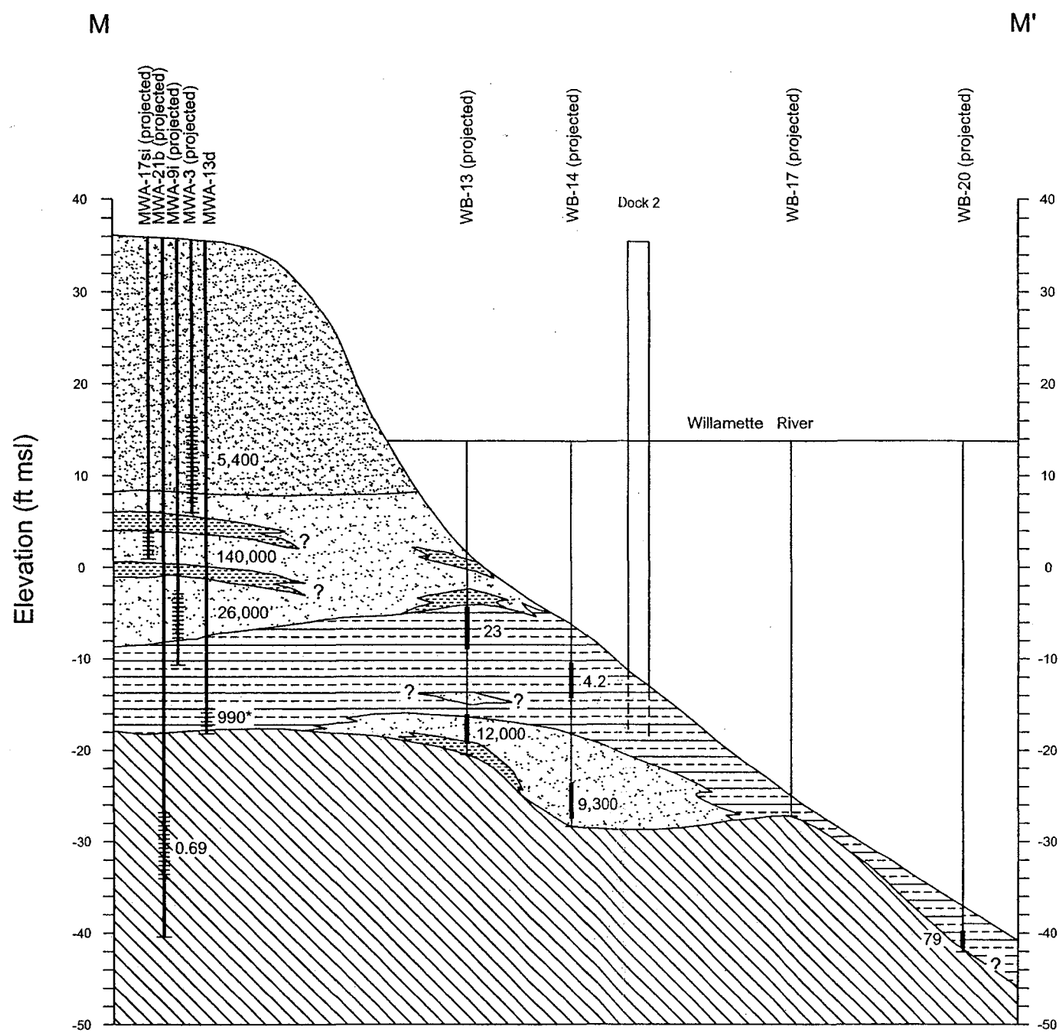
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (μg/L). DDT concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.
DDT concentrations in monitoring wells are from April 2002.

Exponent

Figure 7b. Cross-section L-L' with DDT concentrations in groundwater

8601192.001.0634\L-L' DDT.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate

J Estimated

0 80 feet

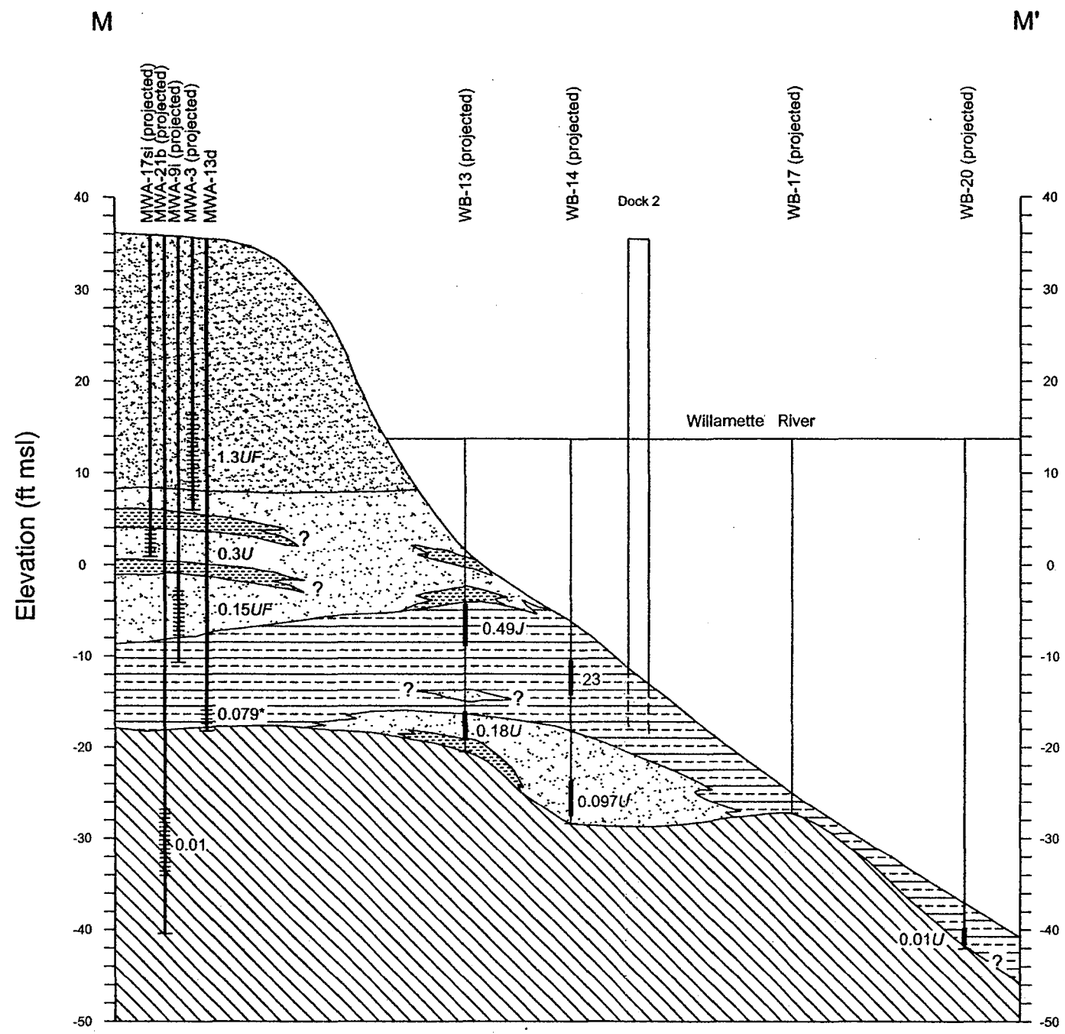
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (μg/L). Chlorobenzene concentrations in WB boreholes are from grab groundwater samples collected in June 2002 and February-March 2003. Chlorobenzene concentrations in monitoring wells are from April 2002.

Exponent

Figure 8a. Cross-section M-M' with chlorobenzene concentrations in groundwater

8601192.001.0634\M-M' CHLOR.dwg 12/05/03 QR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
F Field quality control sample (blanks or reference materials) criteria not met
J Estimated
U Undetected at detection limit shown

0 80 feet

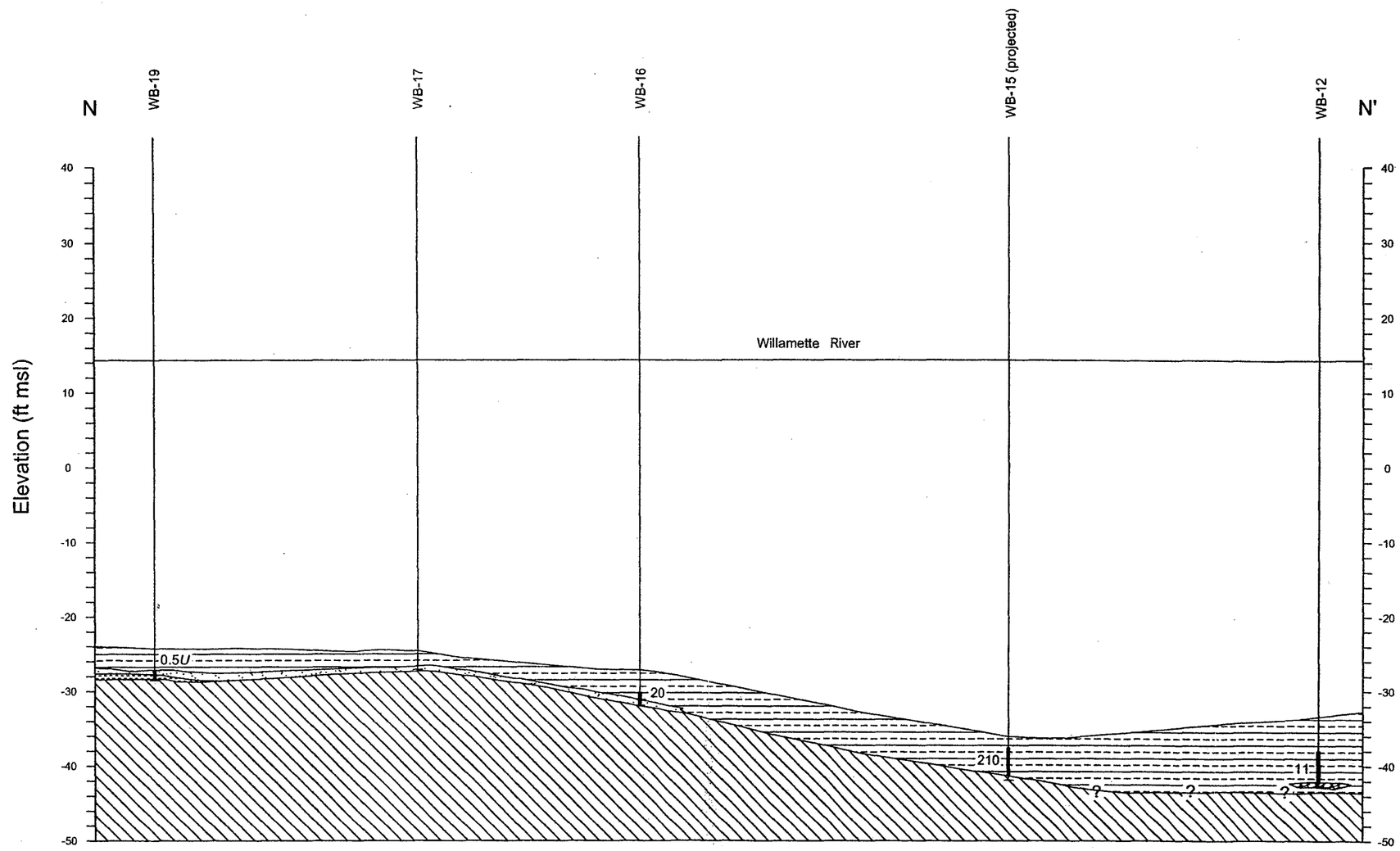
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (μg/L). DDT concentrations in WB boreholes are from grab groundwater samples collected in June 2002 and February-March 2003. DDT concentrations in monitoring wells are from April 2002. Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 8b. Cross-section M-M' with DDT concentrations in groundwater

8601192.001.0634\M-M' DDT.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt
- Gravel

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate

J Estimated

U Undetected at detection limit shown

0 80 feet

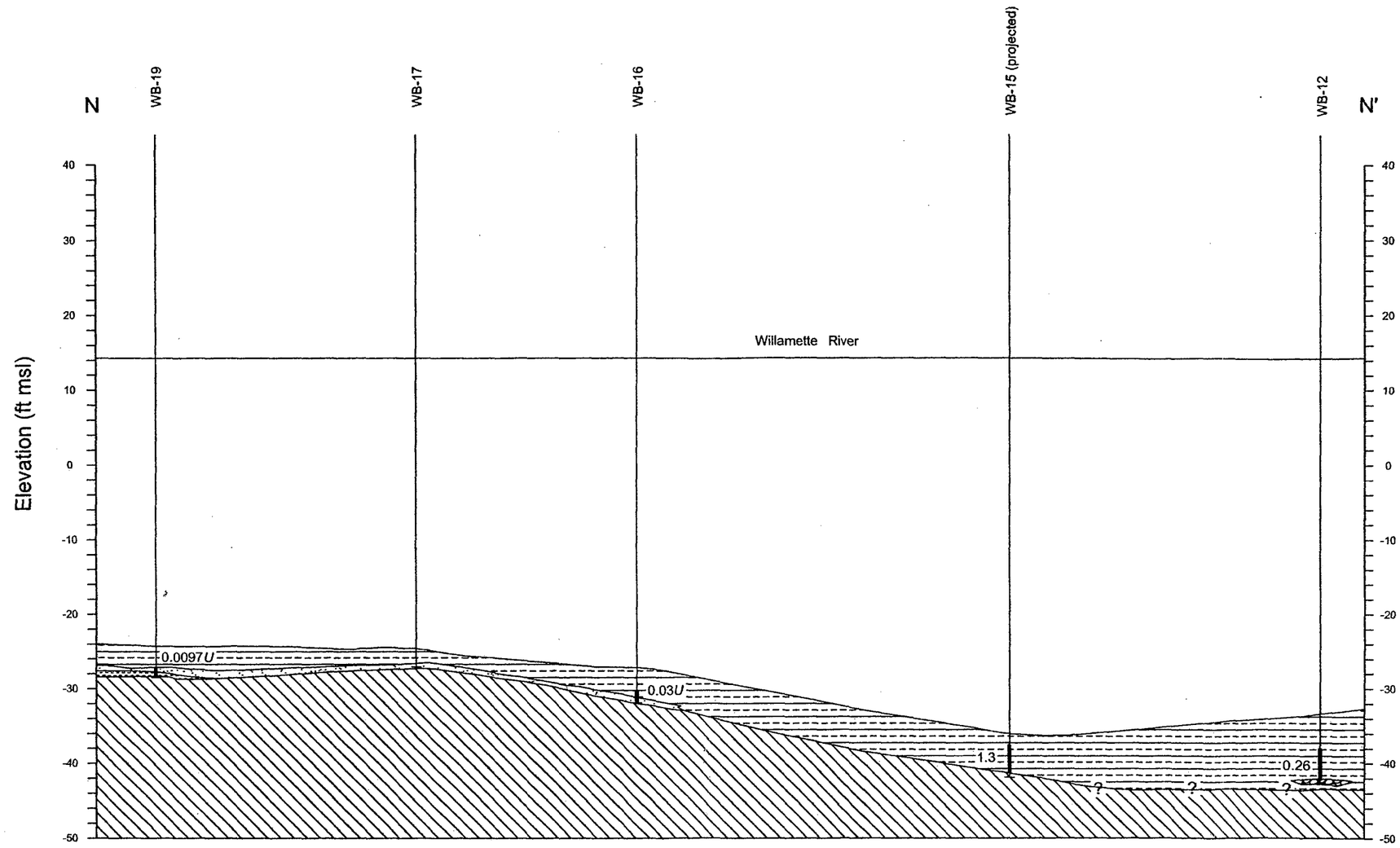
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (μg/L). Chlorobenzene concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.

Exponent

Figure 9a. Cross-section N-N' with chlorobenzene concentrations in groundwater

8601192.001.0634\L-L' CHLOR.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt
- Gravel

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
J Estimated
U Undetected at detection limit shown

0 80 feet

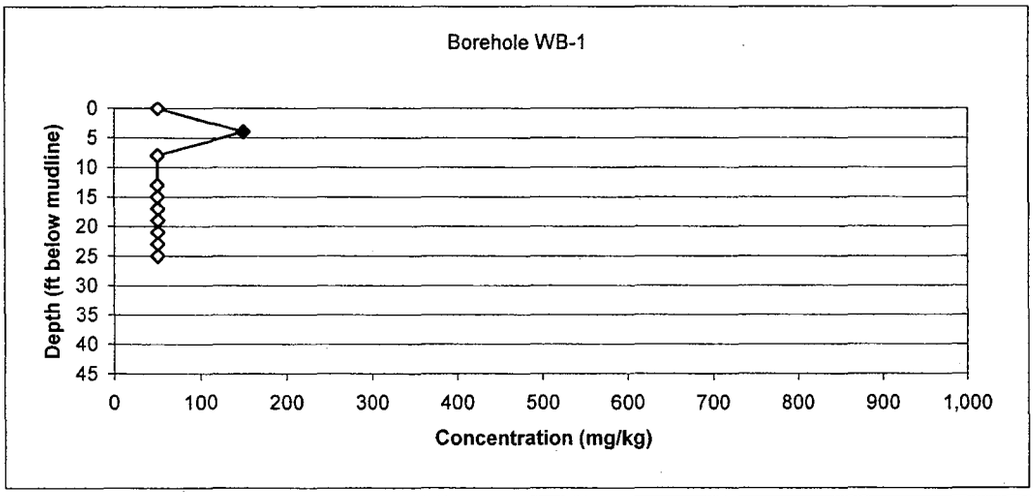
Note: Vertical scale exaggerated 5x

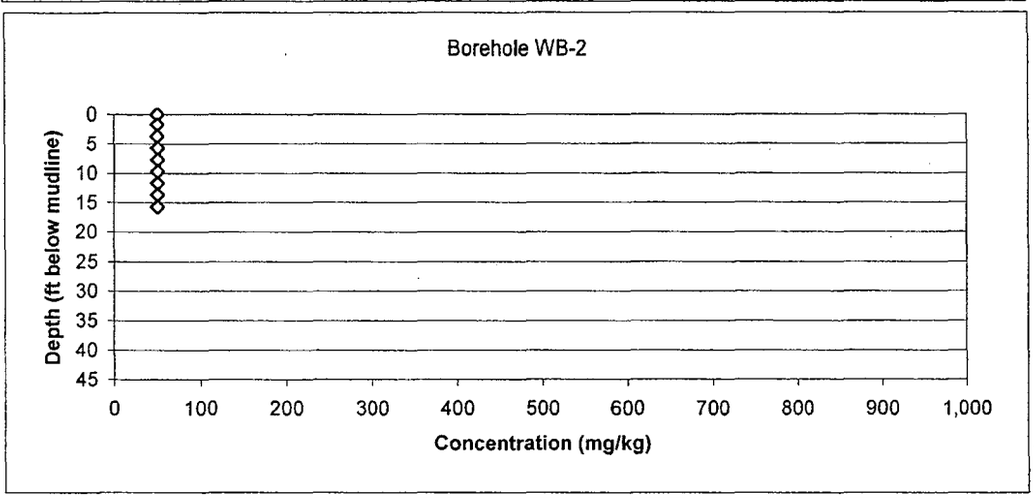
Notes: All concentrations are in micrograms per liter (μg/L). DDT concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

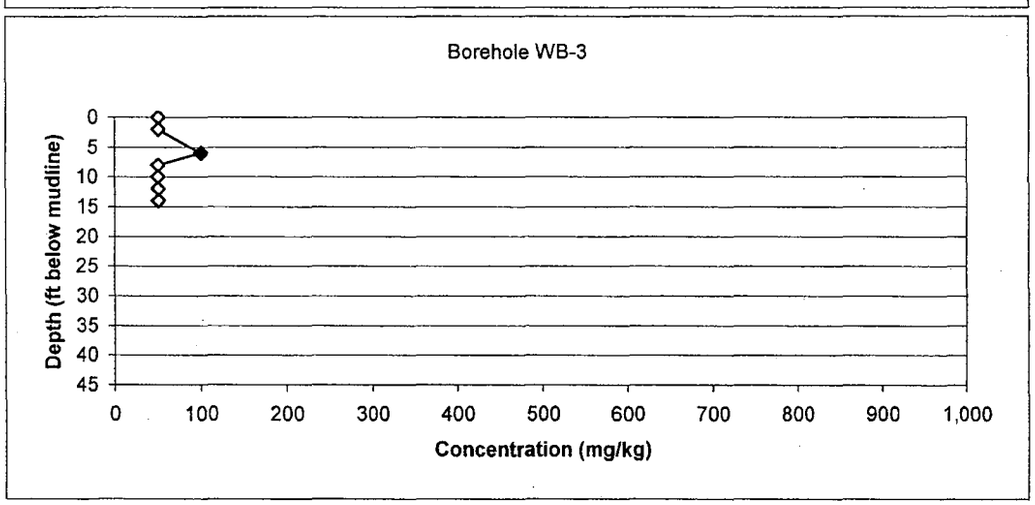
Exponent

Figure 9b. Cross-section N-N' with DDT concentrations in groundwater

8601192.001.0634\N-N' DDT.dwg 12/05/03 OR







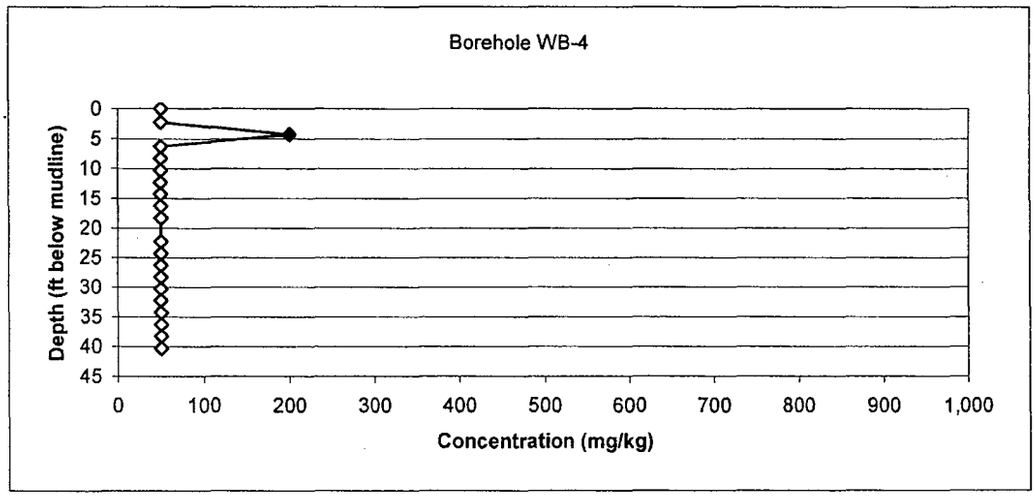
◇ DDT by TLC (open symbol - undetected[a])

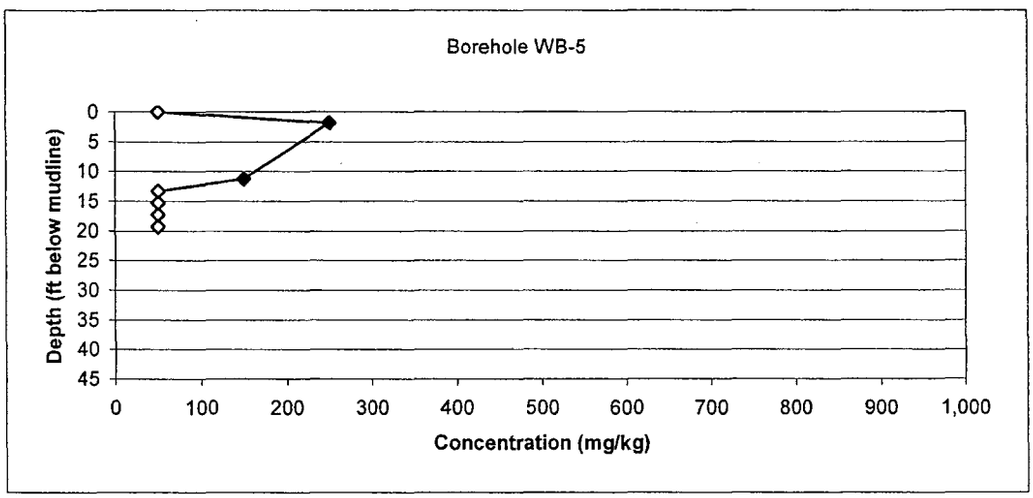
◆ DDT by TLC (filled symbol - detected)

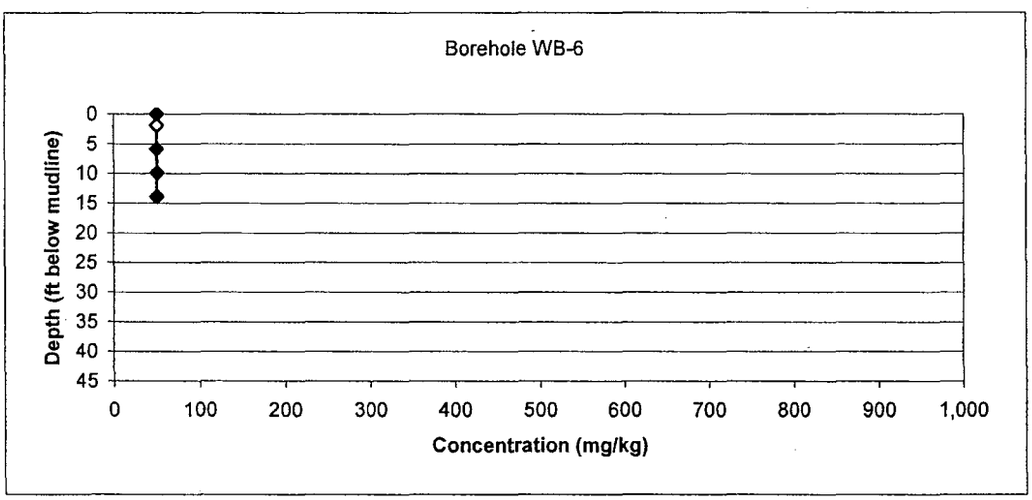
[a] Concentration represents detection limit

Figure 10. Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.







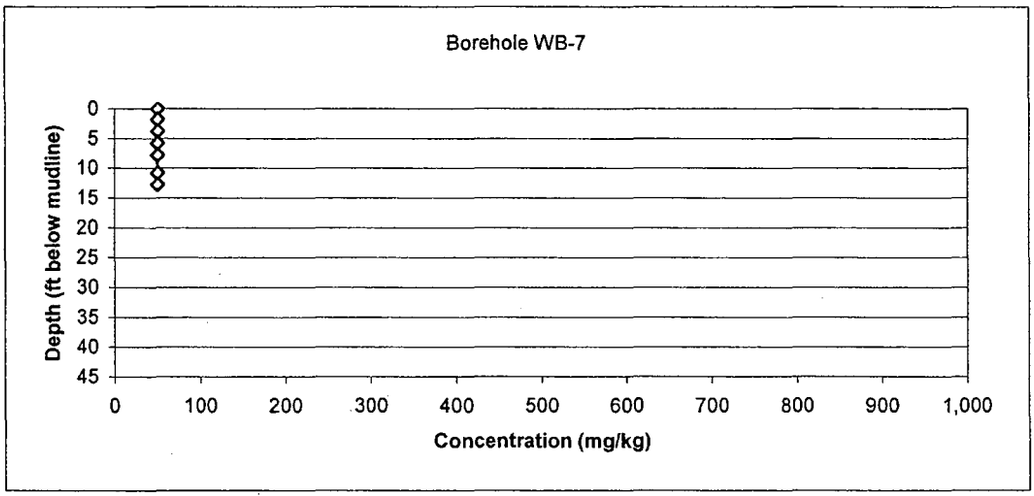
◇ DDT by TLC (open symbol - undetected[a])

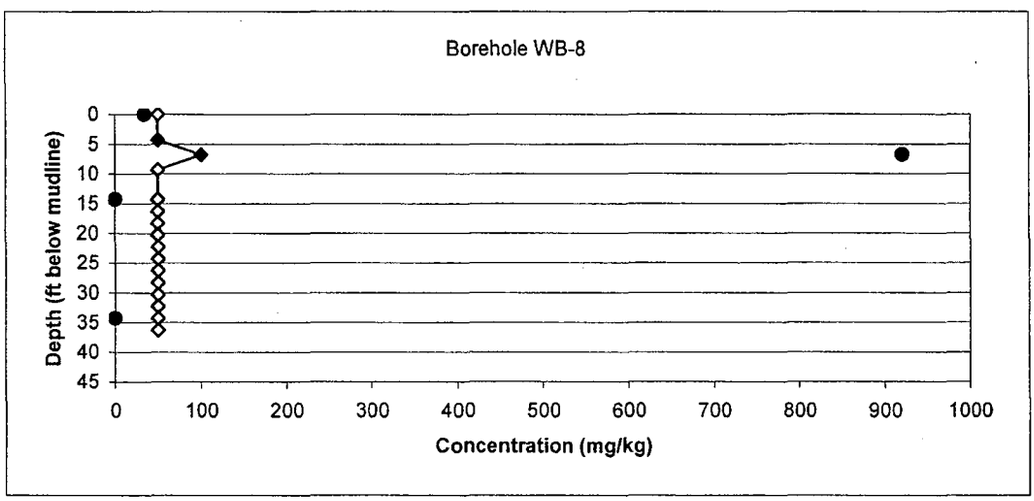
◆ DDT by TLC (filled symbol - detected)

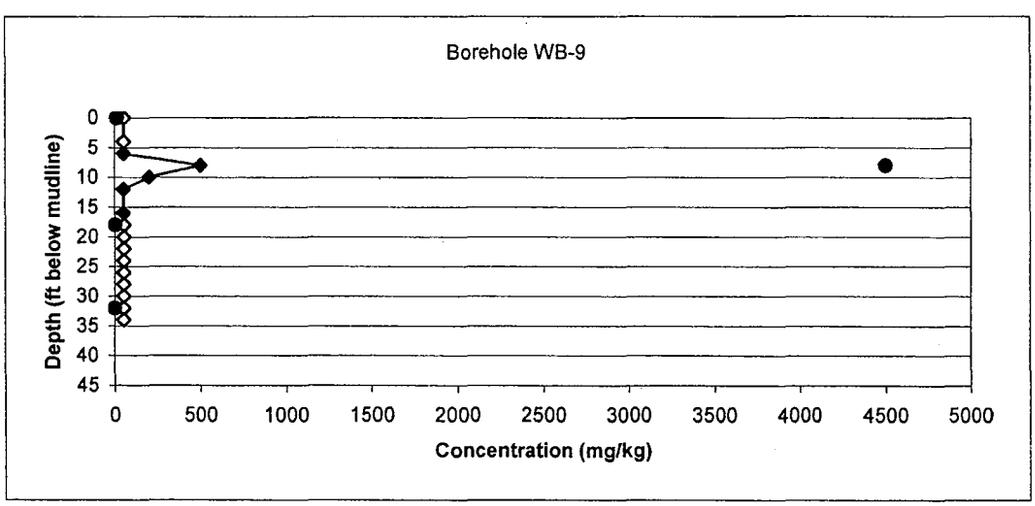
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





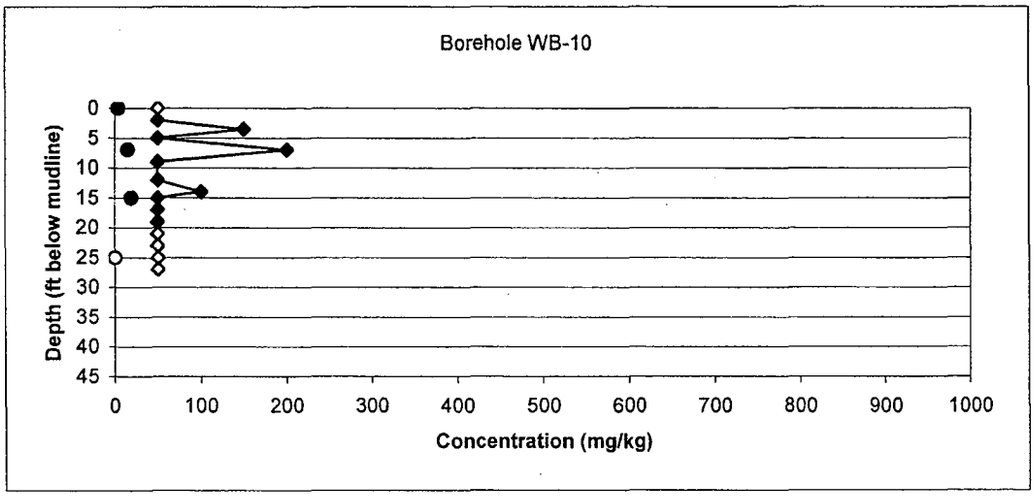


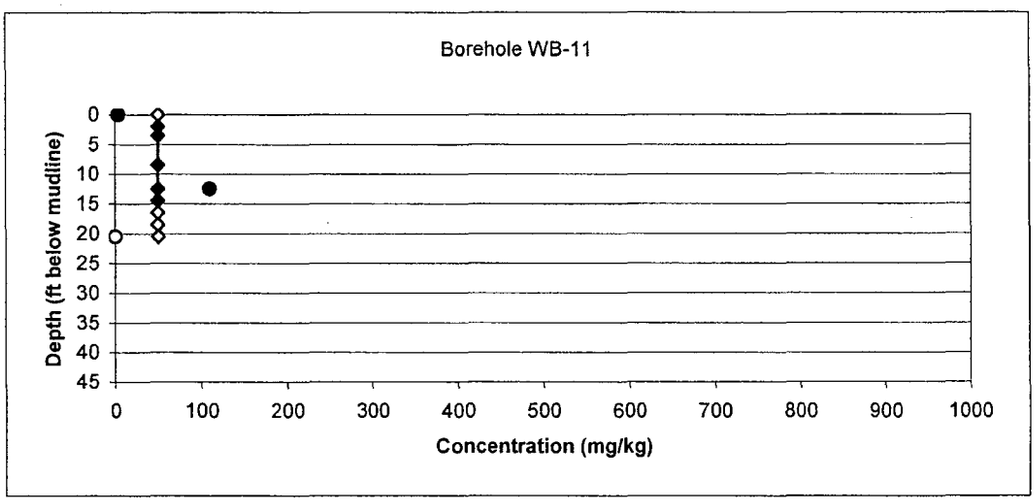
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

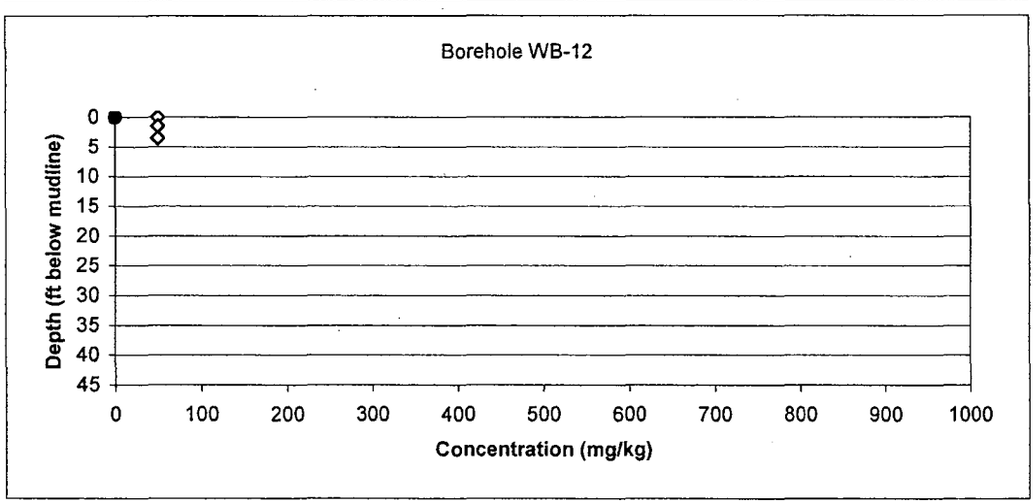
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





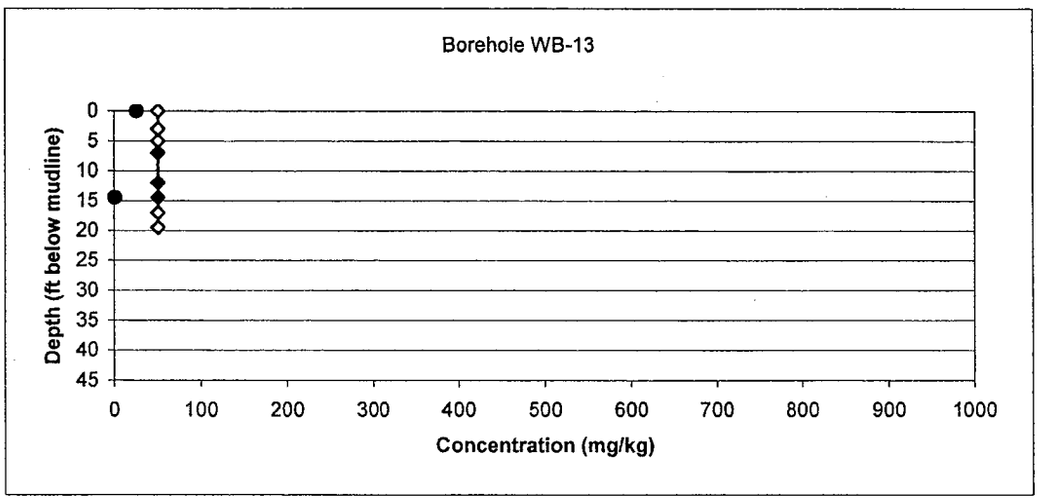


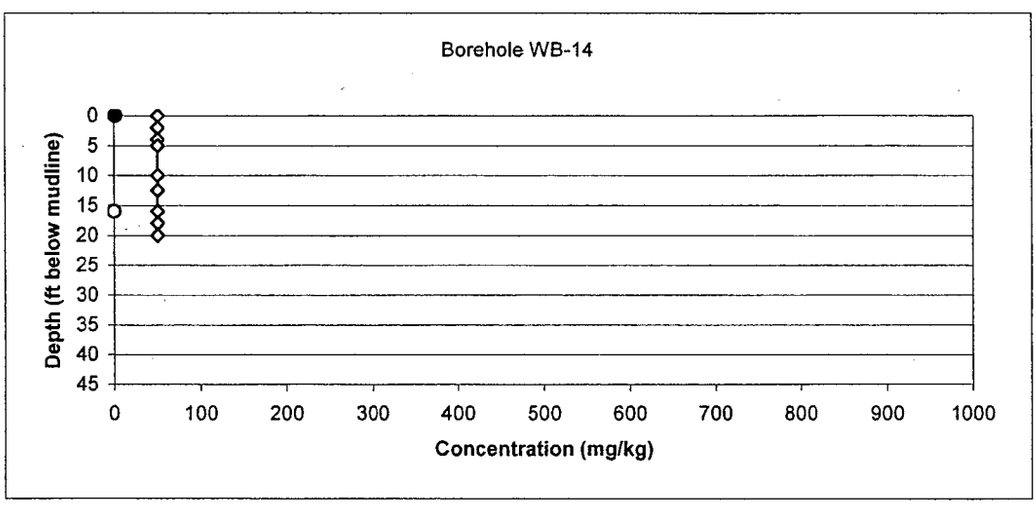
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

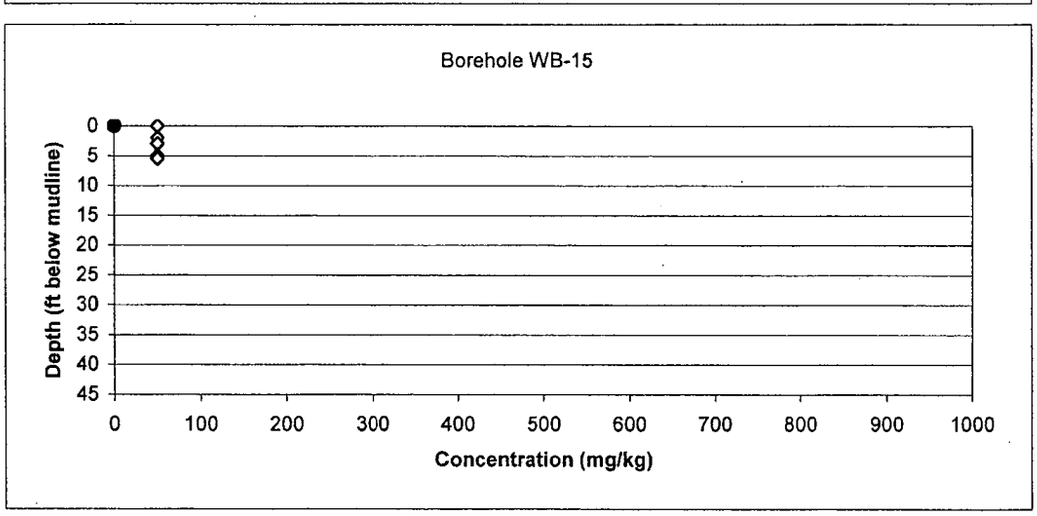
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





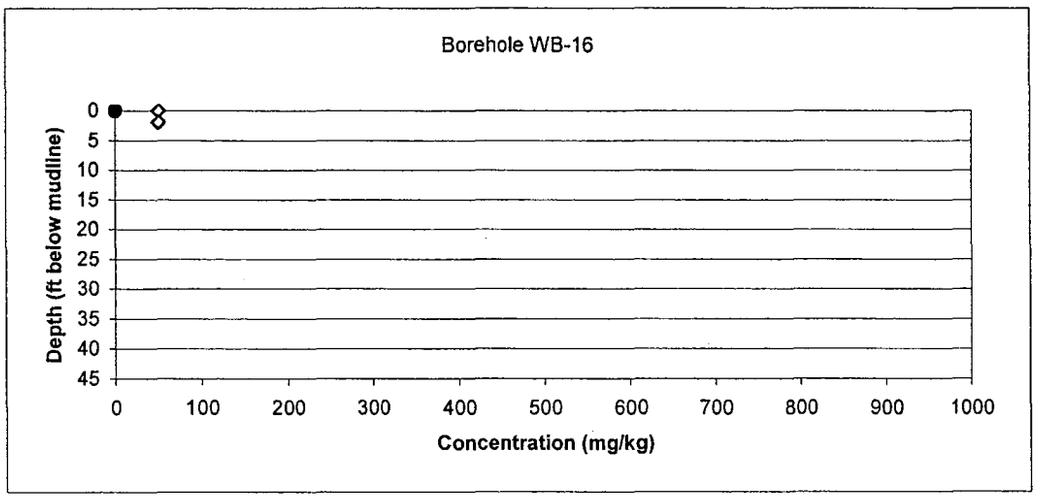


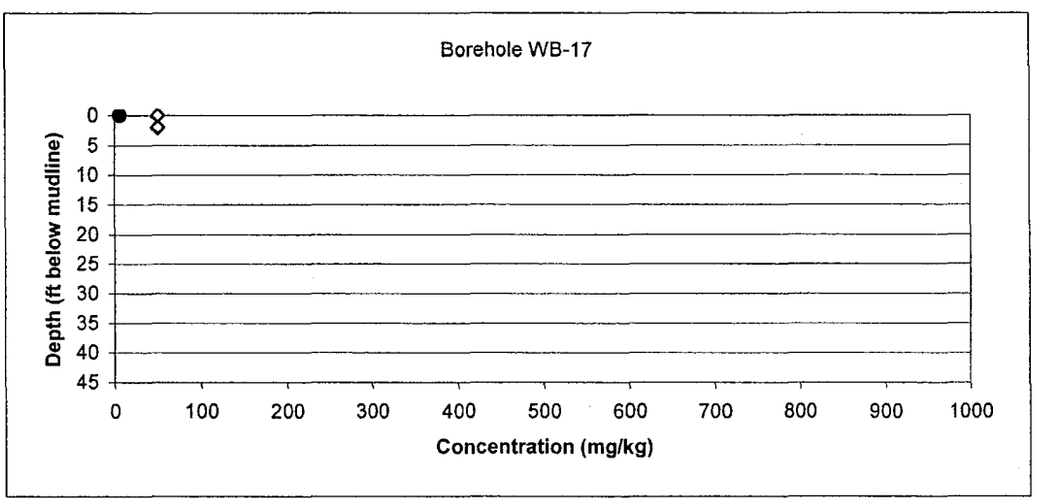
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

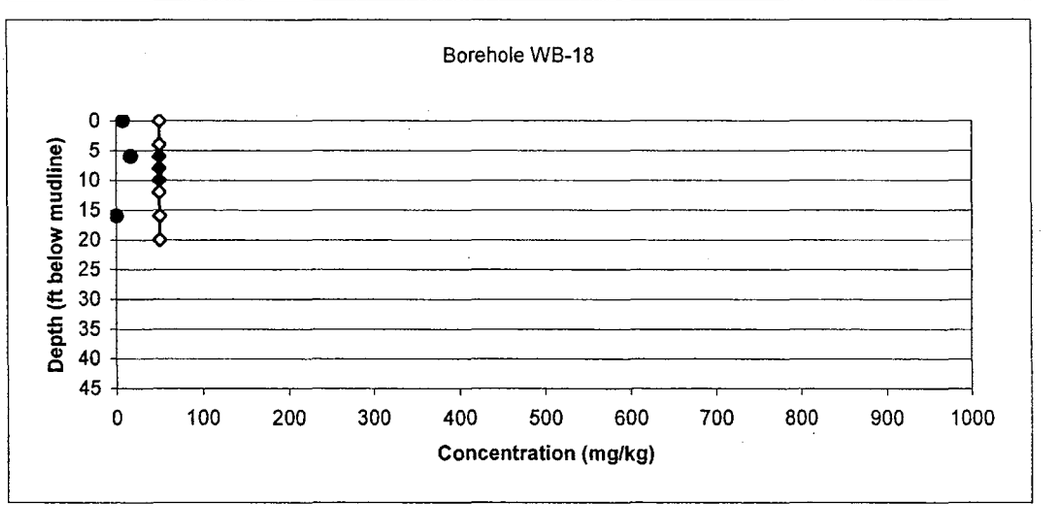
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





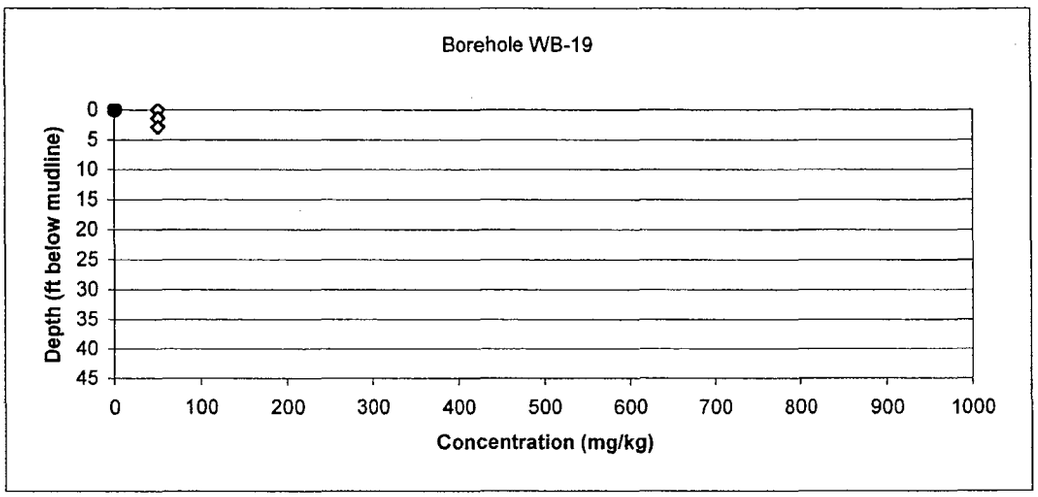


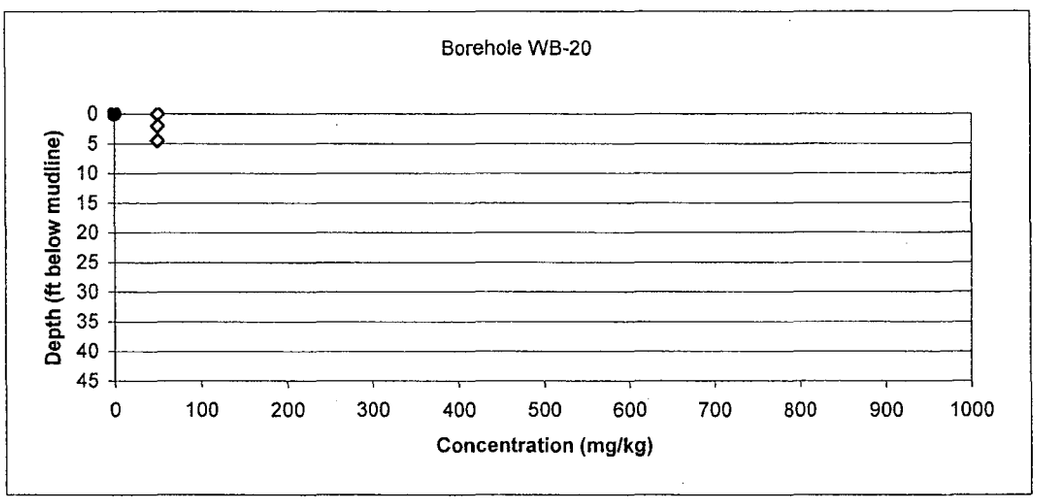
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

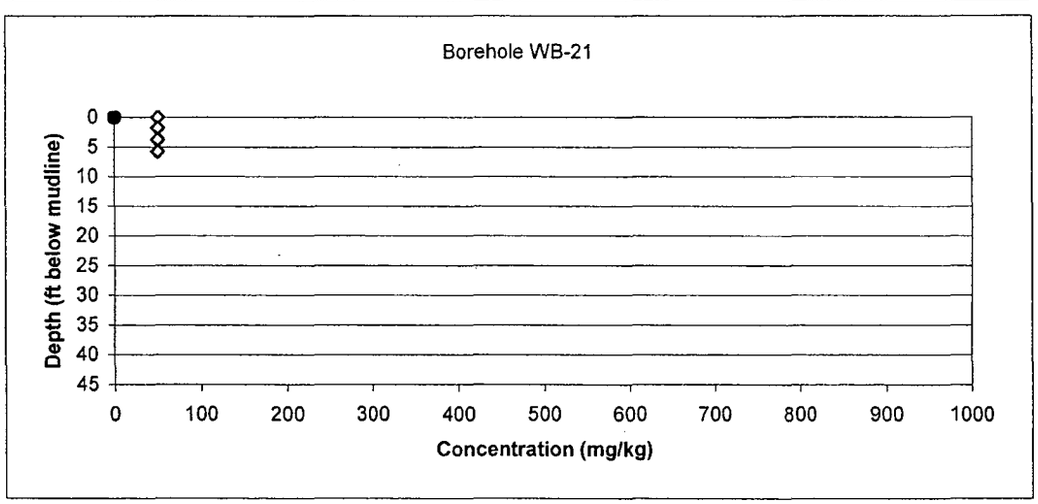
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





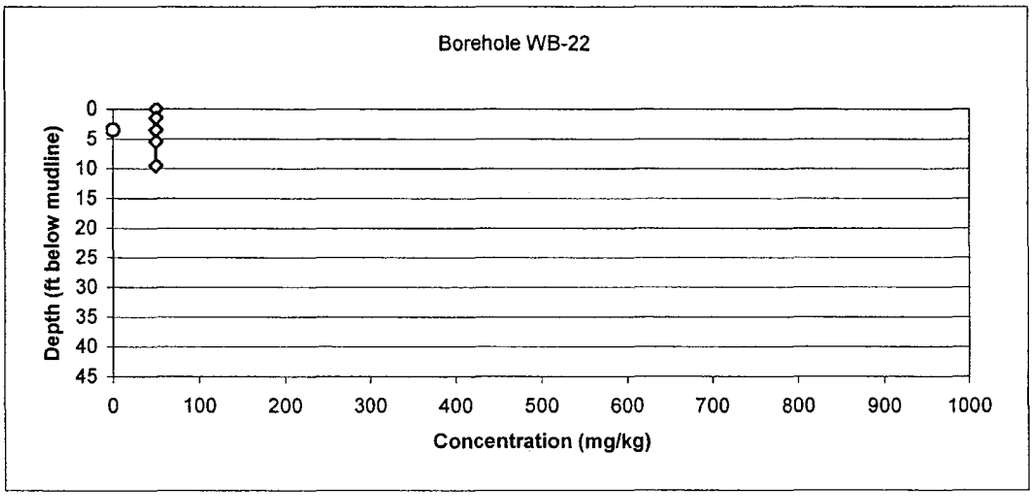


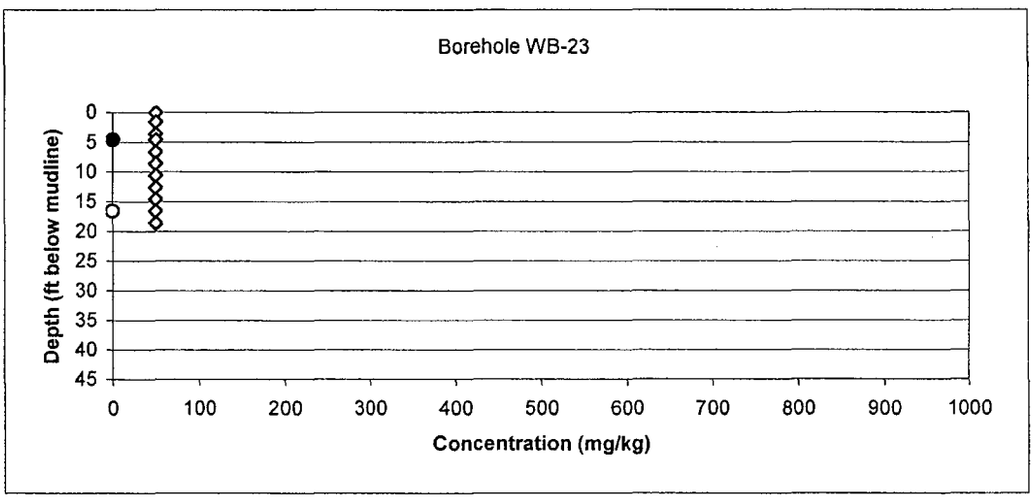
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

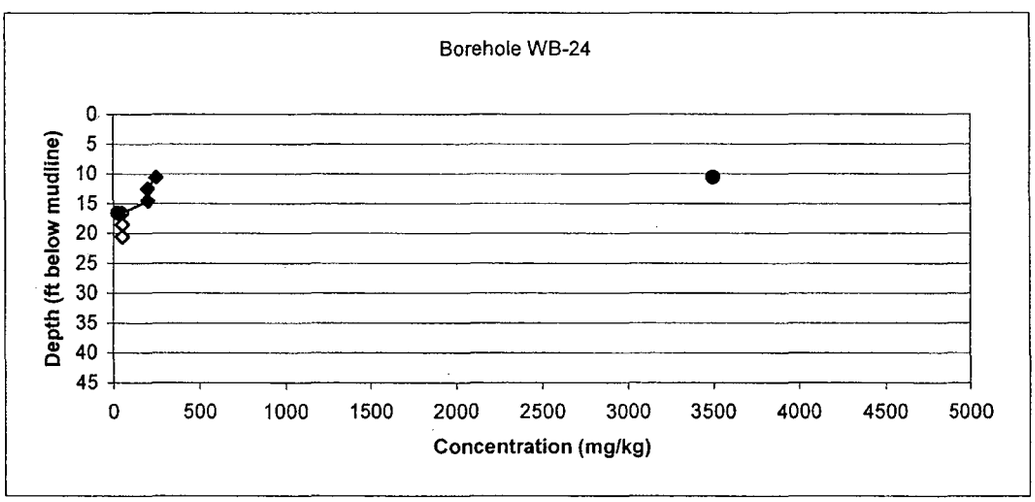
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





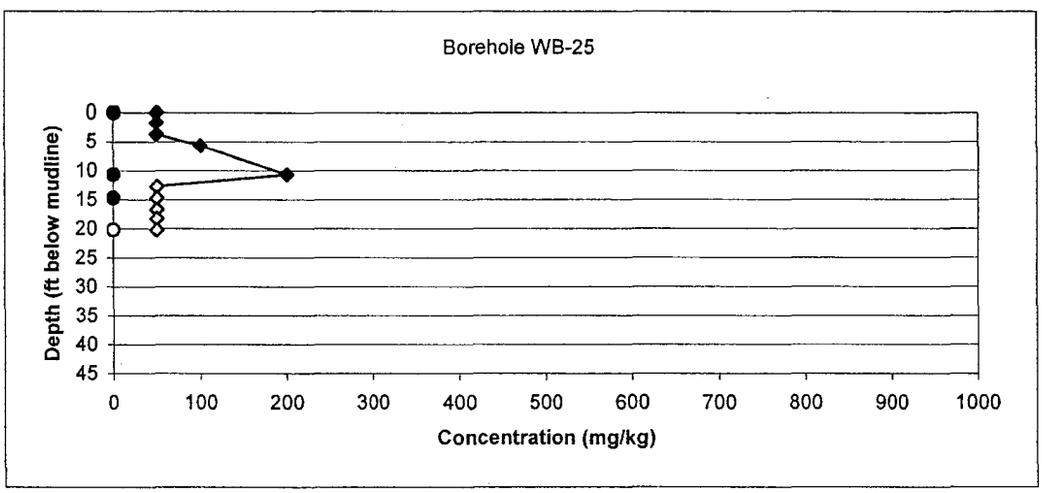


◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.



◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.

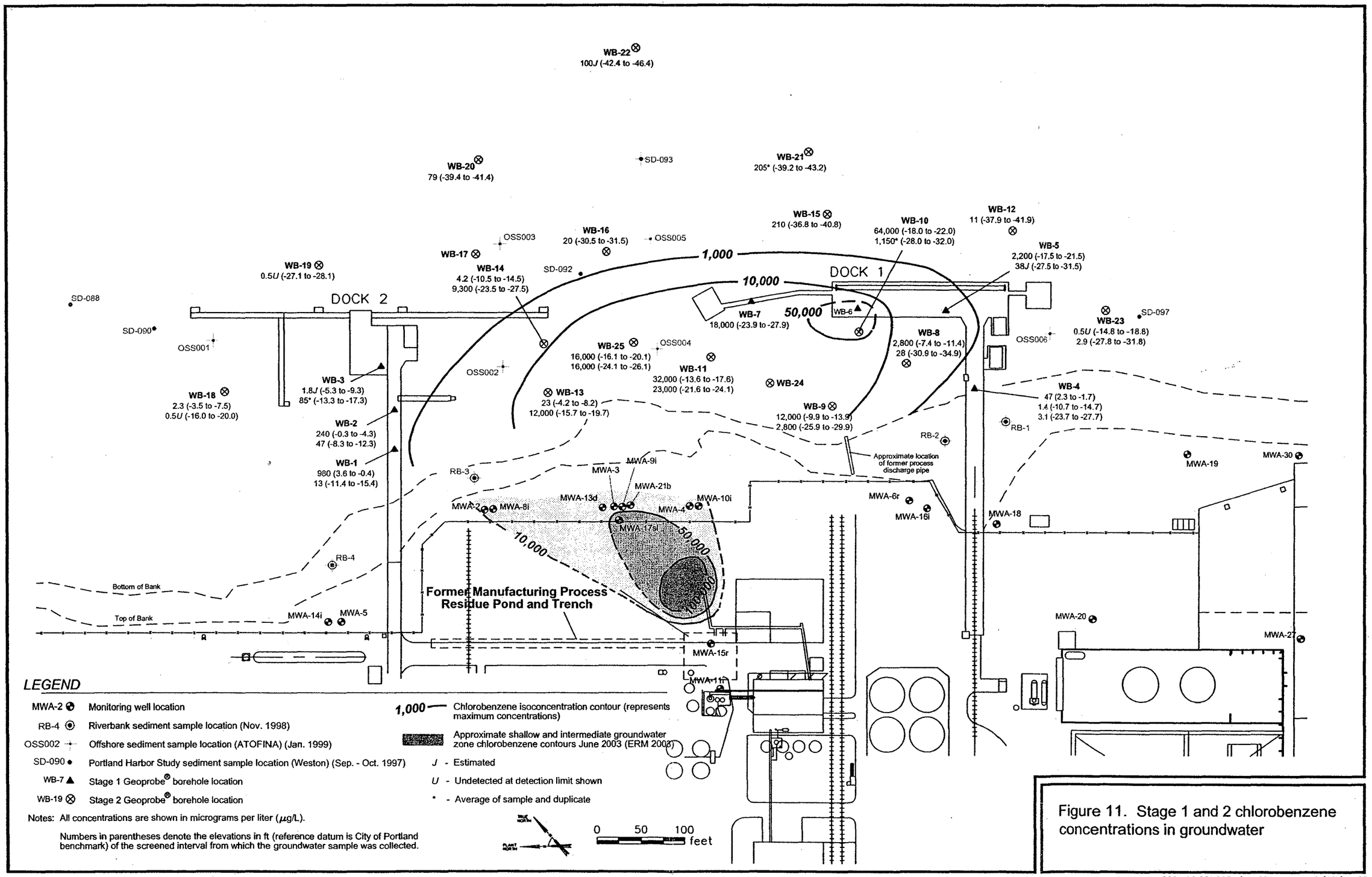


Figure 11. Stage 1 and 2 chlorobenzene concentrations in groundwater

8601192.001.0634/CHLOR GW.dwg 12/05/03 OR

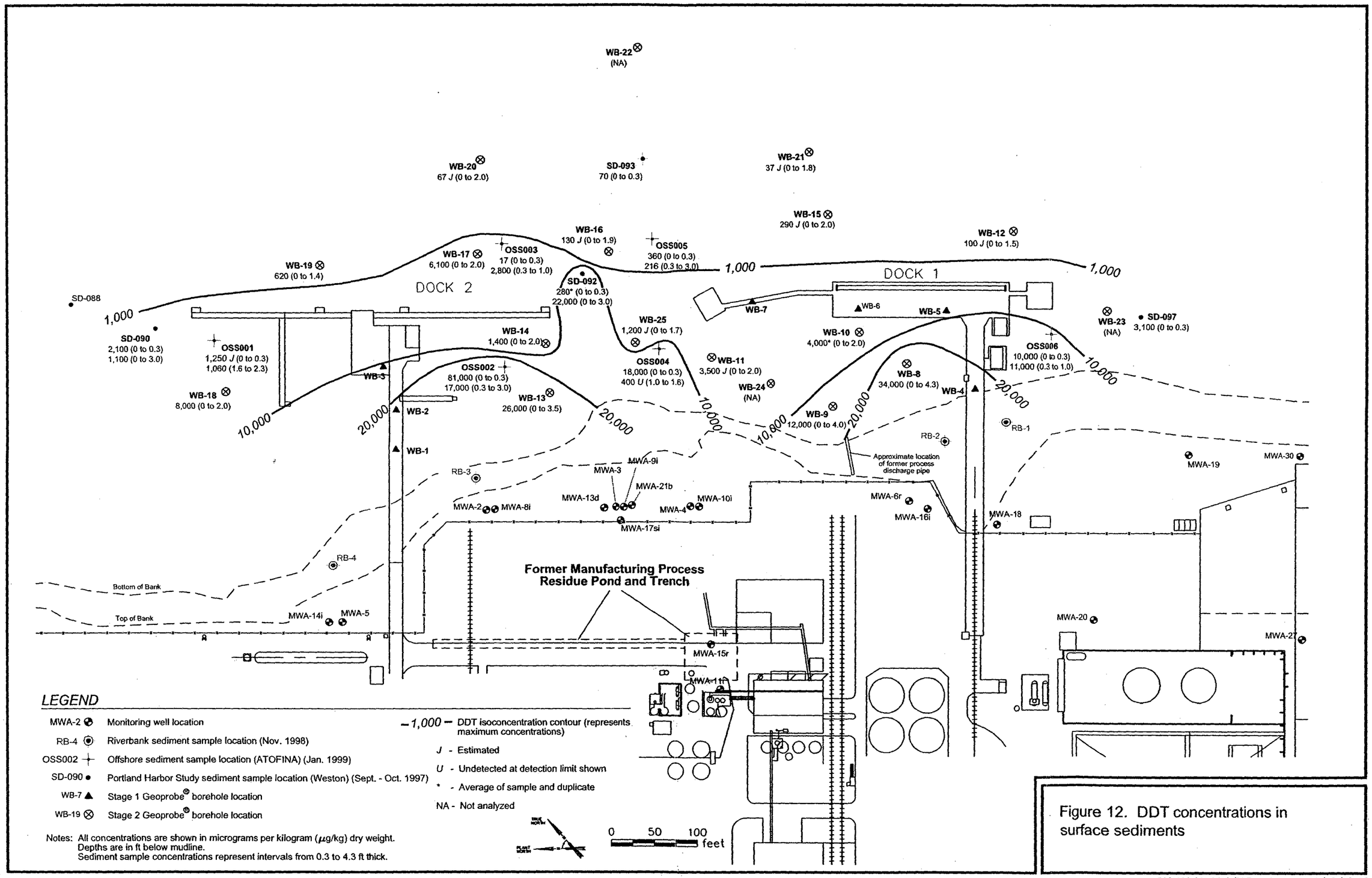


Figure 12. DDT concentrations in surface sediments

8601192.001.0612/DDT surfsed.dwg 12/05/03 QR

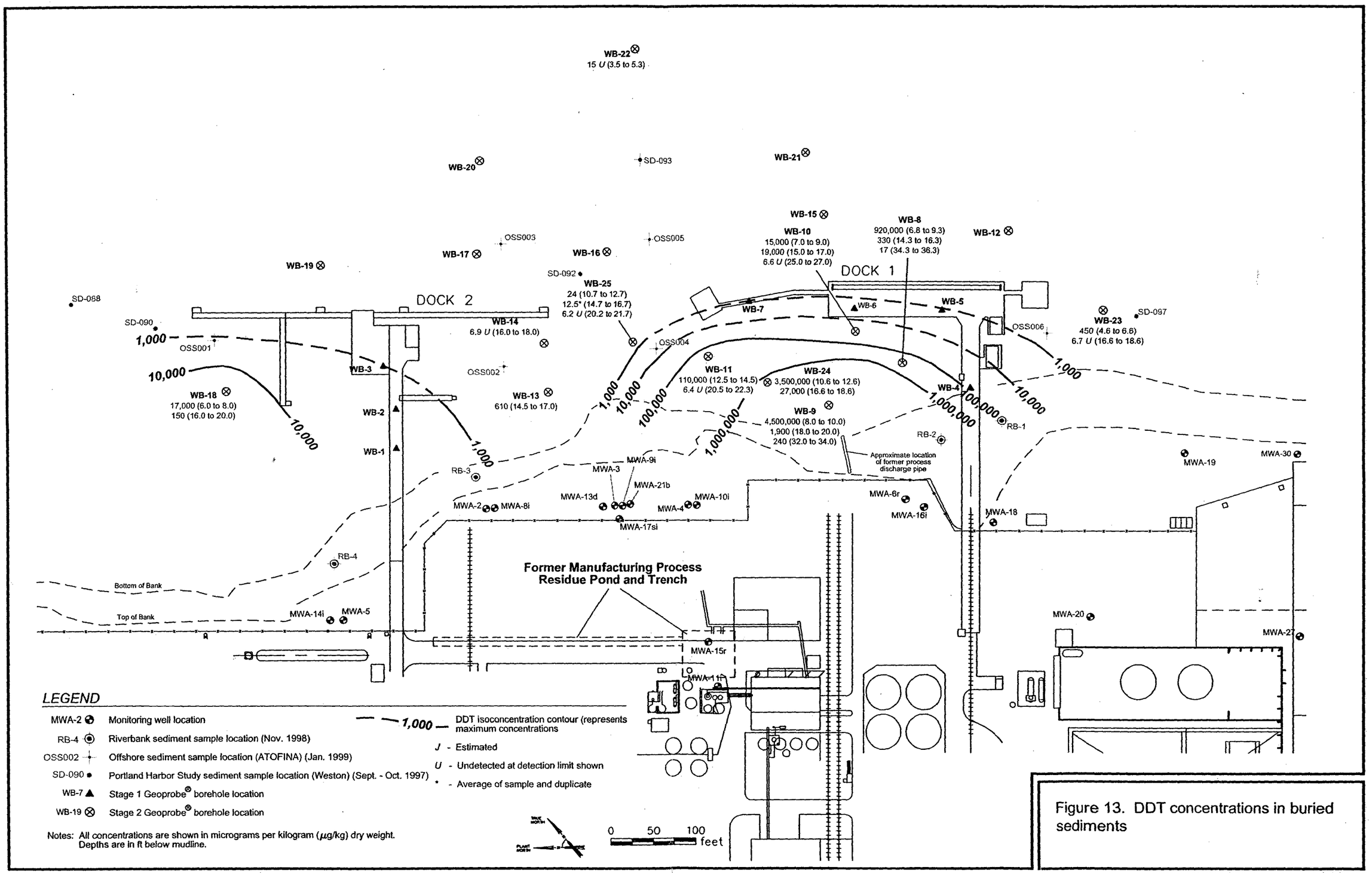


Figure 13. DDT concentrations in buried sediments

8601192.001.0612/DDT deepsed.dwg 12/05/03 QR

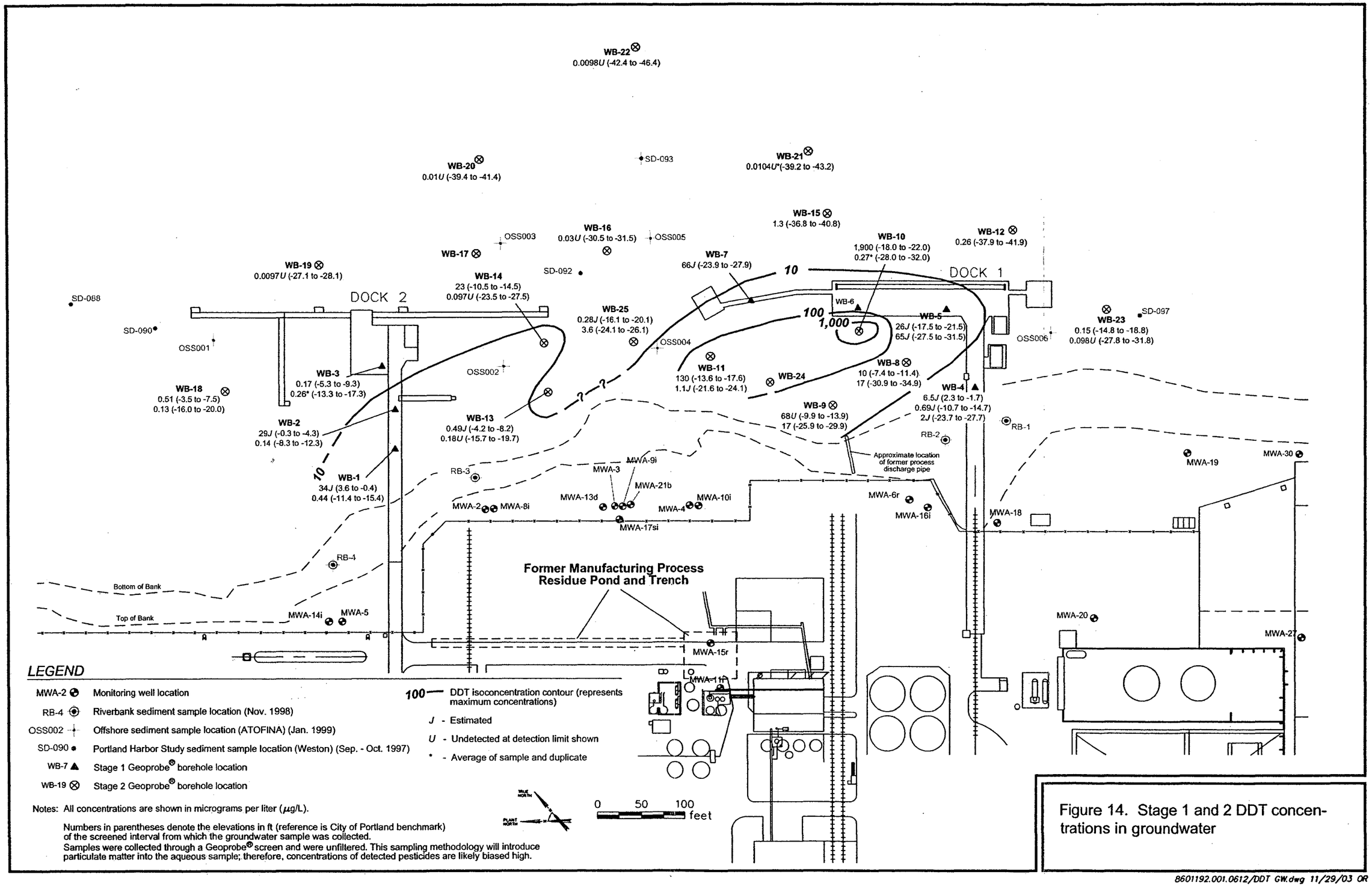


Figure 14. Stage 1 and 2 DDT concentrations in groundwater

8601192.001.0612/DDT GW.dwg 11/29/03 OR

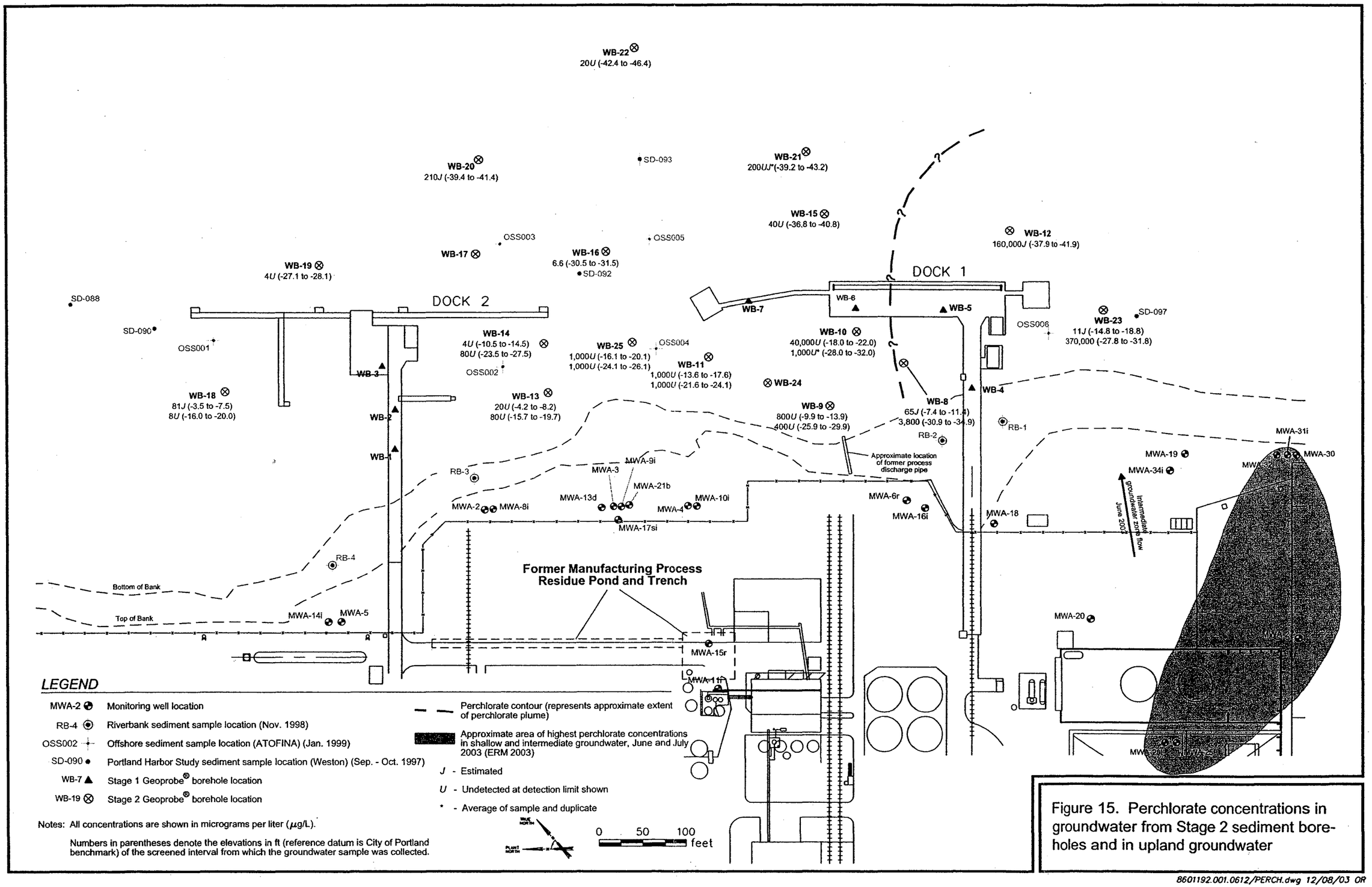


Figure 15. Perchlorate concentrations in groundwater from Stage 2 sediment boreholes and in upland groundwater

8601192.001.0612/PERCH.dwg 12/08/03 OR

INTER-
LEAVED

Appendix A

Borehole Logs

Stage 1 Borehole Logs

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-1

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 29.0' below dock - Depth to river surface 24.75' at time of sampling	
5								
10								
15								
20								
25							River surface	
30	SO1711	0.0	50%	NA		SP	Fine to medium SAND, predominantly fine sand, dark yellow-brown (10YR 4/4), wet, few fine gravels, few wood chunks, no odor.	BACKFILLED w/BENTONITE GROUT
35	SO1712	34.2	50%	NA		ML SW	Sandy SILT, fine to med. sand in thin lenses, very dark gray (2.5Y 3/1), wet. At 34' no sand, faint odor. Fine to med. SAND, very dark gray (2.5Y 3/1), wet.	
40	SO1713	85.7	35%	NA		ML	Clayey SILT, very dark gray (2.5Y 3/1), wet, slight organic odor.	

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 3-4 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.58

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-1

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40								40
	SO1713	85.7	35%	NA		SP	Fine to medium SAND, predominantly fine sand, black (2.5Y 2.5/1), wet, few wood chunks, red grains throughout, no odor.	
	SO1714	3.4	50%	NA				
45	SO1715	3.4	100%	NA				45
	SO1716	0.0	100%	NA				
	SO1717	0.0	15%	NA				BACKFILLED w/BENTONITE GROUT
50	SO1718	1.7	50%	NA				50
	SO1719	1.7	100%	NA		ML	SILT, very dark gray (5Y 3/1), wet.	
						SM	Slightly silty, fine SAND, very dark gray (5Y 3/1), silt ~10-20%, grades to some brown mottling.	
55	SO1720	1.7	100%	NA		ML	Slightly very fine, sandy SILT (sand ~10%), dark yellow-brown (10YR 4/4), wet.	55
							Refusal on vesicular basalt @ 56'. Groundwater sample GW06040201 collected from 33'-37' BGS Groundwater sample GW06040202 collected from 48'-52' BGS	
60								60
65								65
70								70
75								75
80								80

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 3-4 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.58

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-2

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 33.3' below dock - Depth to river surface 24.50' at time of sampling	
5								
10								
15								
20								
25							River surface	
30								
35	SO1721	8.1	60%	NA		SP	Fine to med. SAND, predominantly fine grained, trace silt, dark olive-brown (2.5Y 3/3), wet, scattered red grains throughout. Silt lens 1.5" thick (depth uncertain). Color change to very dark gray (2.5Y 3/1) @ 34.8'.	BACKFILLED w/BENTONITE GROUT
	SO1721	0.0	20%	NA		ML	Very fine sandy SILT, very dark gray (2.5Y 3/1), fibrous organic material 35.4-35.7', no odor, wet. Grades to clayey SILT w/ trace v. fine sand, dark gray (2.5Y 3/1), wet.	
	SO1722	0.0	65%	NA				
40	SO1723	0.0	50%	NA				

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 4-5 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.67

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-2

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40	SO1723	0.0	50%	NA		ML	Clayey SILT w/ trace very fine, sand, dark gray(2.5Y 3/1), wet.	BACKFILLED w/BENTONITE GROUT
	SO1724	8.1	75%	NA			Fine to medium SAND lens (2" thick), black (10YR 2/1), scattered red grains throughout @ 40.7 BGS.	
	SO1725	15.7	65%	NA			2" layer w/ odor, some sand and single apparent volcanic gravel (1" dia.) @ 44.1' BGS.	
45	SO1726	55.5	50%	NA		SP/ ML	Becomes fine bedded with above and fine to med. SAND, predominantly fine sand, black (2.5Y 2.5/1), wet, red grains throughout.	
	SO1727	15.3	50%	NA		SP	Sand only as above.	
50	SO1728	0.0	65%	NA		ML	SILT, dark gray (2.5Y 4/1), wet.	
55							Refusal on vesicular basalt @ 51'. Groundwater sample GW06040203 collected from 37'-41' BGS. Groundwater sample GW06040204 collected from 45'-49' BGS	
60								
65								
70								
75								
80								

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 4-5 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.67

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-3

Ground surface: Dock #2

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL		LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0								- Mudline @ 39.0' below dock - Depth to river surface 22.04' at time of sampling	0
5									5
10									10
15									15
20									20
								River surface	
25									25
30									30
35									35
40	SO1729	2.8	85%	NA			ML	Clayey SILT, very dark gray (7.5Y 3/1), trace (5-10%) organics, trace very fine sand, wet, soft.	BACKFILLED w/BENTONITE GROUT 40

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 5-6 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.71

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-3

Ground surface: Dock #2

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40	SO1729	2.8	85%	NA		ML	Clayey SILT, very dark gray (7.5Y 3/1), trace (5-10%) organics, trace very fine sand, wet, soft.	BACKFILLED w/BENTONITE GROUT
	SO1730	4.7	85%	NA		CL	Silty CLAY, dark gray (7.5YR 3/1), ~40-50% silt, trace organics (~2%), soft, wet.	
			0%	NA				
45	SO1731	2.8	100%	NA		ML/CL	Clayey SILT/silty CLAY, dark gray (2.5Y 4/1), trace organics, wet, soft.	
	SO1732	4.7	50%	NA		ML	Clayey SILT, very dark gray (2.5Y 3/1), clay ~10-15%, trace (~5-15%) very fine sand, trace non carbonized wood, very moist.	
50	SO1733	4.7	75%	NA		SM		
	SO1734	2.8	55%	NA		SP	Grading to silty fine to med. SAND, very dark gray (2.5Y 3/1) ~25-35% silt, wet, ~5-10% wood fragments, clayey silt laminations (~0.08' thick) @ 50' BGS.	
	SO1735	2.8	75%	NA		ML/SM	Fine to med. SAND, black (2.5Y 2.5/1), trace silt (<5%), micaceous, trace red grains and organics, wet. Silt lamination @ 52.2, 52.5' and 53.3' BGS (~0.02" thick).	
55							Silty, very fine SAND/sandy very fine SILT, dark gray (2.5Y 4/1), micaceous, wet.	
							Refusal @ 54.5' on BASALT, black (2.5Y 2.5/1), slightly vesicular.	
60							Groundwater sample GW06050201 collected from 42'-46' BGS. Groundwater sample GW06060201 and GW06060202 (duplicate) collected from 50'-54' BGS.	
65								
70								
75								
80								

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 5-6 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.71

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-4

Ground surface: Dock #1

Geologist: David Lamadrid, Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 29.7' below dock - Depth to river surface @ 23.82' at time of sampling	
5								
10								
15								
20								
25							River surface	
30	SO1736	7.3	~10%	NA		SW	Gravelly, fine to coarse SAND, very dark gray (7.5YR 3/1), predominantly fine to med. sand, gravel up to 1", trace red brick, wet.	BACKFILLED w/BENTONITE GROUT
	SO1737	10.9	~10%	NA			Fine to medium SAND, trace silt, black (10YR 2/1), wet, single wood fragment.	
35	SO1738	7.3	~10%	NA		ML	Clayey SILT, very dark gray (5Y 3/1), wet, wood fragments.	
	SO1739	3.5	50%	NA		SM/ML	Silty SAND/sandy SILT, fine sand, dark brown (10YR 3/3), wet, abundant wood fibers.	
	SO1740	5.4	50%	NA		SP	Fine to med. SAND, predominantly fine grained, very dark gray-brown (10YR 2/2), wet, red grains throughout.	
40								

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 6-10 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.32

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-4

Ground surface: Dock #1

Geologist: David Lamadrid, Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40	SO1741	5.4	60%	NA		SP	Fine to med. SAND, predominantly fine grained, very dark gray-brown (10YR 2/2), wet, red grains throughout. Silt lens (0.5" thick) @ 40.8' BGS. Color grades to brown (10YR 4/3), increased med. grained.	
	SO1742	5.4	50%	NA				
45	SO1743	5.4	50%	NA				
	SO1744	0.0	15%	NA			Color grades to dark yellow-brown (10YR 3/4).	
	SO1745	1.8	50%	NA				
50			0%	NA		SM	Silty, very fine SAND, olive-brown (2.5Y 4/3), micaceous, ~25-35% silt, wet.	
	SO1746	3.6	80%	NA		ML	SILT, olive-brown (2.5Y 4/3), wet.	
55	SO1747	5.4	100%	NA		SM	Silty v. fine SAND, dark gray-brown (2.5Y 4/2), micaceous, ~30-35% silt, wet.	
	SO1748	3.6	100%	NA		ML-SM	Bedded silty SAND, sandy SILT and SILT, grayish brown (2.5Y 5/2), micaceous sand, wet, beds 0.5' to 2.5' thick.	BACKFILLED w/BENTONITE GROUT
	SO1749	3.6	100%	NA				
60	SO1750	1.8	100%	NA		SM	Silty, very fine SAND, dark gray-brown (2.5Y 4/2), ~15-25% silt, micaceous, wet. Silt lens, olive-brown (2.5Y 4/3), ~0.1' thick @ 62.2' BGS.	
	SO1751	3.6	100%	NA		ML/SM	Silty, very fine SAND, very fine, sandy SILT, olive-brown (2.5Y 4/3), micaceous, wet. Silt lens 0.1' thick @ 63.5', color as above.	Boring terminated at 64' BGS on 6/6/02, resumed on 6/10/02.
65	SO1757	1.7	100%	NA				
	SO1758	0.0	75%	NA		ML	Becomes bedded SILT and sandy, very fine SAND/sandy SILT, olive-brown (2.5Y 4/3), wet, slightly micaceous, beds 0.5' to 2' thick.	
	SO1759	0.0	100%	NA				
70	SO1760	5.4	100%	NA				
75							Refusal on BASALT @ 72.5' BGS Groundwater sample GW06100201 collected from 34'-38' BGS. Groundwater sample GW06100202 collected from 47'-51' BGS. Groundwater sample GW06100203 (duplicate) collected from 60'-64' BGS.	
80								

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 6-10 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.32

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-5

Ground surface: Dock #1

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 48.7' below dock - Depth to river surface 24.98' at time of sampling	0
5								5
10								10
15								15
20								20
25							River surface	25
30								30
35								35
40								40

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.51

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-5

Ground surface: Dock #1

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40							Water	40
45								45
50	SO1775	5.4	100%	NA		ML	Very clayey SILT, very dark gray (2.5Y 3/1), clay ~25-35%, wet, some scattered fibrous organics throughout, faint odor decreasing with depth.	50
	SO1776	16.3	100%	NA				
			0%	NA				
55			0%	NA				55
			0%	NA				
60	SO1777	283	30%	NA			Scattered small wood chunks to 1" dia., silty fine sand lens (0.5" thick), black (2.5Y 2.5/1), faint odor.	60
	SO1778	7.2	75%	NA		SP	Fine to med. SAND, predominantly fine grained, dark olive-brown (2.5Y 3/3), wet, red grains throughtout, no odor.	BACKFILLED w/BENTONITE GROUT
65	SO1779	3.6	35%	NA			Very silty fine sand lenses (0.5" thick), single wood chunk in one lens @ 60.2 and 60.5' BGS.	65
	SO1780	1.8	50%	NA				
	SO1781	5.4	75%	NA		ML	Slightly clayey SILT, olive-brown (2.5Y 4/3), slight orange-brown mottling, wet, no odor.	
70						ML/SM	Fine sandy SILT/silty SAND, olive-brown (2.5Y 4/3), slight orange-brown mottling, wet, no odor.	70
75							Refusal @ 70.2', likely BASALT, but no sample observed. Total depth 70.2'. Groundwater sample GW06110202 collected from 54'-58' BGS. Groundwater sample GW06110203 collected from 64-68' BGS.	75
80								80

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.51

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-6 (revised 9/02)

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 49.1' below dock	0
5								5
10								10
15								15
20								20
25								25
30								30
35								35
40								40

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 7 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.56

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-6 (revised 9/02)

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40								40
45								45
50	SO1752	7.1	100%	NA		ML	Clayey SILT, dark gray (10YR 4/1), ~15-20% clay, wet, trace (5%) tan powdery material, trace (5%) tan to light brown material, weak odor, discontinuous sheen on water.	50
	SO1753	8.9	100%	NA			Decreased clay content below 49.5' BGS.	
			0%	NA			Tan powdery material absent below 51' BGS, trace (~5-10%) non-carbonized wood, tan @ 52.5-53' BGS.	
55	SO1754	314	30%	NA			SILT, very dark gray (10YR 3/1), some very fine sandy silt zones (~25-35%), moist, weak to moderate odor.	55 BACKFILLED w/BENTONITE GROUT
60	SO1755	>3000	60%	NA			SILT, very dark gray (2.5Y 3/1), trace very fine sand, wet, ~5-10% carbonized and non-carbonized wood, strong odor.	60
			0%	NA		SM	Silty, very fine SAND, gray (2.5Y 5/1), ~10-20% silt, strong odor, residual NAPL observed from 60.9-61.0 ft.	
							Soft probing @ 61-63'. Very soft from 63-65'. Geoprobe rods sank to 65'. No sample collected.	
65	SO1756	1389	60%	NA		ML	SILT, dark gray (7.5YR 4/1), trace fibrous organics (<5%), soft, strong odor at top of sample, weak odor elsewhere, trace fine sand.	65
							Boring terminated @ 67' BGS'.	
70								70
75								75
80								80

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 7 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.56

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-7

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 50.2' below dock - Depth to river surface @ 24.38' at time of sampling	0
5								5
10								10
15								15
20								20
25							River surface	25
30								30
35								35
40								40

Drilled By: Cascade Drilling

Drill Method: Direct push probe (tripod)

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 37.11

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-7

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40							Water	40
45								45
50								50
	SO1761	3.6	100%	NA		ML	Very clayey SILT, very dark gray-brown (2.5Y 3/2), ~15-25% clay, trace fibrous organic material, wet.	
	SO1762	12.6	100%	NA			As above, weak odor.	
55	SO1763	9.0	<1%	NA			As above, color change to dark gray (5Y 4/1).	55
	SO1764	56.1	30%	NA		SP	Contact contained ~0.7" wood. Fine to med. SAND, very dark gray (5Y 3/1), trace (<5%) red grains, wet, weak odor.	BACKFILLED w/BENTONITE GROUT
	SO1765	63.7	60%	NA		ML	Clayey SILT, very dark gray (5Y 3/1), ~10-20% clay, trace (<2%) wood, soft, wet. Fine sandy SILT @ 59.6' BGS, very dark gray (5Y 3/1), ~25-35% sand, ~10-15% wood.	
60								60
	SO1766	57.1	40%	NA		SP	Fine to med. SAND, very dark gray (5Y 3/1), trace coarse sand (<5%) and silt (<5%), wet. Occasional silt laminations, weak odor.	
	SO1767	54.0	30%	NA		ML	SILT, grayish brown (2.5YR 5/2), wet, weak odor at ~64.5'-65' BGS, fine to med. sand lens, very dark gray (2.5Y 5/2), 2" thick @ 64' BGS.	
65							Boring terminated @ 65' BGS'.	65
							Groundwater sample GW06120202 collected from 61'-65' BGS.	
70								70
75								75
80								80

Drilled By: Cascade Drilling

Drill Method: Direct push probe (tripod)

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 37.11

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Stage 2 Borehole Logs

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-8

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	9							Barge Deck	
0									
								Willamette River surface.	
	5								
5								Mudline at 5.7 ft below barge deck.	
							SP	Very fine to fine SAND, dark yellow brown (10YR 3/6), slightly micaceous, trace black asphalt-like fragments, wet.	
							SM	Silty very fine to fine SAND, black (5Y 2.5/1), 10-20% silt, trace red grains, weak odor, slight sheen on liquid in sampler. Grades to dark olive gray (5Y 3/2).	
		SO1915	6.2	Neg.	25%				
	0								
10									
		SO1916	12.0	Neg.	100%		CL/ ML	Silty CLAY/Clayey SILT, black (2.5Y 2.5/1) with dark olive gray mottling (5Y 3/2), soft, trace sand and wood fragments, wet, moderate odor, sheen.	
	-5	SO1917	12.0	Neg.	100%				
15							SM	Silty very fine SAND, dark olive gray (5Y 3/2), 20-30% silt, trace red grains, wet, moderate odor, sheen.	
							SP		

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 28, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.6 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 3

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-8

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
		SO1918	15.5	Neg.	100%		SP	Grading to very fine to fine SAND, black (5Y 2.5/1), trace red grains, some wood fragments, wet, moderate odor, sheen.			
	-10	NA	NA	NA	0%		CL	Silty CLAY, light olive brown (2.5Y 5/4), 10-20% silt, moderately firm, moist to wet, no odor.			-10
21		SO1919	7.0	Neg.	90%		ML	SILT, olive brown, trace clay, some zones slightly more clayey, slightly micaceous, wet, no odor.		21	
		SO1920	5.4	Neg.	100%						
	-15										-15
		SO1921	4.5	Neg.	100%		SP	Very fine to fine SAND, black (5Y 2.5/1), trace red grains, wet, moderate odor, sheen.			
26		SO1922	6.2	Neg.	100%		SM/ ML	Very fine sandy SILT/Silty very fine SAND, olive brown (2.5Y 4/3), very slightly micaceous, wet, no odor.		26	
							SM	Grading to silty very fine SAND, olive brown (2.5Y 4/3), 20-30% silt, very slightly micaceous, wet, no odor.			
	-20	SO1923	5.4	Neg.	100%						-20
							ML	SILT, olive brown (2.5Y 4/3), trace to 30% very fine sand, slightly micaceous, sand in mixed zones.			
31		SO1924	5.4	Neg.	100%					31	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 28, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.6 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 3

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-8

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-25	SO1925	6.4	Neg.	100%		ML	SILT, olive brown (2.5Y 4/3), trace to 30% very fine sand, slightly micaceous, sand in mixed zones.	
		SO1926	7.0	Neg.	70%		SM	Grades to silty very fine SAND, 5-15% silt, micaceous, wet.	
37		SO1927	5.4	Neg.	80%		SP	Grades to very fine to fine SAND, olive brown (2.5Y 4/3), micaceous, wet.	
	-30	SO1928	7.0	Neg.	100%		ML	Very fine sandy SILT, olive brown (2.5Y 4/3), trace orange mottling at 39 ft, 10-20% sand, wet.	
		SO1929	5.4	Neg.	75%		SM	Grading to silty very fine SAND, olive brown (2.5Y 4/3), 20-30% silt, wet.	
42		SO1930	2.0	Neg.	25%		SW	Fine to coarse SAND, black (2.5Y 2.5/1), trace red grains, wet.	
	-35						Rx	BASALT, black, massive.	
47								Refusal on basalt at 43.8 ft below barge deck. Groundwater sample GW02280301 collected at 16-20 ft below deck. Groundwater sample GW02280302 collected at 39.5-43.5 ft below deck.	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 28, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.6 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 3 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-9

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	10							Barge Deck	
								Willamette River surface.	
								Mudline at 5 ft below barge deck.	
5	5						SW	Gravelly fine to coarse SAND, very dark gray (10YR 3/1), trace of silt, gravel up to 1" dia., trace organics, no odor.	
		SO1931	0.0	Neg.	15%				
								Becomes very dark gray (7.5YR 3/1), trace of concrete, red brick, and glass.	
10	0	SO1932	0.9	Neg.	25%				
							SP	Fine to medium SAND, gray (7.5YR5/1), miceaeous, trace fine gravel, weak odor.	
		SO1933	3.4	Neg.	90%				
								Trace wood.	
		SO1934	3.5	Neg.	60%			Becomes dark gray (2.5Y 4/1), 15-20% silt, weak to moderate odor, possible sheen at bottom of sampler.	
15									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 4, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-9

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1935	6.1	Neg.	5%		SP	Fine to medium SAND, dark gray (2.5Y 4/1), 15-20% silt, micaceous, trace fine gravel, weak to moderate odor.	
								5-10% silt, no sheen.	
							ML	SILT, very dark gray (2.5Y 3/1), soft, trace organic fibers, weak odor.	
		SO1936	0.0	Neg.	100%			Becomes dark gray (2.5Y 4/1), trace very fine sand, micaceous, weak to indistinct odor.	
20	-10	NA	NA	NA	0%				
		SO1937	0.0	Neg.	60%		SM	Silty fine to med. SAND, very dark gray (2.5Y 3/1), 15-20% silt, weak to moderate odor, light iridescent sheen.	
							ML	SILT, dark gray (10YR 4/1), slightly stiff, weak odor.	
							SP	Fine to med. SAND, very dark gray (2.5Y 3/1), trace red grains, indistinct odor, no sheen.	
		SO1938	0.1	Neg.	60%			SILT layers, dark gray (10YR 4/1), at 24' bgs (2" thick) and 24.5' bgs (1.2" thick), sheen between layers.	
25	-15							Trace of wood and silt.	
		SO1939	0.4	Neg.	40%				
							ML	SILT, dark gray (10YR 4/1), slightly stiff, indistinct odor.	
							SM	Silty fine SAND, dark gray (10YR 4/1), 10-15% silt, moderate odor, iridescent sheen.	
		SO1940	0.0	Neg.	90%			Grading to silty very fine SAND, grayish brown (2.5Y 5/2), micaceous.	
							ML	Grading to SILT, grayish brown (2.5Y 5/2), slightly stiff, indistinct odor, no sheen.	
							SM	Silty very fine SAND, dark gray brown (2.5Y 4/2), 15-20% silt, micaceous, indistinct odor.	
30		SO1941	0.0	Neg.	100%		ML		

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 4, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-9

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
							ML	SILT, grayish brown (2.5Y 5/2), trace clay, moderately stiff, no odor.	
								Sandy silt zone 1 in. thick.	
								20-30% clay, stiff.	
		SO1942	0.0	Neg.	100%			Very fine sandy SILT, grayish brown (2.5Y 5/2), 20-40% sand, indistinct odor.	
								Grading to SILT.	
							SM	Silty very fine SAND, brown (10YR 4/3), 15-25% silt, micaceous, indistinct odor.	
		SO1943	0.0	Neg.	85%			Becomes dark yellow brown (10YR 3/4).	
35	-25							Becomes dark gray brown (10YR 4/3), some orange mottling, weak to moderate odor.	
		SO1944	0.0	Neg.	100%		ML	SILT, grayish brown (10YR 5/2), slightly to moderately stiff, trace orange mottling, weak to moderate odor.	
							SM	Silty very fine to fine SAND, dark gray brown (10YR 4/2), 15-25% silt, trace orange banding, micaceous, weak to moderate odor.	
		SO1945	0.0	Neg.	75%		ML	Becomes dark yellow brown (10YR 4/4), mostly fine sand.	
								Very fine sandy SILT, dark gray brown (10YR 4/2), micaceous, 30-45% sand, indistinct odor.	
		SO1946	0.0	Neg.	NA		SM	Silty very fine SAND, brown (10YR 5/3), 20-30% silt, micaceous, indistinct odor, no sheen.	
40	-30						Rx	BASALT: black (2.5Y 2.5/1), massive, well indurated, indistinct odor.	
								Refusal on basalt at 40.2 ft below barge deck.	
								Groundwater sample GW03040301 collected at 20-24 ft below deck.	
								Groundwater sample GW03040302 collected at 36-40 ft below deck.	
45									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 4, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 3 of 3

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-10

Ground Surface: Barge Deck

Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0							Mudline at 14 ft below barge deck.		10	0
							ML	SILT, dark olive gray (5Y 3/2), trace clay and organics, soft, wet, weak to indistinct odor.			
15	-5	SO1947*	4.8	Neg.	100%			Fine sandy SILT zone 0.3' thick.		15	-5

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 5-6, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.0 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-10

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
		SO1949	5.9	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace clay and organics, soft, wet, weak to indistinct odor. Very fine sandy SILT zone 0.3' thick, few thin (1/32" thick) tan clay laminations. Trace fibrous organics, indistinct odor.			
		SO1950	8.0	Neg.	NA			Becomes very dark gray (5Y 3/1), trace sand, weak to moderate odor, trace of iridescent sheen.			
	-10	SO1951	12.1	Neg.	100%			5-10% very fine sand, indistinct odor, no sheen.			-10
21										21	
		SO1952	8.0	Neg.	100%			Increased fibrous organic content and decreased sand content.			
		SO1953	6.7	Neg.	70%			Becomes dark olive gray (5Y 3/2), with some tan clay laminations (1/32" thick).			
	-15										-15
26								Becomes very dark gray (5Y 3/1), occasional tan clay laminations, weak odor.		26	
		SO1954	32.2	Neg.	100%						
		SO1955	117	Neg.	100%						
							SM	Silty fine SAND, dark gray (10YR 4/1), 20-30% silt, strong odor, sheen.			
							ML	SILT, dark gray (10YR 4/1), 5-10% fibrous organics, soft to slightly stiff, strong odor, no sheen.			
	-20	SO1956	2280	Neg.	100%						-20
31										31	
		SO1957	271	Neg.	100%			2-5% fiberous organics, moderate odor.			

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 5-6, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.0 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 3

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-10

Ground Surface: Barge Deck

Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
							ML	SILT, dark gray (10YR 4/1), 2-5% fibrous organics, soft to slightly stiff, moderate odor, no sheen.	
								Silty fine SAND layer at 31.9-32.0 ft below deck.	
		SO1958	24.3	Neg.	95%			Becomes very dark gray (5Y 3/1), 5-15% very fine sand, trace clay, decreased fibrous organics content, weak odor.	
								Sand rich zone at 33.9-34.0 ft below deck.	
	-25								-25
								Trace carbonized wood, no odor, sand, or clay.	
		SO1959	8.9	Neg.	90%				
							SM	Silty medium to coarse SAND, very dark gray (2.5Y 3/1), 5-10% wood, no odor, light organic sheen. Grades to silty very fine sand below 36.7 ft.	
37							SP		37
		SO1960	5.8	Neg.	100%			Fine SAND, dark gray (2.5Y 4/1), 5-10% silt, trace red grains, no odor or sheen.	
								Silt and wood rich zone 0.3' thick.	
	-30	SO1961	3.5	Neg.	100%			Trace silt.	-30
								Becomes very dark gray brown (2.5Y 3/2).	
		SO1962	1.1	Neg.	15%				
42							GW	Fine to coarse GRAVEL, very dark gray (10YR 3/1), subrounded to rounded, no odor or sheen.	42
							Rx	BASALT, black (5Y 2.5/1), vesicular, well indurated, orange staining lining vesicles, no odor or sheen.	
								Refusal on basalt at 42.7 ft below barge deck.	
								Groundwater sample GW03050302 collected at 28-32 ft below deck.	
	-35							Groundwater sample GW03060301 and duplicate sample GW03060302 collected at 38-42 ft below deck.	-35
								*Duplicate soil sample SO1948 collected from this interval.	
47									47

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 5-6, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.0 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 3 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-11

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	9							Barge Deck	
0									
								Willamette River surface.	
5	5								
10	0							Mudline at 11.5 ft below barge deck.	
		SO1963	4.4	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace fine sand and organics, soft, no odor.	
								Light tan clay-rich zones, 5-10% fibrous organics.	
	-5	SO1964	3.7	Neg.	100%			Occasional tan clay rich laminations, weak odor.	
15		SO1965	14.8	Neg.	30%			As above with color dark gray (5Y 4/1), weak odor, trace of dark brown oily material.	
	-10							As above with consolidated tan fiberous material 19.3-19.4 ft below deck.	
20									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 6-7, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.4 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-11

Ground Surface: Barge Deck

Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1966	109	Neg.	20%		ML	SILT, dark gray (10YR 4/1), trace of very fine sand and fiberous organics, slightly stiff, weak to moderate odor.	
	-15	SO1967	1230	Neg.	60%			As above with ¼" thick very fine sand rich (30-40%) zone. As above with strong odor, 5-10% fiberous material, few black bands 1" thick. Trace of Silty fine SAND at bottom of sampler, dark gray (10YR 4/1), possible sheen.	
25		SO1968	78.5	Neg.	100%			SILT, dark gray (10YR 4/1), trace micaceous very fine sand and carbonize/noncarbonized wood, slightly stiff, weak odor.	
		SO1969	12.8	Neg.	75%			As above with very fine micaceous sand (10-20%), indistinct odor.	
	-20								
30		SO1970	21.4	Neg.	45%		SP	Slightly silty fine SAND, dark gray (2.5Y 4/1), trace wood and red grains, indistinct odor, light organic sheen at 31.7 ft only.	
		SO1971	13.5	Neg.	35%			As above with very fine to fine sand, no wood, moderate odor.	
							SM	Silty very fine SAND, olive brown (2.5Y 4/3), micaceous, 30-40% silt, piece of wood at bottom of unit, moderate odor.	
	-25						Rx	BASALT: very dark gray (2.5Y 3/1), massive, well indurated, moderate odor.	
35								Refusal on basalt at 34.0 ft below deck. Groundwater sample GW03070302 collected at 23-27 ft below deck. Groundwater sample GW03070301 collected at 31-33.5 ft below deck.	
	-30								
40									

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 6-7, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.4 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-12

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10
25	-15									25	-15
30										30	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 19-20, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.1 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-12

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
35	-25								
40	-30							Mudline at 43.0 ft below barge deck.	
		SO1870	2.1	Neg.	100%		ML	SILT, dark gray (10YR 4/1), trace clay, minor fine rootlets, soft, wet, organic odor.	
45	-35	SO1871	0.7	Neg.	NA			Some black mottling.	
		SO1872	2.2	NA	NA			Clayey SILT, dark olive brown (2.5Y 3/3), 20-30% clay, minor fine rootlets, wet, weak to indistinct odor.	
50	-40	NA	NA	NA	0%				
								GRAVEL, rounded, primarily basalt with minor quartzite, up to 2-in. dia.	
55	-45							Refusal on gravel at 52.2 ft below barge deck. Groundwater sample GW02200301 collected at 48-52 ft below deck.	
60									

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 19-20, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.1 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-13

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	9							Barge Deck	
								Willamette River surface.	
5	5								
								Mudline at 8 ft below barge deck.	
	0						ML	Fine to medium sandy SILT layer, dark olive gray (5Y 3/2), wet, at 8.00 to 8.04 ft below deck.	
							SM	SILT, dark olive gray (5Y 3/2), soft, single wood fragment 2" thick, wet.	
10		SO1896	3.2	Neg.	40%			Fine to medium SAND, very dark gray (5Y 3/1), wet.	
							ML	Silty very fine SAND, mottled dark olive gray (5Y 3/2) and very dark gray (5Y 3/1), slightly micaceous, 20-30% silt, wet.	
		SO1897	7.4	Neg.	100%			Silt content decreased with depth.	
	-5	SO1898	5.7	Neg.	100%			Fine to medium sandy SILT, dark olive gray (5Y 3/2), 30-40% sand, soft, trace organics and wood fragments, rare shells, slight iridescent sheen, wet.	
15								At 13 ft below deck, clayey SILT, dark olive gray (5Y 3/2), 20-30% clay, soft, abundant wood fragments at contact, wet.	
								Trace clay, slight black mottling, slightly micaceous, trace fiberous organics and wood fragments, faint iridescent sheen.	
		SO1899	6.5	Neg.	100%			Grades to 20-30% clay.	
	-10								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 26, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.8 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-13

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
							ML/CL	Clayey SILT / silty CLAY, dark olive gray (5Y 3/2), abundant black mottling that decreases with depth, weak odor, wet.			
		SO1900	12.3	Neg.	100%						
							SP	Very fine to fine SAND, dark olive gray (5Y 3/2), wet, weak odor, faint sheen.			
24	-15	SO1901	25.5	Neg.	100%		ML/CL	Clayey SILT / silty CLAY, dark olive gray (5Y 3/2), abundant black mottling that decreases with depth, weak odor, wet.		24	-15
		SO1902	28.8	Neg.	100%		SP	Very fine to fine SAND, very dark gray (5Y 3/1), trace red grains and mica, faint to no odor.			
		SO1903	16.4	Neg.	100%		ML	Abundant wood at 27.5 ft only, grades to very fine to medium sand.			
29	-20							Very fine sandy SILT, light olive brown (2.5Y 5/4), slightly micaceous, wet, faint odor.		29	-20
								BASALT (recovery too poor for description).			
								Refusal on basalt at 28.5 ft below deck.			
								Groundwater sample GW02260303 collected at 13-17 ft below deck.			
								Groundwater sample GW02260304 collected at 24.5-28.5 ft below deck.			
34	-25									34	-25

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 26, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.8 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-14

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	8							Barge Deck	
0									
								Willamette River surface.	
	5								
5									
	0								
10									
	-5							Mudline at 15 ft below barge deck.	
15		SO1906	13.8	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), soft, trace fibrous organics, rare wood fragments, few scattered pale yellow (2.5Y 7/4) thin clay laminations (1/8" thick), wet.	
	-10	SO1907	16.2	Neg.	100%			Grades to 20-30% clay.	
		SO1908	14.6	Neg.	100%			No clay laminations.	
20								Single broken plastic fragment.	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 27, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.5 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-14

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-15	SO1909	8.9	Neg.	60%		ML	As above with 5-15% clay, three layers (up to 1" thick) of black staining with weak odor at 22-22.7 ft below deck. Less odor with depth.	
		SO1910	14.6	Neg.	100%				
27							SM	Silty very fine to fine SAND, dark olive gray (5Y 3/2), 20-30% silt, wet, no odor.	
	-20	SO1911	18.7	Neg.	10%		SP	Very fine to fine SAND, dark gray (5Y 3/1), trace red grains, rare small wood fragments, wet, no odor.	
32		SO1912	NA	Neg.	15%				
	-25	SO1913	NA	Neg.	15%			Single 1" thick gray (5Y 5/1) SILT layer. Possible weak odor.	
		SO1914	NA	Neg.	30%		SM	Silty very fine to fine SAND, very dark gray (5Y 3/1), 10-20% silt, trace red grains, wet.	
37							ML/SM	2" thick gray (5Y 5/1) SILT layer, underlain by 1" thick very fine to fine SAND at 36.3 ft below deck.	
	-30							Very fine sandy SILT/silty very fine SAND, light olive brown (2.5Y 5/4), slightly micaceous, wet.	
								BASALT, slightly vesicular, slight green secondary mineralization in vesicles (few broken fragments only).	
								Refusal on basalt at 37.0 ft below deck.	
42								Groundwater sample GW02270301 collected at 19-23 ft below deck. Groundwater sample GW02270302 collected at 32-36 ft below deck.	
	-35								

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 27, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.5 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-15

Ground Surface: Barge Deck

Logged By: David Livermore

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	8							Barge Deck			8
0										0	
								Willamette River surface (estimated).			
	5										5
5										5	
	0										0
10										10	
	-5										-5
15										15	
	-10										-10
20										20	
	-15										-15
25										25	
	-20										-20
30										30	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 17, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-15

Ground Surface: Barge Deck

Logged By: David Livermore

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
								Mudline at 44 ft below barge deck.	
45		SO1850	0	Neg.	100%		ML	SILT, very dark gray (2.5Y 3/1), very soft, trace of very fine roots, wet.	
		SO1851	0	Neg.	100%				
		SO1852	0	Neg.	100%			Trace mica and charcoal, some clay, moderately plastic.	
		SO1853	3.0	Neg.	100%			Becomes very dark gray (2.5Y 3/1) to black (2.5Y 2.5/1), trace sand.	
50		SO1854	0	Neg.	100%		Rx	BASALT, dark gray, vesicular, slightly weathered, hard, dense.	

Refusal on basalt at 50.0 ft below barge deck.

Groundwater sample GW02170301 collected at 45.3 ft to 49.3 ft below deck.

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 17, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-16

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	11							Barge Deck	
0									
	10								
								Willamette River surface.	
5									
	5								
10									
	0								
15									
	-5								
20									
	-10								
25									
	-15								
30									

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 19, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 11.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-16

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet) / ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
-20								
35								
-25							Mudline at 38.6 ft below barge deck.	
40	SO1867	8.1	Neg.	100%		ML	SILT, mottled dark gray (10YR 4/1) and black (10YR 2/1), trace clay, wet, weak to moderate odor.	
-30	SO1868	11.8	Neg.	100%			Becomes light olive brown (2.5Y 4/1), slightly micaceous, moderate odor.	
	SO1869	NA	NA	50%		SP	Very fine to fine SAND, dark gray brown (2.5Y 4/2), uniform, wet, slight odor.	
45							BASALT, massive (few broken fragments only).	
-35							Refusal at 43.3 ft below barge deck. Groundwater sample GW02190301 collected at 42-43 ft below deck.	
50								
-40								
55								
-45								
60								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 19, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 11.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-17

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
0	9							Barge Deck		0	9
								Willamette River surface.			
	5										5
5										5	
	0										0
10										10	
	-5										-5
15										15	
	-10										-10
20										20	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 27, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.8 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634	**Borehole: WB-17**
Project: ATOFINA	
Client: ATOFINA Chemicals, Inc.	Ground Surface: Barge Deck
Location: Portland, OR	Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
								Mudline at 34.0 ft below barge deck.	
35	-25	SO1904	7.3	Neg.	25%		ML	Slightly clayey SILT, very dark gray (5Y 3/1), 5-15% clay, soft, trace rootlets and black mottling, wet, organic odor.	
		SO1905	13	Neg.	100%			Very fine to fine SAND, very dark gray (5Y 3/1), trace red grains, wet, no odor.	
								BASALT, black, massive (few fragments only).	
								Refusal on basalt at 36.2 ft below deck.	
								No groundwater samples collected.	

Drilled By: Cascade Drilling	Well Casing Elevation: NA	Datum: City of Portland Datum - 1929
Drill Method: Direct Push	Barge Deck Elevation: 8.8 ft	
Drill Date February 27, 2003	Borehole Diameter: Varies	Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-18

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	10							Barge Deck	
								Willamette River surface.	
5	5								
								Mudline at 8 ft below barge deck.	
		SO1888	5.1	Neg.	100%		SM	Silty very fine SAND, very dark gray (5Y 3/1), 30-40% silt, slightly micaceous, trace fibrous organics and fine rootlets, rare fine gravel, few wood fragments, wet.	
10	0						ML	Grading to slightly sandy SILT, very dark gray (5Y 3/1), 5-15% fine sand, slightly micaceous, trace fiberous organics and fine rootlets, rare fine gravel, few wood fragments, wet.	
		NA	NA	NA	0%				

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 25-26, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-18

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
		SO1889	5.1	Neg.	100%		ML	Slightly sandy SILT, very dark gray (5Y 3/1), 5-15% fine sand, slightly micaceous, trace fibrous organics and fine rootlets, rare fine gravel, few wood fragments, wet.			
							SM	Silty very fine SAND, very dark gray (5Y 3/1), trace fibrous organics, abundant wood fragments at 14 ft, wet.			
	-5	SO1890	4.3	Neg.	100%		ML	Slightly sandy SILT, very dark gray (5Y 3/1), 5-15% sand, slightly micaceous, trace organics, wet.			-5
							SM	Silty very fine to fine SAND, very dark gray (5Y 3/1), 20-30% silt, trace fibrous organics and fine rootlets, few wood fragments, wet.			
							ML	Slightly clayey SILT, dark olive gray, trace organics and very fine sand, 5-15% clay, wet, no odor, sheen.			
							SM	2" thick silty SAND layer, 10-20% silt, weak odor, sheen.			
17		SO1891	5.1	Neg.	60%			Clayey SILT, dark olive gray (5Y 3/2), rare wood fragments, wet, faint odor.		17	
		SO1892	6.7	Neg.	100%						
	-10							1" thick black (5Y 2.5/1) fine to medium sand layer, wet, moderate odor.			-10
								Clayey SILT as above with weak odor.			
22		SO1893	5.9	Neg.	50%		SP	Very fine to fine SAND, black (5Y 2.5/1), trace red grains and fine mica flakes, few scattered thin (1/4" to 3/4" thick) silt laminations, wet, faint odor, sheen. Odor decreases with depth.		22	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 25-26, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.5 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 3

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-18

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	-15						SP	Very fine to fine SAND, black (5Y 2.5/1), trace red grains and fine mica flakes, few scattered thin (1/4" to 3/4" thick) silt laminations, wet, faint odor, sheen.			-15
		SO1894	6.7	Neg.	15%						
		SO1895	6.7	Neg.	75%						
29	-20						ML	Clayey SILT, dark olive gray, few wood fragments, wet, no odor, no sheen.		29	-20
								BASALT, black, massive (few fragments only).			
								Refusal on basalt at 29.7 ft below deck.			
								Groundwater sample GW02250302 collected at 13-17 ft below deck.			
								Groundwater sample GW02260301 collected at 25.5-29.5 ft below deck.			
34	-25									34	-25

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 25-26, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 3 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-19

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
0	10							Barge Deck		0	10
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 24-25, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.9 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-19

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-15								
28									
	-20								
33								Mudline at 34.1 ft below barge deck.	
	-25	SO1885	3.6	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), soft, trace fine rootlets and clay, trace mica, single ½" dia. gravel at 34.1 ft, organic odor.	
		SO1886	4.5	Neg.	40%			½" thick lamination of fine to medium SAND at 35.5 ft.	
		SO1887	5.4	Neg.	100%		SM	Trace fine sand with depth and black mottling at 36 ft.	
38							ML/SP	Silty very fine to fine SAND, very dark gray (5Y 3/1), 10-20% silt, wood fragments up to 1" dia., wet.	
	-30							SILT, olive (5Y 5/3), trace clay with some mixed very fine to fine SAND, very dark gray (5Y 3/1), single 2.5" long wood fragment, organic odor.	
								Few BASALT fragments in sample shoe.	
								Refusal on basalt at 38.1 ft below deck.	
43								Groundwater sample GW02250301 collected at 37-38 ft below deck.	
	-35								

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 24-25, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.9 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-20

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10
25	-15									25	-15
30	-20									30	-20

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 24, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.6 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-20

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
35	-25								
40	-30								
45	-35							Mudline at 46.5 ft below barge deck.	
		SO1882	1.7	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), soft, trace fine rootlets and clay, wet, organic odor.	
50	-40	SO1883	3.5	Neg.	60%				
		SO1884	3.5	Neg.	100%		Rx	BASALT, black (2.5Y 2.5/1), moderately vesicular, green secondary mineralization in vesicles, no odor.	
55	-45							Refusal on basalt at 51.8 ft below deck. Groundwater sample GW02240301 collected at 49-51 ft below deck.	
60	-50								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 24, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.6 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-21

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10
25	-15									25	-15
30										30	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 20, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.3 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-21

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-20								
35	-25								
40	-30								
								Mudline at 45.2 ft below barge deck.	
45	-35	SO1873	2.6	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace clay, minor fine rootlets, soft, wet, organic odor.	
		SO1874	2.6	Neg.	80%				
50	-40	SO1875	4.7	Neg.	100%			As above with minor black (10YR 2/1) mottling.	
		SO1876	4.0	Neg.	100%				
		NA	NA	NA	0%			Some sand in sampler shoe at 52.3 ft below deck.	
								Refusal on rock or gravel (?) at 53.4 ft below barge deck.	
55	-45							Groundwater sample GW02200302 collected at 49.5-53.5 ft below deck.	
60									

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 20, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.3 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634	**Borehole: WB-22**
Project: ATOFINA	
Client: ATOFINA Chemicals, Inc.	Ground Surface: Barge Deck
Location: Portland, OR	Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	12							Barge Deck			12
0										0	
	10										10
								Willamette River surface.			
5										5	
	5										5
10										10	
	0										0
15										15	
	-5										-5
20										20	
	-10										-10
25										25	
	-15										-15
30										30	
	-20										-20

Drilled By: Cascade Drilling	Well Casing Elevation: NA	Datum: City of Portland Datum - 1929
Drill Method: Direct Push	Barge Deck Elevation: 11.6 ft	
Drill Date February 21, 2003	Borehole Diameter: Varies	Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-22

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-25								
39									
	-30								
44									
	-35								
49								Mudline at 50.5 ft below barge deck.	
	-40	SO1877	6.3	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace clay and rootlets, wet, organic odor.	
		SO1878	5.3	Neg.	90%				
54		SO1879	5.3	Neg.	100%		SM	Slightly silty very fine to fine SAND, dark olive gray (5Y 3/2), trace to 15% silt, trace red grains.	
	-45	SO1880	6.3	Neg.	25%		SP	Very fine to fine SAND, very dark gray (2.5Y 3/1), trace red grains, wet.	
59									
	-50	SO1881	6.3	Neg.	25%		GW	Fine to coarse GRAVEL, dark gray (2.5Y 4/1), primarily rounded basalt with minor quartzite, 10-20% very fine to fine sand.	
64								Refusal due to gravel at 62.5 ft below barge deck. Groundwater sample GW02210301 collected at 54-58 ft below deck.	
	-55								

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 21, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 11.6 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-23

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	10							Barge Deck	
0									
								Willamette River surface.	
5	5								
10	0								
15	-5								
20	-10							Mudline at 21.4 ft below barge deck.	
		SO1855	1.0	Neg.	100%		ML	SILT, very dark gray (10YR 3/1), trace clay, very soft, uniform, trace wood fragments and very fine rootlets, organic odor, wet.	
		SO1856	1.0	Neg.	100%			As above with 10-20% clay, trace of fine sand, single 1/8" thick sand laminae.	
25	-15	SO1857	1.0	Neg.	5%				
		SO1858	1.7	Neg.	100%				
		SO1859	2.7	Neg.	80%			Grades to dark olive gray (5Y 3/2)	
30									

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 18, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.2 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-23

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1860	2.7	Neg.	50%		ML		
		SO1861	2.7	Neg.	100%			Clayey SILT, dark yellow brown (10YR 4/4), trace fine sand, wood fragments up to 2" dia., soft, wet.	
35	-25	SO1862	2.7	Neg.	NA			Grades to very dark gray brown (10YR 3/2)	
		SO1863	2.4	Neg.	80%			Grades to 5-10% sand.	
		SO1864	2.4	Neg.	100%		SP	Very fine to fine SAND, trace silt and fine organics, wet, no odor.	
40	-30						ML	Slightly clayey SILT, olive yellow (2.5Y 6/6), firm, moist to wet.	
		SO1865	2.0	Neg.	100%		SP	Very fine to fine SAND, olive brown (2.5Y 4/3), trace silt and fine organics, rare pieces of wood, wet, no odor.	
		SO1866	NA	Neg.	100%		ML	SILT, olive yellow, firm, moist to wet.	
							Rx	BASALT, black, massive.	
45	-35							Refusal at 42.4 ft below barge deck.	
								Groundwater sample GW02180301 collected 25-29 ft below deck.	
								Groundwater sample GW02180302 collected 38-42 ft below deck.	
								Note: Sample interval for SO1857 is 25-29 ft below deck.	
50	-40								
55	-45								
60									

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 18, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.2 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-24

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
0	10							Barge Deck		0	10
								Willamette River surface (estimated).			
5	5									5	5
								Mudline at 9.4 ft below barge deck. No soil samples collected at 9.4-20 ft below deck.			
10	0									10	0
15	-5									15	-5

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 7, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.0 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-24

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-10								
		SO1972	316	Neg.	100%		ML	Slightly clayey SILT, olive brown (2.5Y 4/3), 10-20% clay, abundant hairline organics, wet, moderate odor. Slightly silty fine to medium SAND layer 21.3-21.6 ft below deck, olive brown (2.5Y 4/3), slightly micaceous, 10-20% silt, wet, strong odor, slight sheen. Similar layers (1" thick) at 22 and 22.5 ft below deck.	
		SO1973	337	Neg.	100%				
24								At 22.9 ft, slightly clayey SILT, very dark gray, no hairline organics, odor decreases with depth, rare wood fragments.	
	-15	SO1974	23.9	Neg.	90%				
		SO1975	9.5	Neg.	50%		SP	Fine to medium SAND, dark gray brown (2.5Y 4/2), trace of red grains, rare wood fragments, faint odor decreasing with depth.	
29		SO1976	4.2	Neg.	50%			2" thick fine to medium sandy SILT layer, dark gray brown (2.5Y 4/2), 10-20% sand, wet.	
	-20	SO1977	10.5	Neg.	NA				
34								Boring terminated at 32 ft below barge deck. No groundwater samples collected.	
	-25								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 7, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.0 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-25

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	10							Barge Deck	
								Willamette River surface.	
5	5								
10	0							Mudline at 14.3 ft below barge deck.	
15	-5	SO1978*	1.5	Neg.	100%		ML	Clayey SILT, dark olive gray (5Y 3/2), 10-20% clay, very soft, trace hairline organics, abundant white clay laminations up to1/8" thick , wet.	
		SO1980	0.0	Neg.	100%		SM	Silty very fine to fine SAND layer, dark olive gray (5Y 3/2), 20-30% silt, wet.	
								Clayey SILT as above with 20-30% clay.	
		SO1981	0.2	Neg.	100%		SM	Silty very fine to fine SAND layer, dark olive gray (5Y 3/2), 20-30% silt, wet.	
20	-10						ML	Grading to SILT, dark olive gray (5Y 3/2), trace of clay and very fine sand, soft, wet.	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 7-10, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.9 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634	**Borehole: WB-25**
Project: ATOFINA	
Client: ATOFINA Chemicals, Inc.	Ground Surface: Barge Deck
Location: Portland, OR	Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1982	0.1	Neg.	60%		ML	SILT, dark olive gray (5Y 3/2), trace of clay and very fine sand, soft, wet. Clayey SILT, dark olive gray (5Y 3/2), some black mottling, 10-20% clay, trace wood fragments, slight odor.	
	-15								
26		SO1983	1.0	Neg.	40%		SM / SP	Silty very fine to fine SAND, very dark gray (5Y 3/1), 20-30% silt, wet, slight odor.	
		SO1984	1.0	Neg.	30%			Grades to very fine to fine SAND, very dark gray (5Y3/1), trace of red grains, 20-30% silt, wet, slight odor.	
	-20	SO1985	8.5	Neg.	45%		SP/ ML	Bedded very fine to fine SAND, black (5Y 2.5/1), and clayey SILT, olive gray (5Y 4/2), beds up to 3" thick, trace red grains in sand, rare wood fragments, weak odor decreases with depth.	
31		SO1986	4.4	Neg.	100%				
		SO1987	0.0	Neg.	40%				
	-25	SO1988	0.0	Neg.	50%		SP	Fine to medium SAND, olive gray (5Y 4/2), mostly fine sand, slightly micaceous, wet, faint odor.	
36							Rx	BASALT: black (5Y 2.5/1), slightly vesicular, indurated, faint odor.	
								Refusal on basalt at 36.0 ft below barge deck. *Duplicate soil sample SO1979 collected on this interval. Groundwater sample GW03100301 collected at 26-30 ft below deck. Groundwater sample GW03100302 collected at 34-36 ft below deck.	
	-30								
41									

Drilled By: Cascade Drilling	Well Casing Elevation: NA	Datum: City of Portland Datum - 1929
Drill Method: Direct Push	Barge Deck Elevation: 9.9 ft	
Drill Date March 7-10, 2003	Borehole Diameter: Varies	Sheet: 2 of 2

HAHN AND ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

Project No: 2128.01.08 TASK 2

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March 15, 2004

Mr. Matt McClincy
Oregon Department of Environmental Quality
Voluntary Cleanup and Site Assessment Section
2020 SW 4th Avenue, Suite 400
Portland Oregon 97201

HAI Project No. 5237

SUBJECT: Response to Comments and Final Work Plan for City Outfall 22C Evaluation, Phase I Site Characterization and Source Control Evaluation, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon

Dear Mr. McClincy:

At the request of NW Natural, Hahn and Associates, Inc. (HAI) has prepared this Work Plan for additional characterization activities relating to City Outfall 22C, as originally requested by the Oregon Department of Environmental Quality (DEQ) in correspondence dated September 9, 2003 (Mr. Matt McClincy to Mr. Bob Wyatt and Ms. Cathryn Young). The Work Plan included herein has been revised in response to DEQ's November 3, 2003 comments generated from review of HAI's October 13, 2003 draft Work Plan. A response to DEQ's November 3, 2003 comments are provided below, followed by the revised Work Plan.

Response to DEQ Comments

1) Add columns in the screening criteria table (e.g., Table 1) for ambient water quality criteria (AWQC) and DEQ Level II Screening Values (SLVs) that do not employ a multiplier. Contaminant concentrations in the discharge from City Outfall 22C that are interpreted to be groundwater are to be screened directly against AWQC and SLVs. Concentrations measured during a "storm event" (i.e., discharge from this outfall representative of stormwater) which in this case is a combination of groundwater and stormwater, are to be screened employing the multiplier of 5.

   Response: DEQ requests that screening values employed in the initial evaluation of discharges from Outfall 22C be based on the source of the water being discharged (i.e., stormwater vs. groundwater). Because the water is discharging to the river at a single outfall, which the stormwater multiplier was designed to account for[1], it would seem more reasonable to screen all water discharging from

[1] "[I]t should be noted that piped discharges to surface water are fundamentally different than groundwater discharges. Groundwater discharges have the potential to exert toxic effects on the benthic community with little or no dilution.

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Outfall 22C using the same criteria, including the multiplier. This screening approach would likely be more effective in focusing follow-up evaluation to those COIs where such evaluation is truly merited.

Regardless, the screening approach as requested by DEQ in its November 3, 2003 correspondence will be used. It is noted that all screening levels are used for comparative purposes only and will focus further evaluation needs. Screening levels are in no way indicative of cleanup goals or of actual risk.

2) Modify the work plan scope of work to include:

- Collection of an effluent sample from City Outfall 22C during a dry interval (i.e., at least 7 days subsequent to the previous storm event) during the dry season (Summer/Fall). This sample was requested in DEQ's September 9, 2003 letter to confirm the levels of contaminants measured at Outfall 22C during dry weather and low groundwater conditions.

  Response: HAI included the collection of a dry season / storm sampling event in the October 13, 2003 Work Plan. The Work Plan has been revised to update the dry season sampling to a non-storm sampling event.

- Collection of surface water samples from the Northwest Drainage Pond (NDP) during the wet and dry season interval sampling event at Outfall 22C. While there are a number of existing shallow monitoring wells on the Wacker Siltronic property that could potentially be utilized to determine the contaminant levels in groundwater discharging to the drainage ditch, the NDP, and the City Outfall 22C sewer line (see DEQ scope of work in September 9, 2003 letter), testing both the NDP and the outfall effluent during dry intervals is a starting point.

  Response: The requested modification is agreed to.

- Collect surface (upper 6 inches) sediment from the NDP and at a point midway between the NDP and proposed sample station 03 in the off-site drainage ditch. The previous request by DEQ to characterize the ditch/pond sediment was made to determine if contaminated sediments are present that could potentially be flushed to the Willamette River during a large storm event.

  Response: The requested modification is agreed to.

However, piped discharges are typically diluted through rapid mixing with the waters of the receiving body." Joint Source Control Strategy for Portland Harbor, §4.6.3 (draft April 15, 2003).

3) Test water/effluent samples for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total and amenable cyanide and total metals (antimony, barium, chromium, iron, manganese, mercury, nickel, selenium, silver, thallium, zinc, leas, arsenic, copper, and cadmium).

   Response: The requested analytes are all contaminants of interest as identified within the approved RI Work Plan (HAI, 2001), and will be included in the scope of work for further investigation.

4) Test sediment samples for semi volatile organic compounds, total and amenable cyanide, and metals (antimony, barium, chromium, iron, manganese, mercury, nickel, selenium, silver, thallium, zinc, lead, arsenic, copper, and cadmium).

   Response: The requested analytes are all contaminants of interest as identified within the approved RI Work Plan (HAI, 2001), and will be included in the scope of work for further investigation.

5) While we agree that it is important to quantify the contaminant load entering the off-site ditch system as proposed in the draft plan, DEQ does want to clarify that it will not consider contaminants detected in stormwater leaving the Gasco site (proposed sample station 04) to be "background". Also, additional evaluation of contaminant levels detected in water exiting North Doane Lake may be necessary before DEQ can agree to the "background" designation as the nature and extent of shallow groundwater impacts from Gasco-related wastes in this area has not been determined.

   Response: Because discharge from Outfall 22C is derived from a watershed of 1,008 acres occupied by industrial, commercial, residential, as well as green space uses, there is an obvious need to evaluate COI distribution, as possible, from the various points of entry to the unnamed ditch adjacent to the Wacker site. NW Natural is not suggesting that water entering the ditch from off-site properties is representative of naturally-occurring background. Instead, data regarding COIs entering the ditch/outfall 22C from off-site properties would act as control samples, thereby assisting in the interpretation of COI origin.

As discussed during our meeting of November 26, 2003, we understand that additional investigation activities involving Outfall 22C, and including the NDP, are to be conducted by AMEC Earth and Environmental, Inc. (AMEC) as part of the adjacent property Rhone-Poulenc RI. Further, we understand that the City of Portland may have completed sampling or clean-out work related to the off-site drainage ditch / Outfall 22C. NW Natural is currently inquiring as to the nature of the work by the City of Portland. Should results of additional investigation activities from the City of Portland and/or AMEC become available that would duplicate the work proposed herein, we understand that NW Natural would have the option of omitting the duplicative tasks from the Work Plan.

WORK PLAN FOR ADDITIONAL SOURCE CHARACTERIZATION - CITY OUTFALL 22C

Outfall Surface Water Sample Collection

Stormwater / effluent samples will be collected from City Outfall 22C and three up-stream locations on three occasions, as described below

1) During the wet season (Winter/Spring) at the time of a storm event that is greater than 0.1 inches in magnitude, and that occurs at least 72 hours from the previous measurable (greater than 0.1 inches rainfall) storm event.

2) During the dry season (Summer/Fall) at a time when base flow should consist predominantly of groundwater (i.e., a non-storm event).

3) During the wet season (Winter/Spring) during a dry interval (i.e., at least 7 days subsequent to the previous storm event).

During each sampling event, representative grab samples of the water discharging from City Outfall 22C (Station -01)will be obtained by hand by directly filling sample containers from the outfall pipe. At the same time, grab samples will be collected in the same manner of water discharging from the two culvert pipes located at the northwestern end of the BNSF ditch [e.g., the Koppers Industries, Inc. culvert and the NW St. Helens Road culvert (Stations -03 and -04)], and from North Doane Lake at the entrance to the pipe leading to the NDP (Station -02). The proposed sampling locations are depicted on Figure 1.

NDP Surface Water Samples

During the dry season event and the wet season dry interval event, one surface water grab sample will be collected from the NDP (Station -05 on Figure 1) by hand by directly filling sample containers.

Sediment Samples

During the first outfall sampling event, sediment samples will be collected from the NDP as well as from a location midway between the NDP and the two culvert pipes located at the northwestern end of the BNSF ditch (Figure 1). Sediment samples will be collected from below the water line from the upper 6-inches of material with the use of a decontaminated stainless steel hand trowel.

Analytical Methods

All surface water samples will be analyzed for contaminants of interest as identified within the approved RI Work Plan (HAI, 2001). Specifically surface water samples will be analyzed for VOCs by EPA Method 8260B, while all surface water and sediment

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samples will be analyzed for SVOCs by EPA Method 8270C and/or 8270 SIM, for total and amenable cyanide by EPA Method 9010, and for 15 total metals (see Tables 2 and 3) by EPA Method 200.7, 245.1, and 7000 Series. Target Laboratory Reporting Levels for primary contaminants of interest are provided in Tables 2 (water) and 3 (sediment). All sample management and analyses will be as provided within the approved RI Work Plan (HAI, 2001).

Quality Control Samples

All sample management and analyses will be as provided within the approved RI Work Plan (HAI, 2001). With regard to this evaluation, one duplicate water sample will be collected and analyzed for PAHs and inorganic COIs during each sampling event. Further, one field blank per sampling event will be collected and analyzed for PAHs during each surface water sampling event.

Schedule

The proposed work activities may commence once access has been obtained from BNSF. At this time, representatives of BNSF have returned an updated access agreement to NW Natural with their edits for review and approval. However, this current draft agreement is based on previous scope of work, which did not include sample collection. As discussed with a BNSF representative, a revised scope of work, to include physical collection of environmental samples, would require execution of a different type of access agreement. Once approval with regard to a scope of work has been received, all efforts will be made to expedite execution of the appropriate access agreement.

Should you have any questions concerning the above, please contact the undersigned.

Sincerely,

Robert Ede, R.G.
Associate

rede@hahnasoc.com

c: Mr. Bob Wyatt, NW Natural
Ms. Patty Dost, Schwabe, Williamson & Wyatt
Mr. Carl Stivers, Anchor Environmental LLC
Ms. Cathryn Young, Wacker Siltronic
Mr. Rod Struck, DEQ Northwest Region

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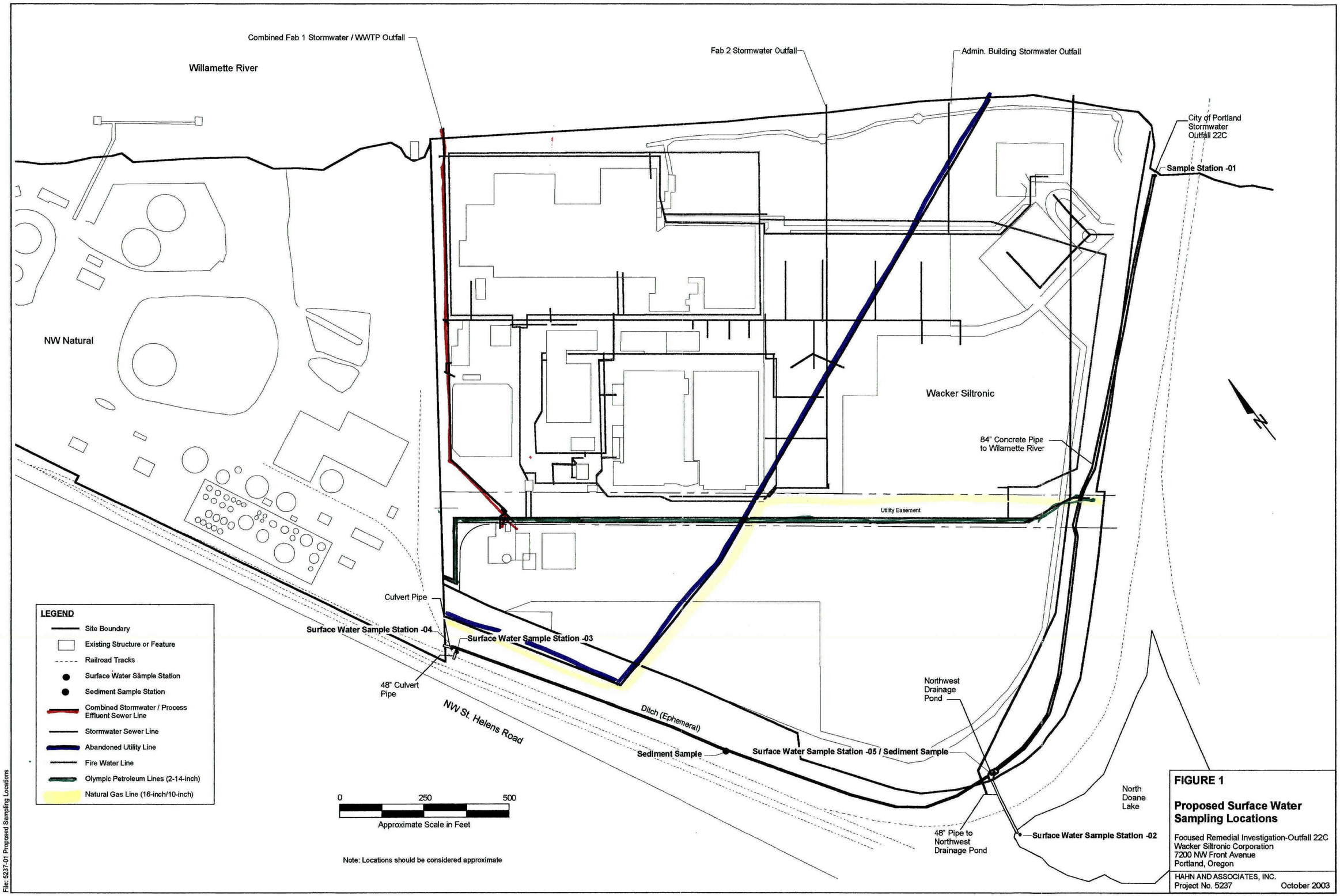

FIGURE 1

Proposed Surface Water Sampling Locations

Focused Remedial Investigation-Outfall 22C
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon

HAHN AND ASSOCIATES, INC.
Project No. 5237 October 2003

TABLE 1 – Summary of Surface Water Testing Results, Detections Only

Analytical Parameters	Laboratory Analytical Testing Results in ug/L (ppb)		Screening Levels[5] in ug/L					
Sample Location ==>	Northwest Drainage Pond	City Outfall 22C	Ambient Water Quality Criteria[2] (Human)	Ambient Water Quality Criteria[2] (Aquatic-CCC)	DEQ Level II Screening Level[3] Values	Ambient Water Quality Criteria x 5 (Human)	Ambient Water Quality Criteria x 5 (Aquatic-CCC)	DEQ Level II Screening Level Values x 5
Sample Number ==>	NDP-101-W	CO-22C-01						
Sampled By [1] ==>	AMEC	AMEC						
Sample Date ==>	13-Aug-02	13-Aug-02						
General Chemistry by EPA 160.2, 2340B, 300, 310.1			(for comparison with non-stormwater)			(for comparison with stormwater)		
Total Suspended Solids	93,000.	47,000.	#	#	#	#	#	#
Hardness	110,000.	290,000.	#	#	#	#	#	#
Chloride	14,000.	30,800.	#	230,000.	#	#	1,150,000.	#
Sulfate	1,560.	4,710.	#	#	#	#	#	#
Alkalinity	**160,000.**	**360,000.**	#	20,000.	#	#	100,000.	#
Volatile Organic Compounds (VOCs) by EPA 8260B								
Acetone	2.95	3.56	#	#	1,500.	#	#	7,500.
Benzene	1.47	3.15	51.	#	130.	255.	#	650.
Chlorobenzene	0.5 U	0.605	21,000.	#	50.	105,000.	#	250.
iso-Propylbenzene	0.5 U	0.577	#	#	#	#	#	#
Naphthalene	5.89	13.4	#	#	620.	#	#	3,100.
Toluene	0.563	0.5 U	200,000.	#	9.8	1,000,000.	#	49.
Semi-Volatile Organic Compounds (SVOCs) by EPA 8270C								
Acenaphthene	9.53	32.5	990.	#	520.	4,950.	#	2,600.
Acenapthylene	0.0144 U	0.182	#	#	#	#	#	#
Anthracene	0.184	0.456	40,000.	#	13.	200,000.	#	65.
Benz(a)anthracene	**0.141**	0.0422 U	0.018	#	0.027	0.09	#	0.135
Benzo(ghi)perylene	0.163	0.0326 U	#	#	#	#	#	#
Benzo(b)fluoranthene	**0.453**	0.0365 U	0.018	#	#	0.09	#	#
Chrysene	**0.25**	0.024 U	0.018	#	#	0.09	#	#
Dibenzofuran	1.01	1.72	#	#	3.7	#	#	18.5
Fluoranthene	1.59	2.05	140.	#	6.16	700.	#	30.8
Fluorene	1.16	**6.26**	5,300.	#	3.9	26,500.	#	19.5
Indeno(1,2,3-cd)pyrene	**0.136**	0.0288 U	0.018	#	#	0.09	#	#
Naphthalene	0.0211 U	0.688	#	#	620.	#	#	3,100.
Phenanthrene	0.0211 U	0.243	#	#	6.3	#	#	31.5
Pyrene	1.57	2.03	4,000.	#	#	20,000.	#	#

TABLE 1 – Summary of Surface Water Testing Results, Detections Only

Analytical Parameters	Laboratory Analytical Testing Results in ug/L (ppb)		Screening Levels[5] in ug/L					
Sample Location ==>	Northwest Drainage Pond	City Outfall 22C	Ambient Water Quality Criteria[2] (Human)	Ambient Water Quality Criteria[2] (Aquatic-CCC)	DEQ Level II Screening Level[3] Values	Ambient Water Quality Criteria x 5 (Human)	Ambient Water Quality Criteria x 5 (Aquatic-CCC)	DEQ Level II Screening Level Values x 5
Sample Number ==>	NDP-101-W	CO-22C-01						
Sampled By [1] ==>	AMEC	AMEC						
Sample Date ==>	13-Aug-02	13-Aug-02						
Total Metals by EPA 6010 or 6020								
Arsenic	**11.6** J	**1.14** J	0.14	150.	150.	0.7	750.	750.
Aluminum	**1,780.**	9. U	#	#	87.	#	#	435.
Barium	**96.4**	**56.9**	1,000.	#	4.	5,000.	#	20.
Boron	**121.**	**73.7**	#	#	1.6	#	#	8.
Cadmium[4]	0.016	0.0071 U	#	0.09	2.2	#	0.45	11.
Calcium	27,200.	70,800.	#	#	116,000.	#	#	580,000.
Chromium	4.04	0.0354 U	#	11.	11.	#	55.	55.
Cobalt	9.52	2.74	#	#	23.	#	#	115.
Copper[4]	**11.1**	**45.**	1,300.	2.7	9.	6,500.	13.5	45.
Iron	**22,300.**	**19,100.**	300.	1,000.	1,000.	1,500.	5,000.	5,000.
Lead[4]	**5.2**	0.082 U	#	0.54	2.5	#	2.7	12.5
Magnesium	9,380.	26,700.	#	#	82,000.	#	#	410,000.
Manganese	**2,660.**	**3,470.**	100.	#	120.	500.	#	600.
Molybdenum	44.1	13.6	#	#	370.	#	#	1,850.
Nickel[4]	4.41	2.23	4,600.	16.1	52.	23,000.	80.5	260.
Potassium	2,270.	4,770.	#	#	53,000.	#	#	265,000.
Silicon Dioxide	35,400.	42,600.	#	#	#	#	#	#
Silver	0.8 U	**1.18**	#	3.2	0.12	#	16.	-
Sodium	25,300.	36,100.	#	#	680,000.	#	#	3,400,000.
Vanadium	**21.** J	0.726 U	#	#	20.	#	#	100.
Zinc[4]	**345.**	7.64 U	26,000.	36.5	120.	130,000.	182.5	600.

Note: 1 = AMEC Earth & Environmental, Inc., *Remaining Remedial Investigation Technical Memorandum, RPAC-Portland Site,* February 4, 2003.
2 = Lowest value provided in the Ambient Water Quality Criteria (EPA 822-R-02-047, November 2002) based on Fresh Acute, Fresh Cronic (Aquatic Life Protection) and Fish Consumption Only (Human Health) Pathway.
3 = Where no AWQC are available, DEQ Level II Screening Level Values for Ecological Risk Assessment were used, Revised December 2001.
4 = AWQC adjusted based on a hardness of 25 parts per million.
5 = Screening levels are used for comparative purposes only.

Bold = Concentration exceeds Reference Level
AWQC = Ambient Water Quality Criteria
DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
J = estimated concentration
ppb = parts per billion
U = not detected above concentration indicated
ug/l = micrograms/liter
= Reference Level not established

TABLE 2 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Water Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/L (ppb)	Screening Levels[1] in ug/L		
		Ambient Water Quality Criteria[2] (Human)	Ambient Water Quality Criteria[2] (Aquatic-CCC)	DEQ Level II Screening Level Values[3]
Volatile Organic Compounds (VOCs) by EPA 8260B				
Acetone	25.	#	#	1,500.
Benzene	1.	51.	#	130.
Chlorobenzene	1.	21,000.	#	50.
Ethylbenzene	1.	29,000.	#	7.3
Naphthalene	2.	#	#	620.
Toluene	1.	200,000.	#	9.8
Xylenes, total	2.	#	#	13.
Semi-Volatile Organic Compounds (SVOCs) by EPA 8270C or 8270 SIM				
Acenaphthene	0.02	990.	#	520.
Acenapthylene	0.02	#	#	#
Anthracene	0.02	40,000.	#	13.
Benz(a)anthracene	0.02 (MDL = 0.01)	0.018	#	0.027
Benzo(a)pyrene	0.02 (MDL = 0.01)	0.018	#	0.014
Benzo(ghi)perylene	0.02	#	#	#
Benzo(b)fluoranthene	0.02 (MDL = 0.01)	0.018	#	#
Benzo(k)fluoranthene	0.02 (MDL = 0.01)	0.018	#	#
Carbazole	10.	#	#	#
Chrysene	0.02 (MDL = 0.01)	0.018	#	#
Dibenzofuran	0.02	#	#	3.7
Fluoranthene	0.02	140.	#	6.16
Fluorene	0.02	5,300.	#	3.9
Indeno(1,2,3-cd)pyrene	0.02 (MDL = 0.01)	0.018	#	#
2-Methylnaphthalene	0.02	#	#	#
Naphthalene	0.02	#	#	620.
Phenanthrene	0.02	#	#	6.3
Pyrene	0.02	4,000.	#	#
Cyanide by EPA 9010				
Total Cyanides	5.	220,000.	5.2	5.2
Amenable Cyanide	5.	#	#	#

TABLE 2 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Water Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/L (ppb)	Screening Levels[1] in ug/L		
		Ambient Water Quality Criteria[2] (Human)	Ambient Water Quality Criteria[2] (Aquatic-CCC)	DEQ Level II Screening Level Values[3]
Total Metals by EPA 6010 or 6020				
Antimony	0.5	640.	#	1,000.
Arsenic	1. (MDL=0.9)	0.14	150.	150.
Barium	1.	1,000.	#	4.
Cadmium[4]	0.1 (MDL = 0.03)	#	0.09	2.2
Chromium	1.	#	11.	11.
Copper[4]	2.	1,300.	2.7	9.
Iron	100.	300.	1,000.	1,000.
Lead[4]	1. (MDL = 0.04)	#	0.54	2.5
Manganese	10.	100.	#	120.
Mercury	0.2	#	0.77	0.77
Nickel[4]	2.	4,600.	16.1	52.
Selenium	1.	4,200.	5.	5.
Silver	1. (MDL = 0.08)	#	3.2	0.12
Thallium	1.	6.3	#	40.
Vanadium	5.	#	#	20.

Note:

1 = Screening levels are used for comparative purposes only.
2 = Lowest value provided in the Ambient Water Quality Criteria (EPA 822-R-02-047, November 2002) based on Fresh Acute Fresh Cronic (Aquatic Life Protection) and Fish Consumption Only (Human Health) Pathway.
3 = Where no AWQC are available, DEQ Level II Screening Level Values for Ecological Risk Assessment were used, Revised December 2001.
4 = AWQC adjusted based on a hardness of 25 parts per million.

AWQC = Ambient Water Quality Criteria
DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
MDL = method detection limit
ppb = parts per billion

ug/l = micrograms/liter
= Reference Level not established

TABLE 3 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Soil or Sediment Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/kg (ppb)	Screening Levels[1] in ug/kg DEQ Level II Screening Level Values[2]
Semi-Volatile Organic Compounds (SVOCs) by EPA 8270C or 8270 SIM		
Acenaphthene	13.4	290.
Acenapthylene	13.4	160.
Anthracene	13.4	57.
Benz(a)anthracene	13.4	32.
Benzo(a)pyrene	13.4	32.
Benzo(ghi)perylene	13.4	300.
Benzo(b)fluoranthene	13.4	#
Benzo(k)fluoranthene	13.4	27.
Carbazole	330. (MDL = 22.)	140.
Chrysene	13.4	57.
Dibenzofuran	13.4	5,100.
Fluoranthene	13.4	111.
Fluorene	13.4	77.
Indeno(1,2,3-cd)pyrene	13.4	17.
2-Methylnaphthalene	13.4	#
Naphthalene	13.4	176.
Phenanthrene	13.4	42.
Pyrene	13.4	53.
Cyanide by EPA 9010		
Total Cyanides	0.25	#
Amenable Cyanide	0.25	#

TABLE 3 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Soil or Sediment Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/kg (ppb)	Screening Levels[1] in ug/kg DEQ Level II Screening Level Values[2]
Total Metals by EPA 6010 or 6020		
Antimony	500.	3,000.
Arsenic	500.	4,000.
Barium	500.	#
Cadmium	500. (MDL=200.)	3.
Chromium	500.	3,700.
Copper	2,000.	10,000.
Iron	10,000.	#
Lead	500.	3,500.
Manganese	500.	1,100,000.
Mercury	100.	200.
Nickel	1,000.	1,800.
Selenium	500. (MDL=200.)	100.
Silver	500.	4,500.
Thallium	500.	700.
Vanadium	500.	#

Note: 1 = Screening levels are used for comparative purposes only.
2 = DEQ Level II Screening Level Values for Ecological Risk Assessment Lowest Freshwater or Bioaccumulation, Revised December 2001

DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
ppb = parts per billion
MDL = method detection limit

ug/kg = micrograms/kilogram
= Reference Level not established

WACKER SILTRONIC

TOM MCCUE
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3 Page(s) incl. coversheet

December Progress Report

Project No: 8128.01.06 / 06

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HAHN AND ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

January 15, 2004

Mr. Matt McClincy
Oregon Department of Environmental Quality
Northwest Region, Portland Office
Voluntary Cleanup and Site Assessment Section
2020 SW Fourth Avenue, Suite 400
Portland Oregon 97201-4987

HAI Project No. 5237

SUBJECT: December 2003 Progress Report for Remedial Investigation (RI) Activities, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon

Dear Mr. McClincy:

Hahn and Associates, Inc. (HAI) has prepared this Progress Report summarizing RI work activities conducted by NW Natural that have occurred relating to the Wacker Siltronic Corporation (Wacker) property during the month of December 2003. RI field activities for the site have been conducted as per the approved Final Focused Remedial Investigation (RI) Work Plan[1] (RI Work Plan), as well as the approved Supplemental RI Work Plan[2]. This Progress Report has been prepared as per an Order (DEQ No. ECVC-NWR-00-27) issued jointly to both NW Natural and Wacker by the Oregon Department of Environmental Quality (DEQ), dated October 4, 2000. As per the referenced Order, monthly progress reports are to be prepared by the 15th day of each month, with the reporting to continue for the duration of the project.

The *Phase I Site Characterization Summary Report*, prepared by HAI and dated November 7, 2003, as well as the *Preliminary Source Control Evaluation Report*, prepared by Anchor Environmental, L.L.C., and dated November 2003, were delivered to DEQ on November 7, 2003. NW Natural is presently awaiting review of these documents by DEQ. Presently outstanding RI tasks include preparation of a response/revisions related to DEQ's November 3, 2003 review of NW Natural's Work Plan for City of Portland Outfall 22C.

Anticipated Activities in January and February 2004

After gaining information regarding the City of Portland's plans (investigation and/or clean-out) with regard to the unnamed drainage ditch adjacent to the Wacker property, NW Natural will prepare a response to DEQ's November 3, 2003 correspondence, including a revised Work Plan for Outfall 22C evaluation. Such a plan is anticipated in January 2004.

---

[1] Hahn and Associates, Inc. (2001). *Final Focused Remedial Investigation Work Plan, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon.* June 1, 2001.

[2] Hahn and Associates, Inc. (2002). *Supplemental Remedial Investigation Work Plan, Wacker Siltronic Corporation,, 7200 NW Front Avenue, Portland, Oregon.* March 7, 2002.

434 NW 6th AVENUE, SUITE 203 • PORTLAND, OREGON 97209-3651
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Once approval with regard to a scope of work regarding investigation activities relating to City Outfall 22C has been received from DEQ, all efforts will be made to expedite execution of the appropriate access agreement with the Burlington Northern Santa Fe Railroad Company (BNSF). Further, once these additional data are collected, then an addendum to the *Phase I Site Characterization Summary Report*, will be prepared.

Should you have any questions, please contact the undersigned.

Sincerely,

Robert Ede, R.G.
Associate

rede@hahnasoc.com

c: Mr. Bob Wyatt, NW Natural
Ms. Patty Dost, Schwabe, Williamson & Wyatt
Mr. Carl Stivers, Anchor Environmental, L.L.C.
Ms. Cathryn Young, Wacker Siltronic Corporation

THIS WAS
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ATOFINA

ATOFINA Chemicals, Inc.

DEPT OF ENVIRONMENTAL QUALITY
RECEIVED
DEC 09 2003
NORTHWEST REGION

December 9, 2003

Mr. Matt McClincy
Department of Environmental Quality
Northwest Region
2020 S.W. Fourth Ave., Suite 400
Portland, Oregon 97201-4987

Dear Mr. McClincy:

Enclosed are five copies of the Phase II Stage 1 & 2 In-River Groundwater and Sediment Investigation report. This report summarizes the Stage 1 work that was conducted from our docks during June of 2002, and the Stage 2 work that was conducted from a barge during February and March of 2003. A copy of this report has been sent directly to Tara Martich at EPA.

If you have any questions, please feel free to contact me at 503-225-7210.

Sincerely,
ATOFINA Chemicals, Inc.

Larry D. Patterson

Larry D. Patterson
Environmental Manager

P:vmon

ATOFINA Chemicals, Inc.
6400 N.W. Front Avenue
Portland, Oregon 97210
503-228-7655

File copy
ATOFINA

DEC 09 2003

PHASE II STAGE 1 & 2 IN-RIVER GROUNDWATER AND SEDIMENT INVESTIGATION

Prepared for

ATOFINA Chemicals, Inc.

6400 N.W. Front Avenue
Portland, Oregon 97210

Prepared by

integral consulting inc.

811 SW Naito Parkway, Suite 430
Portland, Oregon 97204

December 2003

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
COIs	chemicals of interest
CPD	City of Portland datum (benchmark #2529)
DDT	dichlorodiphenyltrichloroethane
DEQ	Oregon Department of Environmental Quality
DGPS	differential global positioning system
DNAPL	dense nonaqueous-phase liquid
DO	dissolved oxygen
Eh	oxidation-reduction potential
EPA	United States Environmental Protection Agency
FSP	field sampling plan
HSP	health and safety plan
ID	inside diameter
MCB	monochlorobenzene
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MPR	manufacturing process residue
mV	millivolts
NAPL	nonaqueous-phase liquid
OD	outside diameter
OVM	organic vapor meter
QAPP	quality assurance project plan
RI	remedial investigation
TLC	thin-layer chromatography
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
VOC	volatile organic compound

SCOEPA00012833

1. INTRODUCTION

This report presents the results of the Phase II Stage 1 and 2 in-river groundwater and sediment investigation offshore of the ATOFINA Chemicals, Inc. (ATOFINA) facility in Portland, Oregon. The Stage 1 investigation was conducted to characterize the nature and extent of chemicals of interest (COIs) in groundwater and sediments that are downgradient of the existing monitoring well network on the upland portion of the site. This work was designed to obtain an understanding of the potential transport and fate of COIs along pathways downgradient of the former Acid Plant, and to use those data as part of the criteria for choosing borehole locations for the Stage 2 investigation. The primary objective of the Phase II Stage 2 investigation was to develop additional information on hydrolithologic units, concentrations of COIs, and potential pathways in affected sediment areas to address source control issues at the site. The combined data from the Phase II Stage 1 and 2 investigations will be used to identify the need for additional source control measures at the site. Ongoing and recently completed remedial activities at the ATOFINA site include the completion of the uplands remedial investigation, the completion of two phases of upland soil removal, and bench- and field-scale pilot studies for the in-situ treatment of monochlorobenzene (MCB), perchlorate, and hexavalent chromium. The results of these ongoing studies will be used along with the data from this report to assess further source control evaluation alternatives.

The Phase II Stage 1 investigation was conducted at the site from June 3-12, 2002. The work was conducted in general accordance with a work plan submitted by ATOFINA to the Oregon Department of Environmental Quality (DEQ) on May 10, 2002 (ATOFINA 2002a), as modified according to DEQ comments and ATOFINA responses in letters dated May 29, 2002 and May 31, 2002, respectively. The preliminary findings of the Stage 1 investigation were reported in an August 23, 2002 letter to DEQ. A total of seven boreholes were advanced during the Stage 1 investigation.

The Phase II Stage 2 investigation was conducted at the site from February 17 through March 10, 2003. The work was conducted in general accordance with a work plan submitted by ATOFINA to DEQ on August 23, 2002 (ATOFINA 2002c) as modified according to letters dated September 20, 2002 (DEQ 2002b), September 24, 2002 (EPA 2002), October 25, 2002 (DEQ 2002c), November 14, 2002 (ATOFINA 2002d), and November 25, 2002 (DEQ 2002d). A total of 18 boreholes were advanced during the Stage 2 investigation.

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2. PHASE II STAGE 1 AND 2 INVESTIGATION RESULTS

A total of seven boreholes were advanced from Docks 1 and 2 during the Stage 1 investigation (Figure 1). The only significant deviation from the work plan was that a groundwater sample was not collected from borehole WB-6. A groundwater sample was not collected from this borehole because of time constraints resulting from the slow hydraulic ram on the modified Geoprobe® unit that was used to advance this borehole. The tool assembly had to be removed from the conductor casing using the hydraulic ram because the Geoprobe® unit was not equipped with a winch.

A total of 18 boreholes were advanced during the Stage 2 investigation within a 400 ft by 1,000 ft area in the vicinity of Docks 1 and 2 (Figure 1). Two of these boreholes (WB-24 and WB-25) were unplanned and were added to the scope of the investigation at the end of the planned field program to further delineate the distribution of COIs on the landward side of the docks. There were no other significant deviations from the work plan.

2.1 FIELD METHODS

The field methods employed during the Stage 1 investigation differed from those used in the Stage 2 investigation and are presented separately below.

2.1.1 Stage 1 Investigation Methods

A total of seven boreholes (WB-1 through WB-7) were advanced using direct-push techniques from Docks 1 and 2. Boreholes WB-1 through WB-5 were advanced using a standard Geoprobe® push-probe rig. Borehole WB-6 was advanced using a smaller Geoprobe® push-probe unit attached to the bed of a standard pick-up truck because of a structural weight-load limitation on that portion of the dock. Borehole WB-7 was advanced on a narrow walkway on Dock 1 using a portable tripod Geoprobe® unit. The field methods described below apply to all three Geoprobe® units employed during the Stage 1 work.

Two sets of conductor casing were set at each borehole location to ensure alignment and advancement of the borehole in its proper location. One conductor casing was used to advance a borehole for sediment sampling; the other conductor casing was used to collect groundwater samples. Sediment samples were collected using a square aluminum sediment sampler (2.5 in. square by 3.5 ft long) for the shallowest interval and Geoprobe® Macrocore samplers (2 in. diameter by 4 ft long) with new acetate liners for each sample interval collected from the deeper sediments.

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Sediments were continuously sampled for lithologic description and field screening. Where possible, sediments were composited over approximate 2-ft intervals and field screened for volatile organic compounds (VOCs) using an organic vapor monitor (OVM), for nonaqueous-phase liquid (NAPL) using Sudan IV® hydrophobic dye, and for dichlorodiphenyltrichloroethane (DDT) using thin-layer chromatography (TLC) methods. If there was sufficient recovery, sediment samples were collected from each 2-ft interval and archived frozen at an analytical laboratory for possible future analysis.

Groundwater samples were collected from one or more discrete intervals at each borehole station (except WB-6, as discussed above) to provide further data on the vertical distribution of MCB and DDT and its metabolites in groundwater. Following termination of the sediment borehole at each location, the Geoprobe® unit was moved over a short distance (1-2 ft) and the second borehole was advanced to collect the groundwater samples. At each borehole, the shallower grab groundwater sample was obtained by advancing the drill bit to the bottom of the first target interval and then retracting the sheath to expose the 4-ft long stainless-steel Geoprobe® screen. Prior to sampling, groundwater and river water levels were measured with an electronic water level meter relative to the dock surface to an accuracy of 0.01 ft. Groundwater and river levels were measured inside and just outside the push-probe rods, respectively, until the readings had stabilized. After sample collection, the tool assembly was removed and decontaminated, and the borehole was advanced to the bottom of the second target interval, if applicable, and the groundwater sampling process was repeated. The target depth for the groundwater samples was determined from the lithologic information collected from the first borehole in each pair and was selected in an attempt to target physically distinct groundwater intervals. Field parameters (i.e., temperature, pH, dissolved oxygen [DO], oxidation-reduction potential [Eh], and specific conductance) were measured during purging. One groundwater sample was collected from each target depth for field screening (OVM headspace monitoring) and for laboratory analysis for VOCs by U. S. Environmental Protection Agency (EPA) Method 8260B and for organochlorine pesticides by EPA Method 8081A. Once the groundwater sampling was completed, the sediment and groundwater boreholes were abandoned with bentonite grout.

The horizontal location and elevation of the top of each Geoprobe® borehole was surveyed to within 0.1 ft and 0.01 ft accuracy, respectively, by a public land surveyor licensed in the state of Oregon. All work was conducted in general accordance with the detailed field and laboratory procedures outlined in the field sampling plan (FSP; Appendix A), the quality assurance project plan (QAPP; Appendix B), and the health and safety plan (HSP; Appendix C) of the Elf Atochem Acid Plant Area Remedial Investigation and Feasibility Study Work Plan (Exponent 1998).

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2.1.2 Stage 2 Investigation Methods

A total of 18 sediment boreholes (WB-8 through WB-25) were advanced using a Geoprobe® push-probe rig mounted on a barge. The barge platform had a moon hole in the approximate center of the barge through which tooling was advanced to collect sediment and groundwater samples. Some boreholes were advanced with the Geoprobe® rig mounted at the back of the barge so the boreholes could be advanced in shallow water and other limited access areas. The barge and Geoprobe® rig were positioned over each target location utilizing a small tugboat or aluminum boat and were guided to the location using a differential global positioning system (DGPS). Once positioned over the target location, the barge spuds were gradually advanced into the sediments to provide a stable drilling platform.

Two sets of conductor casing were set at each borehole location to ensure alignment and advancement of the borehole in its proper location. One conductor casing was used to advance a borehole for sediment sampling; the other conductor casing was used to collect groundwater samples.

Once the conductor casing (5-in. diameter) was set, a combination of square sediment samplers (2-1/2-in. square by 3.5 ft long), split spoon samplers (3-in. diameter by 5 ft long), and Geoprobe® Macrocore samplers with sand catchers (2-in. diameter sampler by 4 ft long) were used to continuously collect the sediment samples for visual examination, logging, and field screening. The shallowest sediment samples were collected using a square aluminum sediment sampler (2.5 in. square by 3.5 ft long). Subsequent samples were collected using the 5 ft long split-spoon sampler. The conductor casing (dual tube casing) and the 5 ft long sampler were advanced with direct-push techniques. The conductor casing was advanced simultaneously with the sampler to each target sampling interval, effectively casing off the previously sampled sediment interval. Upon driving the dual tube system at 5 ft intervals within the sediment, the inner string of sampling equipment was retrieved. The dual tube method was employed until there was insufficient sample recovery or until the pressure required to drive the dual tubes was beyond the capabilities of the push-probe rig (i.e., refusal). At that point, a Geoprobe® Macrocore sampler with new acetate liners for each sample interval was employed to advance the borehole to the target depth (refusal).

Sediments were continuously sampled for lithologic description and field screening. Where possible, sediments were composited over approximate 2 ft intervals and field screened for VOCs using an OVM, for NAPL using Sudan IV® hydrophobic dye, and for DDT using TLC methods. If there was sufficient recovery, sediment samples were collected from each 2 ft interval and selected samples were analyzed for organochlorine pesticides by EPA Method 8081A. The sediment samples that were not analyzed were sent to the analytical laboratory to be archived frozen for possible future analysis.

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Groundwater samples were collected from each Geoprobe® borehole in which ample penetration of the sediments could be achieved (i.e., a minimum of 4 ft), with the exception of borehole WB-24, which was advanced only for the purpose of collecting sediment samples. Groundwater samples were collected from each borehole with the exception of borehole WB-17, where only 2.2 ft of sediment was encountered prior to sampler refusal on basalt. Prior to sampling, groundwater and river water levels were measured with an electronic water level meter relative to the barge deck surface to an accuracy of 0.01 ft. Groundwater and river levels were measured inside and just outside the push-probe rods, respectively, until the readings had stabilized.

The groundwater sampling procedure employed in the Stage 2 boreholes was the same as that used in the Stage 1 boreholes. Each groundwater sample was analyzed for VOCs by EPA Method 8260B, for organochlorine pesticides by EPA Method 8081A, and for perchlorate by EPA Method 314.0. Once the groundwater sampling was completed, the sediment and groundwater boreholes were abandoned with bentonite grout.

The horizontal location of each Geoprobe® borehole was surveyed to within an approximate 1 meter accuracy using a DGPS unit. The elevation of each borehole (i.e., mudline) was measured by using a laser level to determine the elevation of the barge deck relative to arbitrary benchmarks located on platforms beneath Docks 1 and 2. Periodic measurements were made throughout each day to monitor river stage changes. Based on this information, adjustments were made to the sediment and groundwater sample depth intervals to compensate for river stage changes. The elevations of the arbitrary benchmarks on the platforms beneath the docks were measured relative to two permanent onsite monitoring wells using the laser level. The accuracy of the elevations, relative to two existing monitoring wells, is $\pm$ 0.1 ft. Further error may have been introduced to the elevation estimate as a result of the difficulty in assessing the top of the soft mudline in some areas and also because of fluctuations in the river surface from tidal influences. For these reasons, the mudline elevations are assumed to be accurate to $\pm$ 1 ft.

All work was conducted in general accordance with the detailed field and laboratory procedures outlined in the FSP (Appendix A), the QAPP (Appendix B), and the HSP (Appendix C) of the Elf Atochem Acid Plant Area Remedial Investigation and Feasibility Study Work Plan (Exponent 1998).

2.2 HYDROSTRATIGRAPHY

Geoprobe® boreholes WB-1 through WB-25 were advanced during the Phase II Stage 1 and 2 investigations (Figure 1). Borehole logs are presented in Appendix A.

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The total depth of borehole penetration ranged from approximately 2 (WB-17) to 43 (WB-4) ft below mudline (Table 1). Sediments were thickest on the landward side of Docks 1 and 2. The mudline elevation generally decreases eastward, as shown on the bathymetric map (Figure 2). The top of the mudline was encountered at elevations ranging from 7.6 ft City of Portland datum (CPD; corresponds to mean sea level) at borehole WB-1 on Dock 2 to -38.9 ft CPD at borehole WB-22, the eastern-most borehole (Table 1; Figure 2).

The top of the underlying basalt surface was encountered in 20 boreholes at elevations ranging from -14.3 (WB-2) to -43.1 (WB-21) ft CPD (Table 1). The basalt surface generally slopes to the east (Figure 3). There is an apparent high spot (i.e., mound) on the basalt surface around borehole WB-2. There are also two apparent troughs in the basalt surface. One trough is centered on Dock 1 and the other is just south of Dock 2, near borehole WB-14. The troughs may be erosional features produced by streams that previously flowed into the ancestral Willamette River at these locations.

Cross-sections in the vicinity of the Phase II boreholes are presented in Figures 4a through 9b. The sediments above the basalt become finer-grained and sand horizons are of more limited vertical extent farther from the shoreline (Figures 5a and 9a). The sediment thickness also thins away from the shoreline (in an eastward direction). The increased thickness of sediments on the landward side of the docks is likely a result of increased deposition because of the sheltering effect of the docks. In general, the sediments observed during the Phase II investigation represent a fining upward sequence (i.e., coarser sediments at the bottom and finer sediments at the top of the sequence) and become thinner toward the east.

Thin (i.e., less than 1 ft thick) sand and silt layers were observed in a number of the boreholes and are shown on the cross-sections. Based on the available data, many of these layers appear to be discontinuous. Some of these layers appear to dip to the east, consistent with the slope of the basalt surface. As discussed in Section 3, some of these horizons may be important controls on the migration pathways of COIs.

2.3 SEDIMENT RESULTS

Sediment sampling was attempted continuously in each borehole and sample recovery ranged from excellent (100 percent) to poor (0 percent), but generally was good to excellent. Sediment samples were screened for VOCs with an OVM and via obvious odor, for NAPL using hydrophobic dye and visual observations, and for DDT by TLC. None of the Stage 1 sediment samples was analyzed for pesticides. Selected sediment samples from the Stage 2 boreholes were submitted to a laboratory for analysis of organochlorine pesticides by EPA Method 8081A. The remaining sediment samples from the Phase II investigation were archived at the laboratory for possible future analysis.

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2.3.1 VOC Field Screening

Field screening results for VOCs are presented in Table 2. The OVM used to screen the Phase II sediment samples for VOCs was calibrated with an isobutylene calibration standard; therefore, the reported OVM measurements are indicators of relative VOC concentrations but not specifically MCB concentrations.

OVM measurements were generally at background or low levels (i.e., less than 100 ppm) except in boreholes WB-5, WB-6, WB-10, WB-11, and WB-24. In borehole WB-5, the highest OVM measurement of 280 ppm was recorded at an elevation of -23.5 to -25.5 ft CPD. The highest OVM measurements in borehole WB-6 were 3,000 and 1,400 ppm at elevations of -22.4 to -24.4 ft and -28.4 to -30.4 ft CPD, respectively. In borehole WB-10, the highest OVM measurements of 120 ppm, 2,300 ppm, and 270 ppm were recorded at elevations of -18.0 to -19.0, -19.0 to -21.0 ft, and 21.0 to -23.0 ft CPD, respectively. The OVM readings throughout the remainder of boreholes WB-6 and WB-10 were at low or background levels. The highest OVM measurements in borehole WB-11 were 110 ppm and 1,200 ppm at elevations of -10.6 to -14.6 ft and -14.6 to -16.6 ft CPD, respectively. The OVM readings throughout the remainder of the WB-11 borehole were at low levels. In borehole WB-24, the highest OVM measurements were 320 ppm and 340 ppm at elevations of -10.0 to -12.0 and -12.0 to -14.0 ft CPD, respectively. The OVM readings were at low levels below these intervals; however, sediment samples were not collected above an elevation of -10.0 ft CPD (the mudline elevation was approximately 0.5 ft CPD). The OVM readings were generally consistent with organic odors noted by field personnel during the Phase II investigation.

The only sediment sample in the Stage 1 and 2 investigations exhibiting a positive response to the Sudan IV® field screening for NAPL was the sediment sample collected at an elevation of -12.5 to -14.4 ft CPD from borehole WB-6. However, this response may have been attributable to petroleum hydrocarbons rather than MCB, based on visual evidence and low OVM measurements. Residual NAPL of an uncertain origin was observed by visual inspection of the sample in borehole WB-6 collected at an elevation of -22.4 to -24.4 ft CPD. Residual NAPL was not detected with the Sudan IV® field screening of this sample, although there was limited sample available for screening. An approximate 0.1 ft thickness of sediment with visual evidence of residual NAPL characteristic of DDT manufacturing process residue (MPR) was observed in this sample interval, which also exhibited a high OVM measurement (3,000 mg/kg).

2.3.2 DDT Field Screening and Analytical Results

Each sediment sample collected from the Stage 1 and 2 investigations was screened for DDT by TLC. Field screening and analytical results for DDT are presented in Table 2.

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Profiles of DDT concentrations in sediments are shown in Figure 10. Laboratory reports are presented in Appendix B.

2.3.2.1 Stage 1 and 2 Field Screening Results

None of the TLC DDT results exceeded 250 mg/kg in the Stage 1 boreholes. A horizon with elevated DDT concentrations was identified using TLC screening in boreholes WB-1, WB-3, and WB-4 at 4-8 ft below mudline (-10.3 to 3.6 ft CPD). The highest DDT concentration by TLC (250 mg/kg) was measured in borehole WB-5 at 1.8 to 3.8 ft below mudline (-14.0 to -16.0 ft CPD). No DDT was detected above 50 mg/kg in boreholes WB-2, WB-6, and WB-7.

In the Stage 2 boreholes, TLC DDT results exceeded 50 mg/kg in WB-8, WB-9, WB-10, WB-24, and WB-25. These boreholes are all located to the landward side of Dock 1. The higher concentrations of DDT (i.e., at or above 200 mg/kg) were observed in boreholes WB-9, WB-10, WB-24, and WB-25 at depths ranging from approximately 7 to 17 ft below mudline (-3 to -17 ft CPD). Selected sediment samples from the Stage 2 investigation were analyzed for pesticides and the results are presented in the following section.

2.3.2.2 Stage 2 Analytical Results

The DDT sediment concentrations are presented in Table 3 and in Figures 11 and 12 for surface and deeper sediments, respectively. Figure 12 also presents the data collected from the OSS shallow sediment samples in 1999 (Exponent 1999). Profiles of DDT concentrations in sediments are shown in Figure 10. In general, there is a reasonable correlation between the TLC and laboratory analyses for DDT, given the limitations with TLC methods (i.e., detection limit of 50 mg/kg and maximum detectable concentration of 500 mg/kg).

All surface sediment samples from the Stage 2 investigation were analyzed for DDT by EPA Method 8081A, except the samples collected from boreholes WB-22, WB-23, and WB-24. The surface sediment sample intervals varied based on recovery from 1.4 to 4.3 ft below mudline (if recovery was poor, the sample was composited over a larger interval). DDT concentrations greater than 1,000 μg/kg in surface sediments are generally confined to the landward side of the docks, except for the sample collected from borehole WB-17 (6,100 μg/kg). The highest DDT concentrations are found in the vicinity of Dock 1 and at the south end of Dock 2 (specifically borehole WB-13). Surface sediment DDT concentrations generally decrease to the east beyond the docks.

The highest DDT concentrations (i.e., greater than 100,000 μg/kg) in subsurface sediments were generally found 7 to 14.5 feet below mudline (elevations ranging from -4 to -17 ft CPD). These higher DDT concentrations were all found on the landward side of Dock 1

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(boreholes WB-8, WB-9, WB-11, and WB-24). The highest DDT concentration (4,500,000 μg/kg) was found in borehole WB-9 at 8.0 to 10.0 ft below mudline (-2.9 to -4.9 ft CPD). Other DDT concentrations greater than 1,000 μg/kg were found in boreholes WB-10 (15,000 μg/kg and 19,000 μg/kg at 7.0 to 9.0 ft [-11.0 to -13.0 ft CPD] and 15.0 to 17.0 ft [-19.0 to -21.0 ft CPD] below mudline, respectively) and WB-18 (17,000 μg/kg from 6.0 to 8.0 ft below mudline [-4.5 to -6.5 ft CPD]). DDT concentrations were below 1,000 μg/kg in deeper sediments collected from boreholes WB-12, WB-13, WB-14, WB-15, WB-16, WB-17, WB-19, WB-20, WB-21, WB-22, WB-23, and WB-25.

2.4 GROUNDWATER RESULTS

Groundwater grab samples were collected at one or more depth intervals within each borehole, with the exception of boreholes WB-6 (groundwater sample in this area was collected from adjacent borehole WB-10), WB-17 (insufficient sediment thickness), and WB-24 (added to investigation as a sediment borehole only). Each groundwater sample was analyzed for VOCs by EPA Method 8260B, and for organochlorine pesticides by EPA Method 8081A. Selected groundwater samples were analyzed for conventional parameters (i.e., cations and anions). Stage 2 groundwater samples were also analyzed for perchlorate by EPA Method 314.0.

Relative surface water and groundwater level measurements were collected at each screened interval prior to groundwater sample collection (Table 1). The results of these measurements indicate that the potentiometric surface of groundwater in sediments is generally higher than the river level (typical head difference ranged between 0.1 and 1.0 ft). Some of the measurements, however, indicated a potentiometric surface of groundwater in sediments lower than the river level. The surface water potentiometric surface differences should be interpreted with caution because the groundwater levels were measured from temporary monitoring points and water levels may not represent a static equilibrated groundwater surface.

Groundwater field parameter results are presented in Table 4. Groundwater with the highest specific conductance was found in boreholes WB-4, WB-5, WB-8, WB-9, WB-10, WB-12, and WB-23, which are generally located downgradient of the salt pads on the southern portion of the ATOFINA facility. The pH values in groundwater ranged from acidic (5.25 in WB-7) to slightly alkaline (7.67 in the shallow interval from WB-3). Temperatures ranged from 5.15 (deep interval collected from WB-18) to 26.2 (deep interval from WB-5) degrees Celsius. The generally higher temperature of the Stage 1 groundwater samples may be attributable to warmer ambient air conditions during this portion of the investigation. Dissolved oxygen ranged from 0.760 (deep interval from WB-23) to 13.1 (deep interval from WB-4) mg/L and redox potential ranged from -166

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millivolts (mV) (deep interval from WB-4) to 271 mV (deep interval from WB-10). Dissolved oxygen concentrations were generally lower in the deeper intervals.

Conventional parameter analytical results (Table 4) indicate that groundwater samples collected from the Stage 1 and 2 boreholes have higher cation and anion concentrations than the water sample collected from the Willamette River, confirming that groundwater in sediments beneath the river has a chemical signature that is distinct from Willamette River water. Elevated sodium and chloride concentrations were detected in groundwater samples collected from boreholes WB-9 and WB-10, which are located downgradient of the salt pads on the southern portion of the ATOFINA facility. This finding is consistent with high specific conductance measurements collected from boreholes in this area.

2.4.1 MCB and DDT

Groundwater sample analytical results for MCB and DDT are summarized in Tables 5 and 6, respectively, and are posted in Figures 13 and 14, respectively. The MCB and DDT concentrations in groundwater are also posted on the cross-sections (Figures 4a through 9b). A groundwater sample was not collected from WB-6; however, groundwater samples were collected from adjacent borehole WB-10, which generally represents the groundwater quality in this area.

The correlation between MCB and DDT concentrations in groundwater is generally good (compare Figures 13 and 14). The highest concentration of MCB in groundwater (64,000 μg/L) was detected in borehole WB-10 at a screened interval elevation of -18.0 to -22.0 CPD. This interval also had the highest DDT groundwater concentration (1,900 μg/L). The higher concentrations of MCB and DDT (greater than 1,000 μg/L and 10 μg/L, respectively) were confined to the landward side of Docks 1 and 2. The MCB and DDT concentrations outside of the docks were substantially lower than those on the landward side of the docks. MCB and DDT concentrations were lower than 250 μg/L and 2.5 μg/L, respectively, in all groundwater samples collected outside Docks 1 and 2.

2.4.2 Perchlorate

Groundwater samples collected from the Stage 2 boreholes were analyzed for perchlorate (Table 7 and Figure 15). Perchlorate was detected in groundwater samples collected from six boreholes in two general areas. The highest perchlorate concentrations were observed in the deeper sample intervals in the vicinity of the southern portion of Dock 1. In this area, perchlorate was detected in groundwater samples collected from boreholes WB-8, WB-12, and WB-23. The highest perchlorate concentration was detected in borehole WB-23 at 370,000 μg/L (screened interval elevation of -27.8 to -31.8 ft CPD). The highest concentrations in boreholes WB-8 and WB-23 were detected in the deep groundwater sample intervals.

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Perchlorate was also detected at low concentrations (below 250 μg/L) in groundwater samples collected from boreholes WB-16, WB-18, and WB-20 in the vicinity of Dock 2.

2.5 QUALITY ASSURANCE/QUALITY CONTROL

The data validation reports summarize the results of the data quality review conducted for this investigation. Data validation qualifiers were assigned to selected results, as required by Functional Guidelines (US EPA 1994, 1999), because of exceedances of project or laboratory quality control criteria. Selected results were qualified as undetected (assigned a *U* qualifier) because of the detection of target analytes in associated laboratory or field blanks. Selected results were qualified as estimated (assigned a *J* qualifier) because of the exceedance of laboratory control limits for matrix spike results, surrogate recoveries, calibration verification, and other laboratory quality control samples. Selected results were rejected (assigned an *R* qualifier) because of quality control exceedances for instrument calibration. The data validation reports provide a summary of the qualifiers assigned and the rationale for the assignment of each data validation qualifier. The data validation reports for the Phase II data have been submitted to DEQ separately.

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3. ANALYSIS OF PHASE II RESULTS

The following section presents an analysis of the Phase II Stage 1 and 2 investigation results in relation to the soil and groundwater results from the upland remedial investigation. Shallow sediment data collected in January 1999 (Exponent 1999) are included in the analysis because they provide additional data between the Phase II boreholes.

3.1 POTENTIAL SOURCES AND TRANSPORT PATHWAYS

This section discusses the potential sources and transport pathways that are inferred from the analysis of the upland groundwater and soil data and Phase II investigation groundwater and sediment data.

3.1.1 MCB in Groundwater

The highest MCB concentrations in sediment groundwater are located east and southeast of the former Acid Plant area, in an area generally confined to the landward side of Docks 1 and 2 (Figure 11). The MCB sediment groundwater concentrations are generally consistent with concentrations of MCB in upland groundwater immediately downgradient from the Acid Plant. The MCB concentrations in monitoring wells MWA-9i, MWA-10i, and MWA-17si are all of the same order-of-magnitude as the highest concentration measured in borehole WB-10 during the Phase II investigation.

Based on data from the upland groundwater monitoring well network, the groundwater gradients and groundwater flow directions in both the shallow and intermediate groundwater zones are generally along a line from the Acid Plant toward Dock 2. Even though the MCB plume extends in that direction in the nearshore sediments, higher concentrations of MCB were measured in sediment groundwater south and east of the Acid Plant area (Figure 11). The highest MCB concentration detected in sediment groundwater (64,000 μg/L) during the Phase II investigation was found in borehole WB-10 (adjacent to WB-6 on Dock 1) at a screened interval elevation of -18.0 to -22.0 ft CPD. In addition, residual NAPL was observed at only one location, borehole WB-6 at -24.3 to -24.4 ft CPD, near borehole WB-10.

These data suggest that MCB has been transported in groundwater from the Acid Plant area into the nearshore sediments adjacent to the Acid Plant area of the ATOFINA Portland Plant. Furthermore, the highest MCB concentrations in sediment groundwater appear to be related to stratigraphically controlled flow of historical discharges of MPR fluids into the former MPR pond and trench in the form of a dense non-aqueous phase

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liquid (DNAPL). The DNAPL fluids likely migrated along more permeable sand beds within the finer-grained and less permeable sediments that slope to the southeast and generally emulate the slope of the basalt surface in the nearshore area.

3.1.2 DDT in Groundwater

There is a close correlation between MCB and DDT concentrations in groundwater both in the upland areas and in sediments (Figures 11 and 14). In selected samples, DDT concentrations in sediment groundwater are up to two orders-of-magnitude more than the aqueous solubility of DDT. Note, however, that because the groundwater samples were collected using the Geoprobe® temporary well screen that the introduction of fine suspended particulate matter could add a high-bias to the measured groundwater DDT concentrations. In general, the areas with exceedances of the aqueous solubility of DDT are collocated with areas of higher MCB concentrations, indicating a likely cosolvent relationship between DDT and MCB. The highest DDT concentration in sediment groundwater (1,900 μg/L) was measured at WB-10 at -18.0 to -22.0 ft CPD.

These data suggest that groundwater DDT concentrations generally covary with MCB concentrations because of the cosolvent relationship between MCB and DDT.

3.1.3 Perchlorate in Groundwater

The highest perchlorate concentrations in sediment groundwater are measured in boreholes immediately south and east of Dock 1 (Figure 15). The highest perchlorate groundwater concentrations (on the order of 160,000 to 370,000 μg/L) were measured in boreholes WB-12 (screened interval elevation of -37.9 to -41.9 ft CPD) and WB-23 (screened interval elevation of -27.8 to -31.8 ft CPD). Perchlorate was detected at 3,800 μg/L in borehole WB-8 at a screened interval elevation of -30.9 to -34.9 ft CPD. Lower concentrations of perchlorate were also detected in groundwater from boreholes WB-16, WB-18, and WB-20 in the vicinity of Dock 2.

Perchlorate concentrations in sediment groundwater are consistent with perchlorate measured in groundwater samples from upland monitoring wells. The highest concentrations of perchlorate are found in shallow groundwater zone monitoring wells in the Chlorate area (Figure 15). Perchlorate concentrations in groundwater from monitoring wells MWA-25 and MWA-27 range from 200,000 to 300,000 μg/L. Perchlorate concentrations attenuate 2 to 3 orders-of-magnitude in a hydraulically downgradient direction in the shallow groundwater zone. The highest perchlorate concentration in the intermediate groundwater zone is found in well MWA-32i (on the order of 200,000 μg/L), located immediately adjacent to well MWA-30 (on the order of 10,000 μg/L).

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These data suggest that perchlorate is being transported from the Chlorate area downgradient to deeper groundwater intervals in the nearshore sediment area around Dock 1.

3.1.4 DDT in Sediments

DDT concentrations greater than 1,000 μg/kg in surface sediments are generally confined to the landward side of Docks 1 and 2 (except for an area just east of Dock 2; Figure 12). The highest DDT concentrations are found in the vicinity of Dock 1 (at WB-8) and in the southern portion of Dock 2 (near WB-13). DDT concentrations generally decrease to the east beyond the docks (Figure 12). The highest DDT concentration measured in surface sediments during the Phase II investigation was 34,000 μg/kg in the 0 to 4.3 ft surface interval at WB-8. The highest surface sediment DDT concentration measured during the 1999 RI sampling was 81,000 μg/kg at OSS002, which is located on the landward side of Dock 2.

The highest concentrations of DDT in deeper sediments are found on the landward side of Dock 1 in the vicinity of borehole WB-9 (Figure 13). The highest concentration of DDT in subsurface sediment is 4,500,000 μg/kg at 8 to 10 ft below mudline at WB-9. The DDT concentration in the shallowest interval (0 to 4 ft below mudline) from the same borehole was over two orders of magnitude lower (12,000 μg/kg). DDT concentrations of 3,500,000 μg/kg and 920,000 μg/kg were measured in WB-24 (10.6 to 12.6 ft below mudline) and WB-8 (6.8 to 9.3 ft below mudline), respectively.

These data suggest that the highest DDT concentrations in subsurface sediments are most likely the result of historical discharges from a temporary MPR discharge pipe that was located along the shoreline in the vicinity of borehole WB-9. DDT discharged from that pipe may have been deposited on the sediment surface and then buried by subsequent sediment deposition. Although there are no bathymetric data available from the time that discharge occurred, there is reason to believe that considerable sediment deposition may have occurred in this area. The shoreline inshore of the area between Docks 1 and 2 has been extended out into the river with fill during the intervening years, and some shoaling may have occurred in the vicinity of the boreholes with high subsurface DDT concentrations. The presence of the docks may tend to shelter this area, allowing greater deposition and accumulation of suspended river sediments. The hypothesized source of these high DDT concentrations in sediments well below the present mudline is further supported by the fact that the elevated DDT sediment concentrations in this area are not associated with elevated MCB concentrations in groundwater, indicating that they are not related to the transport of DDT in groundwater and are not related to the MCB groundwater plume emanating from the former Acid Plant area of the site.

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3.2 DATA USABILITY FOR SOURCE CONTROL EVALUATION

This section summarizes the usability of the existing data set with respect to evaluation of potential source control measures at the site.

3.2.1 MCB and DDT in Groundwater

The existing MCB and DDT groundwater data are sufficient to evaluate source control measures in nearshore sediments. The existing data indicate that MCB and DDT in sediment groundwater are likely associated with the advective movement of MCB and DDT in groundwater from the uplands Acid Plant area of the site. Some of the areas with higher MCB and DDT concentrations may be related to the historical migration of MCB in the MPR from the former MPR pond and trench.

3.2.2 Perchlorate in Groundwater

The perchlorate concentrations in sediment groundwater in the vicinity of Dock 1 are consistent with perchlorate concentrations measured in shallow and intermediate groundwater on the upland portion of the site. The existing data indicate that perchlorate in sediment groundwater is likely associated with the advective movement of perchlorate in groundwater from the uplands Chlorate area.

3.2.3 MCB in Sediments

The existing MCB sediment data adequately characterize the sediments for potential source control measures appropriate for the site. The only visual evidence of residual NAPL characteristic of DDT MPR was from a very thin zone (0.1 ft thickness) in borehole WB-6. Although the sediment from the interval containing that thin zone did not yield a positive response in the Sudan IV® field screening for NAPL, there was limited sample available for screening. That sample interval did, however, have a high OVM measurement (3,000 ppm). MCB was found only in the dissolved phase in groundwater in the remainder of the Phase II boreholes.

MCB that is derived from residual NAPL beneath the MPR pond has been well characterized in upland soils in the former Acid Plant area and enough data are available to evaluate potential source control measures.

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4. SUMMARY AND CONCLUSIONS

The results of the Phase II Investigation indicate that sediments and groundwater in the vicinity of Docks 1 and 2 have been affected by the migration of MCB, DDT, and perchlorate via historical MPR discharges or by groundwater migration. Sediments in the nearshore area are primarily fine-grained silts and clays with minor sand horizons. The sediments are underlain by basalt bedrock at depths of greater than 40 ft below mudline nearshore to less than 3 ft below mudline toward the river channel. The top of the underlying basalt surface generally slopes to the east. Thin sand beds are sometimes present and apparently dip to the east and may control the migration of COIs in groundwater in some locations.

Concentrations of MCB and DDT greater than 1,000 μg/L and 10 μg/L, respectively, in sediment groundwater are confined to the landward side of Docks 1 and 2. The MCB and DDT concentrations outside of the docks were substantially lower than those on the landward side of the docks. In groundwater samples collected outside Docks 1 and 2, MCB and DDT concentrations were all lower than 250 μg/L and 2.5 μg/L, respectively. The correlation between MCB and DDT concentrations in sediment groundwater is generally good, indicating a likely cosolvent relationship between these constituents. MCB and DDT in sediment groundwater are likely associated with the advective movement of MCB and DDT in groundwater from the uplands Acid Plant area of the site; however, in some areas MCB and DDT concentrations may also be from the dissolution of MCB that historically migrated from the former MPR pond and trench into the nearshore sediments. The existing MCB and DDT groundwater data are sufficient for evaluating potential source control measures.

Perchlorate concentrations greater than 1,000 μg/L were found in sediment groundwater in the vicinity of the southern portion of Dock 1. The existing data indicate that perchlorate in sediment groundwater is likely associated with the advective movement of perchlorate from the uplands Chlorate area.

In surface sediments, DDT concentrations greater than 1,000 μg/kg in surface sediments are generally confined to the landward side of the docks. The highest DDT concentrations are found in the vicinity of Dock 1 (at borehole WB-8) and inshore of the south end of Dock 2 (near borehole WB-13). DDT concentrations generally decrease to the east beyond the docks. The highest DDT concentrations (i.e., greater than 100,000 μg/kg) were found in deeper sediments from 7 to 14.5 feet below mudline on the landward side of Dock 1. The areas of highest sediment DDT concentrations appear to be associated with temporary MPR discharges from a pipe that was located along the shoreline in the vicinity of borehole WB-9. The bulk of the buried DDT mass appears to be associated

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with discharges that occurred for a brief period of time more than 50 years ago. A very small portion of the DDT sediment mass may be associated with the ongoing cosolvent migration of MCB and DDT (as summarized above). The existing data set adequately characterizes the DDT in surface and subsurface sediments for the purpose of evaluating potential source control measures that may be appropriate for the area between Docks 1 and 2.

Ongoing and recently completed remedial activities at the ATOFINA site include the completion of the uplands remedial investigation, the completion of two phases of upland soil removal, and bench- and field-scale pilot studies for the in-situ treatment of MCB, perchlorate, and hexavalent chromium. The results of these ongoing studies will be used along with the data from this report to assess further source control evaluation alternatives.

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Tables

Table 1. Station coordinates and borehole elevation data for the Stage 1 and 2 boreholes

										Shallow Groundwater Sample Interval			
Borehole I.D.	Start Date	Latitude	Longitude	Barge Deck or Dock Elevation (ft)	Mudline Elevation (ft)	Basalt Elevation (ft)	Sediment Thickness (ft)	Upper Elevation (ft)	Lower Elevation (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Ground-water elevation (ft)	River elevation (ft)
WB-1	6/3/02	45° 34' 19.4"	122° 44' 37.36"	36.6	7.6	-19.4	27.0	3.6	-0.4	4.0	8.0	12.1	11.8
WB-2	6/4/02	45° 34' 19.6"	122° 44' 36.9"	36.7	3.4	-14.3	17.7	-0.3	-4.3	3.7	7.7	12.3	12.2
WB-3	6/5/02	45° 34' 20"	122° 44' 36.5"	36.7	-2.3	-17.8	15.5	-5.3	-9.3	3.0	7.0	12.9	12.7
WB-4	6/6/02	45° 34' 14.9"	122° 44' 30.48"	36.3	6.6	-36.2	42.8	2.3	-1.7	4.3	8.3	12.5	12.5
WB-5	6/11/02	45° 34' 15.7"	122° 44' 29.8"	36.5	-12.2	-33.7	21.5	-17.5	-21.5	5.3	9.3	12.0	11.5
WB-6	6/7/02	45° 34' 16.5"	122° 44' 30.7"	36.6	-12.5	--	--	--	--	--	--	--	--
WB-7	6/11/02	45° 34' 17.46"	122° 44' 31.82"	37.1	-13.1	--	--	-23.9	-27.9	10.8	14.8	13.0	12.7
WB-8	2/28/03	45° 34' 15.72313"	122° 44' 30.91913"	8.6	2.9	-34.9	37.8	-7.4	-11.4	10.3	14.3	8.6	7.4
WB-9	3/4/03	45° 34' 16.01279"	122° 44' 32.21358"	10.1	5.1	-29.7	34.8	-9.9	-13.9	15.0	19.0	9.6	8.3
WB-10	3/5/03	45° 34' 16.33975"	122° 44' 31.04529"	10.0	-4.0	-32.2	28.2	-18.0	-22.0	14.0	18.0	10.1	8.8
WB-11	3/6/03	45° 34' 17.40241"	122° 44' 32.92170"	9.4	-2.1	-24.2	22.1	-13.6	-17.6	11.5	15.5	7.6	8.2
WB-12	2/19/03	45° 34' 15.80398"	122° 44' 28.21504"	10.1	-32.9	--	--	-37.9	-41.9	5.0	9.0	8.6	7.7
WB-13	2/26/03	45° 34' 18.50116"	122° 44' 35.07325"	8.8	0.8	-19.8	20.6	-4.2	-8.2	5.0	9.0	7.8	7.6
WB-14	2/27/03	45° 34' 18.90736"	122° 44' 34.52794"	8.5	-6.5	-28.5	22.0	-10.5	-14.5	4.0	8.0	7.5	7.2
WB-15	2/17/03	45° 34' 17.465"	122° 44' 30.036"	8.5	-35.5	-41.0	5.5	-36.8	-40.8	1.3	5.3	3.7 [b]	2.5 [b]
WB-16	2/19/03	45° 34' 19.05831"	122° 44' 32.77159"	11.5	-27.1	-31.9	4.8	-30.5	-31.5	3.4	4.4	10.9	9.0
WB-17	2/27/03	45° 34' 20.13637"	122° 44' 34.18409"	8.8	-25.2	-27.3	2.1	--	--	--	--	--	--
WB-18	2/25/03	45° 34' 21.21688"	122° 44' 38.47890"	9.5	1.5	-20.1	21.6	-3.5	-7.5	5.0	9.0	8.9	8.2
WB-19	2/24/03	45° 34' 21.36651"	122° 44' 35.97411"	9.9	-24.2	-28.2	4.0	-27.1	-28.1	2.9	3.9	10.3	7.4
WB-20	2/24/03	45° 34' 20.80447"	122° 44' 33.03850"	9.6	-36.9	-41.4	4.5	-39.4	-41.4	2.5	4.5	8.1	7.2
WB-21	2/20/03	45° 34' 18.09158"	122° 44' 29.44381"	10.3	-34.9	-43.1	8.2	-39.2	-43.2	4.3	8.3	9.2	8.0
WB-22	2/21/03	45° 34' 20.31419"	122° 44' 30.04633"	11.6	-38.9	--	--	-42.4	-46.4	3.5	7.5	9.9	9.2
WB-23	2/18/03	45° 34' 14.41471"	122° 44' 28.14914"	10.2	-11.2	-31.8	20.6	-14.8	-18.8	3.6	7.6	8.0	7.8
WB-24	3/7/03	45° 34' 16.70581"	122° 44' 32.59989"	10.0	0.6	--	--	--	--	--	--	--	--
WB-25	3/7/03	45° 34' 18.15890"	122° 44' 33.56621"	9.9	-4.4	-25.7	21.3	-16.1	-20.1	11.7	15.7	8.7	8.7

Table 1 (con't)

	Deep Groundwater Sample Interval						Additional Groundwater Sample Interval					
Borehole I.D.	Upper Elevation (ft)	Lower Elevation (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Ground-water elevation (ft)	River elevation (ft)	Upper Elevation (ft)	Lower Elevation (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Ground-water elevation (ft)	River elevation (ft)
WB-1	-11.4	-15.4	19.0	23.0	11.9	11.8	--	--	--	--	--	--
WB-2	-8.3	-12.3	11.7	15.7	8.4 [a]	12.2	--	--	--	--	--	--
WB-3	-13.3	-17.3	11.0	15.0	14.2	14.0	--	--	--	--	--	--
WB-4	-10.7	-14.7	17.3	21.3	12.7	12.5	-23.7	-27.7	30.3	34.3	12.5	12.5
WB-5	-27.5	-31.5	15.3	19.3	3.0 [a]	11.5	--	--	--	--	--	--
WB-6	--	--	--	--	--	--	--	--	--	--	--	--
WB-7	--	--	--	--	--	--	--	--	--	--	--	--
WB-8	-30.9	-34.9	33.8	37.8	7.1	7.3	--	--	--	--	--	--
WB-9	-25.9	-29.9	31.0	35.0	9.1	8.2	--	--	--	--	--	--
WB-10	-28.0	-32.0	24.0	28.0	8.9	8.9	--	--	--	--	--	--
WB-11	-21.6	-24.1	19.5	22.0	7.6	8.2	--	--	--	--	--	--
WB-12	--	--	--	--	--	--	--	--	--	--	--	--
WB-13	-15.7	-19.7	16.5	20.5	7.9	7.4	--	--	--	--	--	--
WB-14	-23.5	-27.5	17.0	21.0	7.7	7.2	--	--	--	--	--	--
WB-15	--	--	--	--	--	--	--	--	--	--	--	--
WB-16	--	--	--	--	--	--	--	--	--	--	--	--
WB-17	--	--	--	--	--	--	--	--	--	--	--	--
WB-18	-16.0	-20.0	17.5	21.5	9.0	8.2	--	--	--	--	--	--
WB-19	--	--	--	--	--	--	--	--	--	--	--	--
WB-20	--	--	--	--	--	--	--	--	--	--	--	--
WB-21	--	--	--	--	--	--	--	--	--	--	--	--
WB-22	--	--	--	--	--	--	--	--	--	--	--	--
WB-23	-27.8	-31.8	16.6	20.6	8.5	7.9	--	--	--	--	--	--
WB-24	--	--	--	--	--	--	--	--	--	--	--	--
WB-25	-24.1	-26.1	19.7	21.7	8.4	8.7	--	--	--	--	--	--

Note: -- not measured or data not available.

Note: Barge deck or dock elevation represents the initial elevation from which all relative borehole depths were measured. Groundwater samples were not collected from all boreholes. Some boreholes had only one groundwater sample interval. Vertical reference datum for elevations is City of Portland Datum, unless otherwise noted.

[a]The measured groundwater elevation may not represent a stabilized reading and therefore no intrepretation of potentiometric surface should be made using this measurement.

[b]Vertical reference datum was the Geoprobe rods rather than the City of Portland Datum

Table 2. Field screening results and analytical results for select pesticides in sediments from Stage 1 and 2 boreholes.

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (µg/kg)	4,4'-DDE (8081A) (µg/kg)	4,4'-DDT (8081A) (µg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1711	WB-1	6/3/2002	29–33	0.0	4.0	7.6	3.6	0	-	--	--	--	50 *U*
SO1712	WB-1	6/3/2002	33–37	4.0	8.0	3.6	-0.4	34	-	--	--	--	150
SO1713	WB-1	6/3/2002	37–39	8.0	10.0	-0.4	-2.4	86	-	--	--	--	50 *U*
SO1714	WB-1	6/3/2002	42–44	13.0	15.0	-5.4	-7.4	3.4	-	--	--	--	50 *U*
SO1715	WB-1	6/3/2002	44–46	15.0	17.0	-7.4	-9.4	3.4	-	--	--	--	50 *U*
SO1716	WB-1	6/3/2002	46–48	17.0	19.0	-9.4	-11.4	0	-	--	--	--	50 *U*
SO1717	WB-1	6/3/2002	48–50	19.0	21.0	-11.4	-13.4	0	-	--	--	--	50 *U*
SO1718	WB-1	6/3/2002	50–52	21.0	23.0	-13.4	-15.4	1.7	-	--	--	--	50 *U*
SO1719	WB-1	6/3/2002	52–54	23.0	25.0	-15.4	-17.4	1.7	-	--	--	--	50 *U*
SO1720	WB-1	6/3/2002	54–56	25.0	27.0	-17.4	-19.4	1.7	-	--	--	--	50 *U*
SO1721	WB-2	6/4/2002	33.3–35	0.0	1.7	3.4	1.7	8.1	-	--	--	--	50 *U*
SO1721Z	WB-2	6/4/2002	35–37	1.7	3.7	1.7	-0.3	0	-	--	--	--	50 *U*
SO1722	WB-2	6/4/2002	37–39	3.7	5.7	-0.3	-2.3	0	-	--	--	--	50 *U*
SO1723	WB-2	6/4/2002	39–41	5.7	7.7	-2.3	-4.3	0	-	--	--	--	50 *U*
SO1724	WB-2	6/4/2002	41–43	7.7	9.7	-4.3	-6.3	8.1	-	--	--	--	50 *U*
SO1725	WB-2	6/4/2002	43–45	9.7	11.7	-6.3	-8.3	16	-	--	--	--	50 *U*
SO1726	WB-2	6/4/2002	45–47	11.7	13.7	-8.3	-10.3	56	-	--	--	--	50 *U*
SO1727	WB-2	6/4/2002	47–49	13.7	15.7	-10.3	-12.3	15	-	--	--	--	50 *U*
SO1728	WB-2	6/4/2002	49–51	15.7	17.7	-12.3	-14.3	0	-	--	--	--	50 *U*
SO1729	WB-3	6/5/2002	39–41	0.0	2.0	-2.3	-4.3	2.8	-	--	--	--	50 *U*
SO1730	WB-3	6/5/2002	41–43	2.0	4.0	-4.3	-6.3	4.7	-	--	--	--	50 *U*
SO1731	WB-3	6/5/2002	45–47	6.0	8.0	-8.3	-10.3	2.8	-	--	--	--	100
SO1732	WB-3	6/5/2002	47–49	8.0	10.0	-10.3	-12.3	4.7	-	--	--	--	50 *U*
SO1733	WB-3	6/5/2002	49–51	10.0	12.0	-12.3	-14.3	4.7	-	--	--	--	50 *U*
SO1734	WB-3	6/5/2002	51–53	12.0	14.0	-14.3	-16.3	2.8	-	--	--	--	50 *U*
SO1734A	WB-3 (dup)	6/5/2002	51–53	12.0	14.0	-14.3	-16.3	NA	NA	--	--	--	50 *U*
SO1735	WB-3	6/5/2002	53–54.5	14.0	15.5	-16.3	-17.8	2.8	-	--	--	--	50 *U*
SO1736	WB-4	6/6/2002	29.7–32	0.0	2.3	6.6	4.3	7.3	-	--	--	--	50 *U*
SO1737	WB-4	6/6/2002	32–34	2.3	4.3	4.3	2.3	11	-	--	--	--	50 *U*
SO1738	WB-4	6/6/2002	34–36	4.3	6.3	2.3	0.3	7.3	-	--	--	--	200
SO1739	WB-4	6/6/2002	36–38	6.3	8.3	0.3	-1.7	3.5	-	--	--	--	50 *U*
SO1740	WB-4	6/6/2002	38–40	8.3	10.3	-1.7	-3.7	5.4	-	--	--	--	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (μg/kg)	4,4'-DDE (8081A) (μg/kg)	4,4'-DDT (8081A) (μg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1741	WB-4	6/6/2002	40–42	10.3	12.3	-3.7	-5.7	5.4	-	--	--	--	50 *U*
SO1742	WB-4	6/6/2002	42–44	12.3	14.3	-5.7	-7.7	5.4	-	--	--	--	50 *U*
SO1743	WB-4	6/6/2002	44–46	14.3	16.3	-7.7	-9.7	5.4	-	--	--	--	50 *U*
SO1744	WB-4	6/6/2002	46–48	16.3	18.3	-9.7	-11.7	0	-	--	--	--	50 *U*
SO1745	WB-4	6/6/2002	48–50	18.3	20.3	-11.7	-13.7	1.8	-	--	--	--	50 *U*
SO1746	WB-4	6/6/2002	52–54	22.3	24.3	-15.7	-17.7	3.6	-	--	--	--	50 *U*
SO1747	WB-4	6/6/2002	54–56	24.3	26.3	-17.7	-19.7	5.4	-	--	--	--	50 *U*
SO1748	WB-4	6/6/2002	56–58	26.3	28.3	-19.7	-21.7	3.6	-	--	--	--	50 *U*
SO1749	WB-4	6/6/2002	58–60	28.3	30.3	-21.7	-23.7	3.6	-	--	--	--	50 *U*
SO1750	WB-4	6/6/2002	60–62	30.3	32.3	-23.7	-25.7	1.8	-	--	--	--	50 *U*
SO1751	WB-4	6/6/2002	62–64	32.3	34.3	-25.7	-27.7	3.6	-	--	--	--	50 *U*
SO1757	WB-4	6/10/2002	64–66	34.3	36.3	-27.7	-29.7	1.7	-	--	--	--	50 *U*
SO1758	WB-4	6/10/2002	66–68	36.3	38.3	-29.7	-31.7	0	-	--	--	--	50 *U*
SO1759	WB-4	6/10/2002	68–70	38.3	40.3	-31.7	-33.7	0	-	--	--	--	50 *U*
SO1760	WB-4	6/10/2002	70–72.5	40.3	42.8	-33.7	-36.2	0	-	--	--	--	50 *U*
SO1775	WB-5	6/11/2002	48.7–50.5	0.0	1.8	-12.2	-14.0	5.4	-	--	--	--	50 *U*
SO1775A	WB-5 (dup)	6/11/2002	48.7–50.5	0.0	1.8	-12.2	-14.0	NA	NA	--	--	--	50 *U*
SO1776	WB-5	6/11/2002	50.5–52.5	1.8	3.8	-14.0	-16.0	16	-	--	--	--	250
SO1777	WB-5	6/11/2002	60–62	11.3	13.3	-23.5	-25.5	280	-	--	--	--	150
SO1778	WB-5	6/11/2002	62–64	13.3	15.3	-25.5	-27.5	7.2	-	--	--	--	50 *U*
SO1779	WB-5	6/11/2002	64–66	15.3	17.3	-27.5	-29.5	3.6	-	--	--	--	50 *U*
SO1780	WB-5	6/11/2002	66–68	17.3	19.3	-29.5	-31.5	1.8	-	--	--	--	50 *U*
SO1781	WB-5	6/11/2002	68–70	19.3	21.3	-31.5	-33.5	5.4	-	--	--	--	50 *U*
SO1752	WB-6	6/7/2002	49.1–51	0.0	1.9	-12.5	-14.4	7.1	+[d]	--	--	--	50
SO1752A	WB-6 (dup)	6/7/2002	49.1–51	0.0	1.9	-12.5	-14.4	NA	NA	--	--	--	50
SO1753	WB-6	6/7/2002	51–53	1.9	3.9	-14.4	-16.4	8.9	-	--	--	--	50 *U*
SO1753A	WB-6 (dup)	6/7/2002	51–53	1.9	3.9	-14.4	-16.4	NA	NA	--	--	--	50 *U*
SO1754	WB-6	6/7/2002	55–59	5.9	9.9	-18.4	-22.4	310	-	--	--	--	50
SO1755	WB-6	6/7/2002	59–61	9.9	11.9	-22.4	-24.4	3,000	-[e]	--	--	--	50
SO1756	WB-6	6/7/2002	63–67	13.9	17.9	-26.4	-30.4	1,400	-	--	--	--	50
SO1761	WB-7	6/11/2002	50.2–52	0.0	1.8	-13.1	-14.9	3.6	-	--	--	--	50 *U*
SO1762	WB-7	6/11/2002	52–54	1.8	3.8	-14.9	-16.9	13	-	--	--	--	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (μg/kg)	4,4'-DDE (8081A) (μg/kg)	4,4'-DDT (8081A) (μg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1763	WB-7	6/11/2002	54–56	3.8	5.8	-16.9	-18.9	120	+[d]	--	--	--	50 *U*
SO1764	WB-7	6/11/2002	56–58	5.8	7.8	-18.9	-20.9	56	-	--	--	--	50 *U*
SO1765	WB-7	6/11/2002	58–60	7.8	9.8	-20.9	-22.9	64	-	--	--	--	50 *U*
SO1766	WB-7	6/11/2002	61–63	10.8	12.8	-23.9	-25.9	57	-	--	--	--	50 *U*
SO1767	WB-7	6/11/2002	63–65	12.8	14.8	-25.9	-27.9	54	-	--	--	--	50 *U*
SO1915	WB-8	2/28/2003	5.7-10	0.0	4.3	2.9	-1.4	6.2	-	3,800	570 *J*	34,000	50 *U*
SO1916	WB-8	2/28/2003	10-12.5	4.3	6.8	-1.4	-3.9	12.0	-	--	--	--	50
SO1916D	WB-8 (dup)	2/28/2003	10-12.5	4.3	6.8	-1.4	-3.9	NA	NA	--	--	--	50
SO1917	WB-8	2/28/2003	12.5-15	6.8	9.3	-3.9	-6.4	12.0	-	470,000	9,000	920,000	100
SO1917D	WB-8 (dup)	2/28/2003	12.5-15	6.8	9.3	-3.9	-6.4	NA	NA	--	--	--	100
SO1918	WB-8	2/28/2003	15-17.5	9.3	11.8	-6.4	-8.9	15.5	-	--	--	--	50 *U*
SO1919	WB-8	2/28/2003	20-22	14.3	16.3	-11.4	-13.4	7.0	-	95	7.1 *U*	330	50 *U*
SO1920	WB-8	2/28/2003	22-24	16.3	18.3	-13.4	-15.4	5.4	-	--	--	--	50 *U*
SO1921	WB-8	2/28/2003	24-26	18.3	20.3	-15.4	-17.4	4.5	-	--	--	--	50 *U*
SO1922	WB-8	2/28/2003	26-28	20.3	22.3	-17.4	-19.4	6.2	-	--	--	--	50 *U*
SO1923	WB-8	2/28/2003	28-30	22.3	24.3	-19.4	-21.4	5.4	-	--	--	--	50 *U*
SO1924	WB-8	2/28/2003	30-32	24.3	26.3	-21.4	-23.4	5.4	-	--	--	--	50 *U*
SO1925	WB-8	2/28/2003	32-34	26.3	28.3	-23.4	-25.4	6.4	-	--	--	--	50 *U*
SO1926	WB-8	2/28/2003	34-36	28.3	30.3	-25.4	-27.4	7.0	-	--	--	--	50 *U*
SO1927	WB-8	2/28/2003	36-38	30.3	32.3	-27.4	-29.4	5.4	-	--	--	--	50 *U*
SO1928	WB-8	2/28/2003	38-40	32.3	34.3	-29.4	-31.4	7.0	-	--	--	--	50 *U*
SO1929	WB-8	2/28/2003	40-42	34.3	36.3	-31.4	-33.4	5.4	-	26	7.0 *U*	17	50 *U*
SO1930	WB-8	2/28/2003	42-43.8	36.3	38.1	-33.4	-35.2	2.0	-	--	--	--	50 *U*
SO1931	WB-9	3/4/2003	5-9	0.0	4.0	5.1	1.1	0.0	-	1,900	730	12,000	50 *U*
SO1932	WB-9	3/4/2003	9-11	4.0	6.0	1.1	-0.9	0.9	-	--	--	--	50 *U*
SO1933	WB-9	3/4/2003	11-13	6.0	8.0	-0.9	-2.9	3.4	-	--	--	--	50
SO1934	WB-9	3/4/2003	13-15	8.0	10.0	-2.9	-4.9	3.5	-	240,000	24,000	4,500,000	500
SO1934D	WB-9 (dup)	3/4/2003	13-15	8.0	10.0	-2.9	-4.9	NA	NA	--	--	--	500
SO1935	WB-9	3/4/2003	15-17	10.0	12.0	-4.9	-6.9	6.1	-	--	--	--	200
SO1936	WB-9	3/4/2003	17-19	12.0	14.0	-6.9	-8.9	0.0	-	--	--	--	50
SO1936D	WB-9 (dup)	3/4/2003	17-19	12.0	14.0	-6.9	-8.9	NA	NA	--	--	--	50
SO1937	WB-9	3/4/2003	21-23	16.0	18.0	-10.9	-12.9	0.0	-	--	--	--	50
SO1938	WB-9	3/4/2003	23-25	18.0	20.0	-12.9	-14.9	0.1	-	130 *U*	130 *U*	1,900	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (µg/kg)	4,4'-DDE (8081A) (µg/kg)	4,4'-DDT (8081A) (µg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1939	WB-9	3/4/2003	25-27	20.0	22.0	-14.9	-16.9	0.4	-	--	--	--	50 *U*
SO1940	WB-9	3/4/2003	27-29	22.0	24.0	-16.9	-18.9	0.0	-	--	--	--	50 *U*
SO1941	WB-9	3/4/2003	29-31	24.0	26.0	-18.9	-20.9	0.0	-	--	--	--	50 *U*
SO1942	WB-9	3/4/2003	31-33	26.0	28.0	-20.9	-22.9	0.0	-	--	--	--	50 *U*
SO1943	WB-9	3/4/2003	33-35	28.0	30.0	-22.9	-24.9	0.0	-	--	--	--	50 *U*
SO1944	WB-9	3/4/2003	35-37	30.0	32.0	-24.9	-26.9	0.0	-	--	--	--	50 *U*
SO1945	WB-9	3/4/2003	37-39	32.0	34.0	-26.9	-28.9	0.0	-	20	6.6 *U*	240	50 *U*
SO1946	WB-9	3/4/2003	39-40.3	34.0	35.3	-28.9	-30.2	0.0	-	--	--	--	50 *U*
SO1947	WB-10	3/5/2003	14-16	0.0	2.0	-4.0	-6.0	4.8	-	950 *J*	160	4,000	50 *U*
SO1948	WB-10 (dup)	3/5/2003	14-16	0.0	2.0	-4.0	-6.0	NA	NA	830 *J*	190	4,000	--
SO1949	WB-10	3/5/2003	16-17.5	2.0	3.5	-6.0	-7.5	5.9	-	--	--	--	50
SO1950	WB-10	3/5/2003	17.5-19	3.5	5.0	-7.5	-9.0	8.0	-	--	--	--	150
SO1951	WB-10	3/5/2003	19-21	5.0	7.0	-9.0	-11.0	12.1	-	--	--	--	50
SO1952	WB-10	3/5/2003	21-23	7.0	9.0	-11.0	-13.0	8.0	-	4,600	660 *J*	15,000	200
SO1953	WB-10	3/5/2003	23-26	9.0	12.0	-13.0	-16.0	6.7	-	--	--	--	50
SO1954	WB-10	3/5/2003	26-28	12.0	14.0	-16.0	-18.0	32.2	-	--	--	--	50
SO1955	WB-10	3/5/2003	28-29	14.0	15.0	-18.0	-19.0	117	-	--	--	--	100
SO1956	WB-10	3/5/2003	29-31	15.0	17.0	-19.0	-21.0	2280	-	640,000	4,300 *U*	19,000	50
SO1956D	WB-10 (dup)	3/5/2003	29-31	15.0	17.0	-19.0	-21.0	NA	NA	--	--	--	50
SO1957	WB-10	3/5/2003	31-33	17.0	19.0	-21.0	-23.0	271	-	--	--	--	50
SO1958	WB-10	3/5/2003	33-35	19.0	21.0	-23.0	-25.0	24.3	-	--	--	--	50
SO1959	WB-10	3/5/2003	35-37	21.0	23.0	-25.0	-27.0	8.9	-	--	--	--	50 *U*
SO1960	WB-10	3/5/2003	37-39	23.0	25.0	-27.0	-29.0	5.8	-	--	--	--	50 *U*
SO1961	WB-10	3/5/2003	39-41	25.0	27.0	-29.0	-31.0	3.5	-	28	6.6 *U*	6.6 *U*	50 *U*
SO1962	WB-10	3/5/2003	41-42.7	27.0	28.7	-31.0	-32.7	1.1	-	--	--	--	50 *U*
SO1963	WB-11	3/6/2003	11.5-13.5	0.0	2.0	-2.1	-4.1	4.4	-	1,300 *J*	400 *J*	3,500 *J*	50 *U*
SO1964	WB-11	3/6/2003	13.5-15	2.0	3.5	-4.1	-5.6	3.7	-	--	--	--	50
SO1965	WB-11	3/6/2003	15-20	3.5	8.5	-5.6	-10.6	14.8	-	--	--	--	50
SO1966	WB-11	3/6/2003	20-24	8.5	12.5	-10.6	-14.6	109	-	--	--	--	50
SO1967	WB-11	3/6/2003	24-26	12.5	14.5	-14.6	-16.6	1230	-	690,000	5,700 *U*	110,000	50
SO1968	WB-11	3/6/2003	26-28	14.5	16.5	-16.6	-18.6	78.5	-	--	--	--	50
SO1969	WB-11	3/6/2003	28-30	16.5	18.5	-18.6	-20.6	12.8	-	--	--	--	50 *U*
SO1970	WB-11	3/6/2003	30-32	18.5	20.5	-20.6	-22.6	21.4	-	--	--	--	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (µg/kg)	4,4'-DDE (8081A) (µg/kg)	4,4'-DDT (8081A) (µg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1971	WB-11	3/6/2003	32-33.8	20.5	22.3	-22.6	-24.4	13.5	-	36	6.4 *U*	6.4 *U*	50 *U*
SO1870	WB-12	2/19/2003	43-44.5	0.0	1.5	-32.9	-34.4	2.1	-	42 *J*	25 *J*	100 *J*	50 *U*
SO1871	WB-12	2/19/2003	44.5-46.5	1.5	3.5	-34.4	-36.4	0.7	-	--	--	--	50 *U*
SO1872	WB-12	2/19/2003	46.5-48	3.5	5.0	-36.4	-37.9	2.2	-	--	--	--	50 *U*
SO1896	WB-13	2/26/2003	8-11.5	0.0	3.5	0.8	-2.7	3.2	-	8,200	780	26,000	50 *U*
SO1897	WB-13	2/26/2003	11-13	3.0	5.0	-2.2	-4.2	7.4	-	--	--	--	50 *U*
SO1898	WB-13	2/26/2003	13-15	5.0	7.0	-4.2	-6.2	5.7	-	--	--	--	50 *U*
SO1899	WB-13	2/26/2003	15-20	7.0	12.0	-6.2	-11.2	6.5	-	--	--	--	50
SO1900	WB-13	2/26/2003	20-22.5	12.0	14.5	-11.2	-13.7	12.3	-	--	--	--	50
SO1901	WB-13	2/26/2003	22.5-25	14.5	17.0	-13.7	-16.2	25.5	-	460	75 *U*	610	50
SO1902	WB-13	2/26/2003	25-27.5	17.0	19.5	-16.2	-18.7	28.8	-	--	--	--	50 *U*
SO1903	WB-13	2/26/2003	27.5-28.5	19.5	20.5	-18.7	-19.7	16.4	-	--	--	--	50 *U*
SO1906	WB-14	2/27/2003	15-17	0.0	2.0	-6.5	-8.5	13.8	-	810	150 *J*	1,400	50 *U*
SO1907	WB-14	2/27/2003	17-19	2.0	4.0	-8.5	-10.5	16.2	-	--	--	--	50 *U*
SO1908	WB-14	2/27/2003	19-20	4.0	5.0	-10.5	-11.5	14.6	-	--	--	--	50 *U*
SO1909	WB-14	2/27/2003	20-25	5.0	10.0	-11.5	-16.5	8.9	-	--	--	--	50 *U*
SO1910	WB-14	2/27/2003	25-27.5	10.0	12.5	-16.5	-19.0	14.6	-	--	--	--	50 *U*
SO1911	WB-14	2/27/2003	27.5-31	12.5	16.0	-19.0	-22.5	18.7	-	--	--	--	50 *U*
SO1912	WB-14	2/27/2003	31-33	16.0	18.0	-22.5	-24.5	--	-	6.9 *U*	6.9 *U*	6.9 *U*	50 *U*
SO1913	WB-14	2/27/2003	33-35	18.0	20.0	-24.5	-26.5	--	-	--	--	--	50 *U*
SO1914	WB-14	2/27/2003	35-37	20.0	22.0	-26.5	-28.5	--	-	--	--	--	50 *U*
SO1850	WB-15	2/17/2003	44-46	0.0	2.0	-35.5	-37.5	0	-	80 *J*	25 *J*	290 *J*	50 *U*
SO1851	WB-15	2/17/2003	46-47	2.0	3.0	-37.5	-38.5	0	-	--	--	--	50 *U*
SO1852	WB-15	2/17/2003	47-49	3.0	5.0	-38.5	-40.5	0	-	--	--	--	50 *U*
SO1853	WB-15	2/17/2003	49-49.5	5.0	5.5	-40.5	-41.0	3.0	-	--	--	--	50 *U*
SO1854	WB-15	2/17/2003	49.5-50	5.5	6.0	-41.0	-41.5	0	-	--	--	--	50 *U*
SO1867	WB-16	2/19/2003	38.6-40.5	0.0	1.9	-27.1	-29.0	8.1	-	39 *J*	11 *UJ*	130 *J*	50 *U*
SO1868	WB-16	2/19/2003	40.5-43.3	1.9	4.7	-29.0	-31.8	11.8	-	--	--	--	50 *U*
SO1904	WB-17	2/27/2003	34-36	0.0	2.0	-25.2	-27.2	7.3	-	320 *J*	92 *U*	6,100	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (µg/kg)	4,4'-DDE (8081A) (µg/kg)	4,4'-DDT (8081A) (µg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1905	WB-17	2/27/2003	36-36.2	2.0	2.2	-27.2	-27.4	13.0	-	--	--	--	50 *U*
SO1888	WB-18	2/25/2003	8-10	0.0	2.0	1.5	-0.5	5.1	-	1,200	350	8,000	50 *U*
SO1889	WB-18	2/25/2003	12-14	4.0	6.0	-2.5	-4.5	5.1	-	--	--	--	50 *U*
SO1890	WB-18	2/25/2003	14-16	6.0	8.0	-4.5	-6.5	9.3	-	3,600	650 *J*	17,000	50
SO1890D	WB-18 (dup)	2/25/2003	14-16	6.0	8.0	-4.5	-6.5	NA	NA	--	--	--	50
SO1891	WB-18	2/25/2003	16-18	8.0	10.0	-6.5	-8.5	5.1	-	--	--	--	50
SO1892	WB-18	2/25/2003	18-20	10.0	12.0	-8.5	-10.5	6.7	-	--	--	--	50
SO1893	WB-18	2/25/2003	20-24	12.0	16.0	-10.5	-14.5	5.9	-	--	--	--	50 *U*
SO1894	WB-18	2/25/2003	24-28	16.0	20.0	-14.5	-18.5	6.7	-	220	6.5 *U*	150	50 *U*
SO1895	WB-18	2/25/2003	28-29.7	20.0	21.7	-18.5	-20.2	6.7	-	--	--	--	50 *U*
SO1885	WB-19	2/24/2003	34.1-35.5	0.0	1.4	-24.2	-25.6	3.6	-	310	100	620	50 *U*
SO1886	WB-19	2/24/2003	35.5-37	1.4	2.9	-25.6	-27.1	4.5	-	--	--	--	50 *U*
SO1887	WB-19	2/24/2003	37-38	2.9	3.9	-27.1	-28.1	5.4	-	--	--	--	50 *U*
SO1882	WB-20	2/24/2003	46.5-48.5	0.0	2.0	-36.9	-38.9	1.7	-	24 *J*	11 *UJ*	67 *J*	50 *U*
SO1883	WB-20	2/24/2003	48.5-51	2.0	4.5	-38.9	-41.4	3.5	-	--	--	--	50 *U*
SO1884	WB-20	2/24/2003	51-51.9	4.5	5.4	-41.4	-42.3	3.5	-	--	--	--	50 *U*
SO1873	WB-21	2/20/2003	45.2-47	0.0	1.8	-34.9	-36.7	2.6	-	29 *J*	9.1 *UJ*	37 *J*	50 *U*
SO1874	WB-21	2/20/2003	47-49	1.8	3.8	-36.7	-38.7	2.6	-	--	--	--	50 *U*
SO1875	WB-21	2/20/2003	49-51	3.8	5.8	-38.7	-40.7	4.7	-	--	--	--	50 *U*
SO1876	WB-21	2/20/2003	51-52.3	5.8	7.1	-40.7	-42.0	4.0	-	--	--	--	50 *U*
SO1877	WB-22	2/21/2003	50.5-52	0.0	1.5	-38.9	-40.4	6.3[f]	-	--	--	--	50 *U*
SO1878	WB-22	2/21/2003	52-54	1.5	3.5	-40.4	-42.4	5.3[f]	-	--	--	--	50 *U*
SO1879	WB-22	2/21/2003	54-55.8	3.5	5.3	-42.4	-44.2	5.3[f]	-	14 *U*	8.1	15 *U*	50 *U*
SO1880	WB-22	2/21/2003	56-60	5.5	9.5	-44.4	-48.4	6.3[f]	-	--	--	--	50 *U*
SO1881	WB-22	2/21/2003	60-62.5	9.5	12.0	-48.4	-50.9	6.3[f]	-	--	--	--	50 *U*
SO1855	WB-23	2/18/2003	21.4-23	0.0	1.6	-11.2	-12.8	1.0	-	--	--	--	50 *U*
SO1856	WB-23	2/18/2003	23-25	1.6	3.6	-12.8	-14.8	1.0	-	--	--	--	50 *U*
SO1857	WB-23	2/18/2003	25-29	3.6	7.6	-14.8	-18.8	1.0	-	--	--	--	50 *U*
SO1858	WB-23	2/18/2003	26-28	4.6	6.6	-15.8	-17.8	1.7	-	230	21 *U*	450	50 *U*

Table 2. (cont.)

Sample Number	Survey Station	Date	Depth[a] (ft)	Upper Depth Below Mudline (ft)	Lower Depth Below Mudline (ft)	Upper Depth Elevation[b] (ft)	Lower Depth Elevation[b] (ft)	OVM/PID (ppm)	Sudan IV Hydrophobic Dye[c]	4,4'-DDD (8081A) (µg/kg)	4,4'-DDE (8081A) (µg/kg)	4,4'-DDT (8081A) (µg/kg)	4,4'-DDT (TLC) (mg/kg)
SO1859	WB-23	2/18/2003	28-30	6.6	8.6	-17.8	-19.8	2.7	-	--	--	--	50 *U*
SO1860	WB-23	2/18/2003	30-32	8.6	10.6	-19.8	-21.8	2.7	-	--	--	--	50 *U*
SO1861	WB-23	2/18/2003	32-34	10.6	12.6	-21.8	-23.8	2.7	-	--	--	--	50 *U*
SO1862	WB-23	2/18/2003	34-36	12.6	14.6	-23.8	-25.8	2.7	-	--	--	--	50 *U*
SO1863	WB-23	2/18/2003	36-38	14.6	16.6	-25.8	-27.8	2.4	-	--	--	--	50 *U*
SO1864	WB-23	2/18/2003	38-40	16.6	18.6	-27.8	-29.8	2.4	-	11 *U*	6.7 *U*	6.7 *U*	50 *U*
SO1865	WB-23	2/18/2003	40-42	18.6	20.6	-29.8	-31.8	2.0	-	--	--	--	50 *U*
SO1972	WB-24	3/7/2003	20-22	10.6	12.6	-10.0	-12.0	316	-	130,000	13,000	3,500,000	250
SO1973	WB-24	3/7/2003	22-24	12.6	14.6	-12.0	-14.0	337	-	--	--	--	200
SO1974	WB-24	3/7/2003	24-26	14.6	16.6	-14.0	-16.0	23.9	-	--	--	--	200
SO1975	WB-24	3/7/2003	26-28	16.6	18.6	-16.0	-18.0	9.5	-	89 *J*	6.9 *U*	27,000	50 *U*
SO1976	WB-24	3/7/2003	28-30	18.6	20.6	-18.0	-20.0	4.2	-	--	--	--	50 *U*
SO1977	WB-24	3/7/2003	30-32	20.6	22.6	-20.0	-22.0	10.5	-	--	--	--	50 *U*
SO1978	WB-25	3/7/2003	14.3-16	0.0	1.7	-4.4	-6.1	1.5	-	--	--	--	50
SO1979	WB-25 (dup)	3/7/2003	14.3-16	0.0	1.7	-4.4	-6.1	NA	NA	350 *J*	110 *UJ*	1,200 *J*	--
SO1980	WB-25	3/7/2003	16-18	1.7	3.7	-6.1	-8.1	0.0	-	--	--	--	50
SO1981	WB-25	3/7/2003	18-20	3.7	5.7	-8.1	-10.1	0.2	-	--	--	--	50
SO1982	WB-25	3/7/2003	20-25	5.7	10.7	-10.1	-15.1	0.1	-	--	--	--	100
SO1983	WB-25	3/7/2003	25-27	10.7	12.7	-15.1	-17.1	1.0	-	10	7.4 *U*	24	200
SO1984	WB-25	3/7/2003	27-29	12.7	14.7	-17.1	-19.1	1.0	-	--	--	--	50 *U*
SO1985	WB-25	3/7/2003	29-31	14.7	16.7	-19.1	-21.1	8.5	-	7.1 *U*	7.1 *U*	11	50 *U*
SO1985DUP	WB-25 (dup)	3/7/2003	29-31	14.7	16.7	-19.1	-21.1	NA	NA	6.9 *U*	6.9 *U*	14	--
SO1986	WB-25	3/10/2003	31-32.5	16.7	18.2	-21.1	-22.6	4.4	-	--	--	--	50 *U*
SO1987	WB-25	3/10/2003	32.5-34.5	18.2	20.2	-22.6	-24.6	0.0	-	--	--	--	50 *U*
SO1988	WB-25	3/10/2003	34.5-36	20.2	21.7	-24.6	-26.1	0.0	-	6.2 *U*	6.2 *U*	6.2 *U*	50 *U*

Notes on following page

Table 2. (cont.)

Note: -- not analyzed
- negative hydrophobic dye screening result
NA - not applicable
OVM - organic vapor monitor
PID - photoionization detector
TLC - thin layer chromatography
U - undetected at detection limit shown
J - estimated

[a] All depths for WB-1 to WB-7 measured from dock surface. All depths for WB-8 to WB-25 measured from barge deck.
[b] Vertical reference datum is City of Portland Benchmark
[c] A negative indicates that nonaqueous phase liquids (NAPLs) were not present and a positive indicates the presence of NAPLs.
[d] NAPL detection is attributed to an organic compound other than monochlorobenzene, perhaps petroleum hydrocarbons based on visual evidence and OVM measurements.
[e] Limited sample was available for hydrophobic dye screening from this interval. NAPL was not detected with hydrophobic dye; however, residual NAPL characteristic of DDT manufacturing process residue was visually observed in a sample from a depth of 60.9-61 ft below the dock surface.
[f] OVM measurement taken in office laboratory within 3 hours of borehole completion.

Table 3. Pesticide results for sediment samples from the Stage 2 boreholes.

			WB-8	WB-8	WB-8	WB-8	WB-9	WB-9	WB-9	WB-9
			2/28/2003	2/28/2003	2/28/2003	2/28/2003	3/4/2003	3/4/2003	3/4/2003	3/4/2003
			SO1915	SO1917	SO1919	SO1929	SO1931	SO1934	SO1938	SO1945
	Depth below mudline (ft)		0.0 to 4.3	6.8 to 9.3	14.3 to 16.3	34.3 to 36.3	0.0 to 4.0	8.0 to 10.0	18.0 to 20.0	32.0 to 34.0
	Elevation (ft CPD)		2.9 to -1.4	-3.9 to -6.4	-11.4 to -13.4	-31.4 to -33.4	5.1 to 1.1	-2.9 to -4.9	-12.9 to -14.9	-26.9 to -28.9
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	3,800	470,000	95	26	1,900	240,000	130 *U*	20
4,4'-DDE	8081A	µg/kg	570 *J*	9,000	7.1 *U*	7.0 *U*	730	24,000	130 *U*	6.6 *U*
4,4'-DDT	8081A	µg/kg	34,000	920,000	330	17	12,000	4,500,000	1,900	240
Aldrin	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,800 *U*	130 *U*	6.6 *U*
alpha-Chlordane	8081A	µg/kg	120 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
alpha-Endosulfan	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
beta-Endosulfan	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *UJ*	38,000 *U*	130 *U*	6.6 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Dieldrin	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Endosulfan sulfate	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Endrin	8081A	µg/kg	70 *UJ*	80 *U*	7.1 *U*	7.0 *U*	64 *UJ*	22,000 *U*	130 *U*	6.6 *U*
Endrin aldehyde	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *UJ*	1,400 *U*	130 *U*	6.6 *U*
Endrin ketone	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
gamma-Chlordane	8081A	µg/kg	70 *U*	93 *U*	7.1 *U*	7.0 *U*	170 *J*	1,400 *U*	130 *U*	6.6 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	76 *U*	80 *U*	7.1 *U*	7.0 *U*	110 *U*	1,400 *U*	130 *U*	6.6 *U*
Heptachlor	8081A	µg/kg	70 *U*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Heptachlor epoxide	8081A	µg/kg	70 *U*	83 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Methoxychlor	8081A	µg/kg	70 *UJ*	80 *U*	7.1 *U*	7.0 *U*	64 *U*	1,400 *U*	130 *U*	6.6 *U*
Toxaphene	8081A	µg/kg	15,000 *U*	22,000 *U*	430 *U*	350 *U*	3,900 *U*	110,000 *U*	6,500 *U*	970 *U*

Table 3. (cont.)

			WB-10	WB-10 (dup)	WB-10	WB-10	WB-10	WB-11	WB-11	WB-11
			3/5/2003	3/5/2003	3/5/2003	3/5/2003	3/5/2003	3/6/2003	3/6/2003	3/6/2003
			SO1947	SO1948	SO1952	SO1956	SO1961	SO1963	SO1967	SO1971
	Depth below mudline (ft)		0.0 to 2.0	0.0 to 2.0	7.0 to 9.0	15.0 to 17.0	25.0 to 27.0	0.0 to 2.0	12.5 to 14.5	20.5 to 22.3
	Elevation (ft CPD)		-4.0 to -6.0	-4.0 to -6.0	-11.0 to -13.0	-19.0 to -21.0	-29.0 to -31.0	-2.1 to -4.1	-14.6 to -16.6	-22.6 to -24.4
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	950 *J*	830 *J*	4,600	640,000	28	1,300 *J*	690,000	36
4,4'-DDE	8081A	µg/kg	160	190	660 *J*	4,300 *U*	6.6 *U*	400 *J*	5,700 *U*	6.4 *U*
4,4'-DDT	8081A	µg/kg	4,000	4,000	15,000	19,000	6.6 *U*	3,500 *J*	110,000	6.4 *U*
Aldrin	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
alpha-Chlordane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
alpha-Endosulfan	8081A	µg/kg	94 *U*	95 *U*	180 *U*	270 *U*	6.6 *U*	97 *U*	310 *U*	6.4 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.6 *U*
beta-Endosulfan	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Dieldrin	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Endosulfan sulfate	8081A	µg/kg	94 *U*	100	180 *U*	170 *U*	6.6 *U*	290	190 *U*	6.4 *U*
Endrin	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Endrin aldehyde	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Endrin ketone	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	120	190 *U*	6.4 *U*
gamma-Chlordane	8081A	µg/kg	140 *J*	150 *U*	180 *U*	440 *U*	6.6 *U*	370 *U*	440 *U*	6.4 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Heptachlor	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Heptachlor epoxide	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	110	190 *U*	6.4 *U*
Methoxychlor	8081A	µg/kg	94 *U*	95 *U*	180 *U*	170 *U*	6.6 *U*	97 *U*	190 *U*	6.4 *U*
Toxaphene	8081A	µg/kg	5,500 *U*	5,000 *U*	17,000 *U*	13,000 *U*	430 *U*	9,200 *U*	9,200 *U*	320 *U*

Table 3. (cont.)

			WB-12	WB-13	WB-13	WB-14	WB-14	WB-15	WB-16	WB-17
			2/19/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003	2/19/2003	2/27/2003
			SO1870	SO1896	SO1901	SO1906	SO1912	SO1850	SO1867	SO1904
	Depth below mudline (ft)		0.0 to 1.5	0.0 to 3.5	14.5 to 17.0	0.0 to 2.0	16.0 to 18.0	0.0 to 2.0	0.0 to 1.9	0.0 to 2.0
	Elevation (ft CPD)		-32.9 to -34.4	0.8 to -2.7	-13.7 to -16.2	-6.5 to -8.5	-22.5 to -24.5	-35.5 to -37.5	-27.1 to -29.0	-25.2 to -27.2
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	42 *J*	8,200	460	810	6.9 *U*	80 *J*	39 *J*	320 *J*
4,4'-DDE	8081A	µg/kg	25 *J*	780	75 *U*	150 *J*	6.9 *U*	25 *J*	11 *UJ*	92 *U*
4,4'-DDT	8081A	µg/kg	100 *J*	26,000	610	1,400	6.9 *U*	290 *J*	130 *J*	6,100
Aldrin	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
alpha-Chlordane	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
alpha-Endosulfan	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	76 *U*	120	97 *U*	240 *U*	11 *UJ*	11 *UJ*	92 *U*
beta-Endosulfan	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	77	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Dieldrin	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endosulfan sulfate	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endrin	8081A	µg/kg	11 *UJ*	93 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endrin aldehyde	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Endrin ketone	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
gamma-Chlordane	8081A	µg/kg	11 *UJ*	110 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Heptachlor	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Heptachlor epoxide	8081A	µg/kg	11 *UJ*	89	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Methoxychlor	8081A	µg/kg	11 *UJ*	76 *U*	75 *U*	97 *U*	6.9 *U*	11 *UJ*	11 *UJ*	92 *U*
Toxaphene	8081A	µg/kg	530 *UJ*	7,800 *U*	3,800 *U*	4,900 *U*	350 *U*	530 *UJ*	570 *UJ*	4,600 *U*

Table 3. (cont.)

			WB-18	WB-18	WB-18	WB-19	WB-20	WB-21	WB-22	WB-23
			2/25/2003	2/25/2003	2/25/2003	2/24/2003	2/24/2003	2/20/2003	2/21/2003	2/18/2003
			SO1888	SO1890	SO1894	SO1885	SO1882	SO1873	SO1879	SO1858
	Depth below mudline (ft)		0.0 to 2.0	6.0 to 8.0	16.0 to 20.0	0.0 to 1.4	0.0 to 2.0	0.0 to 1.8	3.5 to 5.3	4.6 to 6.6
	Elevation (ft CPD)		1.5 to -0.5	-4.5 to -6.5	-14.5 to -18.5	-24.2 to -25.6	-36.9 to -38.9	-34.9 to -36.7	-42.4 to -44.2	-15.8 to -17.8
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	1,200	3,600	220	310	24 *J*	29 *J*	14 *U*	230
4,4'-DDE	8081A	µg/kg	350	650 *J*	6.5 *U*	100	11 *UJ*	9.1 *UJ*	8.1	21 *U*
4,4'-DDT	8081A	µg/kg	8,000	17,000	150	620	67 *J*	37 *J*	15 *U*	450
Aldrin	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
alpha-Chlordane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
alpha-Endosulfan	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
beta-Endosulfan	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	120	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Dieldrin	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endosulfan sulfate	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endrin	8081A	µg/kg	190 *J*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endrin aldehyde	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Endrin ketone	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
gamma-Chlordane	8081A	µg/kg	410 *J*	190 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Heptachlor	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Heptachlor epoxide	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Methoxychlor	8081A	µg/kg	81 *U*	150 *U*	6.5 *U*	88 *U*	11 *UJ*	9.1 *UJ*	7.1 *U*	7.8 *U*
Toxaphene	8081A	µg/kg	17,000 *U*	22,000 *U*	330 *U*	4,400 *U*	520 *UJ*	460 *UJ*	360 *U*	400 *U*

Table 3. (cont.)

			WB-23	WB-24	WB-24	WB-25	WB-25	WB-25	WB-25 (dup)	WB-25
			2/18/2003	3/7/2003	3/7/2003	3/7/2003	3/7/2003	3/7/2003	3/7/2003	3/10/2003
			SO1864	SO1972	SO1975	SO1979	SO1983	SO1985	SO1985DUP	SO1988
	Depth below mudline (ft)		16.6 to 18.6	10.6 to 12.6	16.6 to 18.6	0.0 to 1.7	10.7 to 12.7	14.7 to 16.7	14.7 to 16.7	20.2 to 21.7
	Elevation (ft CPD)		-27.8 to -29.8	-10.0 to -12.0	-16.0 to -18.0	-4.4 to -6.1	-15.1 to -17.1	-19.1 to -21.1	-19.1 to -21.1	-24.6 to -26.1
Chemical	Method	Units								
4,4'-DDD	8081A	µg/kg	11 *U*	130,000	89 *J*	350 *J*	10	7.1 *U*	6.9 *U*	6.2 *U*
4,4'-DDE	8081A	µg/kg	6.7 *U*	13,000	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
4,4'-DDT	8081A	µg/kg	6.7 *U*	3,500,000	27,000	1,200 *J*	24	11	14	6.2 *U*
Aldrin	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
alpha-Chlordane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
alpha-Endosulfan	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
alpha-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	230 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
beta-Endosulfan	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
beta-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
delta-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Dieldrin	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endosulfan sulfate	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	130 *J*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endrin	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endrin aldehyde	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Endrin ketone	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
gamma-Chlordane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	160 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
gamma-Hexachlorocyclohexane	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Heptachlor	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Heptachlor epoxide	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Methoxychlor	8081A	µg/kg	6.7 *U*	1,800 *U*	6.9 *U*	110 *UJ*	7.4 *U*	7.1 *U*	6.9 *U*	6.2 *U*
Toxaphene	8081A	µg/kg	340 *U*	90,000 *U*	350 *U*	5,500 *UJ*	710 *U*	360 *U*	350 *U*	310 *U*

Note: *J* - estimated
U - undetected at detection limit shown
CPD - City of Portland Datum

Table 4. Cation, anion, and field parameter results for groundwater samples from the Stage 1 and 2 boreholes and Willamette River water.

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202
	Depth below mudline (ft)		4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0
	Elevation (ft CPD)		3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	150	86	140	120	1300	40	26
Magnesium	6010B	mg/L	130	59	130	74	530	19	12
Potassium	6010B	mg/L	23	15	11	13	20	4 *U*	4 *U*
Sodium	6010B	mg/L	140	1,200	240	190	41	110	68
Anions									
Bicarbonate	2320B	mg/L	69	550	420	380	750	140	120
Sulfate	300.0	mg/L	25	100	5.8	4.1	3.0	4.4	4.2
Total alkalinity	310.1	mg/L	--	--	--	--	--	--	--
Total chloride	300.0	mg/L	130	1,500	570	500	11	920 *J*	340 *J*
Field Parameters									
Conductivity	SOP	μS/cm	619	4,910	2,960	2,340	4,830	7,770	7,770
Dissolved oxygen	SOP	mg/L	10.4	10.0	10.7	9.86	9.34	2.52	2.52
Oxidation Reduction Potential	SOP	mV	--	--	--	--	247	2.00	2.00
pH	SOP	pH	5.27	6.76	6.90	6.23	7.67	7.15	7.15
Temperature	SOP	degC	15.3	16.4	22.9	20.8	20.3	14.1	14.1
Turbidity	SOP	NTU	--	--	--	--	--	--	--

Table 4. (cont.)

			WB-4	WB-4	WB-4	WB-5	WB-5	WB-7	WB-8
			6/10/2002	6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003
			GW06100201	GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301
	Depth below mudline (ft)		8.3 to 4.3	17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3
	Elevation (ft CPD)		2.3 to -1.7	-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	--	--	--	--	--	--	--
Magnesium	6010B	mg/L	--	--	--	--	--	--	--
Potassium	6010B	mg/L	--	--	--	--	--	--	--
Sodium	6010B	mg/L	--	--	--	--	--	--	--
Anions									
Bicarbonate	2320B	mg/L	--	--	--	--	--	--	--
Sulfate	300.0	mg/L	--	--	--	--	--	--	--
Total alkalinity	310.1	mg/L	--	--	--	--	--	--	--
Total chloride	300.0	mg/L	--	--	--	--	--	--	--
Field Parameters									
Conductivity	SOP	μS/cm	12,500	18,600	55,400	3,020	50,200	3,540	5,260
Dissolved oxygen	SOP	mg/L	11.4	12.4	13.1	8.78	8.36	8.87	2.07
Oxidation Reduction Potential	SOP	mV	36.0	42.0	–166	35.0	–91.0	141	200
pH	SOP	pH	7.03	6.65	6.28	6.43	6.26	5.25	6.34
Temperature	SOP	degC	16.5	20.0	21.8	23.4	26.2	20.6	8.59
Turbidity	SOP	NTU	--	--	--	--	--	--	999

Table 4. (cont.)

			WB-8	WB-9	WB-9	WB-10	WB-10	WB-10 (dup)	WB-11
			2/28/2003	3/4/2003	3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003
			GW02280302	GW03040301	GW03040302	GW03050302	GW03060301	GW03060302	GW03070302
	Depth below mudline (ft)		33.8 to 37.8	15.0 to 19.0	31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5
	Elevation (ft CPD)		-30.9 to -34.9	-9.9 to -13.9	-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	--	200	2,000	810	550	540	--
Magnesium	6010B	mg/L	--	66	270	600	190	180	--
Potassium	6010B	mg/L	--	19	85	28	62	60	--
Sodium	6010B	mg/L	--	4,200	8,800	2,100	8,200	8,300	--
Anions									
Bicarbonate	2320B	mg/L	--	710	2.0 *U*	540	650	640	--
Sulfate	300.0	mg/L	--	160	1,600	3,200	260	260	--
Total alkalinity	310.1	mg/L	--	710	2.0 *U*	540	650	640	--
Total chloride	300.0	mg/L	--	5,300	13,000	3,800	8,400	12,000	--
Field Parameters									
Conductivity	SOP	μS/cm	91,400	23,700	55,500	19,000	50,700	--	1,670
Dissolved oxygen	SOP	mg/L	1.08	1.60	1.91	3.39	1.72	--	3.74
Oxidation Reduction Potential	SOP	mV	2.88	78.0	124	29.0	271	--	192
pH	SOP	pH	5.56	6.70	3.85 [a]	5.53	5.59	--	6.61
Temperature	SOP	degC	8.07	8.67	9.14	10.9	7.09	--	6.58
Turbidity	SOP	NTU	184	162	262	314	40.9	--	311

Table 4. (cont.)

			WB-11	WB-12	WB-13	WB-13	WB-14	WB-14	WB-15
			3/7/2003	2/20/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003
			GW03070301	GW02200301	GW02260303	GW02260304	GW02270301	GW02270302	GW02170301
	Depth below mudline (ft)		19.5 to 22.0	5.0 to 9.0	5.0 to 9.0	16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3
	Elevation (ft CPD)		-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2	-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	--	--	--	--	--	--	60
Magnesium	6010B	mg/L	--	--	--	--	--	--	23
Potassium	6010B	mg/L	--	--	--	--	--	--	3.8
Sodium	6010B	mg/L	--	--	--	--	--	--	440
Anions									
Bicarbonate	2320B	mg/L	--	--	--	--	--	--	83
Sulfate	300.0	mg/L	--	--	--	--	--	--	22
Total alkalinity	310.1	mg/L	--	--	--	--	--	--	83
Total chloride	300.0	mg/L	--	--	--	--	--	--	530 *J*
Field Parameters									
Conductivity	SOP	μS/cm	5,580	99,900	3,660	11,400	213	10,900	1,520
Dissolved oxygen	SOP	mg/L	3.08	1.39	6.23	1.68	6.07	1.06	9.08
Oxidation Reduction Potential	SOP	mV	212	9.00	96.0	152	190	142	-2.00
pH	SOP	pH	5.60	5.54	6.97	6.48	5.86	6.03	6.96
Temperature	SOP	degC	5.34	9.50	11.2	11.2	12.7	14.5	8.50
Turbidity	SOP	NTU	26.1	140	590	57.6	82.7	62.3	379

Table 4. (cont.)

			WB-16	WB-18	WB-18	WB-19	WB-20	WB-21	WB-22
			2/19/2003	2/25/2003	2/26/2003	2/25/2003	2/24/2003	2/20/2003	2/21/2003
			GW02190301	GW02250302	GW02260301	GW02250301	GW02240301	GW02200302	GW02210301
	Depth below mudline (ft)		3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9	2.5 to 4.5	4.3 to 8.3	3.5 to 7.5
	Elevation (ft CPD)		-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1	-39.4 to -41.4	-39.2 to -43.2	-42.4 to -46.4
Chemical	Method	Units							
Cations									
Calcium	6010B	mg/L	--	--	--	--	18	--	33
Magnesium	6010B	mg/L	--	--	--	--	8.3	--	14
Potassium	6010B	mg/L	--	--	--	--	2.1	--	2.6 *J*
Sodium	6010B	mg/L	--	--	--	--	21	--	23
Anions									
Bicarbonate	2320B	mg/L	--	--	--	--	38	--	100
Sulfate	300.0	mg/L	--	--	--	--	11	--	16
Total alkalinity	310.1	mg/L	--	--	--	--	38	--	100
Total chloride	300.0	mg/L	--	--	--	--	56	--	56
Field Parameters									
Conductivity	SOP	μS/cm	237	470	16,100	191	278	1,640	530
Dissolved oxygen	SOP	mg/L	6.55	8.50	1.04	4.07	6.86	3.76	2.42
Oxidation Reduction Potential	SOP	mV	9.00	4.00	171	9.00	7.00	-4.00	-2.00
pH	SOP	pH	5.85	6.58	6.66	5.49	5.83	6.09	6.15
Temperature	SOP	degC	9.70	8.75	5.15	6.83	8.26	9.30	11.5
Turbidity	SOP	NTU	319	192	580	86.5	24.6	244	442

Table 4. (cont.)

			WB-23	WB-23	WB-25	WB-25	WL-RIVER
			2/18/2003	2/18/2003	3/10/2003	3/10/2003	2/24/2003
			GW02180301	GW02180302	GW03100301	GW03100302	GW02240302
	Depth below mudline (ft)		3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7	--
	Elevation (ft CPD)		-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1	--
Chemical	Method	Units					
Cations							
Calcium	6010B	mg/L	--	--	--	--	7.4
Magnesium	6010B	mg/L	--	--	--	--	2.5
Potassium	6010B	mg/L	--	--	--	--	2 *U*
Sodium	6010B	mg/L	--	--	--	--	5
Anions							
Bicarbonate	2320B	mg/L	--	--	--	--	24
Sulfate	300.0	mg/L	--	--	--	--	3.6
Total alkalinity	310.1	mg/L	--	--	--	--	24
Total chloride	300.0	mg/L	--	--	--	--	3.2
Field Parameters							
Conductivity	SOP	μS/cm	2,710	52,900	4,370	7,480	106
Dissolved oxygen	SOP	mg/L	5.57	0.760	2.88	1.75	12.5
Oxidation Reduction Potential	SOP	mV	5.00	4.00	158	44.0	3.00
pH	SOP	pH	6.32	6.19	5.76	5.86	7.20
Temperature	SOP	degC	10.2	11.8	13.6	16.3	7.56
Turbidity	SOP	NTU	272	999	221	462	10.0

Note: -- not analyzed or measured
J - estimated
U - undetected at detection limit shown
SOP - standard operating procedure as outlined in *Elf Atochem Acid Plant Area Remedial Investigation and Feasibility Study Work Plan* (Exponent 1998).
CPD - City of Portland Datum
[a] - pH value may have been collected prior to stabilization.

Table 5. Volatile organic compound results for groundwater samples from the Stage 1 and 2 boreholes

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202
	Depth below mudline (ft)		4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0
	Elevation (ft CPD)		3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,1-Trichloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2-Trichloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethane	8260B	µg/L	13 *U*	1.3	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloropropene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,2,3-Trichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	50 *UR*	2.0 *UR*	10 *UR*	4.0 *UR*	2.0 *UR*	2.0 *UR*	2.0 *UR*
1,2-Dibromoethane	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dichlorobenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
1,2-Dichloroethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2-Dichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
1,3-Dichlorobenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
1,3-Dichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,4-Dichlorobenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
2,2-Dichloropropane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
2-Butanone	8260B	µg/L	500 *UR*	20 *UR*	100 *UR*	40 *UR*	20 *UR*	20 *UR*	20 *UR*
2-Chlorotoluene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
2-Hexanone	8260B	µg/L	500 *U*	20 *U*	100 *U*	40 *U*	20 *U*	20 *U*	20 *U*
4-Chlorotoluene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
4-Isopropyltoluene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
4-Methyl-2-pentanone	8260B	µg/L	500 *UR*	20 *UR*	100 *UR*	40 *UR*	20 *UR*	20 *UR*	20 *UR*
Acetone	8260B	µg/L	500 *UR*	20 *UR*	100 *UR*	40 *UR*	20 *UR*	20 *UR*	20 *UR*
Benzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
Bromobenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
Bromochloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromodichloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromoform	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromomethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202
	Depth below mudline (ft)		4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0
	Elevation (ft CPD)		3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Carbon tetrachloride	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chlorobenzene	8260B	µg/L	980	13	240	47	1.8 *J*	70	100
Chloroethane	8260B	µg/L	13 *UR*	0.50 *UR*	2.5 *UR*	1.0 *UR*	0.50 *UR*	0.50 *UR*	0.50 *UR*
Chloroform	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,2-Dichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromochloromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromomethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dichlorodifluoromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Ethylbenzene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
Hexachlorobutadiene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Isopropylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
meta & *para* Xylenes	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
Methylene chloride	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Naphthalene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.9 *J*	2.0 *U*	2.0 *U*
n-Butylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
n-Propylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
ortho-Xylene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.5 *UJ*	0.5 *U*	0.5 *U*
sec-Butylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
Styrene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
tert-Butylbenzene	8260B	µg/L	50 *U*	2.0 *U*	10 *U*	4.0 *U*	2.0 *UJ*	2.0 *U*	2.0 *U*
Tetrachloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Toluene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*
trans-1,2-Dichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Trichloroethene	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Trichlorofluoromethane	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Vinyl chloride	8260B	µg/L	13 *U*	0.50 *U*	2.5 *U*	1.0 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-4	WB-4	WB-4	WB-5	WB-5	WB-7	WB-8
			6/10/2002	6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003
			GW06100201	GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301
	Depth below mudline (ft)		8.3 to 4.3	17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3
	Elevation (ft CPD)		2.3 to -1.7	-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1-Dichloroethane	8260B	µg/L	0.77	0.59	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *UJ*	2.0 *UJ*	4.0 *UJ*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	10 *U*	1.0 *U*	50 *U*	5.0 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
2-Butanone	8260B	µg/L	20 *UR*	20 *UR*	40 *UR*	200 *U*	20 *U*	1,000 *U*	200 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
2-Hexanone	8260B	µg/L	20 *U*	20 *U*	40 *U*	200 *U*	20 *U*	1,000 *U*	200 *UR*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	20 *UR*	40 *UR*	200 *U*	20 *U*	1,000 *U*	200 *UR*
Acetone	8260B	µg/L	20 *UR*	20 *UR*	40 *UR*	200 *UR*	20 *UR*	1,000 *UR*	200 *UR*
Benzene	8260B	µg/L	0.68	0.50 *U*	1.0 *U*	5.0 *U*	0.59	25 *U*	5.0 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Bromodichloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	4.2	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Bromoform	8260B	µg/L	0.50 *U*	0.56	7.5	10.0 *U*	1.0 *U*	50 *U*	5.0 *U*
Bromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *UJ*	0.50 *UJ*	25 *UJ*	5.0 *U*

Table 5. (cont.)

			WB-4	WB-4	WB-4	WB-5	WB-5	WB-7	WB-8
			6/10/2002	6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003
			GW06100201	GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301
	Depth below mudline (ft)		8.3 to 4.3	17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3
	Elevation (ft CPD)		2.3 to -1.7	-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	10 *U*	1.0 *U*	50 *U*	5.0 *U*
Chlorobenzene	8260B	µg/L	47	1.4	3.1	2,200	38 *J*	18,000	2,800
Chloroethane	8260B	µg/L	0.50 *UR*	0.50 *UR*	1.0 *UR*	5.0 *U*	0.50 *U*	140	5.0 *U*
Chloroform	8260B	µg/L	0.50 *U*	12	270	5.0 *U*	6.4	54	5.0 *U*
Chloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.84	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Dibromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	3.5	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Dibromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.9	10 *U*	1.0 *U*	50 *U*	5.0 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Methylene chloride	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Naphthalene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
ortho-Xylene	8260B	µg/L	0.5 *U*	0.5 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Styrene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	4.0 *U*	20 *U*	2.0 *U*	100 *U*	20 *U*
Tetrachloroethene	8260B	µg/L	1.5	0.89	1.0	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Toluene	8260B	µg/L	0.54	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	0.50 *U*	1.0 *U*	5.0 *U*	0.50 *U*	25 *U*	5.0 *U*

Table 5. (cont.)

			WB-8	WB-9	WB-9	WB-10	WB-10	WB-10 (dup)	WB-11
			2/28/2003	3/4/2003	3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003
			GW02280302	GW03040301	GW03040302	GW03050302	GW03060301	GW03060302	GW03070302
	Depth below mudline (ft)		33.8 to 37.8	15.0 to 19.0	31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5
	Elevation (ft CPD)		-30.9 to -34.9	-9.9 to -13.9	-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1-Dichloroethane	8260B	µg/L	0.54	13 *U*	5.0 *U*	5.0 *J*	1.4	2.5 *U*	50 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	20 *U*	5.0 *U*	10 *U*	200 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	110	5.0 *U*	15 *J*	1.3 *U*	2.5 *U*	50 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	41 *J*	1.3 *U*	2.5 *U*	50 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	1.0 *J*	1.3 *U*	2.5 *U*	50 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	150	5.0 *U*	49 *J*	1.3 *U*	2.5 *U*	50 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
2-Butanone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	260 *J*	50 *UR*	100 *UR*	2,000 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
2-Hexanone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	200 *UR*	50 *UR*	100 *UR*	2,000 *U*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	20 *UR*	50 *UR*	100 *UR*	2,000 *UR*
Acetone	8260B	µg/L	20 *UR*	500 *UR*	200 *UR*	1,300 *J*	50 *UR*	100 *UR*	2,000 *UR*
Benzene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	52 *J*	1.3 *U*	2.5 *U*	50 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Bromodichloromethane	8260B	µg/L	13	13 *U*	5.0 *U*	0.50 *U*	2.6	2.7	50 *U*
Bromoform	8260B	µg/L	13	13 *U*	5.0 *U*	5.0 *U*	1.5	2.5 *U*	50 *U*
Bromomethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *UJ*

Table 5. (cont.)

			WB-8	WB-9	WB-9	WB-10	WB-10	WB-10 (dup)	WB-11
			2/28/2003	3/4/2003	3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003
			GW02280302	GW03040301	GW03040302	GW03050302	GW03060301	GW03060302	GW03070302
	Depth below mudline (ft)		33.8 to 37.8	15.0 to 19.0	31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5
	Elevation (ft CPD)		-30.9 to -34.9	-9.9 to -13.9	-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	13 *J*	1.3 *U*	2.5 *U*	50 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Chlorobenzene	8260B	µg/L	28	12,000	2,800	64,000	1,200	1,100	32,000
Chloroethane	8260B	µg/L	0.50 *U*	57	5.0 *U*	96 *J*	1.6	2.5 *U*	50 *U*
Chloroform	8260B	µg/L	490	150	25	38 *J*	120	130	50 *U*
Chloromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	8.6 *J*	1.3	2.5 *U*	50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Dibromochloromethane	8260B	µg/L	5.7	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Dibromomethane	8260B	µg/L	1.5	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	20 *U*	5.0 *U*	10 *U*	200 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Methylene chloride	8260B	µg/L	2.7	50 *U*	20 *U*	75 *J*	5.0 *U*	10 *U*	200 *U*
Naphthalene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	59 *J*	5.0 *U*	10 *U*	200 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
ortho-Xylene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Styrene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	50 *U*	20 *U*	2.0 *U*	5.0 *U*	10 *U*	200 *U*
Tetrachloroethene	8260B	µg/L	1.4	13 *U*	5.5	23 *J*	6.5	6.7	50 *U*
Toluene	8260B	µg/L	7.0	19 *U*	5.0 *U*	380 *J*	2.0 *U*	2.5 *U*	50 *U*
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	5.0 *U*	1.3 *U*	2.5 *U*	50 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	55	5.0 *U*	16 *J*	5.1	5.5	50 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	13 *U*	5.0 *U*	0.50 *U*	1.3 *U*	2.5 *U*	50 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	23	5.0 *U*	5.8 *J*	1.3 *U*	2.5 *U*	50 *U*

Table 5. (cont.)

			WB-11	WB-12	WB-13	WB-13	WB-14	WB-14	WB-15
			3/7/2003	2/20/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003
			GW03070301	GW02200301	GW02260303	GW02260304	GW02270301	GW02270302	GW02170301
	Depth below mudline (ft)		19.5 to 22.0	5.0 to 9.0	5.0 to 9.0	16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3
	Elevation (ft CPD)		-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2	-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8
Chemical	Method	Units							
1,1,1,2-Tetrachloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1,1-Trichloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1,2-Trichloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1-Dichloroethane	8260B	µg/L	50 *U*	1.5	0.98	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1-Dichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,1-Dichloropropene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2,3-Trichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2-Dibromoethane	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,2-Dichlorobenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2-Dichloroethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,2-Dichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
1,3-Dichlorobenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,3-Dichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
1,4-Dichlorobenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
2,2-Dichloropropane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
2-Butanone	8260B	µg/L	2,000 *UR*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *UR*
2-Chlorotoluene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
2-Hexanone	8260B	µg/L	2,000 *U*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *U*
4-Chlorotoluene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
4-Isopropyltoluene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
4-Methyl-2-pentanone	8260B	µg/L	2,000 *UR*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *UR*
Acetone	8260B	µg/L	2,000 *UR*	20 *UR*	20 *UR*	1,000 *UR*	20 *UR*	500 *UR*	20 *UR*
Benzene	8260B	µg/L	50 *U*	0.92	1.6	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromobenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Bromochloromethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromodichloromethane	8260B	µg/L	50 *U*	6.7	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromoform	8260B	µg/L	50 *U*	9.9	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Bromomethane	8260B	µg/L	50 *UJ*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*

Table 5. (cont.)

			WB-11	WB-12	WB-13	WB-13	WB-14	WB-14	WB-15
			3/7/2003	2/20/2003	2/26/2003	2/26/2003	2/27/2003	2/27/2003	2/17/2003
			GW03070301	GW02200301	GW02260303	GW02260304	GW02270301	GW02270302	GW02170301
	Depth below mudline (ft)		19.5 to 22.0	5.0 to 9.0	5.0 to 9.0	16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3
	Elevation (ft CPD)		-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2	-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8
Chemical	Method	Units							
Carbon disulfide	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Carbon tetrachloride	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Chlorobenzene	8260B	µg/L	23,000	11	23	12,000	4.2	9,300	210
Chloroethane	8260B	µg/L	50 *U*	0.95	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *UR*
Chloroform	8260B	µg/L	85 *U*	430	0.50 *U*	25 *U*	0.50 *U*	13 *U*	2.2
Chloromethane	8260B	µg/L	50 *U*	1.5	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *UJ*
cis-1,2-Dichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Dibromochloromethane	8260B	µg/L	50 *U*	3.3	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Dibromomethane	8260B	µg/L	50 *U*	1.4	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Dichlorodifluoromethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *UJ*
Ethylbenzene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Hexachlorobutadiene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Isopropylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
meta & para Xylenes	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Methylene chloride	8260B	µg/L	200 *U*	2.6	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Naphthalene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
n-Butylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
n-Propylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
ortho-Xylene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
sec-Butylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Styrene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
tert-Butylbenzene	8260B	µg/L	200 *U*	2.0 *U*	2.0 *U*	100 *U*	2.0 *U*	50 *U*	2.0 *U*
Tetrachloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	400	0.86	250	0.50 *U*
Toluene	8260B	µg/L	50 *U*	1.0	1.1	25 *U*	1.7	13 *U*	1.7
trans-1,2-Dichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Trichloroethene	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25	0.50 *U*	190	0.50 *U*
Trichlorofluoromethane	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*
Vinyl chloride	8260B	µg/L	50 *U*	0.50 *U*	0.50 *U*	25 *U*	0.50 *U*	13 *U*	0.50 *U*

Table 5. (cont.)

			WB-16	WB-18	WB-18	WB-19	WB-20	WB-21
			2/19/2003	2/25/2003	2/26/2003	2/25/2003	2/24/2003	2/20/2003
			GW02190301	GW02250302	GW02260301	GW02250301	GW02240301	GW02200302
		Depth below mudline (ft)	3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9	2.5 to 4.5	4.3 to 8.3
		Elevation (ft CPD)	-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1	-39.4 to -41.4	-39.2 to -43.2
Chemical	Method	Units						
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	2.1	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.85	0.50 *U*	0.50 *U*	0.50 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
2-Butanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
2-Hexanone	8260B	µg/L	20 *U*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
Acetone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*	20 *UR*
Benzene	8260B	µg/L	0.50 *U*	0.72	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromodichloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromoform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Bromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-16	WB-18	WB-18	WB-19	WB-20	WB-21
			2/19/2003	2/25/2003	2/26/2003	2/25/2003	2/24/2003	2/20/2003
			GW02190301	GW02250302	GW02260301	GW02250301	GW02240301	GW02200302
		Depth below mudline (ft)	3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9	2.5 to 4.5	4.3 to 8.3
		Elevation (ft CPD)	-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1	-39.4 to -41.4	-39.2 to -43.2
Chemical	Method	Units						
Carbon disulfide	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chlorobenzene	8260B	µg/L	20	2.3	0.50 *U*	0.50 *U*	79	220
Chloroethane	8260B	µg/L	0.50 *UR*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chloroform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Chloromethane	8260B	µg/L	0.50 *UJ*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.4	0.50 *U*	0.50 *U*	0.50 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dibromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *UJ*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Methylene chloride	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Naphthalene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
ortho-Xylene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Styrene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*	2.0 *U*
Tetrachloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Toluene	8260B	µg/L	6.4	31 *U*	7.1 *U*	6.4 *U*	1.5 *U*	2.1
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	1.2	0.50 *U*	0.50 *U*	0.50 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.59	0.50 *U*	0.50 *U*	0.50 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*

Table 5. (cont.)

			WB-21 (dup)	WB-22	WB-23	WB-23	WB-25	WB-25
			2/20/2003	2/21/2003	2/18/2003	2/18/2003	3/10/2003	3/10/2003
			GW02200303	GW02210301	GW02180301	GW02180302	GW03100301	GW03100302
	Depth below mudline (ft)		4.3 to 8.3	3.5 to 7.5	3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7
	Elevation (ft CPD)		-39.2 to -43.2	-42.4 to -46.4	-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1
Chemical	Method	Units						
1,1,1,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1,1-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1,2,2-Tetrachloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1,2-Trichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	2.2	25 *U*	25 *U*
1,1-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,1-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2,3-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2,3-Trichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2,4-Trichlorobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2,4-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2-Dibromo-3-chloropropane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2-Dibromoethane	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,2-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2-Dichloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,3,5-Trimethylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
1,3-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,3-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
1,4-Dichlorobenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
2,2-Dichloropropane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
2-Butanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	40 *UR*	1,000 *UR*	1,000 *UR*
2-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
2-Hexanone	8260B	µg/L	20 *UR*	20 *UR*	20 *U*	40 *U*	1,000 *U*	1,000 *U*
4-Chlorotoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
4-Isopropyltoluene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
4-Methyl-2-pentanone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	40 *UR*	1,000 *UR*	1,000 *UR*
Acetone	8260B	µg/L	20 *UR*	20 *UR*	20 *UR*	40 *UR*	1,000 *UR*	1,000 *UR*
Benzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Bromobenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Bromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Bromodichloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	5.5	25 *U*	25 *U*
Bromoform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	5.1	25 *U*	25 *U*
Bromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *UJ*	25 *UJ*

Table 5. (cont.)

			WB-21 (dup)	WB-22	WB-23	WB-23	WB-25	WB-25
			2/20/2003	2/21/2003	2/18/2003	2/18/2003	3/10/2003	3/10/2003
			GW02200303	GW02210301	GW02180301	GW02180302	GW03100301	GW03100302
	Depth below mudline (ft)		4.3 to 8.3	3.5 to 7.5	3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7
	Elevation (ft CPD)		-39.2 to -43.2	-42.4 to -46.4	-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1
Chemical	Method	Units						
Carbon disulfide	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Carbon tetrachloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Chlorobenzene	8260B	µg/L	190	100 *J*	0.50 *U*	2.9	16,000	16,000
Chloroethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *UR*	1.0 *UR*	25 *U*	25 *U*
Chloroform	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	610	25 *U*	25 *U*
Chloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *UJ*	1.0 *UJ*	25 *U*	25 *U*
cis-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	57	25 *U*
cis-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Dibromochloromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	3.2	25 *U*	25 *U*
Dibromomethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.4	25 *U*	25 *U*
Dichlorodifluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *UJ*	1.0 *U*	25 *U*	25 *U*
Ethylbenzene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Hexachlorobutadiene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Isopropylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
meta & para Xylenes	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Methylene chloride	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Naphthalene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
n-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
n-Propylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
ortho-Xylene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
sec-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Styrene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
tert-Butylbenzene	8260B	µg/L	2.0 *U*	2.0 *U*	2.0 *U*	4.0 *U*	100 *U*	100 *U*
Tetrachloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Toluene	8260B	µg/L	2.2	4.7	3.2	2.5	25 *U*	25 *U*
trans-1,2-Dichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
trans-1,3-Dichloropropene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Trichloroethene	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	45	25 *U*
Trichlorofluoromethane	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*
Vinyl chloride	8260B	µg/L	0.50 *U*	0.50 *U*	0.50 *U*	1.0 *U*	25 *U*	25 *U*

Note: *J* - estimated
R - rejected
U - undetected at detection limit shown
CPD - City of Portland Datum

Table 6. Pesticide results for groundwater samples from the Stage 1 and 2 boreholes

			WB-1	WB-1	WB-2	WB-2	WB-3	WB-3	WB-3 (dup)	WB-4
			6/4/2002	6/4/2002	6/4/2002	6/4/2002	6/5/2002	6/6/2002	6/6/2002	6/10/2002
			GW06040201	GW06040202	GW06040203	GW06040204	GW06050201	GW06060201	GW06060202	GW06100201
Depth below mudline (ft)			4.0 to 8.0	19.0 to 23.0	3.7 to 7.7	11.7 to 15.7	3.0 to 7.0	11.0 to 15.0	11.0 to 15.0	4.3 to 8.3
Elevation (ft CPD)			3.6 to -0.4	-11.4 to -15.4	-0.3 to -4.3	-8.3 to -12.3	-5.3 to -9.3	-13.3 to -17.3	-13.3 to -17.3	2.3 to -1.7
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	15 *J*	1.6 *J*	6.0 *J*	0.78 *J*	1.0 *J*	0.86 *J*	1.6 *J*	5.3 *J*
4,4'-DDE	8081A	µg/L	0.41 *J*	0.018 *J*	0.25 *J*	0.016 *J*	0.10	0.031 *J*	0.056 *J*	0.11 *J*
4,4'-DDT	8081A	µg/L	34 *J*	0.44	29 *J*	0.14	0.17	0.24	0.27	6.5 *J*
Aldrin	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.017 *UR*
alpha-Chlordane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
alpha-Endosulfan	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.054 *UR*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.37 *UR*
beta-Endosulfan	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.088 *UR*
beta-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
delta-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.015 *UR*
Dieldrin	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endosulfan sulfate	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endrin	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endrin aldehyde	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Endrin ketone	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
gamma-Chlordane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.099 *UR*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Heptachlor	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *UR*
Heptachlor epoxide	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Methoxychlor	8081A	µg/L	0.020 *UJ*	0.020 *U*	0.020 *UJ*	0.020 *U*	0.020 *U*	0.020 *U*	0.020 *U*	0.0096 *UR*
Toxaphene	8081A	µg/L	0.50 *UJ*	0.50 *U*	0.50 *UJ*	0.50 *U*	0.50 *U*	0.50 *U*	0.50 *U*	0.48 *UR*

Table 6. (cont.)

			WB-4	WB-4	WB-5	WB-5	WB-7	WB-8	WB-8	WB-9
			6/10/2002	6/10/2002	6/11/2002	6/11/2002	6/12/2002	2/28/2003	2/28/2003	3/4/2003
			GW06100202	GW06100203	GW06110202	GW06110203	GW06120202	GW02280301	GW02280302	GW03040301
	Depth below mudline (ft)		17.3 to 21.3	30.3 to 34.3	5.3 to 9.3	15.3 to 19.3	10.8 to 14.8	10.3 to 14.3	33.8 to 37.8	15.0 to 19.0
	Elevation (ft CPD)		-10.7 to -14.7	-23.7 to -27.7	-17.5 to -21.5	-27.5 to -31.5	-23.9 to -27.9	-7.4 to -11.4	-30.9 to -34.9	-9.9 to -13.9
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	0.38 *J*	0.83 *J*	22 *J*	5 *J*	78 *J*	14	12	72 *J*
4,4'-DDE	8081A	µg/L	0.020 *J*	0.042 *J*	0.55 *J*	0.22 *J*	0.40 *J*	0.097 *U*	0.44 *J*	1.2 *J*
4,4'-DDT	8081A	µg/L	0.69 *J*	2.0 *J*	26 *J*	65 *J*	66 *J*	10	17	68 *U*
Aldrin	8081A	µg/L	0.0098 *UR*	0.027 *UR*	0.0098 *UJ*	0.0098 *UJ*	0.0098 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
alpha-Chlordane	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.011 *UJ*	0.011 *UJ*	0.011 *UJ*	0.097 *U*	0.096 *U*	1.4
alpha-Endosulfan	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0066 *UJ*	0.0066 *UJ*	0.0066 *UJ*	0.097 *U*	0.096 *U*	0.23 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.017 *UR*	0.055 *UR*	0.0051 *UJ*	0.0051 *UJ*	0.0051 *UJ*	0.097 *U*	0.50 *U*	0.53 *U*
beta-Endosulfan	8081A	µg/L	0.012 *UR*	0.020 *UR*	0.0072 *UJ*	0.0072 *UJ*	0.0072 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.017 *UJ*	0.017 *UJ*	0.017 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0020 *UJ*	0.0020 *UJ*	0.0020 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Dieldrin	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0048 *UJ*	0.0048 *UJ*	0.0048 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Endosulfan sulfate	8081A	µg/L	0.0098 *UR*	0.013 *UR*	0.0051 *UJ*	0.0051 *UJ*	0.0051 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Endrin	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0089 *UJ*	0.0089 *UJ*	0.0089 *UJ*	0.34 *U*	0.096 *U*	0.098 *U*
Endrin aldehyde	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0047 *UJ*	0.0047 *UJ*	0.0047 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Endrin ketone	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0020 *UJ*	0.0020 *UJ*	0.0020 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
gamma-Chlordane	8081A	µg/L	0.0098 *UR*	0.013 *UR*	0.0053 *UJ*	0.0053 *UJ*	0.0053 *UJ*	0.097 *U*	0.096 *U*	0.14 *U*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.12 *UR*	0.037 *UR*	0.0034 *UJ*	0.0034 *UJ*	0.0034 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Heptachlor	8081A	µg/L	0.014 *UR*	0.026 *UR*	0.0020 *UJ*	0.0020 *UJ*	0.0020 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Heptachlor epoxide	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0031 *UJ*	0.0031 *UJ*	0.0031 *UJ*	0.097 *U*	0.096 *U*	0.098 *U*
Methoxychlor	8081A	µg/L	0.0098 *UR*	0.012 *UR*	0.0043 *UR*	0.0043 *UR*	0.0043 *UR*	0.097 *U*	0.096 *U*	0.098 *U*
Toxaphene	8081A	µg/L	0.49 *UR*	0.58 *UR*	0.50 *UJ*	0.50 *UJ*	0.50 *UJ*	4.9 *U*	9.2 *U*	4.9 *U*

Table 6. (cont.)

			WB-9	WB-10	WB-10	WB-10 (dup)	WB-11	WB-11	WB-12	WB-13
			3/4/2003	3/5/2003	3/6/2003	3/6/2003	3/7/2003	3/7/2003	2/20/2003	2/26/2003
			GW03040302	GW03050302	GW03060301	GW03060302	GW03070302	GW03070301	GW02200301	GW02260303
	Depth below mudline (ft)		31.0 to 35.0	14.0 to 18.0	24.0 to 28.0	24.0 to 28.0	11.5 to 15.5	19.5 to 22.0	5.0 to 9.0	5.0 to 9.0
	Elevation (ft CPD)		-25.9 to -29.9	-18.0 to -22.0	-28.0 to -32.0	-28.0 to -32.0	-13.6 to -17.6	-21.6 to -24.1	-37.9 to -41.9	-4.2 to -8.2
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	2.2	710	0.20 *U*	0.25 *U*	91	3.5	0.13	0.60
4,4'-DDE	8081A	µg/L	0.16	13	0.0098 *U*	0.0098 *U*	1.5 *J*	0.077 *J*	0.098 *U*	0.0097 *U*
4,4'-DDT	8081A	µg/L	17	1,900	0.21 *U*	0.33 *U*	130	1.1 *J*	0.26	0.49 *J*
Aldrin	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.11 *J*	0.098 *U*	0.0097 *U*
alpha-Chlordane	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
alpha-Endosulfan	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.85 *U*	1.2 *U*	0.028 *U*	0.018 *U*	0.011 *U*	5.9 *U*	0.098 *U*	0.052 *U*
beta-Endosulfan	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.015 *U*	0.19 *J*	0.0097 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.18 *J*	0.98 *U*	0.012 *U*	0.0098 *U*	0.011 *U*	0.028 *U*	0.098 *U*	0.0097 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.019	0.098 *U*	0.0097 *U*
Dieldrin	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Endosulfan sulfate	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.073 *U*	0.018 *U*	0.098 *U*	0.0097 *U*
Endrin	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.014 *U*	0.098 *U*	0.0097 *U*
Endrin aldehyde	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Endrin ketone	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
gamma-Chlordane	8081A	µg/L	0.098 *U*	1.4 *U*	0.0098 *U*	0.0098 *U*	0.097 *U*	0.014 *U*	0.098 *U*	0.0097 *U*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.038 *J*	0.024	0.098 *U*	0.0097 *U*
Heptachlor	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Heptachlor epoxide	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.019 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Methoxychlor	8081A	µg/L	0.098 *U*	0.98 *U*	0.0098 *U*	0.0098 *U*	0.012 *U*	0.0098 *U*	0.098 *U*	0.0097 *U*
Toxaphene	8081A	µg/L	4.9 *U*	250 *U*	0.49 *U*	0.49 *U*	5.6 *U*	2.2 *U*	4.9 *U*	0.49 *U*

Table 6. (cont.)

			WB-13	WB-14	WB-14	WB-15	WB-16	WB-18	WB-18	WB-19
			2/26/2003	2/27/2003	2/27/2003	2/17/2003	2/19/2003	2/25/2003	2/26/2003	2/25/2003
			GW02260304	GW02270301	GW02270302	GW02170301	GW02190301	GW02250302	GW02260301	GW02250301
	Depth below mudline (ft)		16.5 to 20.5	4.0 to 8.0	17.0 to 21.0	1.3 to 5.3	3.4 to 4.4	5.0 to 9.0	17.5 to 21.5	2.9 to 3.9
	Elevation (ft CPD)		-15.7 to -19.7	-10.5 to -14.5	-23.5 to -27.5	-36.8 to -40.8	-30.5 to -31.5	-3.5 to -7.5	-16.0 to -20.0	-27.1 to -28.1
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	0.12	20	0.097 *U*	2.0	0.033	0.16	0.30	0.0097 *U*
4,4'-DDE	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
4,4'-DDT	8081A	µg/L	0.18 *U*	23	0.097 *U*	1.3	0.030 *U*	0.51	0.13	0.0097 *U*
Aldrin	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
alpha-Chlordane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
alpha-Endosulfan	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	14 *U*	0.28 *U*	3.3 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
beta-Endosulfan	8081A	µg/L	0.11 *U*	0.098 *U*	0.097 *U*	0.27 *U*	0.045 *U*	0.16	0.038 *J*	0.025 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.022 *U*	0.0097 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Dieldrin	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endosulfan sulfate	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endrin	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endrin aldehyde	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Endrin ketone	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.019
gamma-Chlordane	8081A	µg/L	0.099 *U*	0.26 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Heptachlor	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Heptachlor epoxide	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Methoxychlor	8081A	µg/L	0.099 *U*	0.098 *U*	0.097 *U*	0.098 *U*	0.0098 *U*	0.097 *U*	0.010 *U*	0.0097 *U*
Toxaphene	8081A	µg/L	5.0 *U*	20 *U*	4.9 *U*	26 *U*	0.49 *U*	4.9 *U*	0.52 *U*	0.49 *U*

Table 6. (cont.)

			WB-20	WB-21	WB-21 (dup)	WB-22	WB-23	WB-23	WB-25	WB-25
			2/24/2003	2/20/2003	2/20/2003	2/21/2003	2/18/2003	2/18/2003	3/10/2003	3/10/2003
			GW02240301	GW02200302	GW02200303	GW02210301	GW02180301	GW02180302	GW03100301	GW03100302
	Depth below mudline (ft)		2.5 to 4.5	4.3 to 8.3	4.3 to 8.3	3.5 to 7.5	3.6 to 7.6	16.6 to 20.6	11.7 to 15.7	19.7 to 21.7
	Elevation (ft CPD)		-39.4 to -41.4	-39.2 to -43.2	-39.2 to -43.2	-42.4 to -46.4	-14.8 to -18.8	-27.8 to -31.8	-16.1 to -20.1	-24.1 to -26.1
Chemical	Method	Units								
4,4'-DDD	8081A	µg/L	0.010 *U*	0.011	0.013	0.0098 *U*	0.13	0.098 *U*	0.42	4.5
4,4'-DDE	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.053 *J*	0.098 *U*	0.017	0.055 *U*
4,4'-DDT	8081A	µg/L	0.010 *U*	0.0098 *U*	0.011 *U*	0.0098 *U*	0.15	0.098 *U*	0.28 *J*	3.6
Aldrin	8081A	µg/L	0.010 *U*	0.010	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.034 *U*	0.036 *U*
alpha-Chlordane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.018 *U*
alpha-Endosulfan	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.018 *U*
alpha-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.012 *U*	0.0099 *U*
beta-Endosulfan	8081A	µg/L	0.022 *U*	0.013 *U*	0.013 *U*	0.016 *U*	0.067 *U*	0.098 *U*	0.074 *U*	0.12 *U*
beta-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.013 *U*
delta-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.019 *J*	0.0099 *U*
Dieldrin	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Endosulfan sulfate	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.017
Endrin	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.013 *U*
Endrin aldehyde	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Endrin ketone	8081A	µg/L	0.031	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
gamma-Chlordane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.025 *UJ*
gamma-Hexachlorocyclohexane	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.028	0.044 *J*
Heptachlor	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Heptachlor epoxide	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.0099 *U*
Methoxychlor	8081A	µg/L	0.010 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.0098 *U*	0.098 *U*	0.0099 *U*	0.030 *U*
Toxaphene	8081A	µg/L	0.51 *U*	0.49 *U*	0.49 *U*	0.49 *U*	1.3 *U*	4.9 *U*	0.75 *U*	3.9 *U*

Note: Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

J - estimated

R - rejected

U - undetected at detection limit shown

CPD - City of Portland Datum

Table 7. Perchlorate results for groundwater samples from the Stage 2 boreholes

Sample number	Survey station	Date	Depth Below Mudline (ft)	Elevation (ft CPD)	Perchlorate (µg/L)
GW02280301	WB-8	2/28/2003	10.3 to 14.3	-7.4 to -11.4	65 *J*
GW02280302	WB-8	2/28/2003	33.8 to 37.8	-30.9 to -34.9	3,800
GW03040301	WB-9	3/4/2003	15.0 to 19.0	-9.9 to -13.9	800 *U*
GW03040302	WB-9	3/4/2003	31.0 to 35.0	-25.9 to -29.9	400 *U*
GW03050302	WB-10	3/5/2003	14.0 to 18.0	-18.0 to -22.0	40,000 *U*
GW03060301	WB-10	3/6/2003	24.0 to 28.0	-28.0 to -32.0	1,000 *U*
GW03060302	WB-10 (dup)	3/6/2003	24.0 to 28.0	-28.0 to -32.0	1,000 *U*
GW03070302	WB-11	3/7/2003	11.5 to 15.5	-13.6 to -17.6	1,000 *U*
GW03070301	WB-11	3/7/2003	19.5 to 22.0	-21.6 to -24.1	1,000 *U*
GW02200301	WB-12	2/20/2003	5.0 to 9.0	-37.9 to -41.9	160,000 *J*
GW02260303	WB-13	2/26/2003	5.0 to 9.0	-4.2 to -8.2	20 *U*
GW02260304	WB-13	2/26/2003	16.5 to 20.5	-15.7 to -19.7	80 *U*
GW02270301	WB-14	2/27/2003	4.0 to 8.0	-10.5 to -14.5	4.0 *U*
GW02270302	WB-14	2/27/2003	17.0 to 21.0	-23.5 to -27.5	80 *U*
GW02170301	WB-15	2/17/2003	1.3 to 5.3	-36.8 to -40.8	40 *U*
GW02190301	WB-16	2/19/2003	3.4 to 4.4	-30.5 to -31.5	6.6
GW02250302	WB-18	2/25/2003	5.0 to 9.0	-3.5 to -7.5	81 *J*
GW02260301	WB-18	2/26/2003	17.5 to 21.5	-16.0 to -20.0	8.0 *U*
GW02250301	WB-19	2/25/2003	2.9 to 3.9	-27.1 to -28.1	4.0 *U*
GW02240301	WB-20	2/24/2003	2.5 to 4.5	-39.4 to -41.4	210 *J*
GW02200302	WB-21	2/20/2003	4.3 to 8.3	-39.2 to -43.2	200 *U*
GW02200303	WB-21 (dup)	2/20/2003	4.3 to 8.3	-39.2 to -43.2	200 *UJ*
GW02210301	WB-22	2/21/2003	3.5 to 7.5	-42.4 to -46.4	20 *U*
GW02180301	WB-23	2/18/2003	3.6 to 7.6	-14.8 to -18.8	11 *J*
GW02180302	WB-23	2/18/2003	16.6 to 20.6	-27.8 to -31.8	370,000
GW03100301	WB-25	3/10/2003	11.7 to 15.7	-16.1 to -20.1	1,000 *U*
GW03100302	WB-25	3/10/2003	19.7 to 21.7	-24.1 to -26.1	1,000 *U*

Note: *J* - estimated
U - undetected at detection limit shown
µg/L - micrograms per liter
CPD - City of Portland Datum

Figures

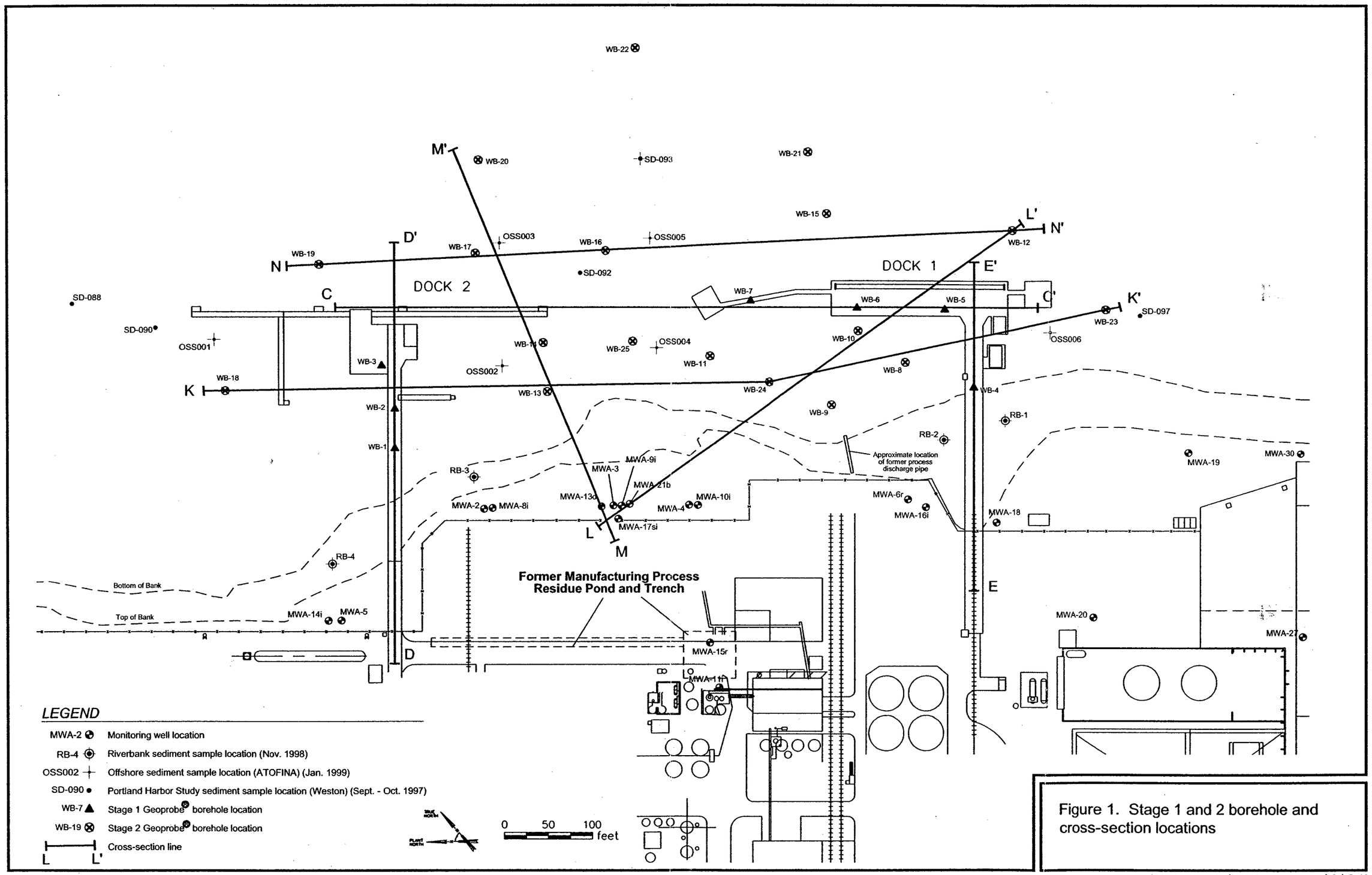


Figure 1. Stage 1 and 2 borehole and cross-section locations

8601192.001.0634/S1 2 BHXSXN.dwg 12/05/03 OR

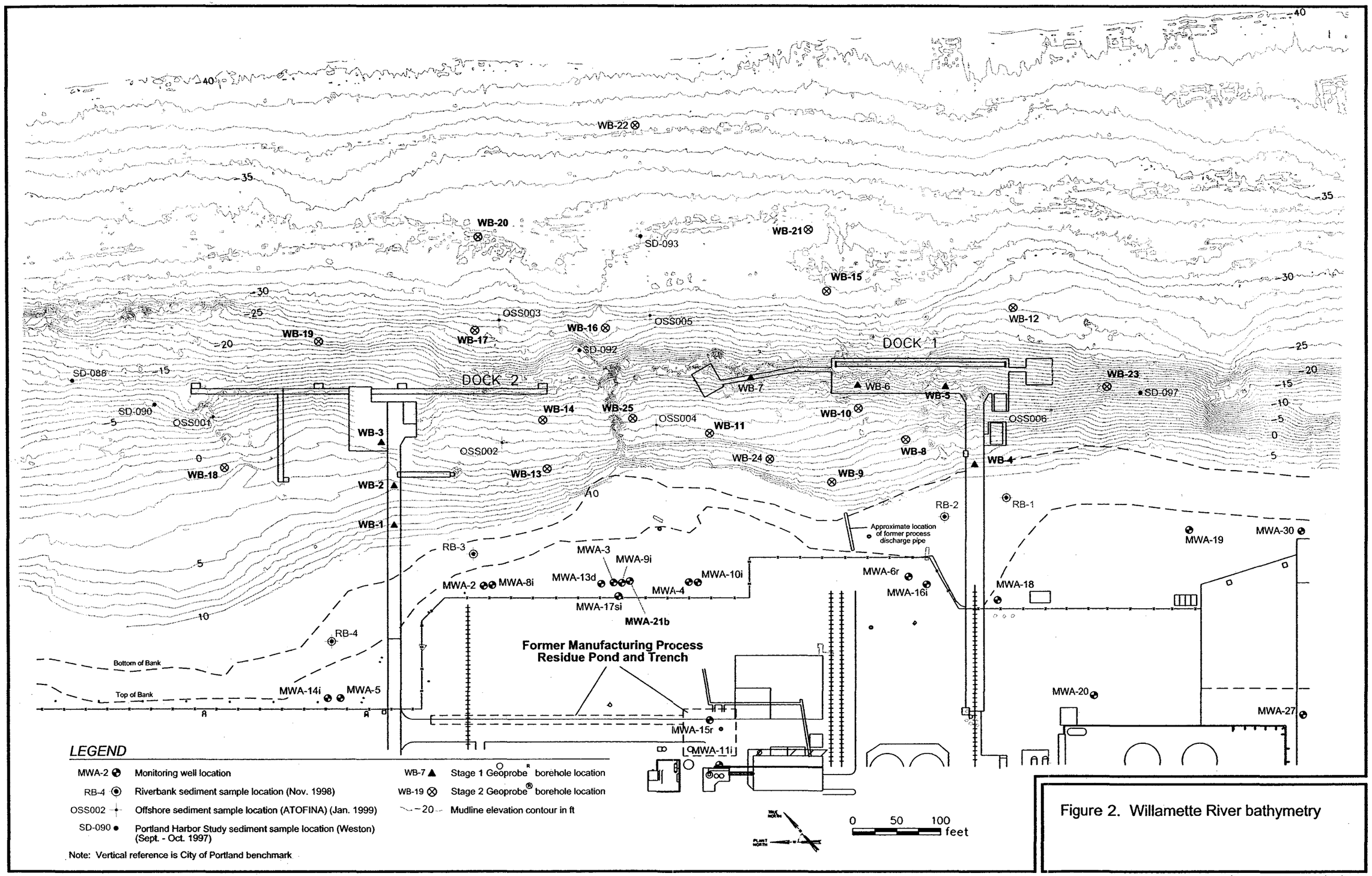


Figure 2. Willamette River bathymetry

8601192.001.0634/BATHYMETRIC.dwg 12/05/03 QR

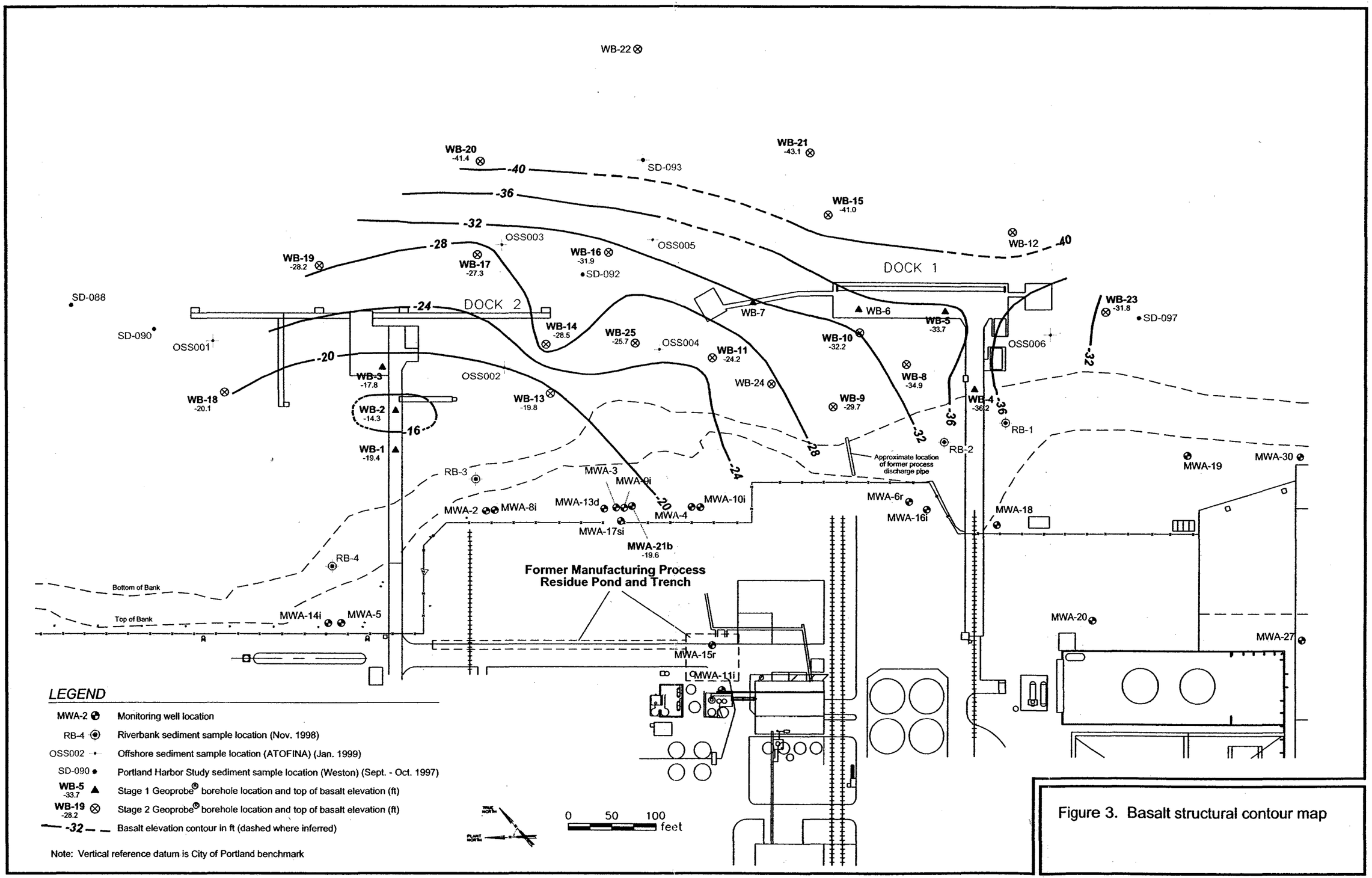
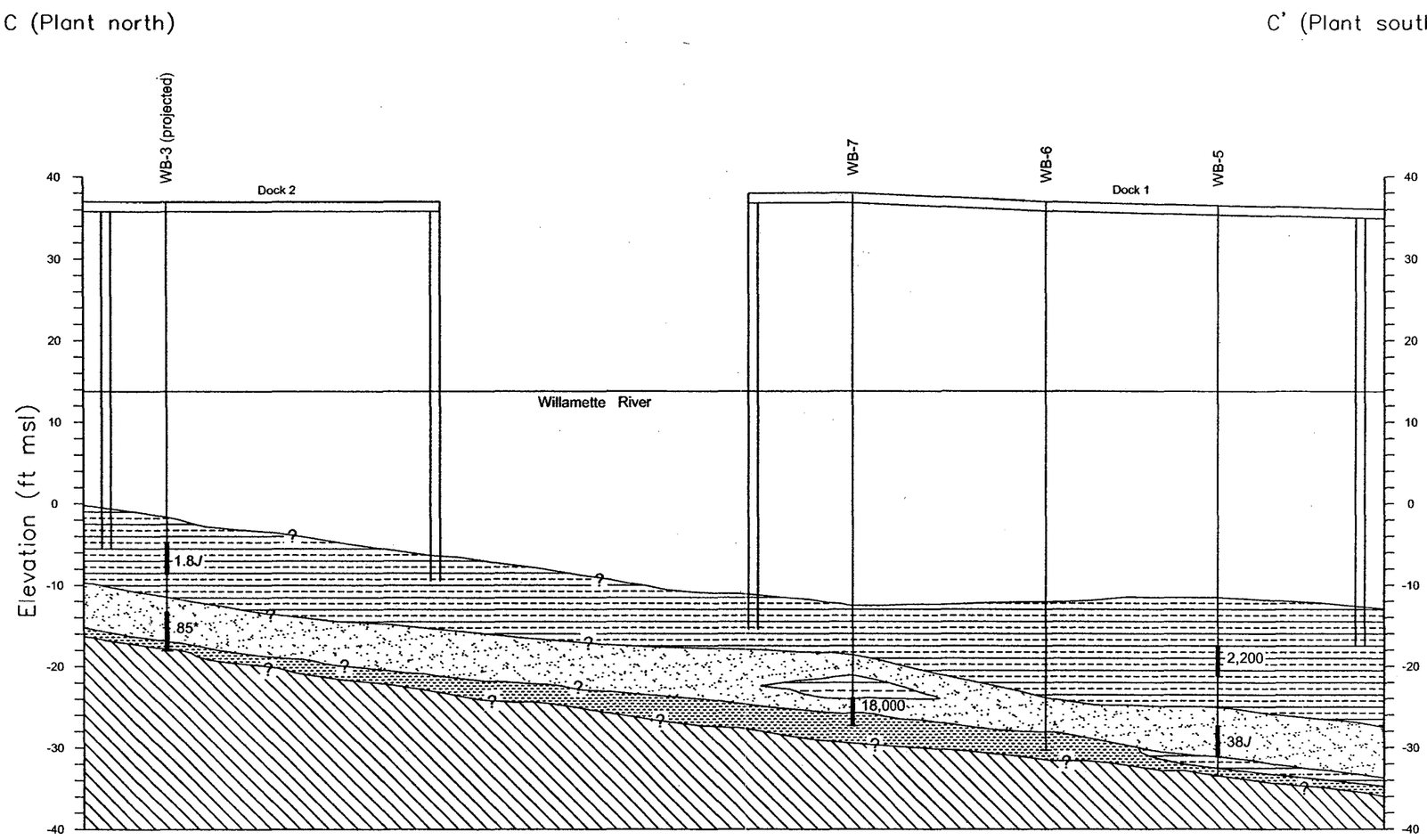


Figure 3. Basalt structural contour map

8601192.001.0634/BASALT.dwg 12/08/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt
- WB-3 — Geoprobe® boring number
- Boring with grab groundwater sample interval
- Inferred soil or geologic contact (queried where uncertain)
- J - Estimated
- * - Average of sample and sample duplicate

0 80 feet

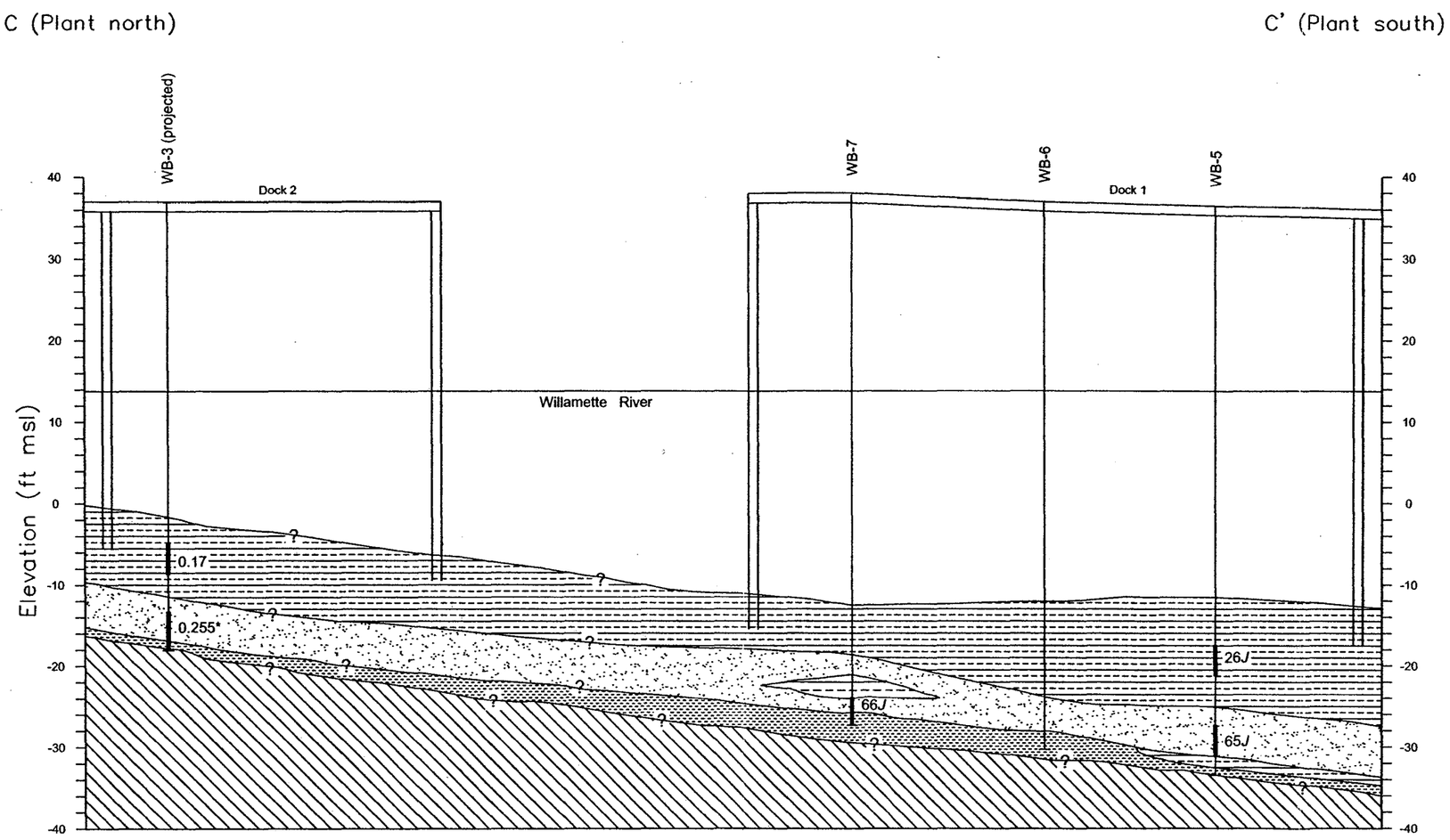
Note: Vertical scale exaggerated 5x

Note: All concentrations are in micrograms per liter (μg/L).
Chlorobenzene concentrations are from grab groundwater samples collected in June 2002.

Exponent

Figure 4a. Cross-section C-C' with chlorobenzene concentrations in groundwater

8601192.001.0634\C-C' Chlor.dwg 11/18/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number

Boring with grab groundwater sample interval

Inferred soil or geologic contact (queried where uncertain)

J - Estimated

* - Average of sample and sample duplicate

0 80 feet

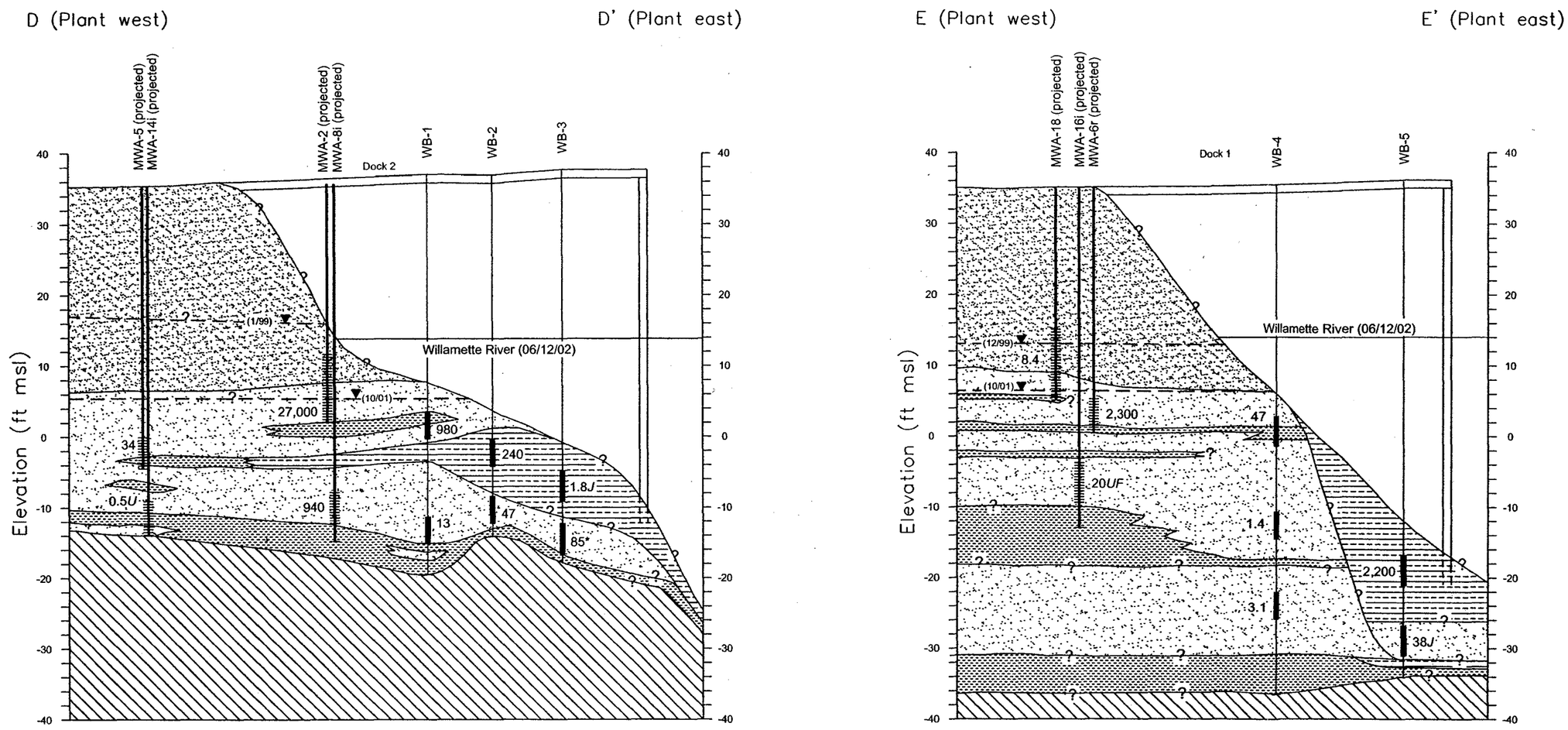
Note: Vertical scale exaggerated 5x

Note: All concentrations are in micrograms per liter (μg/L)
DDT concentrations are from grab groundwater samples collected in June 2002.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 4b. Cross-section C-C' with DDT concentrations in groundwater

8601192.001.0634\C-C' DDT.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number
MWA-1 — Well number
Cased interval
Screen interval

Shallow zone groundwater surface (approximate)
Inferred soil or geologic contact (queried where uncertain)
Boring with grab groundwater sample interval

F - Field quality control sample (blanks or reference materials) criteria not met
J - Estimated
U - Undetected at detection limit shown
* - Average of sample and sample duplicate

0 80 feet

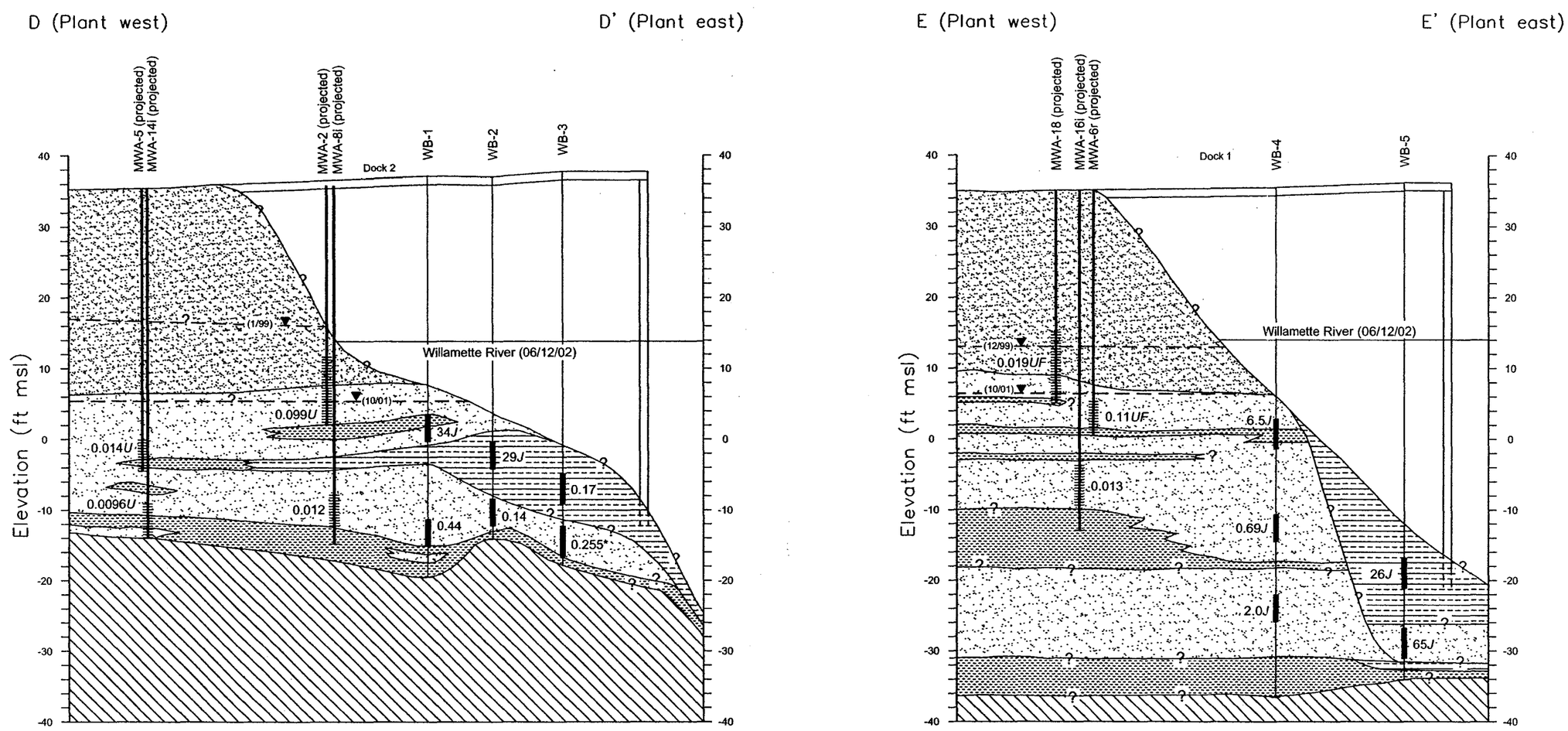
Note: Vertical scale exaggerated 5x

Note: All concentrations are in micrograms per liter (μg/L).
Chlorobenzene concentration data in monitoring wells are from April 2002; Geoprobe® boring data are from June 2002.

Exponent

Figure 5a. Cross-sections D-D' and E-E' with chlorobenzene concentrations in groundwater

8601192.001.0634\DD/EE.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number

MWA-1 — Well number

Cased interval

Screen interval

Shallow zone groundwater surface (approximate)

Inferred soil or geologic contact (queried where uncertain)

Boring with grab groundwater sample interval

F - Field quality control sample (blanks or reference materials) criteria not met

J - Estimated

U - Undetected at detection limt shown

* - Average of sample and sample duplicate

0 80 feet

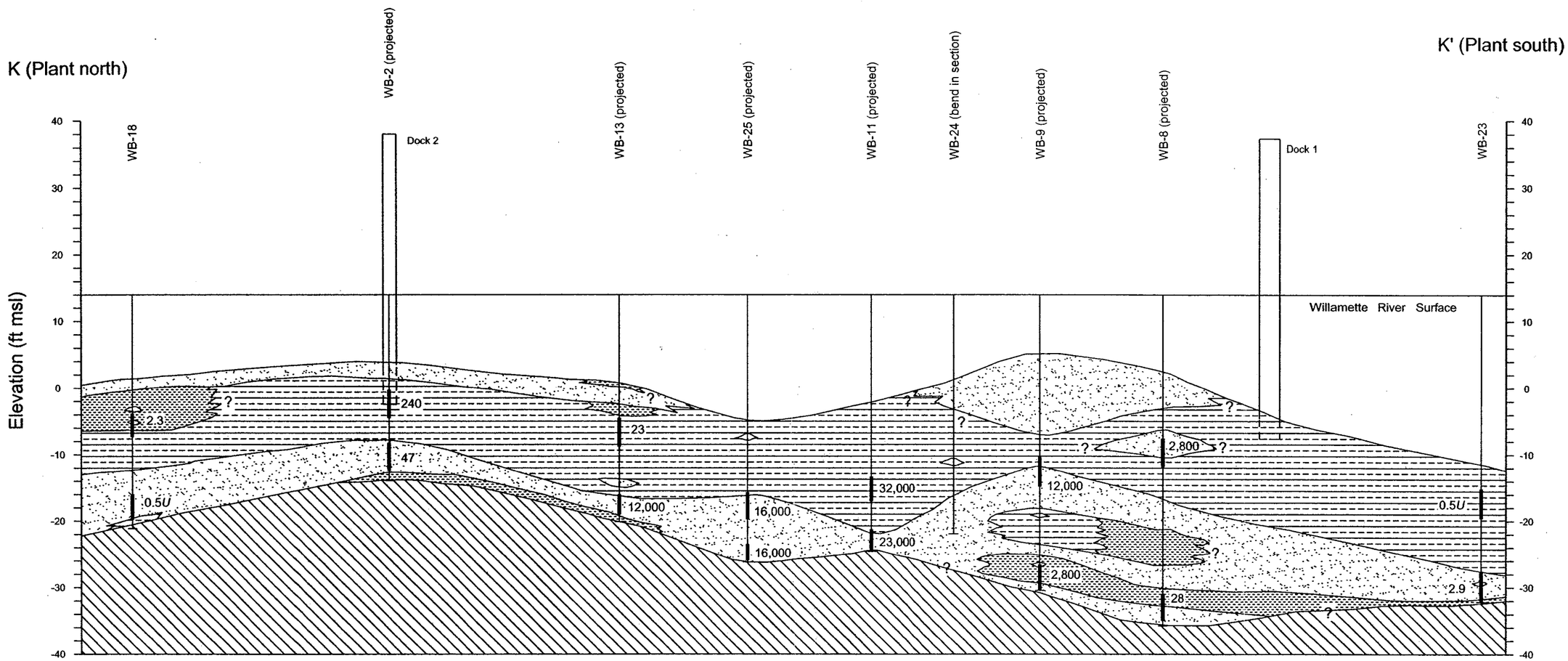
Note: Vertical scale exaggerated 5x

Note: All concentrations are in micrograms per liter (μg/L).
DDT concentration data in monitoring wells are from April 2002; Geoprobe® boring data are from June 2002.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 5b. Cross-sections D-D' and E-E' with DDT concentrations in groundwater

8601192.001.0634\DD and EE.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number

Boring with grab groundwater sample interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
J Estimated
U Undetected at detection limit shown

0 80 feet

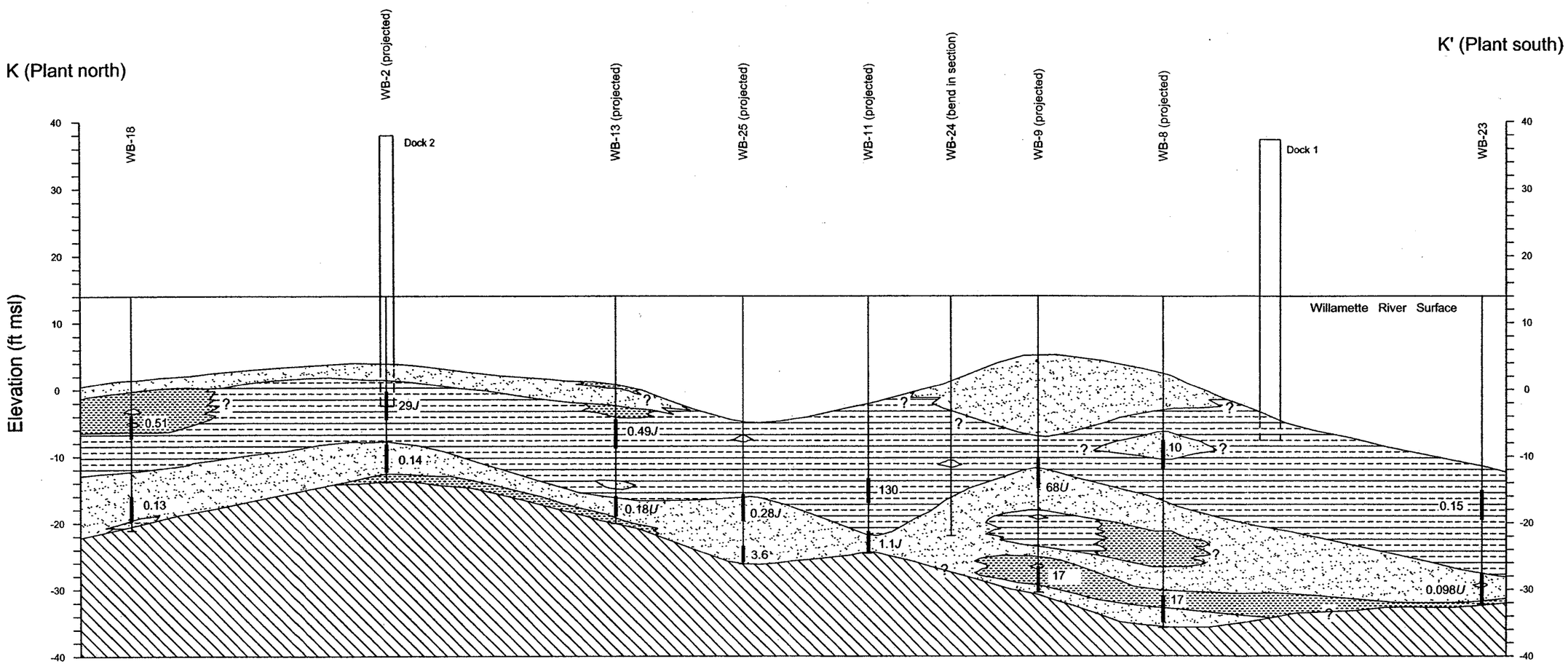
Note: Vertical scale exaggerated 5x

Notes: Stratigraphy in portions of WB-8, WB-9 and WB-25 consists of interlayered silts and sands. Contacts on cross-section are interpretive.
All concentrations are in micrograms per liter (µg/L). Chlorobenzene concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.

Exponent

Figure 6a. Cross-section K-K' with chlorobenzene concentrations in groundwater

8601192.001.0634\K-K' CHLOR.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-3 — Geoprobe® boring number

Boring with grab groundwater sample interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
J Estimated
U Undetected at detection limit shown

0 80 feet

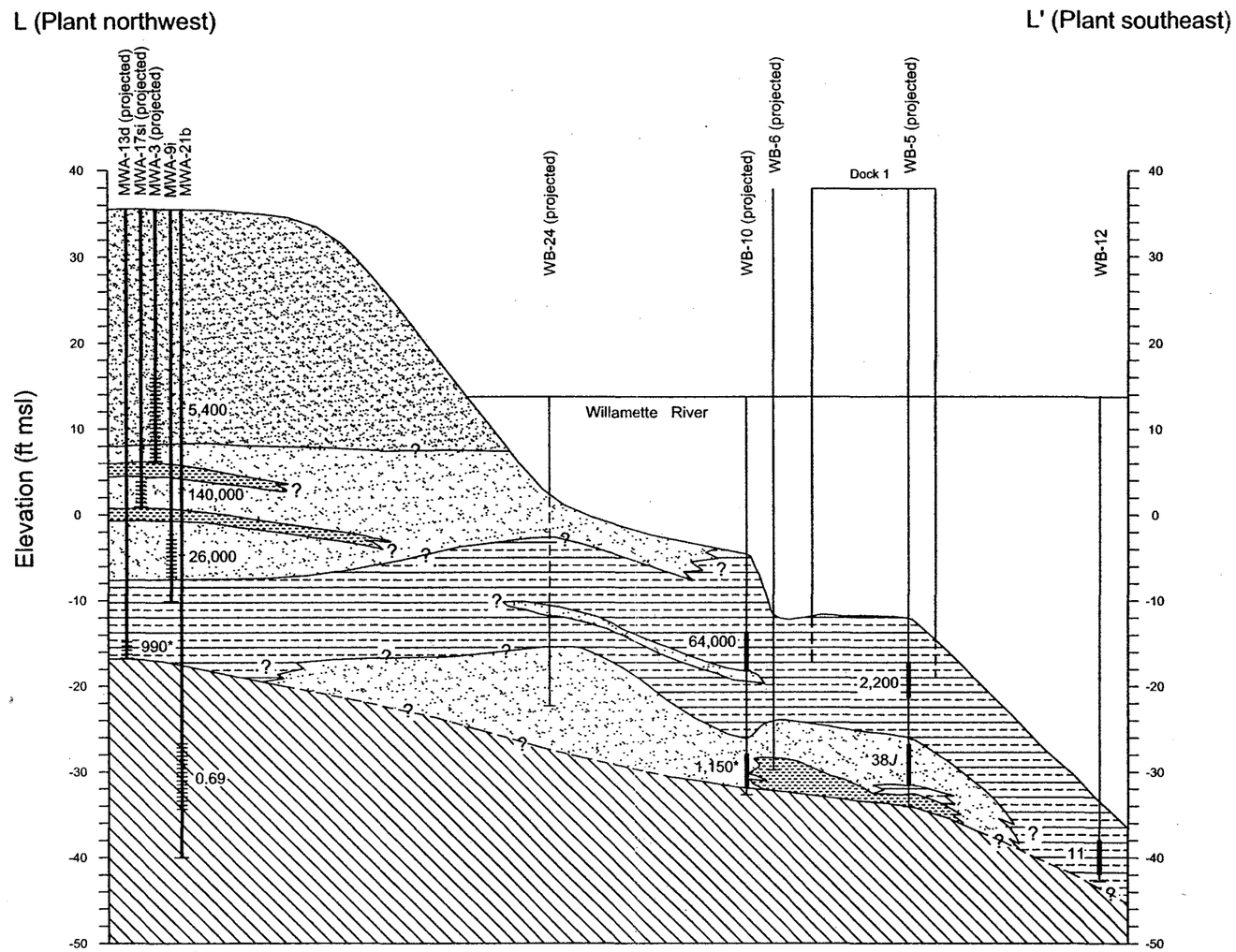
Note: Vertical scale exaggerated 5x

Notes: Stratigraphy in portions of WB-8, WB-9 and WB-25 consists of interlayered silts and sands. Contacts on cross-section are interpretive. All concentrations are in micrograms per liter (μg/L). DDT concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 6b. Cross-section K-K' with DDT concentrations in groundwater

8601192.001.0634\K-K' DDT.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate

J Estimated

0 80 feet

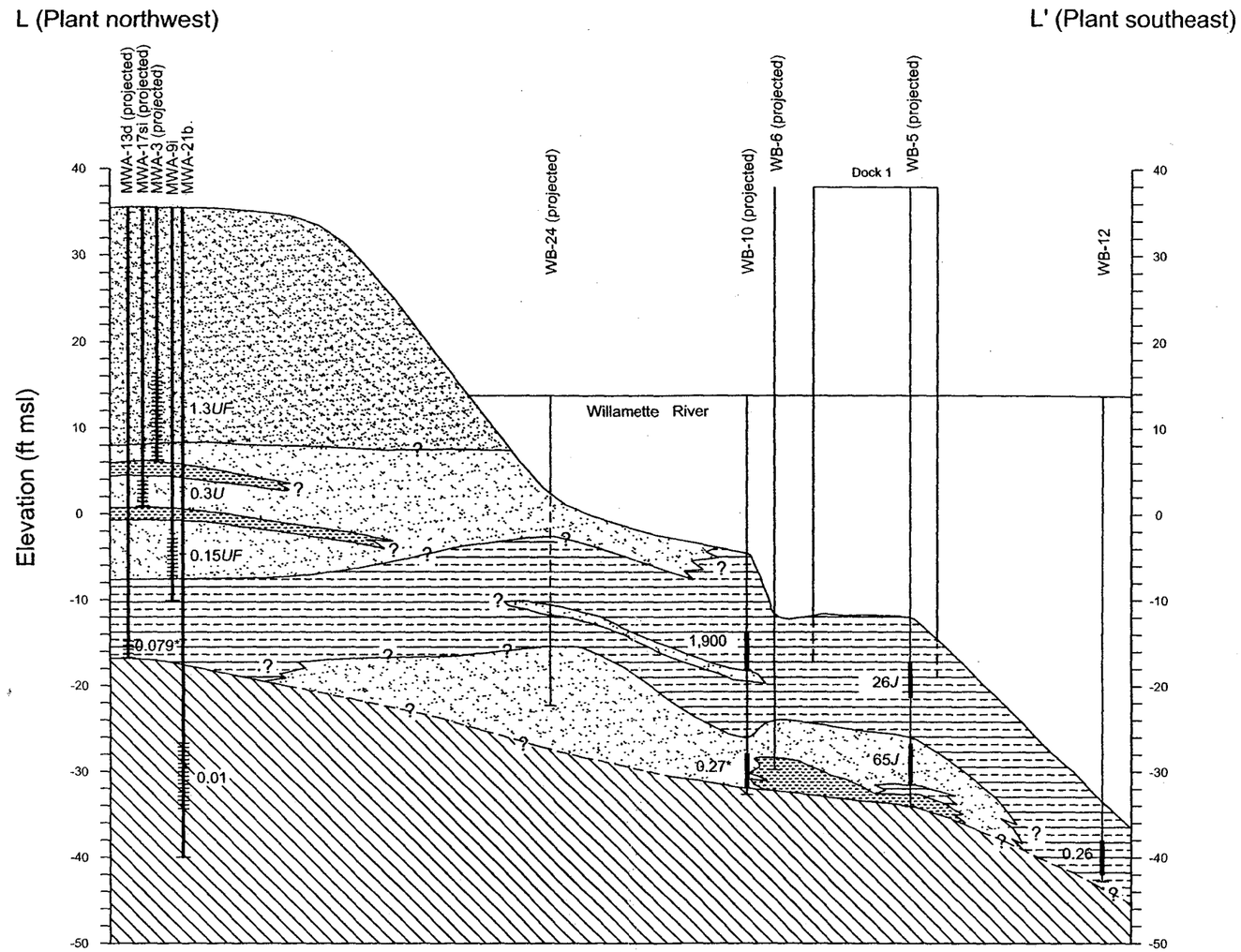
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (µg/L). Chlorobenzene concentrations are from grab groundwater samples collected in June 2002 and February-March 2003. Chlorobenzene concentrations in monitoring wells are from April 2002.

Exponent

Figure 7a. Cross-section L-L' with chlorobenzene concentrations in groundwater

8601192.001.0634\L-L' CHLOR.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
F Field quality control sample (blanks or reference materials) criteria not met
J Estimated
U Undetected at detection limit shown

0 80 feet

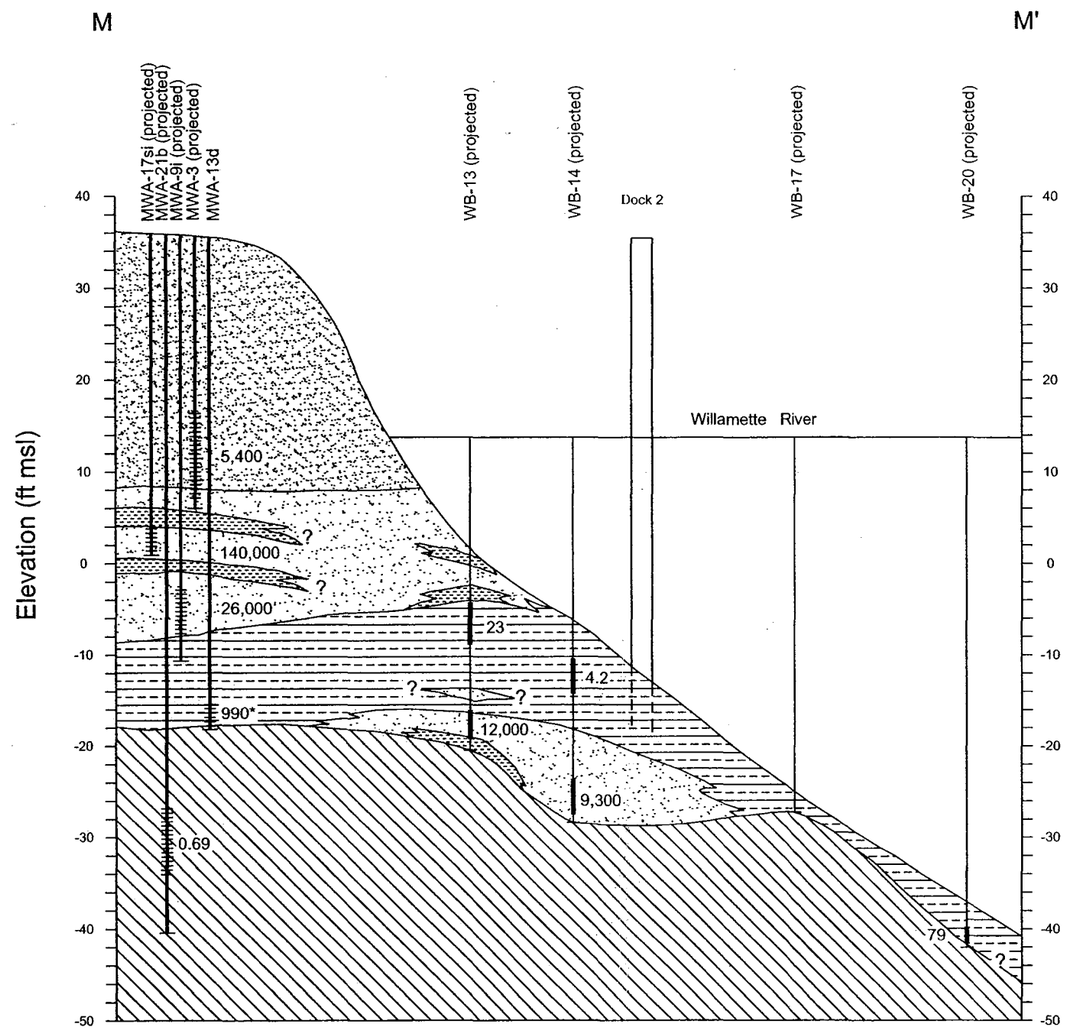
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (μg/L). DDT concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.
Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.
DDT concentrations in monitoring wells are from April 2002.

Exponent

Figure 7b. Cross-section L-L' with DDT concentrations in groundwater

8601192.001.0634\L-L' DDT.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate

J Estimated

0 80 feet

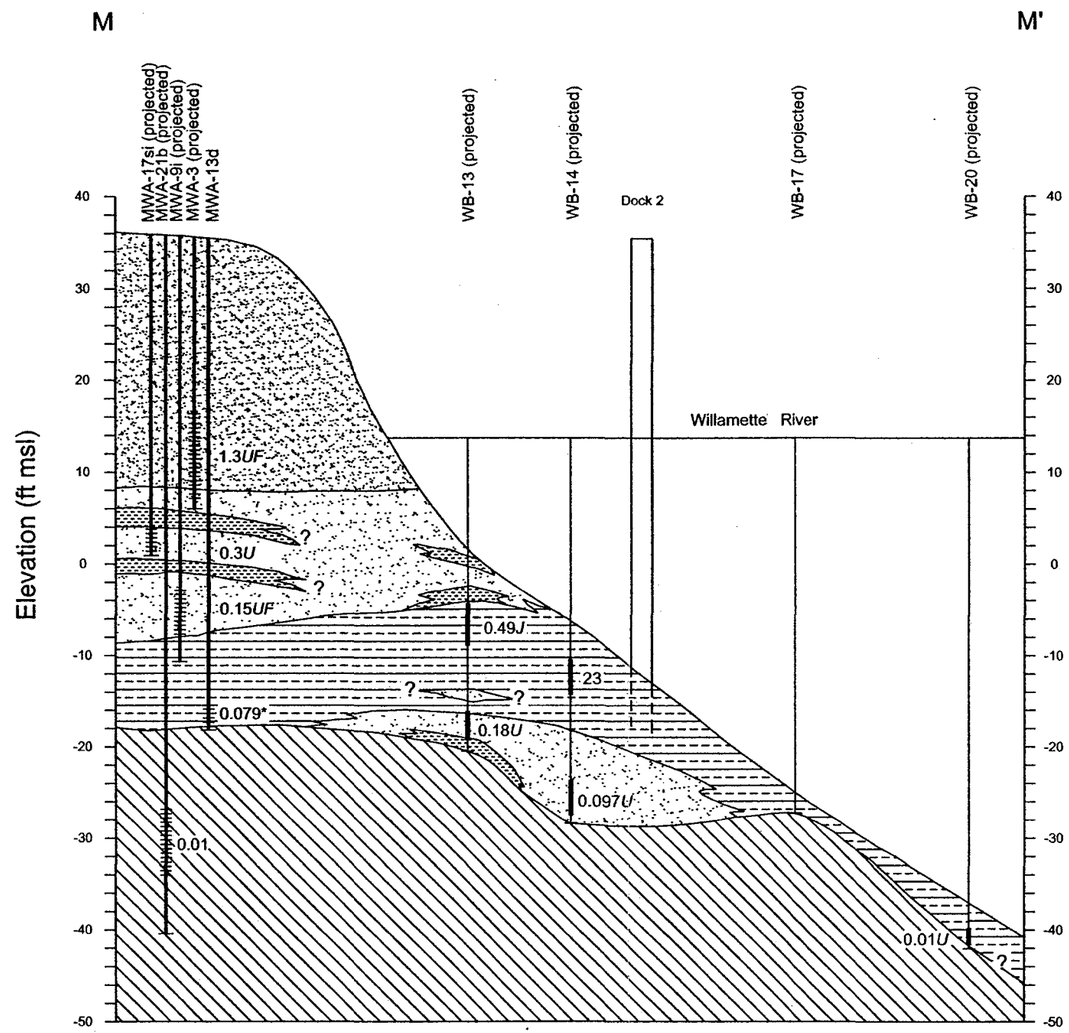
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (µg/L). Chlorobenzene concentrations in WB boreholes are from grab groundwater samples collected in June 2002 and February-March 2003. Chlorobenzene concentrations in monitoring wells are from April 2002.

Exponent

Figure 8a. Cross-section M-M' with chlorobenzene concentrations in groundwater

8601192.001.0634\M-M' CHLOR.dwg 12/05/03 OR



LEGEND

- Fill with debris
- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate
F Field quality control sample (blanks or reference materials) criteria not met
J Estimated
U Undetected at detection limit shown

0 80 feet

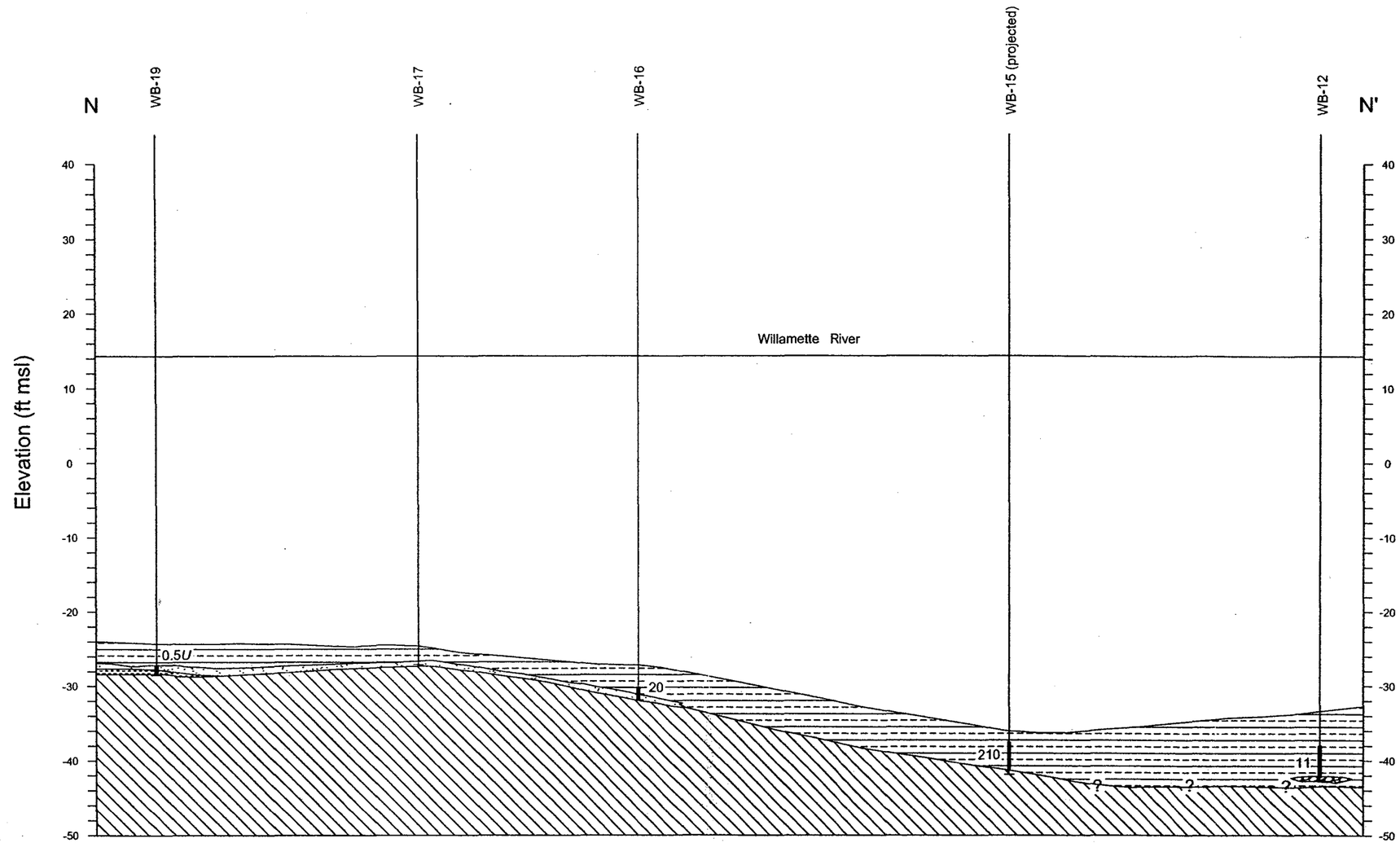
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (µg/L). DDT concentrations in WB boreholes are from grab groundwater samples collected in June 2002 and February-March 2003. DDT concentrations in monitoring wells are from April 2002. Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 8b. Cross-section M-M' with DDT concentrations in groundwater

8601192.001.0634\M-M' DDT.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt
- Gravel

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate

J Estimated

U Undetected at detection limit shown

0 80 feet

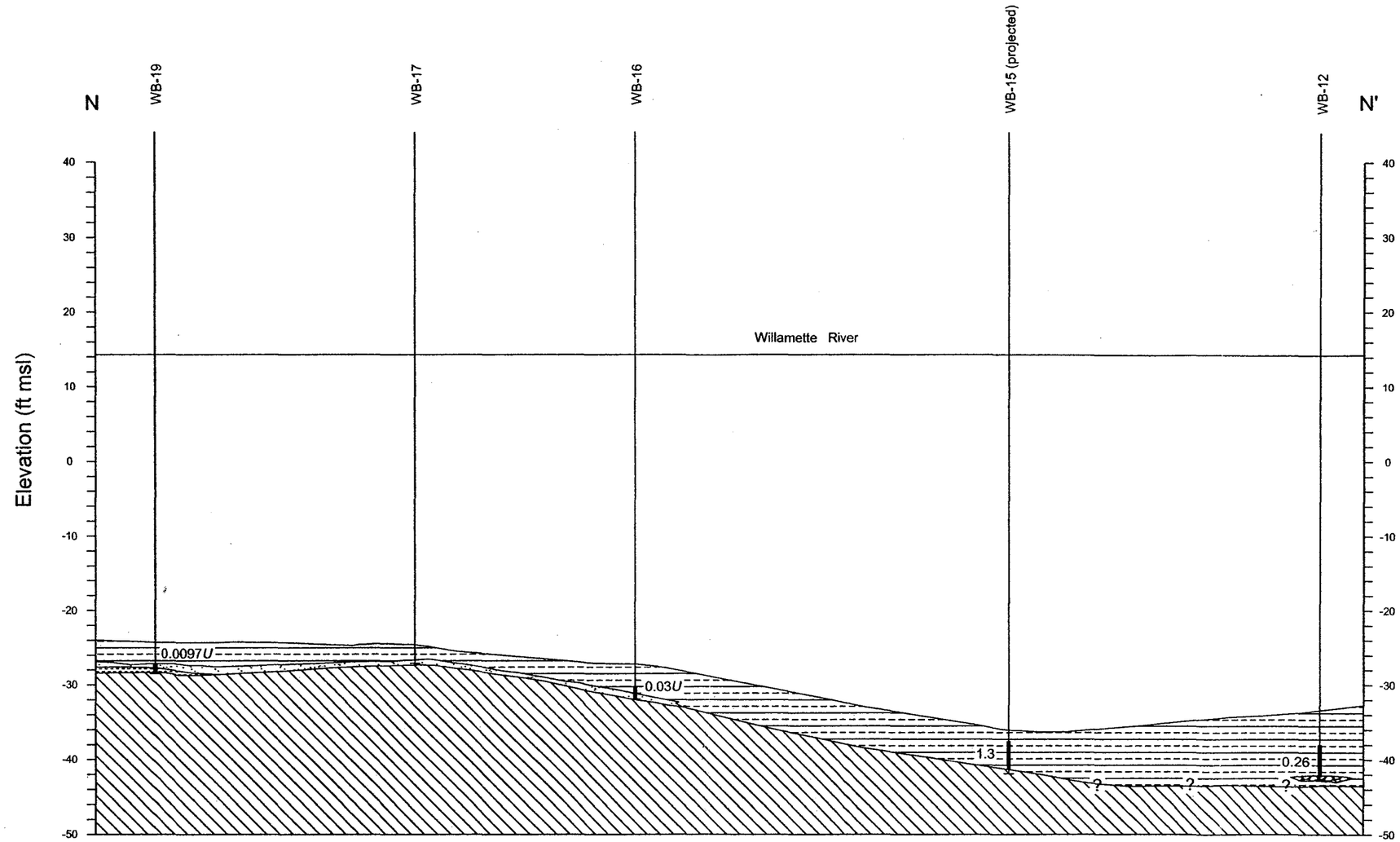
Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (μg/L). Chlorobenzene concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.

Exponent

Figure 9a. Cross-section N-N' with chlorobenzene concentrations in groundwater

8601192.001.0634\L-L' CHLOR.dwg 12/05/03 OR



LEGEND

- Sand with varying amounts of silt
- Silt with varying amounts of fine sand
- Silt with some clay and fine sand
- Basalt
- Gravel

WB-24 — Geoprobe® boring number

Boring with grab groundwater sample interval

MWA-21b — Well number

Cased interval

Screen interval

Inferred soil or geologic contact (queried where uncertain)

* Average of sample and sample duplicate

J Estimated

U Undetected at detection limit shown

0 80 feet

Note: Vertical scale exaggerated 5x

Notes: All concentrations are in micrograms per liter (µg/L). DDT concentrations are from grab groundwater samples collected in June 2002 and February-March 2003.

Samples were collected through a Geoprobe® screen and were unfiltered. This sampling methodology will introduce particulate matter into the aqueous sample; therefore, concentrations of detected pesticides are likely biased high.

Exponent

Figure 9b. Cross-section N-N' with DDT concentrations in groundwater

8601192.001.0634\N-N' DDT.dwg 12/05/03 OR

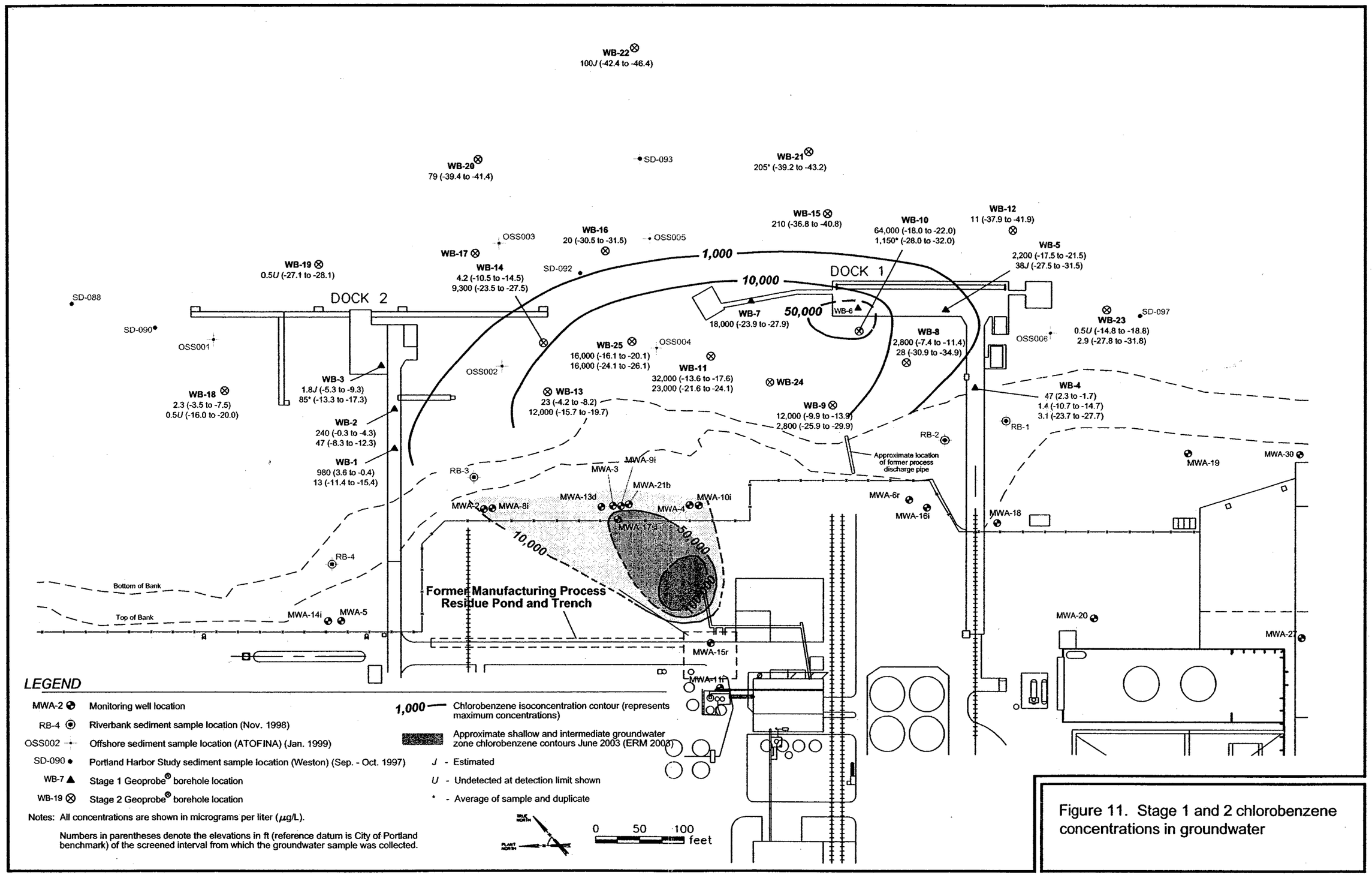


Figure 11. Stage 1 and 2 chlorobenzene concentrations in groundwater

8601192.001.0634/CHLOR GW.dwg 12/05/03 OR

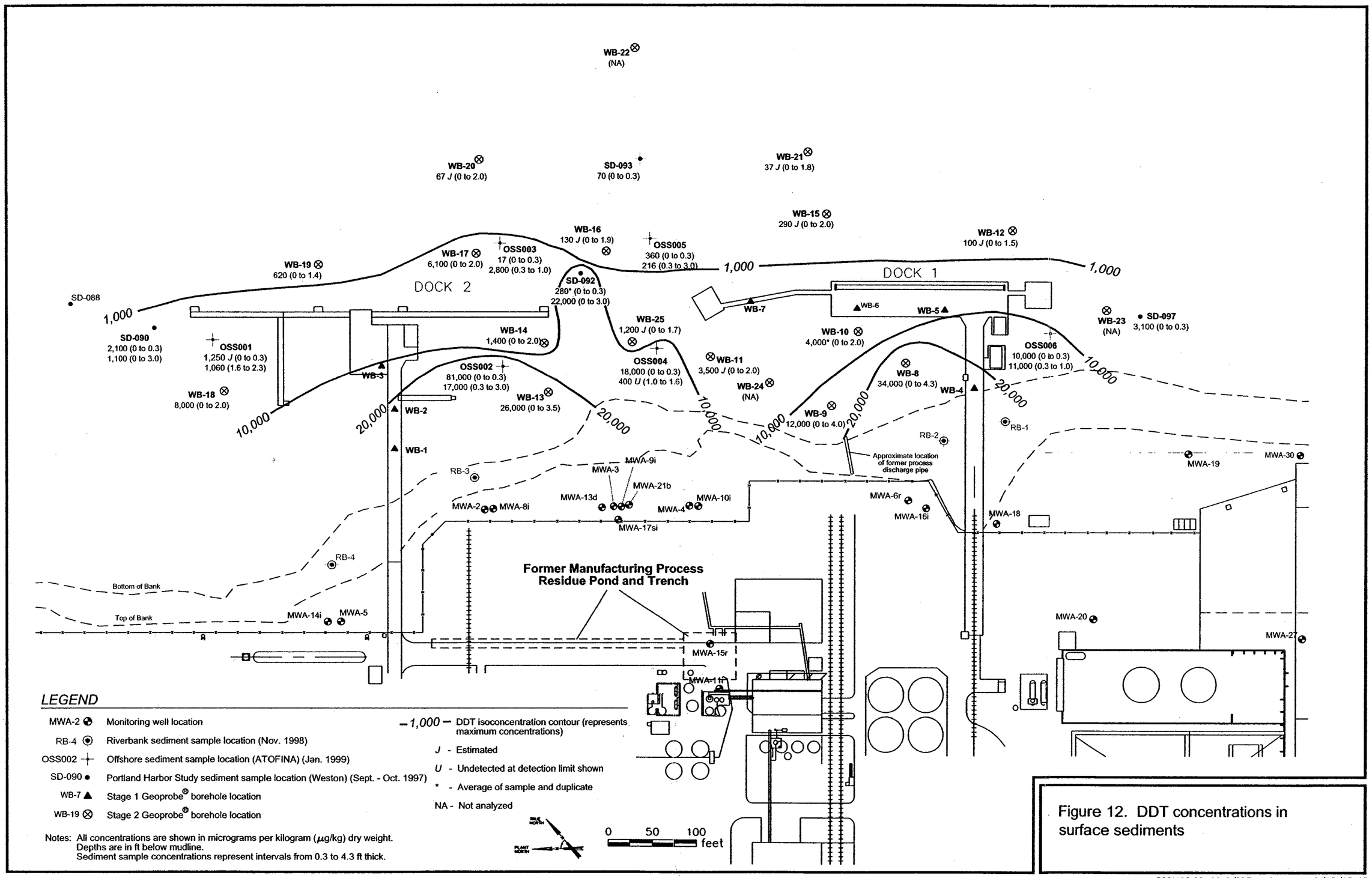


Figure 12. DDT concentrations in surface sediments

8601192.001.0612/DDT surfsed.dwg 12/05/03 OR

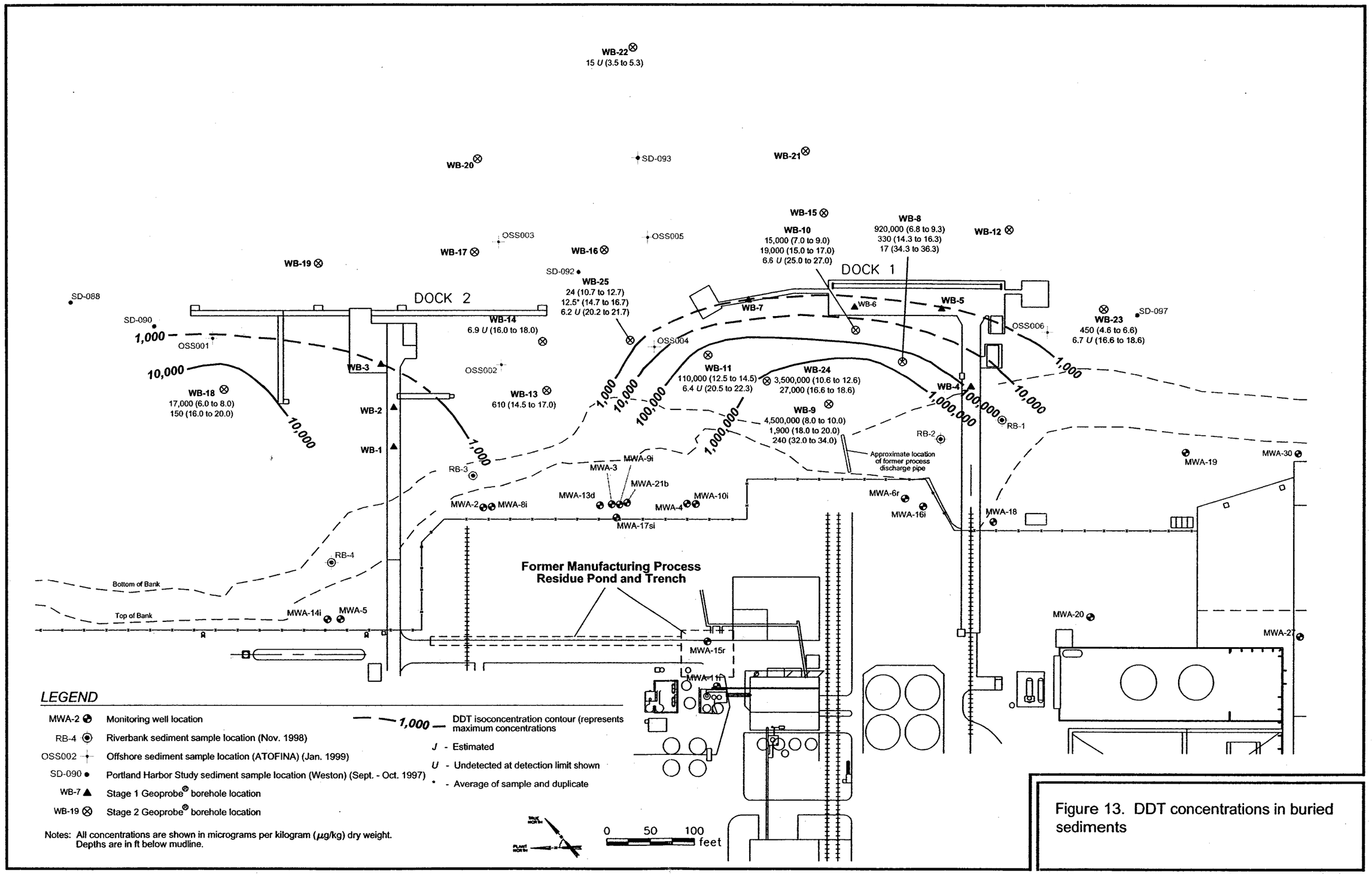


Figure 13. DDT concentrations in buried sediments

8601192.001.0612/DDT deepsed.dwg 12/05/03 OR

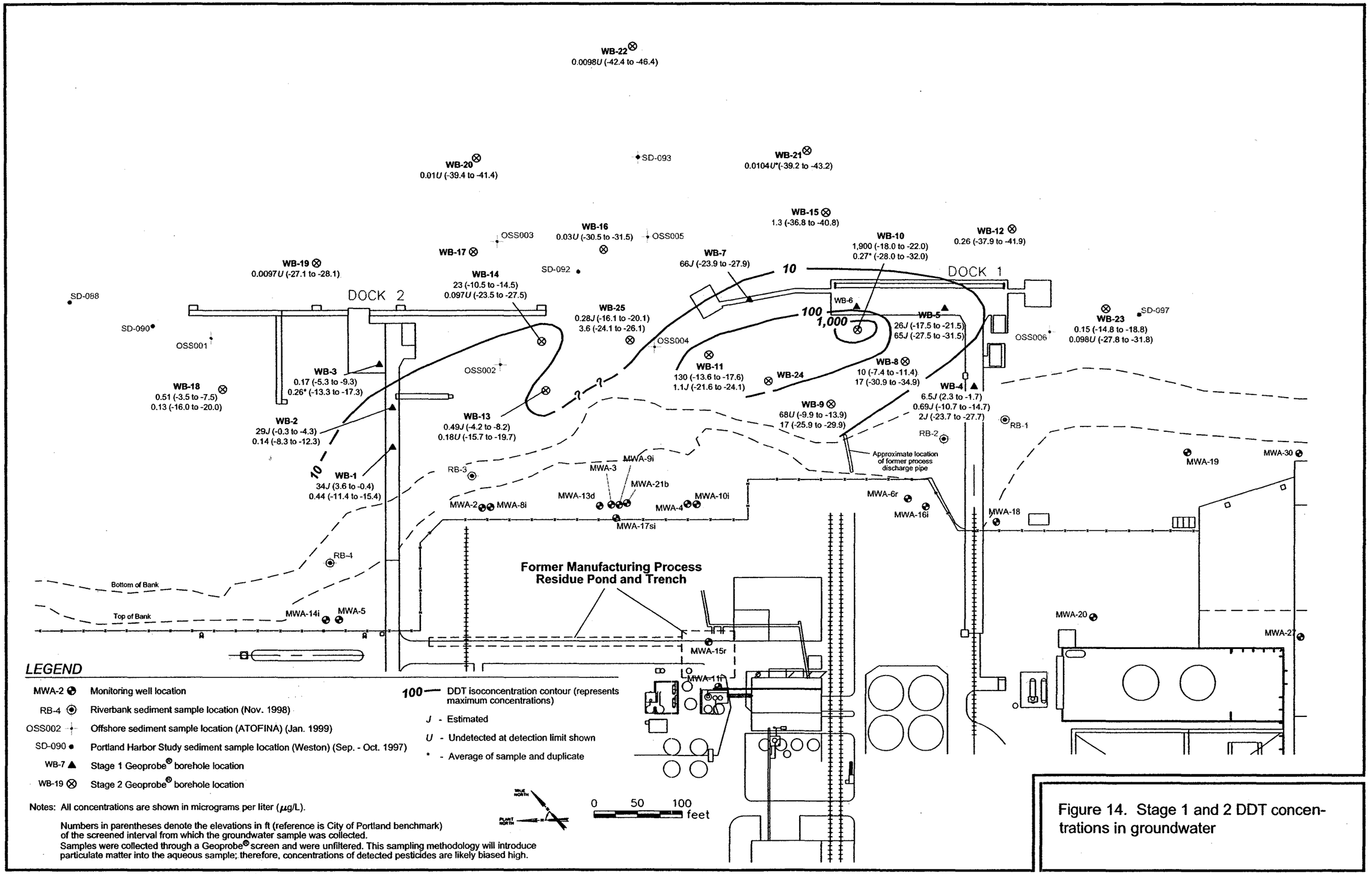


Figure 14. Stage 1 and 2 DDT concentrations in groundwater

8601192.001.0612/DDT GW.dwg 11/29/03 OR

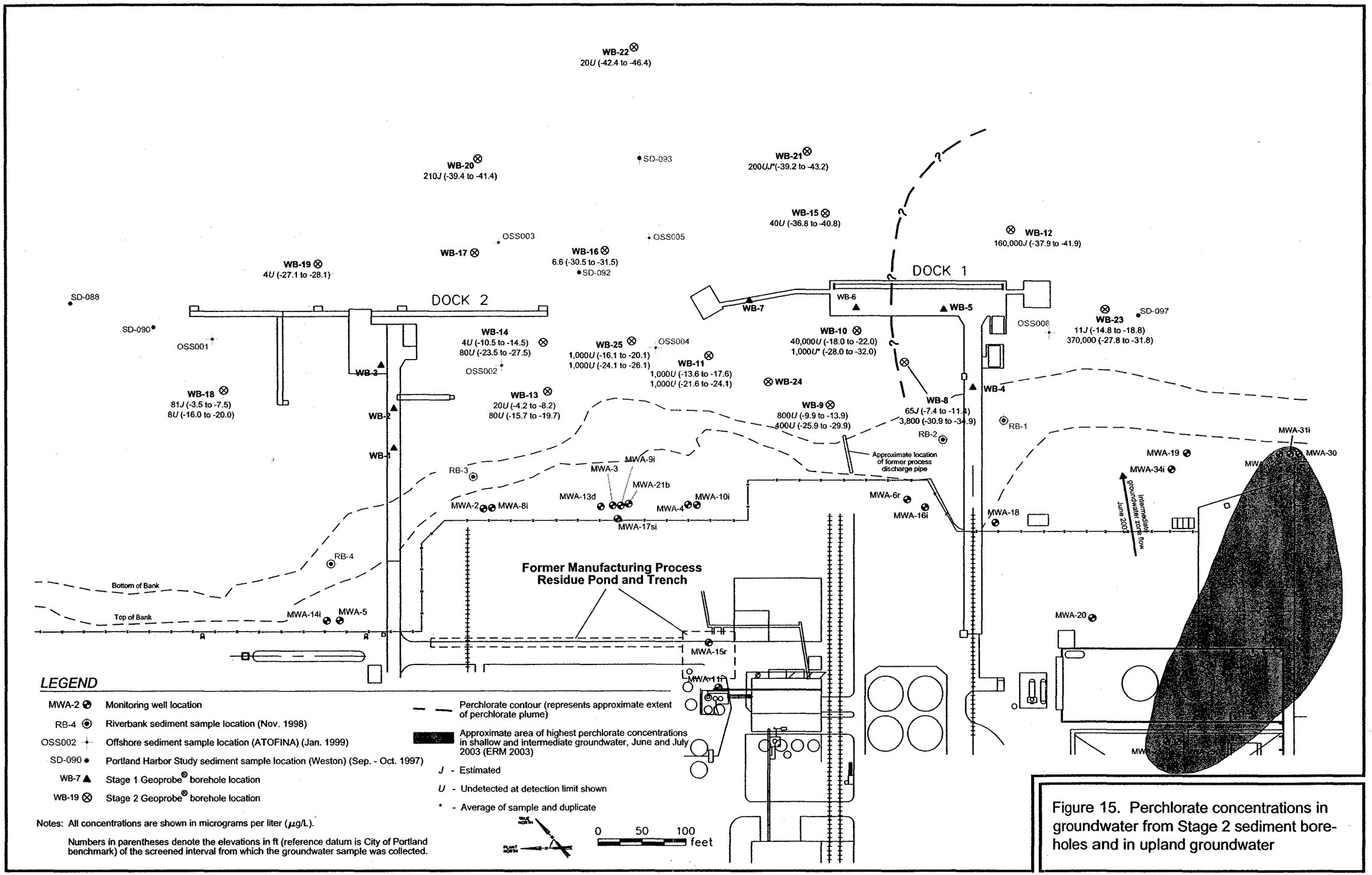
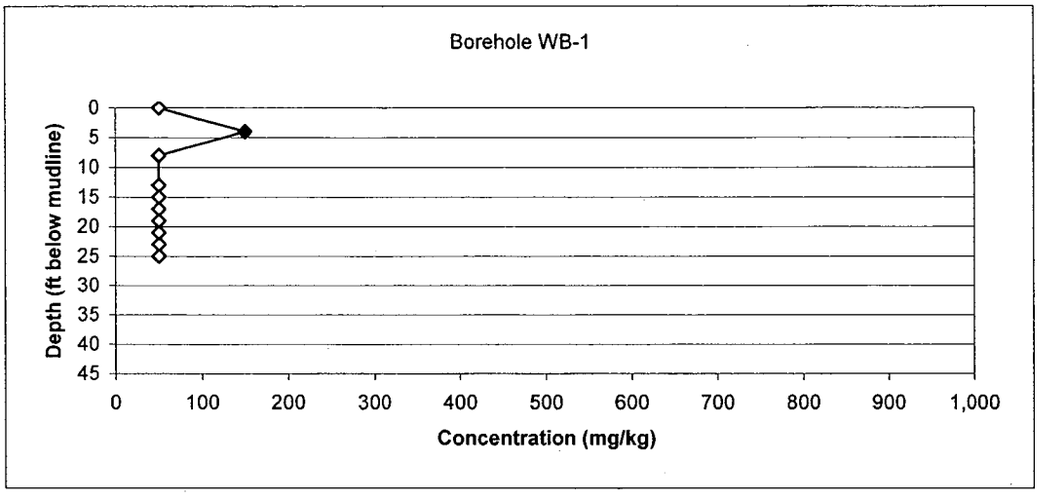
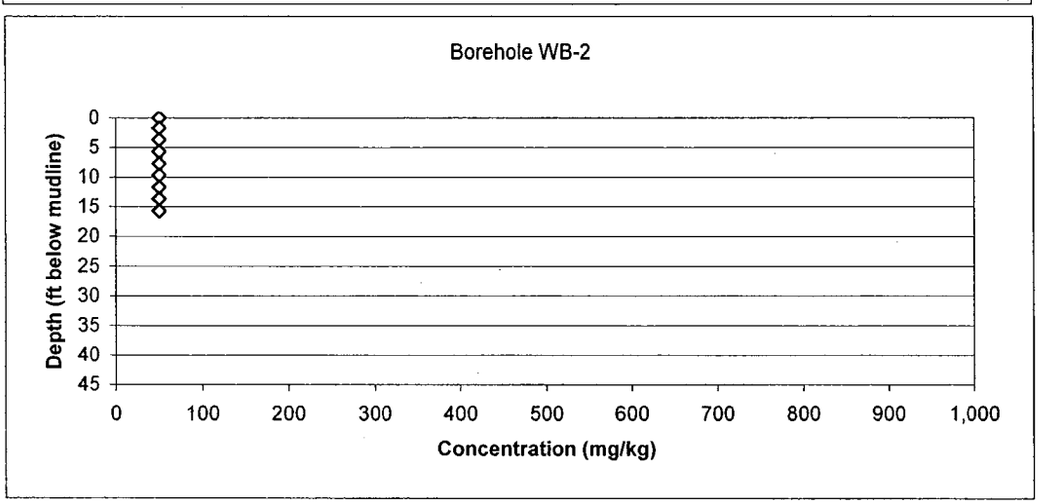
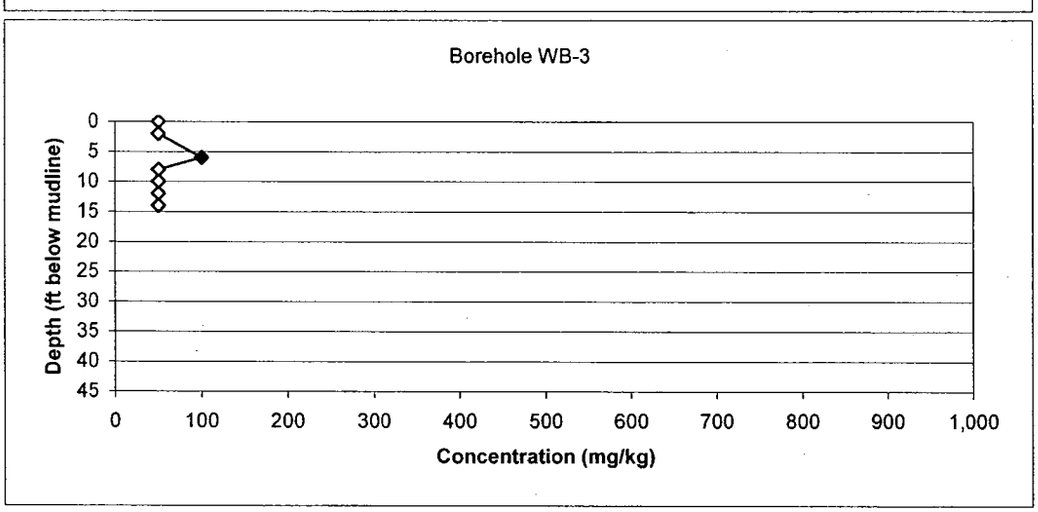


Figure 15. Perchlorate concentrations in groundwater from Stage 2 sediment boreholes and in upland groundwater

8601192.001.0612/PERCH.dwg 12/08/03 OR





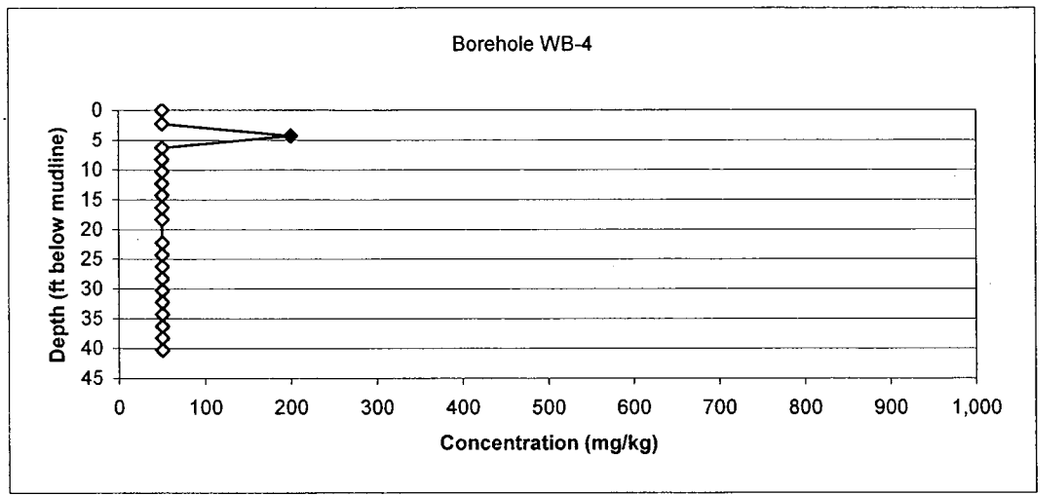


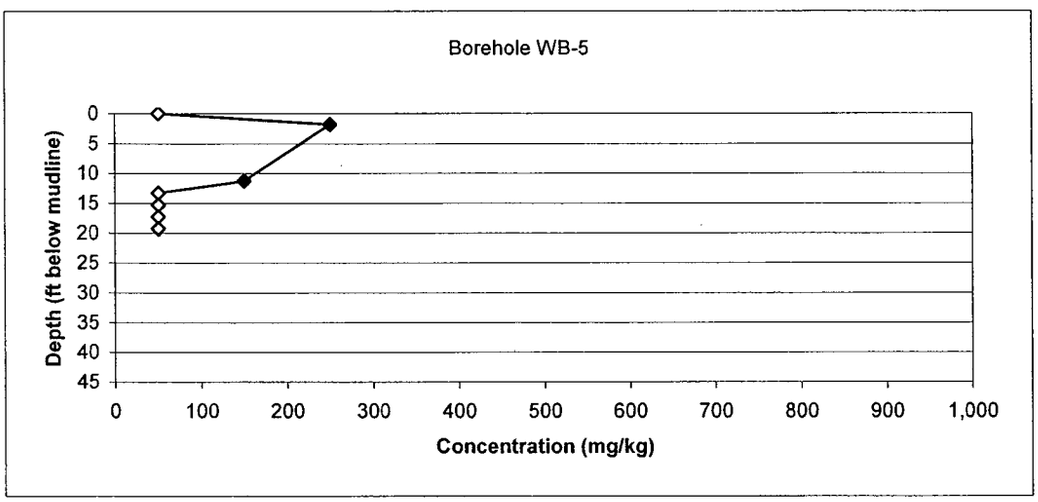
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)

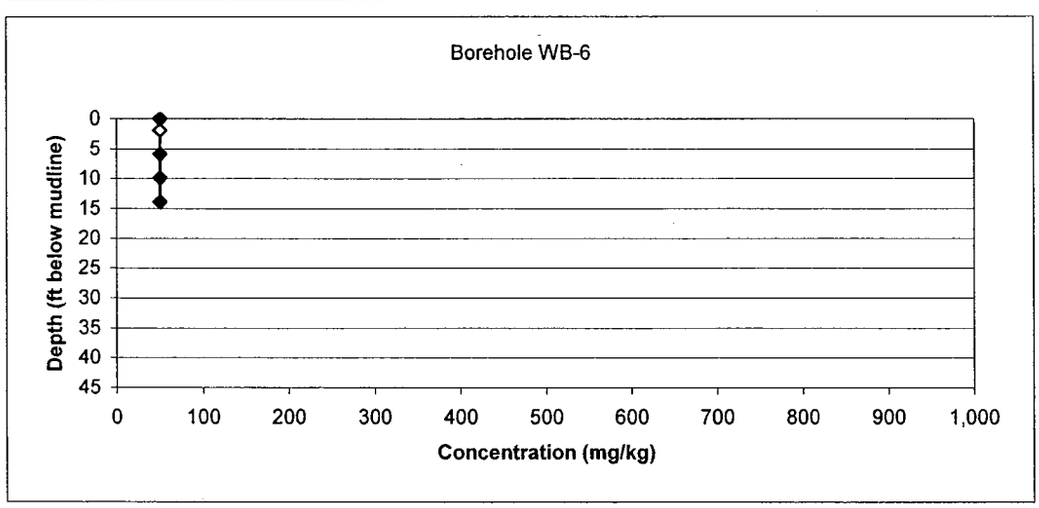
[a] Concentration represents detection limit

Figure 10. Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





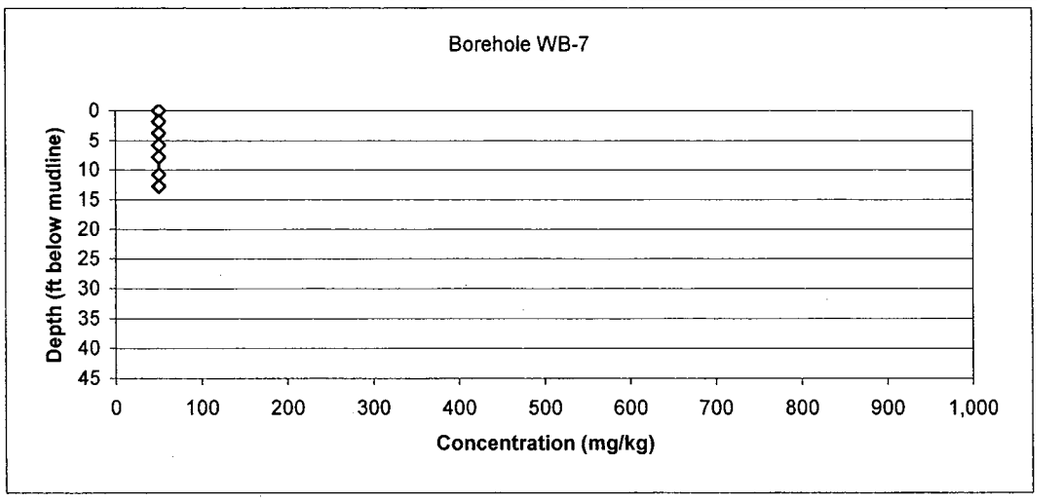


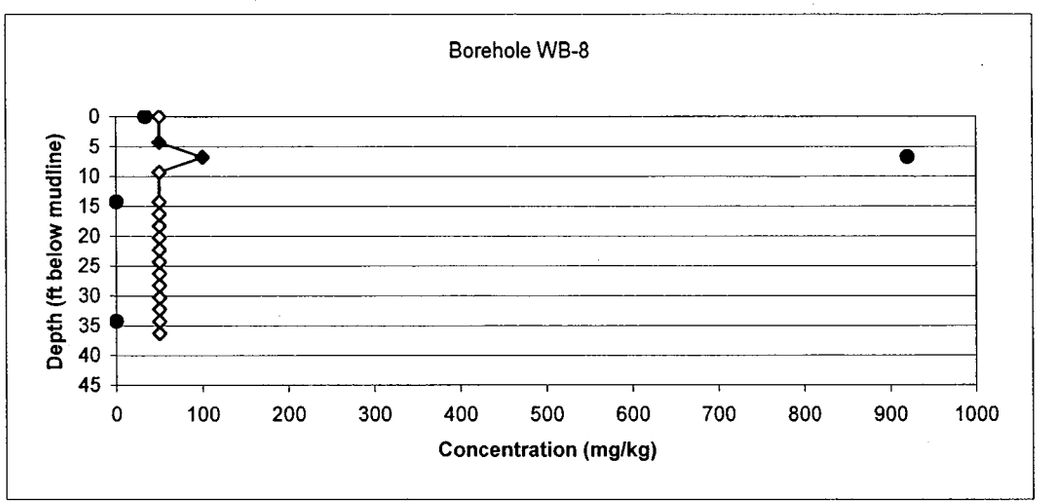
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)

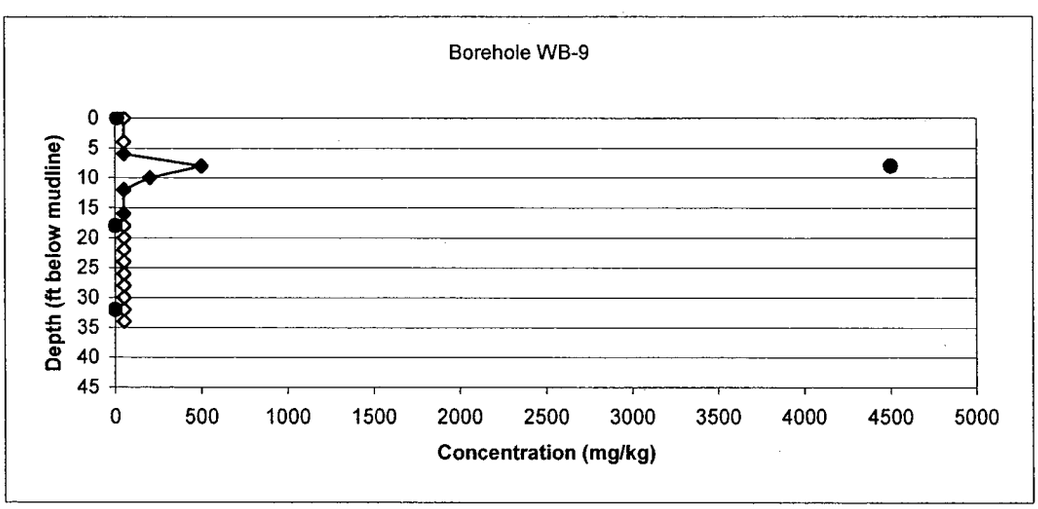
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





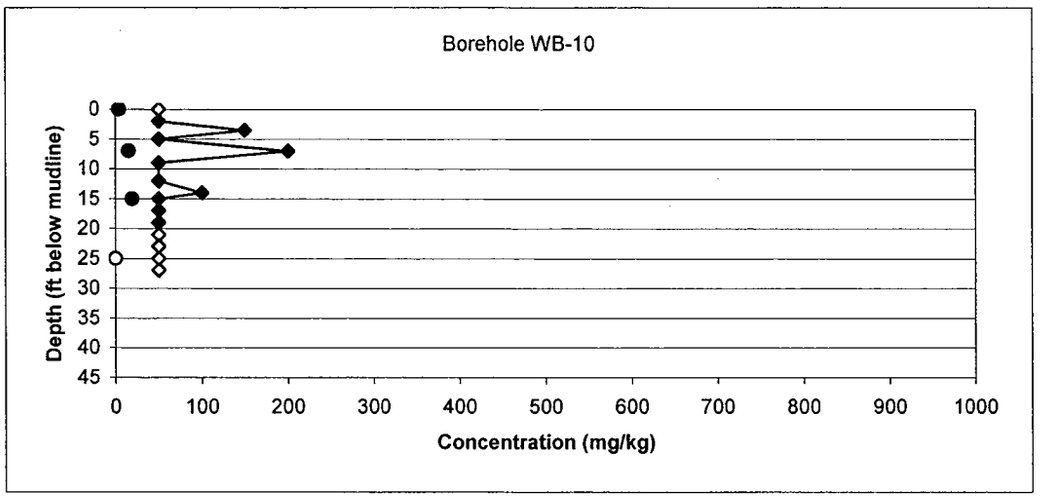


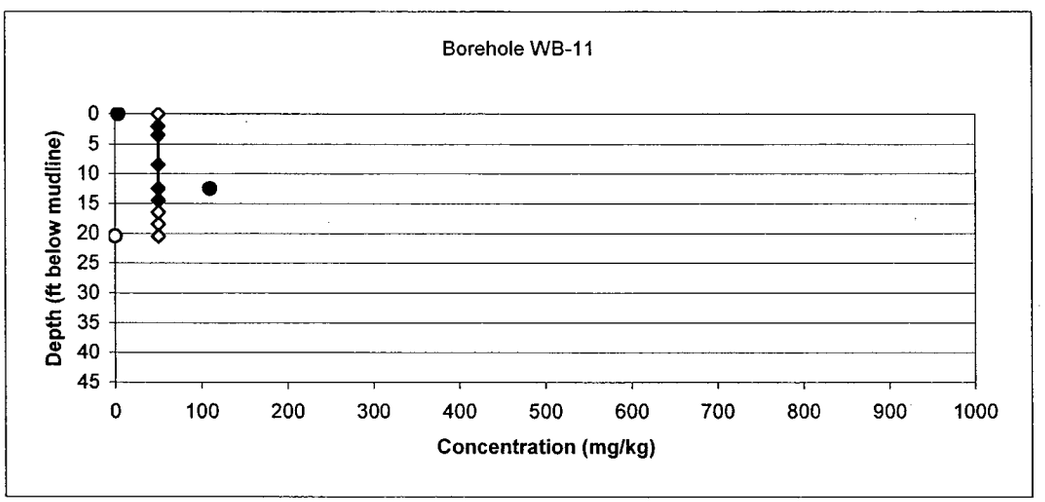
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

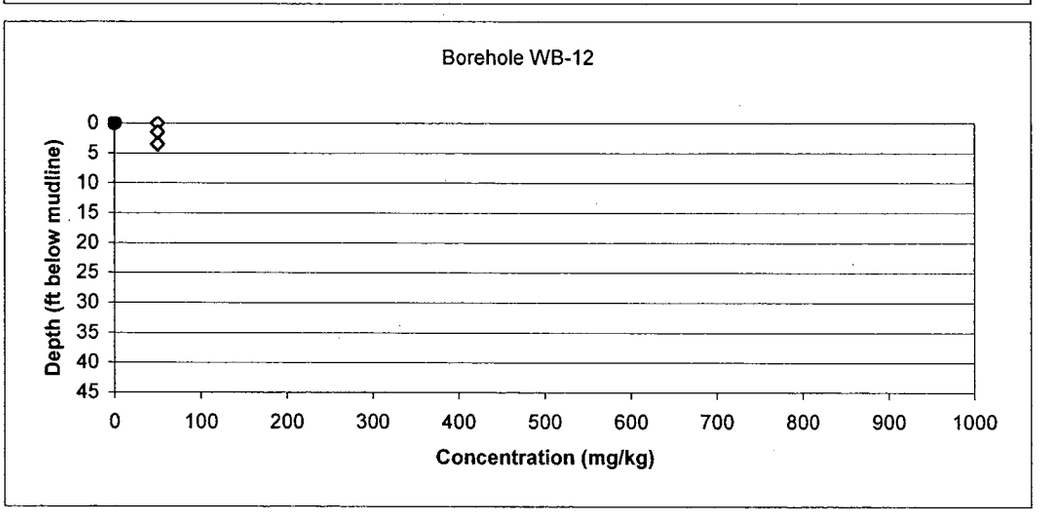
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





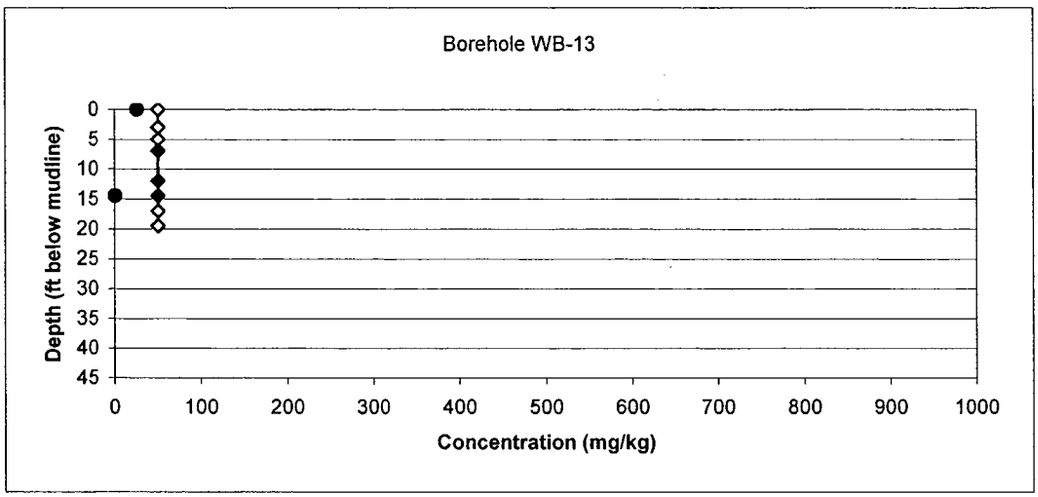


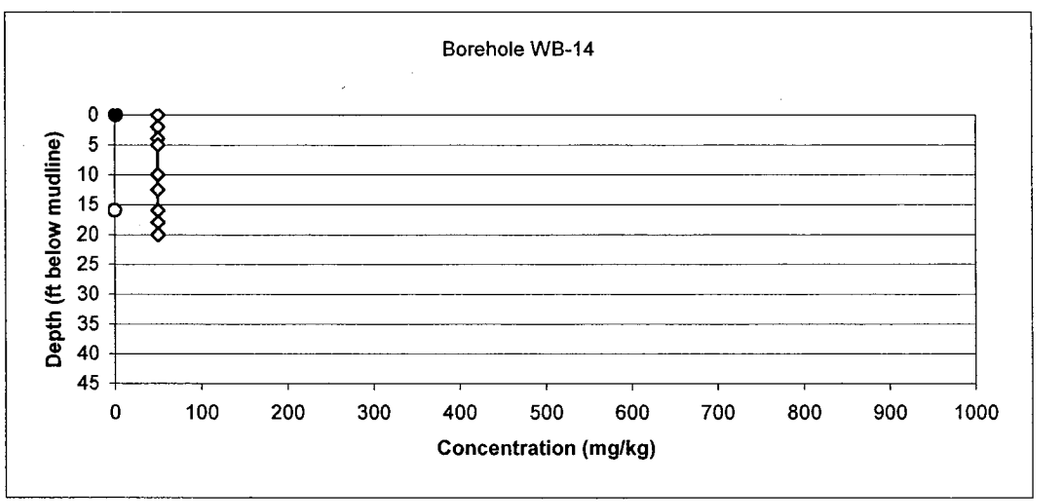
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

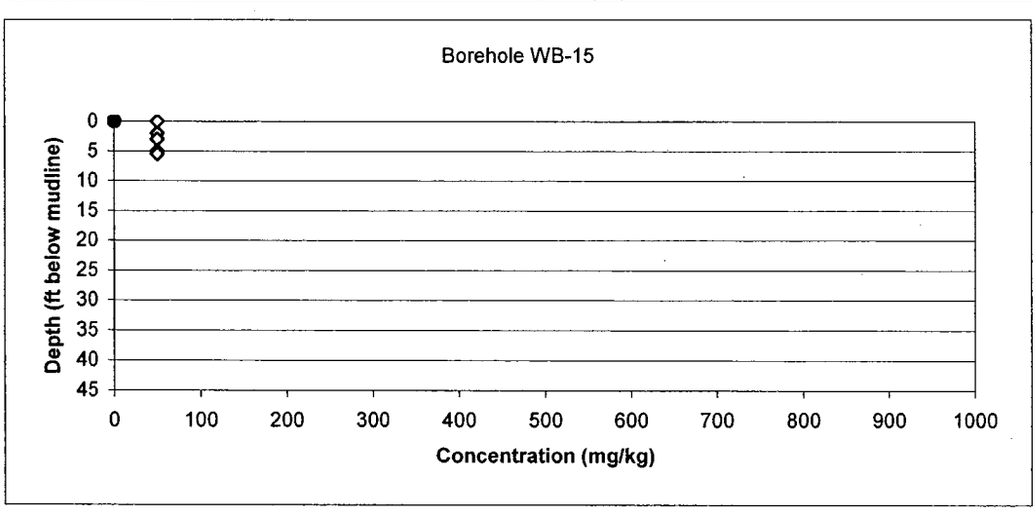
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





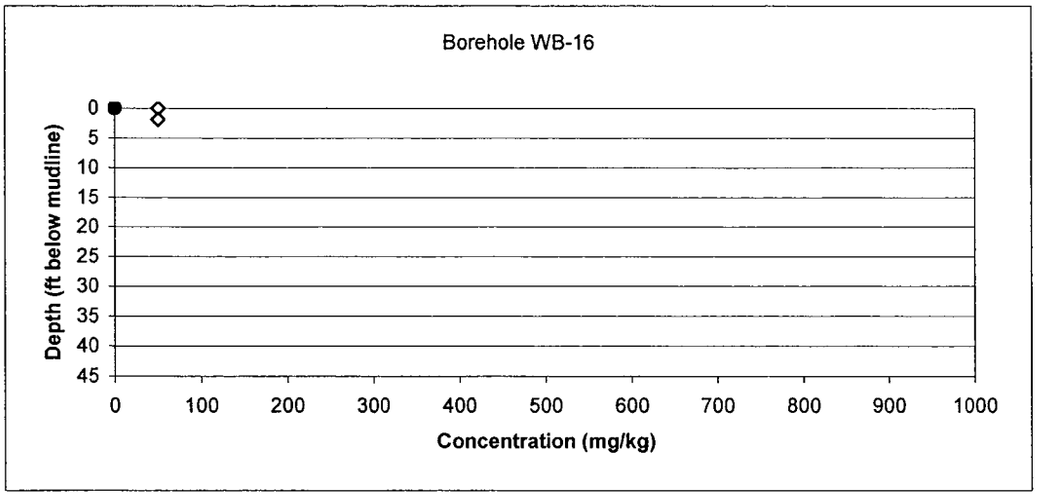


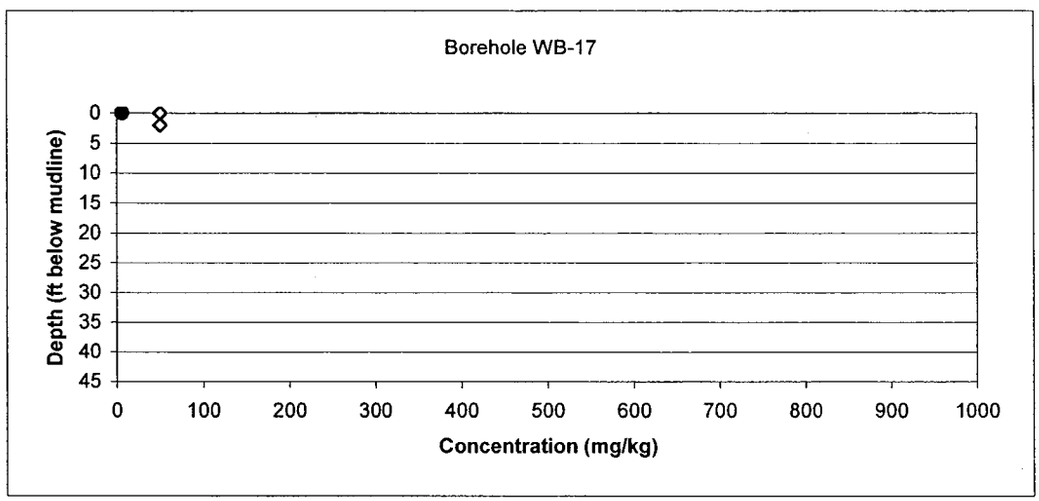
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

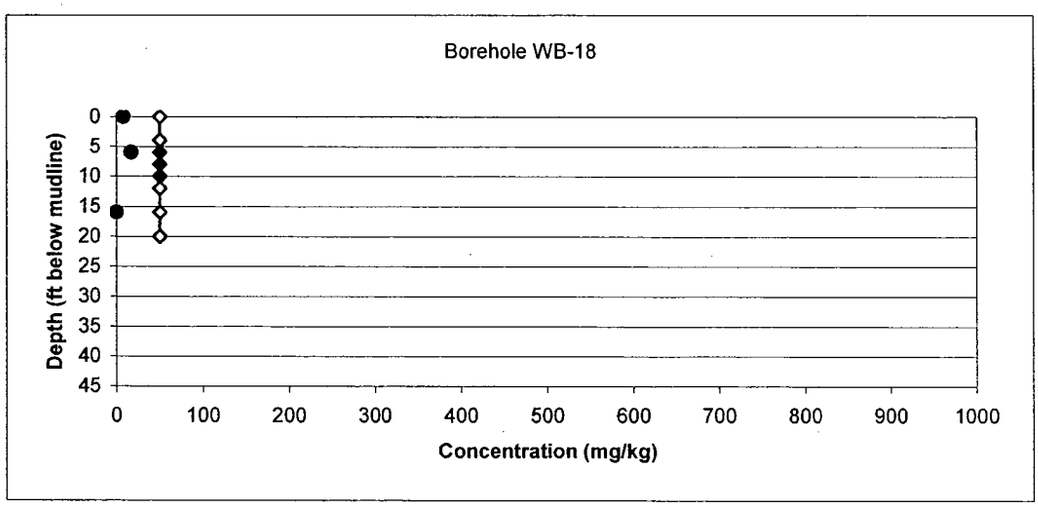
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





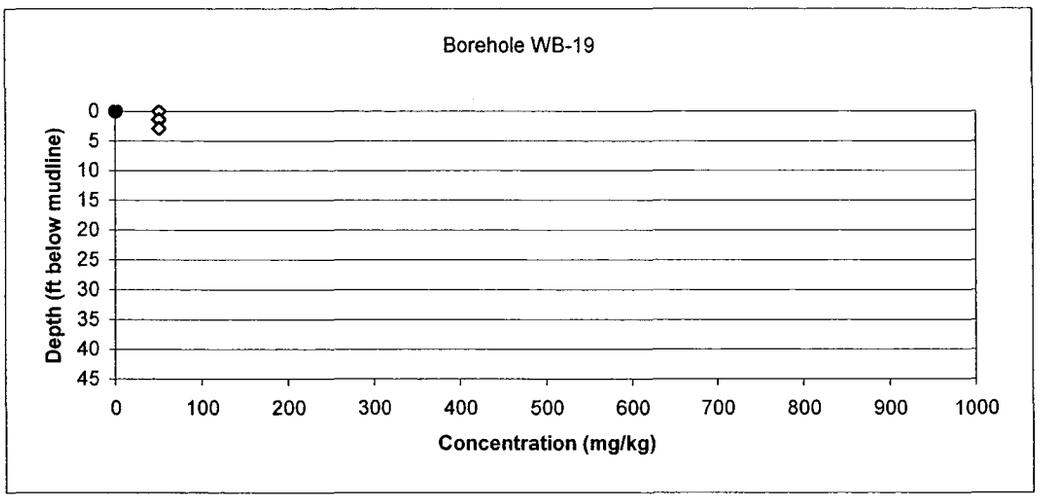


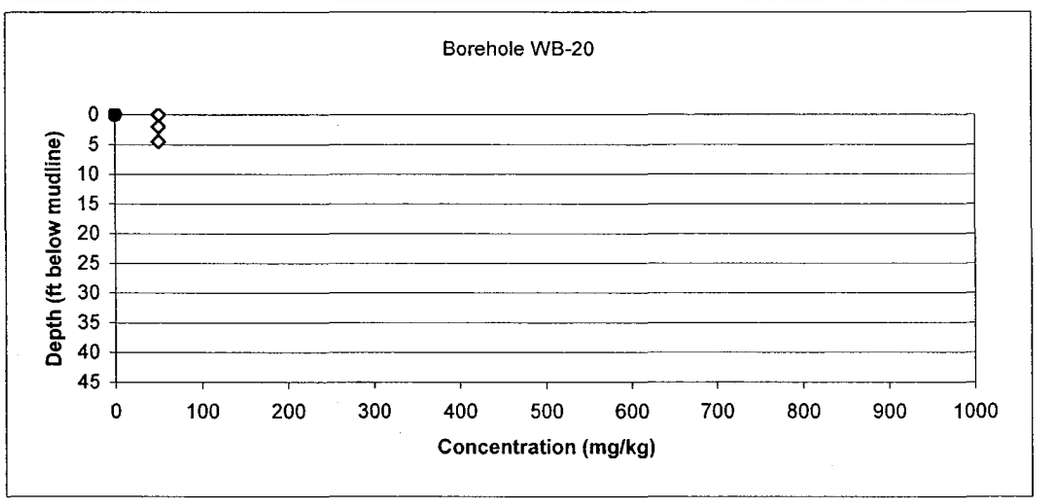
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

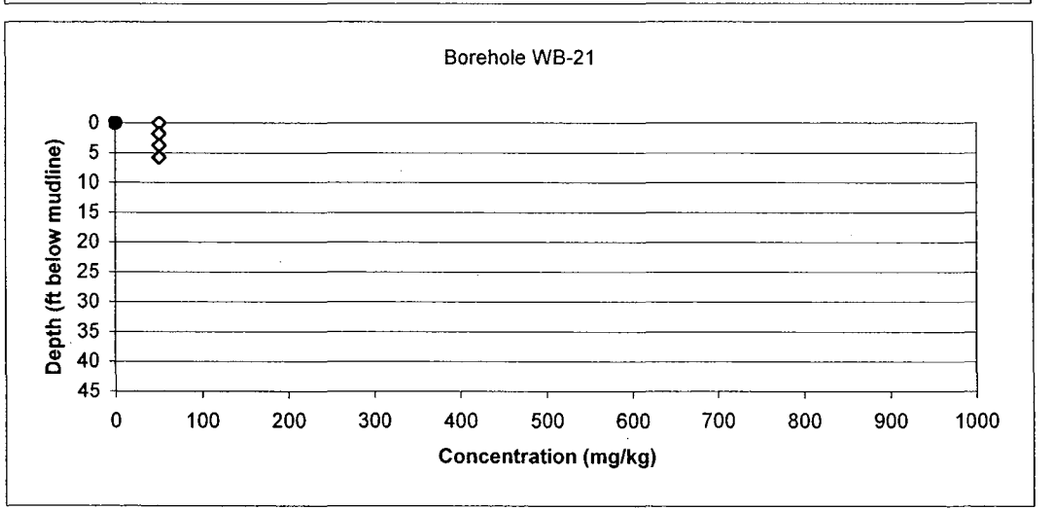
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





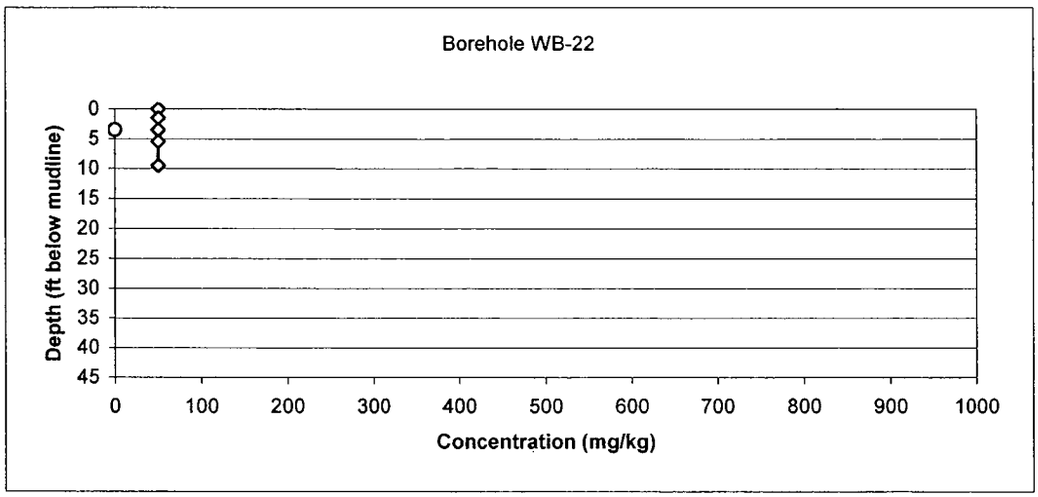


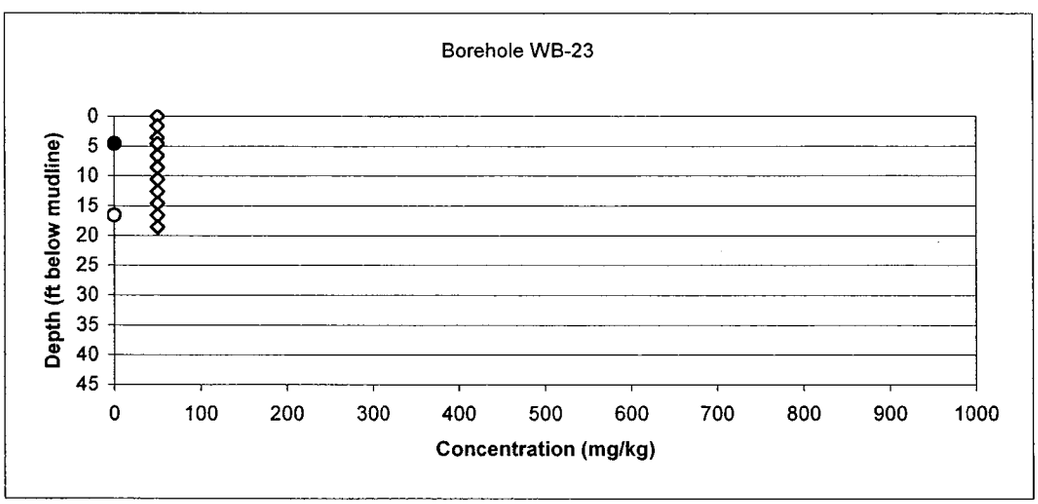
◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

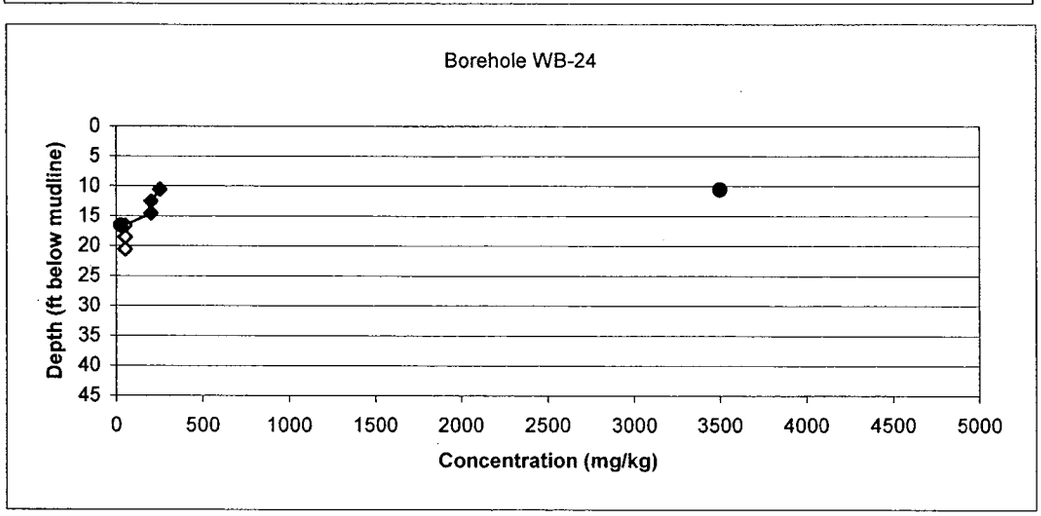
[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.





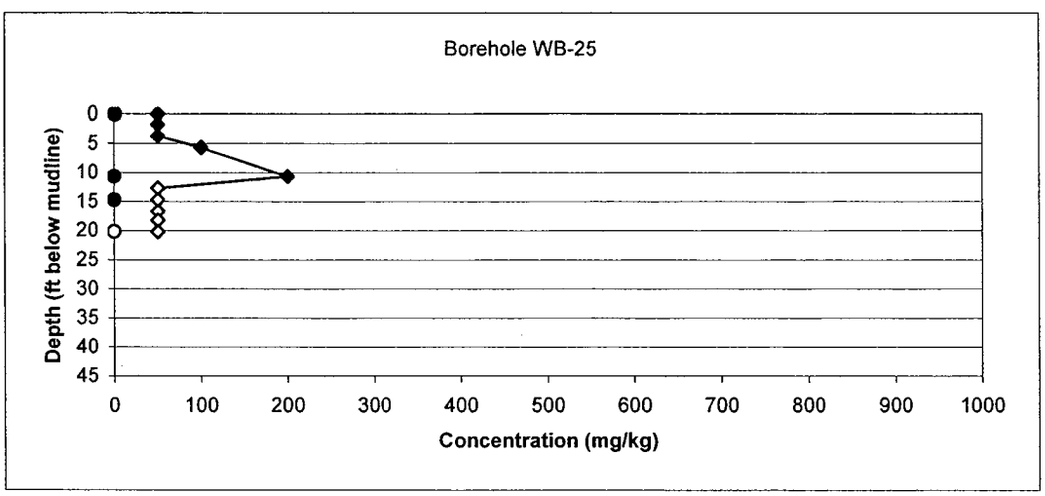


◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

integral consulting inc.



◇ DDT by TLC (open symbol - undetected[a])
◆ DDT by TLC (filled symbol - detected)
○ DDT by 8081A (open symbol - undetected[a])
● DDT by 8081A (filled symbol - detected)

[a] Concentration represents detection limit

Figure 10 (con't). Vertical distribution of DDT in Phase II borehole sediments.

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Appendix A

Borehole Logs

Stage 1 Borehole Logs

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-1

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 29.0' below dock - Depth to river surface 24.75' at time of sampling	
5								
10								
15								
20								
25							River surface	
30	SO1711	0.0	50%	NA		SP	Fine to medium SAND, predominantly fine sand, dark yellow-brown (10YR 4/4), wet, few fine gravels, few wood chunks, no odor.	BACKFILLED w/BENTONITE GROUT
35	SO1712	34.2	50%	NA		ML SW	Sandy SILT, fine to med. sand in thin lenses, very dark gray (2.5Y 3/1), wet. At 34' no sand, faint odor. Fine to med. SAND, very dark gray (2.5Y 3/1), wet.	
40	SO1713	85.7	35%	NA		ML	Clayey SILT, very dark gray (2.5Y 3/1), wet, slight organic odor.	

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 3-4 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.58

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-1

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40								
	SO1713	85.7	35%	NA		SP	Fine to medium SAND, predominantly fine sand, black (2.5Y 2.5/1), wet, few wood chunks, red grains throughout, no odor.	BACKFILLED w/BENTONITE GROUT
	SO1714	3.4	50%	NA				
45	SO1715	3.4	100%	NA				
	SO1716	0.0	100%	NA				
	SO1717	0.0	15%	NA				
50	SO1718	1.7	50%	NA				
	SO1719	1.7	100%	NA		ML	SILT, very dark gray (5Y 3/1), wet.	
						SM	Slightly silty, fine SAND, very dark gray (5Y 3/1), silt ~10-20%, grades to some brown mottling.	
55	SO1720	1.7	100%	NA		ML	Slightly very fine, sandy SILT (sand ~10%), dark yellow-brown (10YR 4/4), wet.	
							Refusal on vesicular basalt @ 56'. Groundwater sample GW06040201 collected from 33'-37' BGS Groundwater sample GW06040202 collected from 48'-52' BGS	
60								
65								
70								
75								
80								

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 3-4 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.58

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-2

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL		LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0								- Mudline @ 33.3' below dock - Depth to river surface 24.50' at time of sampling	
5									
10									
15									
20									
25								River surface	
30									
35	SO1721	8.1	60%	NA			SP	Fine to med. SAND, predominantly fine grained, trace silt, dark olive-brown (2.5Y 3/3), wet, scattered red grains throughout. Silt lens 1.5" thick (depth uncertain). Color change to very dark gray (2.5Y 3/1) @ 34.8'.	BACKFILLED w/BENTONITE GROUT
	SO1721	0.0	20%	NA			ML	Very fine sandy SILT, very dark gray (2.5Y 3/1), fibrous organic material 35.4-35.7', no odor, wet. Grades to clayey SILT w/ trace v. fine sand, dark gray (2.5Y 3/1), wet.	
	SO1722	0.0	65%	NA					
40	SO1723	0.0	50%	NA					

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 4-5 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.67

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-2

Ground surface: Dock #2

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40	SO1723	0.0	50%	NA		ML	Clayey SILT w/ trace very fine, sand, dark gray(2.5Y 3/1), wet.	BACKFILLED w/BENTONITE GROUT
	SO1724	8.1	75%	NA			Fine to medium SAND lens (2" thick), black (10YR 2/1), scattered red grains throughout @ 40.7 BGS.	
	SO1725	15.7	65%	NA			2" layer w/ odor, some sand and single apparent volcanic gravel (1" dia.) @ 44.1' BGS.	
45	SO1726	55.5	50%	NA		SP/ ML	Becomes fine bedded with above and fine to med. SAND, predominantly fine sand, black (2.5Y 2.5/1), wet, red grains throughout.	
	SO1727	15.3	50%	NA		SP	Sand only as above.	
50	SO1728	0.0	65%	NA		ML	SILT, dark gray (2.5Y 4/1), wet.	
55							Refusal on vesicular basalt @ 51'. Groundwater sample GW06040203 collected from 37'-41' BGS. Groundwater sample GW06040204 collected from 45'-49' BGS	
60								
65								
70								
75								
80								

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 4-5 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.67

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-3

Ground surface: Dock #2

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL		LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0								- Mudline @ 39.0' below dock - Depth to river surface 22.04' at time of sampling	0
5									5
10									10
15									15
20									20
								River surface	
25									25
30									30
35									35
40	SO1729	2.8	85%	NA			ML	Clayey SILT, very dark gray (7.5Y 3/1), trace (5-10%) organics, trace very fine sand, wet, soft.	BACKFILLED w/BENTONITE GROUT 40

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 5-6 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.71

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

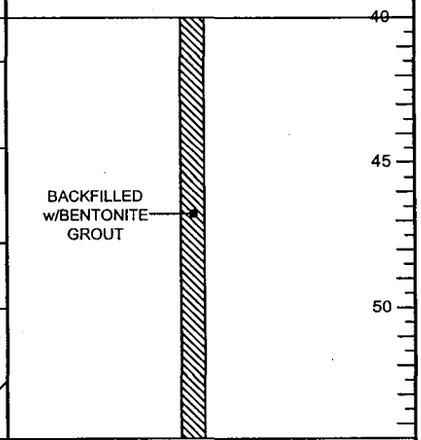
Borehole: WB-3

Ground surface: Dock #2

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION
40	SO1729	2.8	85%	NA		ML	Clayey SILT, very dark gray (7.5Y 3/1), trace (5-10%) organics, trace very fine sand, wet, soft.
	SO1730	4.7	85%	NA		CL	Silty CLAY, dark gray (7.5YR 3/1), ~40-50% silt, trace organics (~2%), soft, wet.
			0%	NA			
45	SO1731	2.8	100%	NA		ML/ CL	Clayey SILT/silty CLAY, dark gray (2.5Y 4/1), trace organics, wet, soft.
	SO1732	4.7	50%	NA		ML	Clayey SILT, very dark gray (2.5Y 3/1), clay ~10-15%, trace (~5-15%) very fine sand, trace non carbonized wood, very moist.
50	SO1733	4.7	75%	NA		SM SP	Grading to silty fine to med. SAND, very dark gray (2.5Y 3/1) ~25-35% silt, wet, ~5-10% wood fragments, clayey silt laminations (~0.08' thick) @ 50' BGS.
	SO1734	2.8	55%	NA			
	SO1735	2.8	75%	NA		ML/ SM	Fine to med. SAND, black (2.5Y 2.5/1), trace silt (<5%), micaceous, trace red grains and organics, wet. Silt lamination @ 52.2, 52.5' and 53.3' BGS (~0.02" thick).
55							Silty, very fine SAND/sandy very fine SILT , dark gray (2.5Y 4/1), micaceous, wet.
							Refusal @ 54.5' on BASALT, black (2.5Y 2.5/1), slightly vesicular.
60							Groundwater sample GW06050201 collected from 42'-46' BGS. Groundwater sample GW06060201 and GW06060202 (duplicate) collected from 50'-54' BGS.
65							
70							
75							
80							

WELL CONSTRUCTION DETAIL



Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 5-6 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.71

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-4

Ground surface: Dock #1

Geologist: David Lamadrid, Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL		LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0								- Mudline @ 29.7' below dock - Depth to river surface @ 23.82' at time of sampling	
5									
10									
15									
20									
25								River surface	
30	SO1736	7.3	~10%	NA			SW	Gravelly, fine to coarse SAND, very dark gray (7.5YR 3/1), predominantly fine to med. sand, gravel up to 1", trace red brick, wet.	BACKFILLED w/BENTONITE GROUT
	SO1737	10.9	~10%	NA				Fine to medium SAND, trace silt, black (10YR 2/1), wet, single wood fragment.	
35	SO1738	7.3	~10%	NA			ML	Clayey SILT, very dark gray (5Y 3/1), wet, wood fragments.	
	SO1739	3.5	50%	NA			SM/ ML	Silty SAND/sandy SILT, fine sand, dark brown (10YR 3/3), wet, abundant wood fibers.	
	SO1740	5.4	50%	NA			SP	Fine to med. SAND, predominantly fine grained, very dark gray-brown (10YR 2/2), wet, red grains throughout.	
40									

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 6-10 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.32

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-4

Ground surface: Dock #1

Geologist: David Lamadrid, Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40								40
	SO1741	5.4	60%	NA		SP	Fine to med. SAND, predominantly fine grained, very dark gray-brown (10YR 2/2), wet, red grains throughout. Silt lens (0.5" thick) @ 40.8' BGS. Color grades to brown (10YR 4/3), increased med. grained.	
	SO1742	5.4	50%	NA				
45	SO1743	5.4	50%	NA				45
	SO1744	0.0	15%	NA			Color grades to dark yellow-brown (10YR 3/4).	
	SO1745	1.8	50%	NA				
50			0%	NA				50
						SM	Silty, very fine SAND, olive-brown (2.5Y 4/3), micaceous, ~25-35% silt, wet.	
	SO1746	3.6	80%	NA				
						ML	SILT, olive-brown (2.5Y 4/3), wet.	
55	SO1747	5.4	100%	NA		SM	Silty v. fine SAND, dark gray-brown (2.5Y 4/2), micaceous, ~30-35% silt, wet.	55
	SO1748	3.6	100%	NA		ML-SM	Bedded silty SAND, sandy SILT and SILT, grayish brown (2.5Y 5/2), micaceous sand, wet, beds 0.5' to 2.5' thick.	BACKFILLED w/BENTONITE GROUT
	SO1749	3.6	100%	NA				
60								60
	SO1750	1.8	100%	NA		SM	Silty, very fine SAND, dark gray-brown (2.5Y 4/2), ~15-25% silt, micaceous, wet. Silt lens, olive-brown (2.5Y 4/3), ~0.1' thick @ 62.2' BGS.	
	SO1751	3.6	100%	NA		ML/SM	Silty, very fine SAND, very fine, sandy SILT, olive-brown (2.5Y 4/3), micaceous, wet. Silt lens 0.1' thick @ 63.5', color as above.	Boring terminated at 64' BGS on 6/6/02, resumed on 6/10/02.
65	SO1757	1.7	100%	NA				65
	SO1758	0.0	75%	NA		ML	Becomes bedded SILT and sandy, very fine SAND/sandy SILT, olive-brown (2.5Y 4/3), wet, slightly micaceous, beds 0.5' to 2' thick.	
	SO1759	0.0	100%	NA				
70	SO1760	5.4	100%	NA				70
							Refusal on BASALT @ 72.5' BGS	
75							Groundwater sample GW06100201 collected from 34'-38' BGS. Groundwater sample GW06100202 collected from 47'-51' BGS. Groundwater sample GW06100203 (duplicate) collected from 60'-64' BGS.	75
80								80

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 6-10 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.32

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-5

Ground surface: Dock #1

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 48.7' below dock - Depth to river surface 24.98' at time of sampling	0
5								5
10								10
15								15
20								20
25							River surface	25
30								30
35								35
40								40

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.51

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-5

Ground surface: Dock #1

Geologist: David Lamadrid

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40							Water	40
45								45
50	SO1775	5.4	100%	NA		ML	Very clayey SILT, very dark gray (2.5Y 3/1), clay ~25-35%, wet, some scattered fibrous organics throughout, faint odor decreasing with depth.	50
	SO1776	16.3	100%	NA				
			0%	NA				
55			0%	NA				55
			0%	NA				
60	SO1777	283	30%	NA			Scattered small wood chunks to 1" dia., silty fine sand lens (0.5" thick), black (2.5Y 2.5/1), faint odor.	60
	SO1778	7.2	75%	NA		SP	Fine to med. SAND, predominantly fine grained, dark olive-brown (2.5Y 3/3), wet, red grains throughtout, no odor.	BACKFILLED w/BENTONITE GROUT
65	SO1779	3.6	35%	NA				65
	SO1780	1.8	50%	NA			Very silty fine sand lenses (0.5" thick), single wood chunk in one lens @ 60.2 and 60.5' BGS.	
	SO1781	5.4	75%	NA		ML	Slightly clayey SILT, olive-brown (2.5Y 4/3), slight orange-brown mottling, wet, no odor.	
70						ML/SM	Fine sandy SILT/silty SAND, olive-brown (2.5Y 4/3), slight orange-brown mottling, wet, no odor.	70
75							Refusal @ 70.2', likely BASALT, but no sample observed. Total depth 70.2'. Groundwater sample GW06110202 collected from 54'-58' BGS. Groundwater sample GW06110203 collected from 64-68' BGS.	75
80								80

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.51

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-6 (revised 9/02)

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 49.1' below dock	0
5								5
10								10
15								15
20								20
25								25
30								30
35								35
40								40

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 7 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.56

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-6 (revised 9/02)

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40								40
45								45
50	SO1752	7.1	100%	NA		ML	Clayey SILT, dark gray (10YR 4/1), ~15-20% clay, wet, trace (5%) tan powdery material, trace (5%) tan to light brown material, weak odor, dis-continuous sheen on water.	50
	SO1753	8.9	100%	NA			Decreased clay content below 49.5' BGS.	
			0%	NA			Tan powdery material absent below 51' BGS, trace (~5-10%) non-carbonized wood, tan @ 52.5-53' BGS.	
55	SO1754	314	30%	NA			SILT, very dark gray (10YR 3/1), some very fine sandy silt zones (~25-35%), moist, weak to moderate odor.	55 BACKFILLED w/BENTONITE GROUT
60	SO1755	>3000	60%	NA			SILT, very dark gray (2.5Y 3/1), trace very fine sand, wet, ~5-10% carbonized and non-carbonized wood, strong odor.	60
			0%	NA		SM	Silty, very fine SAND, gray (2.5Y 5/1), ~10-20% silt, strong odor, residual NAPL observed from 60.9-61.0 ft.	
							Soft probing @ 61-63'. Very soft from 63-65'. Geoprobe rods sank to 65'. No sample collected.	
65	SO1756	1389	60%	NA		ML	SILT, dark gray (7.5YR 4/1), trace fibrous organics (<5%), soft, strong odor at top of sample, weak odor elsewhere, trace fine sand.	65
							Boring terminated @ 67' BGS'.	
70								70
75								75
80								80

Drilled By: Cascade Drilling

Drill Method: Direct push probe

Drill Date: 7 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 36.56

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-7

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
0							- Mudline @ 50.2' below dock - Depth to river surface @ 24.38' at time of sampling	0
5								5
10								10
15								15
20								20
25							River surface	25
30								30
35								35
40								40

Drilled By: Cascade Drilling

Drill Method: Direct push probe (tripod)

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 37.11

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001.0634

Project: Acid Plant RI

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-7

Ground surface: Dock #1

Geologist: Eron Dodak

DEPTH (Feet)	SAMPLE NUMBER	OVM (ppm)	% RECOVERY	BLOW COUNT	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	WELL CONSTRUCTION DETAIL
40							Water	
45								
50								
	SO1761	3.6	100%	NA		ML	Very clayey SILT, very dark gray-brown (2.5Y 3/2), ~15-25% clay, trace fibrous organic material, wet.	
	SO1762	12.6	100%	NA			As above, weak odor.	
55	SO1763	9.0	<1%	NA			As above, color change to dark gray (5Y 4/1).	
	SO1764	56.1	30%	NA		SP	Contact contained ~0.7" wood. Fine to med. SAND, very dark gray (5Y 3/1), trace (<5%) red grains, wet, weak odor.	BACKFILLED w/BENTONITE GROUT
	SO1765	63.7	60%	NA		ML	Clayey SILT, very dark gray (5Y 3/1), ~10-20% clay, trace (<2%) wood, soft, wet. Fine sandy SILT @ 59.6' BGS, very dark gray (5Y 3/1), ~25-35% sand, ~10-15% wood.	
60								
	SO1766	57.1	40%	NA		SP	Fine to med. SAND, very dark gray (5Y 3/1), trace coarse sand (<5%) and silt (<5%), wet. Occasional silt laminations, weak odor.	
	SO1767	54.0	30%	NA		ML	SILT, grayish brown (2.5YR 5/2), wet, weak odor at ~64.5'-65' BGS, fine to med. sand lens, very dark gray (2.5Y 5/2), 2" thick @ 64' BGS.	
65							Boring terminated @ 65' BGS'.	
							Groundwater sample GW06120202 collected from 61'-65' BGS.	
70								
75								
80								

Drilled By: Cascade Drilling

Drill Method: Direct push probe (tripod)

Drill Date: 11-12 June 2002

Well Casing Elevation: NA

Dock Surface Elevation: 37.11

Borehole Diameter: 2.0"

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Stage 2 Borehole Logs

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-8

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	9							Barge Deck	
0									
								Willamette River surface.	
	5								
5								Mudline at 5.7 ft below barge deck.	
							SP	Very fine to fine SAND, dark yellow brown (10YR 3/6), slightly micaceous, trace black asphalt-like fragments, wet.	
							SM	Silty very fine to fine SAND, black (5Y 2.5/1), 10-20% silt, trace red grains, weak odor, slight sheen on liquid in sampler. Grades to dark olive gray (5Y 3/2).	
		SO1915	6.2	Neg.	25%				
	0								
10									
		SO1916	12.0	Neg.	100%		CL/ ML	Silty CLAY/Clayey SILT, black (2.5Y 2.5/1) with dark olive gray mottling (5Y 3/2), soft, trace sand and wood fragments, wet, moderate odor, sheen.	
	-5	SO1917	12.0	Neg.	100%				
15							SM	Silty very fine SAND, dark olive gray (5Y 3/2), 20-30% silt, trace red grains, wet, moderate odor, sheen.	
							SP		

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 28, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.6 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-8

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1918	15.5	Neg.	100%		SP	Grading to very fine to fine SAND, black (5Y 2.5/1), trace red grains, some wood fragments, wet, moderate odor, sheen.	
	-10	NA	NA	NA	0%		CL	Silty CLAY, light olive brown (2.5Y 5/4), 10-20% silt, moderately firm, moist to wet, no odor.	
21		SO1919	7.0	Neg.	90%		ML	SILT, olive brown, trace clay, some zones slightly more clayey, slightly micaceous, wet, no odor.	
	-15	SO1920	5.4	Neg.	100%				
		SO1921	4.5	Neg.	100%		SP	Very fine to fine SAND, black (5Y 2.5/1), trace red grains, wet, moderate odor, sheen.	
26		SO1922	6.2	Neg.	100%		SM/ ML	Very fine sandy SILT/Silty very fine SAND, olive brown (2.5Y 4/3), very slightly micaceous, wet, no odor.	
							SM	Grading to silty very fine SAND, olive brown (2.5Y 4/3), 20-30% silt, very slightly micaceous, wet, no odor.	
	-20	SO1923	5.4	Neg.	100%				
31		SO1924	5.4	Neg.	100%		ML	SILT, olive brown (2.5Y 4/3), trace to 30% very fine sand, slightly micaceous, sand in mixed zones.	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 28, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.6 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 3

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-8

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	-25	SO1925	6.4	Neg.	100%		ML	SILT, olive brown (2.5Y 4/3), trace to 30% very fine sand, slightly micaceous, sand in mixed zones.			-25
		SO1926	7.0	Neg.	70%		SM	Grades to silty very fine SAND, 5-15% silt, micaceous, wet.			
37		SO1927	5.4	Neg.	80%		SP	Grades to very fine to fine SAND, olive brown (2.5Y 4/3), micaceous, wet.		37	
	-30	SO1928	7.0	Neg.	100%		ML	Very fine sandy SILT, olive brown (2.5Y 4/3), trace orange mottling at 39 ft, 10-20% sand, wet.			-30
		SO1929	5.4	Neg.	75%		SM	Grading to silty very fine SAND, olive brown (2.5Y 4/3), 20-30% silt, wet.			
42		SO1930	2.0	Neg.	25%		SW	Fine to coarse SAND, black (2.5Y 2.5/1), trace red grains, wet.		42	
	-35						Rx	BASALT, black, massive.			-35
								Refusal on basalt at 43.8 ft below barge deck. Groundwater sample GW02280301 collected at 16-20 ft below deck. Groundwater sample GW02280302 collected at 39.5-43.5 ft below deck.			
47										47	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 28, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.6 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 3 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-9

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
								Mudline at 5 ft below barge deck.			
5	5						SW	Gravelly fine to coarse SAND, very dark gray (10YR 3/1), trace of silt, gravel up to 1" dia., trace organics, no odor.		5	5
		SO1931	0.0	Neg.	15%						
								Becomes very dark gray (7.5YR 3/1), trace of concrete, red brick, and glass.			
10	0	SO1932	0.9	Neg.	25%					10	0
							SP	Fine to medium SAND, gray (7.5YR5/1), miceaeous, trace fine gravel, weak odor.			
		SO1933	3.4	Neg.	90%						
								Trace wood.			
		SO1934	3.5	Neg.	60%			Becomes dark gray (2.5Y 4/1), 15-20% silt, weak to moderate odor, possible sheen at bottom of sampler.			
15										15	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 4, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-9

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
		SO1935	6.1	Neg.	5%		SP	Fine to medium SAND, dark gray (2.5Y 4/1), 15-20% silt, micaceous, trace fine gravel, weak to moderate odor.			
								5-10% silt, no sheen.			
							ML	SILT, very dark gray (2.5Y 3/1), soft, trace organic fibers, weak odor.			
		SO1936	0.0	Neg.	100%			Becomes dark gray (2.5Y 4/1), trace very fine sand, micaceous, weak to indistinct odor.			
20	-10	NA	NA	NA	0%					20	-10
		SO1937	0.0	Neg.	60%		SM	Silty fine to med. SAND, very dark gray (2.5Y 3/1), 15-20% silt, weak to moderate odor, light iridescent sheen.			
							ML	SILT, dark gray (10YR 4/1), slightly stiff, weak odor.			
							SP	Fine to med. SAND, very dark gray (2.5Y 3/1), trace red grains, indistinct odor, no sheen.			
		SO1938	0.1	Neg.	60%			SILT layers, dark gray (10YR 4/1), at 24' bgs (2" thick) and 24.5' bgs (1.2" thick), sheen between layers.			
25	-15							Trace of wood and silt.		25	-15
		SO1939	0.4	Neg.	40%						
							ML	SILT, dark gray (10YR 4/1), slightly stiff, indistinct odor.			
							SM	Silty fine SAND, dark gray (10YR 4/1), 10-15% silt, moderate odor, iridescent sheen.			
		SO1940	0.0	Neg.	90%		ML	Grading to silty very fine SAND, grayish brown (2.5Y 5/2), micaceous.			
								Grading to SILT, grayish brown (2.5Y 5/2), slightly stiff, indistinct odor, no sheen.			
							SM	Silty very fine SAND, dark gray brown (2.5Y 4/2), 15-20% silt, micaceous, indistinct odor.			
30		SO1941	0.0	Neg.	100%		ML			30	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 4, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-9

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
							ML	SILT, grayish brown (2.5Y 5/2), trace clay, moderately stiff, no odor.	
								Sandy silt zone 1 in. thick.	
								20-30% clay, stiff.	
		SO1942	0.0	Neg.	100%			Very fine sandy SILT, grayish brown (2.5Y 5/2), 20-40% sand, indistinct odor.	
								Grading to SILT.	
							SM	Silty very fine SAND, brown (10YR 4/3), 15-25% silt, micaceous, indistinct odor.	
		SO1943	0.0	Neg.	85%			Becomes dark yellow brown (10YR 3/4).	
35	-25							Becomes dark gray brown (10YR 4/3), some orange mottling, weak to moderate odor.	
		SO1944	0.0	Neg.	100%		ML	SILT, grayish brown (10YR 5/2), slightly to moderately stiff, trace orange mottling, weak to moderate odor.	
							SM	Silty very fine to fine SAND, dark gray brown (10YR 4/2), 15-25% silt, trace orange banding, micaceous, weak to moderate odor.	
		SO1945	0.0	Neg.	75%		ML	Becomes dark yellow brown (10YR 4/4), mostly fine sand.	
								Very fine sandy SILT, dark gray brown (10YR 4/2), micaceous, 30-45% sand, indistinct odor.	
		SO1946	0.0	Neg.	NA		SM	Silty very fine SAND, brown (10YR 5/3), 20-30% silt, micaceous, indistinct odor, no sheen.	
40	-30						Rx	BASALT: black (2.5Y 2.5/1), massive, well indurated, indistinct odor.	
								Refusal on basalt at 40.2 ft below barge deck.	
								Groundwater sample GW03040301 collected at 20-24 ft below deck.	
								Groundwater sample GW03040302 collected at 36-40 ft below deck.	
45									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 4, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 3 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-10

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
0	10							Barge Deck		0	10
								Willamette River surface.			
5	5									5	5
10	0							Mudline at 14 ft below barge deck.		10	0
15	-5	SO1947*	4.8	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace clay and organics, soft, wet, weak to indistinct odor. Fine sandy SILT zone 0.3' thick.		15	-5

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 5-6, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.0 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-10

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1949	5.9	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace clay and organics, soft, wet, weak to indistinct odor. Very fine sandy SILT zone 0.3' thick, few thin (1/32" thick) tan clay laminations.	
		SO1950	8.0	Neg.	NA			Trace fibrous organics, indistinct odor. Becomes very dark gray (5Y 3/1), trace sand, weak to moderate odor, trace of iridescent sheen.	
	-10	SO1951	12.1	Neg.	100%			5-10% very fine sand, indistinct odor, no sheen.	
21									
		SO1952	8.0	Neg.	100%			Increased fibrous organic content and decreased sand content.	
		SO1953	6.7	Neg.	70%			Becomes dark olive gray (5Y 3/2), with some tan clay laminations (1/32" thick).	
	-15								
26									
		SO1954	32.2	Neg.	100%			Becomes very dark gray (5Y 3/1), occasional tan clay laminations, weak odor.	
		SO1955	117	Neg.	100%				
							SM	Silty fine SAND, dark gray (10YR 4/1), 20-30% silt, strong odor, sheen.	
							ML	SILT, dark gray (10YR 4/1), 5-10% fibrous organics, soft to slightly stiff, strong odor, no sheen.	
	-20	SO1956	2280	Neg.	100%				
31									
		SO1957	271	Neg.	100%			2-5% fiberous organics, moderate odor.	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 5-6, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.0 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-10

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
							ML	SILT, dark gray (10YR 4/1), 2-5% fibrous organics, soft to slightly stiff, moderate odor, no sheen.			
								Silty fine SAND layer at 31.9-32.0 ft below deck.			
		SO1958	24.3	Neg.	95%			Becomes very dark gray (5Y 3/1), 5-15% very fine sand, trace clay, decreased fibrous organics content, weak odor.			
								Sand rich zone at 33.9-34.0 ft below deck.			
	-25										-25
								Trace carbonized wood, no odor, sand, or clay.			
		SO1959	8.9	Neg.	90%						
							SM	Silty medium to coarse SAND, very dark gray (2.5Y 3/1), 5-10% wood, no odor, light organic sheen. Grades to silty very fine sand below 36.7 ft.			
37							SP			37	
		SO1960	5.8	Neg.	100%			Fine SAND, dark gray (2.5Y 4/1), 5-10% silt, trace red grains, no odor or sheen.			
								Silt and wood rich zone 0.3' thick.			
	-30	SO1961	3.5	Neg.	100%			Trace silt.			-30
								Becomes very dark gray brown (2.5Y 3/2).			
		SO1962	1.1	Neg.	15%						
42							GW	Fine to coarse GRAVEL, very dark gray (10YR 3/1), subrounded to rounded, no odor or sheen.		42	
							Rx	BASALT, black (5Y 2.5/1), vesicular, well indurated, orange staining lining vesicles, no odor or sheen.			
								Refusal on basalt at 42.7 ft below barge deck.			
								Groundwater sample GW03050302 collected at 28-32 ft below deck.			
	-35							Groundwater sample GW03060301 and duplicate sample GW03060302 collected at 38-42 ft below deck.			-35
								*Duplicate soil sample SO1948 collected from this interval.			
47										47	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 5-6, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.0 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 3 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-11

Ground Surface: Barge Deck
Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	9							Barge Deck	
								Willamette River surface.	
5	5								
10	0							Mudline at 11.5 ft below barge deck.	
		SO1963	4.4	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace fine sand and organics, soft, no odor.	
								Light tan clay-rich zones, 5-10% fibrous organics.	
15	-5	SO1964	3.7	Neg.	100%			Occasional tan clay rich laminations, weak odor.	
		SO1965	14.8	Neg.	30%			As above with color dark gray (5Y 4/1), weak odor, trace of dark brown oily material.	
20	-10							As above with consolidated tan fiberous material 19.3-19.4 ft below deck.	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 6-7, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.4 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-11

Ground Surface: Barge Deck

Logged By: Eron Dodak

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1966	109	Neg.	20%		ML	SILT, dark gray (10YR 4/1), trace of very fine sand and fiberous organics, slightly stiff, weak to moderate odor.	
25	-15	SO1967	1230	Neg.	60%			As above with ¼" thick very fine sand rich (30-40%) zone. As above with strong odor, 5-10% fiberous material, few black bands 1" thick. Trace of Silty fine SAND at bottom of sampler, dark gray (10YR 4/1), possible sheen.	
		SO1968	78.5	Neg.	100%			SILT, dark gray (10YR 4/1), trace micaceous very fine sand and carbonize/noncarbonized wood, slightly stiff, weak odor.	
30	-20	SO1969	12.8	Neg.	75%			As above with very fine micaceous sand (10-20%), indistinct odor.	
		SO1970	21.4	Neg.	45%		SP	Slightly silty fine SAND, dark gray (2.5Y 4/1), trace wood and red grains, indistinct odor, light organic sheen at 31.7 ft only.	
		SO1971	13.5	Neg.	35%			As above with very fine to fine sand, no wood, moderate odor.	
35	-25						SM	Silty very fine SAND, olive brown (2.5Y 4/3), micaceous, 30-40% silt, piece of wood at bottom of unit, moderate odor.	
							Rx	BASALT: very dark gray (2.5Y 3/1), massive, well indurated, moderate odor.	
								Refusal on basalt at 34.0 ft below deck. Groundwater sample GW03070302 collected at 23-27 ft below deck. Groundwater sample GW03070301 collected at 31-33.5 ft below deck.	
40	-30								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 6-7, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.4 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-12

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10
25	-15									25	-15
30										30	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 19-20, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-12

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
35	-25								
40	-30							Mudline at 43.0 ft below barge deck.	
		SO1870	2.1	Neg.	100%		ML	SILT, dark gray (10YR 4/1), trace clay, minor fine rootlets, soft, wet, organic odor.	
45	-35	SO1871	0.7	Neg.	NA			Some black mottling.	
		SO1872	2.2	NA	NA			Clayey SILT, dark olive brown (2.5Y 3/3), 20-30% clay, minor fine rootlets, wet, weak to indistinct odor.	
50	-40	NA	NA	NA	0%				
								GRAVEL, rounded, primarily basalt with minor quartzite, up to 2-in. dia.	
55	-45							Refusal on gravel at 52.2 ft below barge deck. Groundwater sample GW02200301 collected at 48-52 ft below deck.	
60									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 19-20, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.1 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-13

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	9							Barge Deck	
0								Willamette River surface.	
	5								
5								Mudline at 8 ft below barge deck.	
	0						ML	Fine to medium sandy SILT layer, dark olive gray (5Y 3/2), wet, at 8.00 to 8.04 ft below deck.	
							SM	SILT, dark olive gray (5Y 3/2), soft, single wood fragment 2" thick, wet.	
10		SO1896	3.2	Neg.	40%			Fine to medium SAND, very dark gray (5Y 3/1), wet.	
							ML	Silty very fine SAND, mottled dark olive gray (5Y 3/2) and very dark gray (5Y 3/1), slightly micaceous, 20-30% silt, wet. Silt content decreased with depth.	
		SO1897	7.4	Neg.	100%			Fine to medium sandy SILT, dark olive gray (5Y 3/2), 30-40% sand, soft, trace organics and wood fragments, rare shells, slight iridescent sheen, wet.	
	-5	SO1898	5.7	Neg.	100%			At 13 ft below deck, clayey SILT, dark olive gray (5Y 3/2), 20-30% clay, soft, abundant wood fragments at contact, wet.	
15								Trace clay, slight black mottling, slightly micaceous, trace fiberous organics and wood fragments, faint iridescent sheen.	
		SO1899	6.5	Neg.	100%			Grades to 20-30% clay.	
	-10								

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 26, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.8 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-13

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
							ML/CL	Clayey SILT / silty CLAY, dark olive gray (5Y 3/2), abundant black mottling that decreases with depth, weak odor, wet.	
		SO1900	12.3	Neg.	100%				
							SP	Very fine to fine SAND, dark olive gray (5Y 3/2), wet, weak odor, faint sheen.	
24	-15	SO1901	25.5	Neg.	100%		ML/CL	Clayey SILT / silty CLAY, dark olive gray (5Y 3/2), abundant black mottling that decreases with depth, weak odor, wet.	
							SP	Very fine to fine SAND, very dark gray (5Y 3/1), trace red grains and mica, faint to no odor.	
		SO1902	28.8	Neg.	100%				
								Abundant wood at 27.5 ft only, grades to very fine to medium sand.	
		SO1903	16.4	Neg.	100%		ML	Very fine sandy SILT, light olive brown (2.5Y 5/4), slightly micaceous, wet, faint odor.	
29	-20							BASALT (recovery too poor for description).	
								Refusal on basalt at 28.5 ft below deck.	
								Groundwater sample GW02260303 collected at 13-17 ft below deck.	
								Groundwater sample GW02260304 collected at 24.5-28.5 ft below deck.	
34	-25								

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 26, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.8 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-14

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	8							Barge Deck	
								Willamette River surface.	
5	5								
10	0								
	-5							Mudline at 15 ft below barge deck.	
15		SO1906	13.8	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), soft, trace fibrous organics, rare wood fragments, few scattered pale yellow (2.5Y 7/4) thin clay laminations (1/8" thick), wet.	
	-10	SO1907	16.2	Neg.	100%			Grades to 20-30% clay.	
		SO1908	14.6	Neg.	100%			No clay laminations.	
20								Single broken plastic fragment.	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 27, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-14

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-15	SO1909	8.9	Neg.	60%		ML	As above with 5-15% clay, three layers (up to 1" thick) of black staining with weak odor at 22-22.7 ft below deck. Less odor with depth.	
		SO1910	14.6	Neg.	100%				
27							SM	Silty very fine to fine SAND, dark olive gray (5Y 3/2), 20-30% silt, wet, no odor.	
	-20	SO1911	18.7	Neg.	10%		SP	Very fine to fine SAND, dark gray (5Y 3/1), trace red grains, rare small wood fragments, wet, no odor.	
32		SO1912	NA	Neg.	15%				
	-25	SO1913	NA	Neg.	15%			Single 1" thick gray (5Y 5/1) SILT layer. Possible weak odor.	
		SO1914	NA	Neg.	30%		SM	Silty very fine to fine SAND, very dark gray (5Y 3/1), 10-20% silt, trace red grains, wet.	
37							ML/SM	2" thick gray (5Y 5/1) SILT layer, underlain by 1" thick very fine to fine SAND at 36.3 ft below deck.	
	-30							Very fine sandy SILT/silty very fine SAND, light olive brown (2.5Y 5/4), slightly micaceous, wet.	
								BASALT, slightly vesicular, slight green secondary mineralization in vesicles (few broken fragments only).	
								Refusal on basalt at 37.0 ft below deck.	
42								Groundwater sample GW02270301 collected at 19-23 ft below deck.	
	-35							Groundwater sample GW02270302 collected at 32-36 ft below deck.	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 27, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-15

Ground Surface: Barge Deck

Logged By: David Livermore

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
0	8							Barge Deck		0	8
								Willamette River surface (estimated).			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10
25	-15									25	-15
30	-20									30	-20

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 17, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-15

Ground Surface: Barge Deck
Logged By: David Livermore

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
								Mudline at 44 ft below barge deck.	
45		SO1850	0	Neg.	100%		ML	SILT, very dark gray (2.5Y 3/1), very soft, trace of very fine roots, wet.	
		SO1851	0	Neg.	100%				
		SO1852	0	Neg.	100%			Trace mica and charcoal, some clay, moderately plastic.	
		SO1853	3.0	Neg.	100%			Becomes very dark gray (2.5Y 3/1) to black (2.5Y 2.5/1), trace sand.	
50		SO1854	0	Neg.	100%		Rx	BASALT, dark gray, vesicular, slightly weathered, hard, dense.	
								Refusal on basalt at 50.0 ft below barge deck.	
								Groundwater sample GW02170301 collected at 45.3 ft to 49.3 ft below deck.	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 17, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 8.5 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-16

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	11							Barge Deck			11
0										0	
	10										10
								Willamette River surface.			
5										5	
	5										5
10										10	
	0										0
15										15	
	-5										-5
20										20	
	-10										-10
25										25	
	-15										-15
30										30	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 19, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 11.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-16

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
								Mudline at 38.6 ft below barge deck.	
		SO1867	8.1	Neg.	100%		ML	SILT, mottled dark gray (10YR 4/1) and black (10YR 2/1), trace clay, wet, weak to moderate odor.	
		SO1868	11.8	Neg.	100%			Becomes light olive brown (2.5Y 4/1), slightly micaceous, moderate odor.	
		SO1869	NA	NA	50%		SP	Very fine to fine SAND, dark gray brown (2.5Y 4/2), uniform, wet, slight odor.	
								BASALT, massive (few broken fragments only).	
								Refusal at 43.3 ft below barge deck.	
								Groundwater sample GW02190301 collected at 42-43 ft below deck.	

Depth scale: 35, 40, 45, 50, 55, 60
Elevation scale: -20, -25, -30, -35, -40, -45

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 19, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 11.5 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634	**Borehole: WB-17**
Project: ATOFINA	
Client: ATOFINA Chemicals, Inc.	Ground Surface: Barge Deck
Location: Portland, OR	Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	9							Barge Deck			9
0										0	
								Willamette River surface.			
	5										5
5										5	
	0										0
10										10	
	-5										-5
15										15	
	-10										-10
20										20	

Drilled By: Cascade Drilling	Well Casing Elevation: NA	Datum: City of Portland Datum - 1929
Drill Method: Direct Push	Barge Deck Elevation: 8.8 ft	
Drill Date February 27, 2003	Borehole Diameter: Varies	Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-17

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
								Mudline at 34.0 ft below barge deck.	
35	-25	SO1904	7.3	Neg.	25%		ML	Slightly clayey SILT, very dark gray (5Y 3/1), 5-15% clay, soft, trace rootlets and black mottling, wet, organic odor.	
		SO1905	13	Neg.	100%			Very fine to fine SAND, very dark gray (5Y 3/1), trace red grains, wet, no odor.	
								BASALT, black, massive (few fragments only).	
								Refusal on basalt at 36.2 ft below deck.	
								No groundwater samples collected.	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 27, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 8.8 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-18

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	10							Barge Deck	
								Willamette River surface.	
5	5								
								Mudline at 8 ft below barge deck.	
		SO1888	5.1	Neg.	100%		SM	Silty very fine SAND, very dark gray (5Y 3/1), 30-40% silt, slightly micaceous, trace fibrous organics and fine rootlets, rare fine gravel, few wood fragments, wet.	
10	0						ML	Grading to slightly sandy SILT, very dark gray (5Y 3/1), 5-15% fine sand, slightly micaceous, trace fiberous organics and fine rootlets, rare fine gravel, few wood fragments, wet.	
		NA	NA	NA	0%				

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 25-26, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.5 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 3

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-18

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1889	5.1	Neg.	100%		ML	Slightly sandy SILT, very dark gray (5Y 3/1), 5-15% fine sand, slightly micaceous, trace fibrous organics and fine rootlets, rare fine gravel, few wood fragments, wet.	
							SM	Silty very fine SAND, very dark gray (5Y 3/1), trace fibrous organics, abundant wood fragments at 14 ft, wet.	
	-5	SO1890	4.3	Neg.	100%		ML	Slightly sandy SILT, very dark gray (5Y 3/1), 5-15% sand, slightly micaceous, trace organics, wet.	
							SM	Silty very fine to fine SAND, very dark gray (5Y 3/1), 20-30% silt, trace fibrous organics and fine rootlets, few wood fragments, wet.	
							ML	Slightly clayey SILT, dark olive gray, trace organics and very fine sand, 5-15% clay, wet, no odor, sheen.	
							SM	2" thick silty SAND layer, 10-20% silt, weak odor, sheen.	
17		SO1891	5.1	Neg.	60%			Clayey SILT, dark olive gray (5Y 3/2), rare wood fragments, wet, faint odor.	
		SO1892	6.7	Neg.	100%				
	-10							1" thick black (5Y 2.5/1) fine to medium sand layer, wet, moderate odor.	
								Clayey SILT as above with weak odor.	
							SP	Very fine to fine SAND, black (5Y 2.5/1), trace red grains and fine mica flakes, few scattered thin (1/4" to 3/4" thick) silt laminations, wet, faint odor, sheen.	
22		SO1893	5.9	Neg.	50%			Odor decreases with depth.	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 25-26, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.5 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 3

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-18

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-15						SP	Very fine to fine SAND, black (5Y 2.5/1), trace red grains and fine mica flakes, few scattered thin (1/4" to 3/4" thick) silt laminations, wet, faint odor, sheen.	
		SO1894	6.7	Neg.	15%				
		SO1895	6.7	Neg.	75%				
29	-20						ML	Clayey SILT, dark olive gray, few wood fragments, wet, no odor, no sheen.	
								BASALT, black, massive (few fragments only).	
								Refusal on basalt at 29.7 ft below deck.	
								Groundwater sample GW02250302 collected at 13-17 ft below deck.	
								Groundwater sample GW02260301 collected at 25.5-29.5 ft below deck.	
34	-25								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 25-26, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.5 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 3 of 3

Project No: 8601192.001 0634	**Borehole: WB-19**
Project: ATOFINA	
Client: ATOFINA Chemicals, Inc.	Ground Surface: Barge Deck
Location: Portland, OR	Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10

Drilled By: Cascade Drilling	Well Casing Elevation: NA	Datum: City of Portland Datum - 1929
Drill Method: Direct Push	Barge Deck Elevation: 9.9 ft	
Drill Date February 24-25, 2003	Borehole Diameter: Varies	Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-19

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-15								
28									
	-20								
33								Mudline at 34.1 ft below barge deck.	
	-25	SO1885	3.6	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), soft, trace fine rootlets and clay, trace mica, single ½" dia. gravel at 34.1 ft, organic odor.	
		SO1886	4.5	Neg.	40%			½" thick lamination of fine to medium SAND at 35.5 ft.	
		SO1887	5.4	Neg.	100%		SM	Trace fine sand with depth and black mottling at 36 ft.	
38							ML/SP	Silty very fine to fine SAND, very dark gray (5Y 3/1), 10-20% silt, wood fragments up to 1" dia., wet.	
	-30							SILT, olive (5Y 5/3), trace clay with some mixed very fine to fine SAND, very dark gray (5Y 3/1), single 2.5" long wood fragment, organic odor.	
								Few BASALT fragments in sample shoe.	
								Refusal on basalt at 38.1 ft below deck.	
43								Groundwater sample GW02250301 collected at 37-38 ft below deck.	
	-35								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 24-25, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.9 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-20

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10
25	-15									25	-15
30	-20									30	-20

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 24, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.6 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-20

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
35	-25								
40	-30								
45	-35							Mudline at 46.5 ft below barge deck.	
		SO1882	1.7	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), soft, trace fine rootlets and clay, wet, organic odor.	
50	-40	SO1883	3.5	Neg.	60%				
		SO1884	3.5	Neg.	100%		Rx	BASALT, black (2.5Y 2.5/1), moderately vesicular, green secondary mineralization in vesicles, no odor.	
								Refusal on basalt at 51.8 ft below deck. Groundwater sample GW02240301 collected at 49-51 ft below deck.	
55	-45								
60	-50								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 24, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 9.6 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-21

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	10							Barge Deck			10
0										0	
								Willamette River surface.			
5	5									5	5
10	0									10	0
15	-5									15	-5
20	-10									20	-10
25	-15									25	-15
30										30	

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date February 20, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.3 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-21

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-20								
35	-25								
40	-30								
								Mudline at 45.2 ft below barge deck.	
45	-35	SO1873	2.6	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace clay, minor fine rootlets, soft, wet, organic odor.	
		SO1874	2.6	Neg.	80%				
50	-40	SO1875	4.7	Neg.	100%			As above with minor black (10YR 2/1) mottling.	
		SO1876	4.0	Neg.	100%				
		NA	NA	NA	0%			Some sand in sampler shoe at 52.3 ft below deck.	
55	-45							Refusal on rock or gravel (?) at 53.4 ft below barge deck. Groundwater sample GW02200302 collected at 49.5-53.5 ft below deck.	
60									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 20, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.3 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-22

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
	12							Barge Deck			12
0										0	
	10										10
								Willamette River surface.			
5										5	
	5										5
10										10	
	0										0
15										15	
	-5										-5
20										20	
	-10										-10
25										25	
	-15										-15
30										30	
	-20										-20

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 21, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 11.6 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-22

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-25								
39									
	-30								
44									
	-35								
49								Mudline at 50.5 ft below barge deck.	
	-40	SO1877	6.3	Neg.	100%		ML	SILT, dark olive gray (5Y 3/2), trace clay and rootlets, wet, organic odor.	
		SO1878	5.3	Neg.	90%				
54		SO1879	5.3	Neg.	100%		SM	Slightly silty very fine to fine SAND, dark olive gray (5Y 3/2), trace to 15% silt, trace red grains.	
	-45	SO1880	6.3	Neg.	25%		SP	Very fine to fine SAND, very dark gray (2.5Y 3/1), trace red grains, wet.	
59		SO1881	6.3	Neg.	25%		GW	Fine to coarse GRAVEL, dark gray (2.5Y 4/1), primarily rounded basalt with minor quartzite, 10-20% very fine to fine sand.	
	-50							Refusal due to gravel at 62.5 ft below barge deck. Groundwater sample GW02210301 collected at 54-58 ft below deck.	
64									
	-55								

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 21, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 11.6 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-23

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
0	10							Barge Deck	
								Willamette River surface.	
5	5								
10	0								
15	-5								
20	-10							Mudline at 21.4 ft below barge deck.	
		SO1855	1.0	Neg.	100%		ML	SILT, very dark gray (10YR 3/1), trace clay, very soft, uniform, trace wood fragments and very fine rootlets, organic odor, wet.	
		SO1856	1.0	Neg.	100%			As above with 10-20% clay, trace of fine sand, single 1/8" thick sand laminae.	
25	-15	SO1857	1.0	Neg.	5%				
		SO1858	1.7	Neg.	100%				
		SO1859	2.7	Neg.	80%			Grades to dark olive gray (5Y 3/2)	
30									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 18, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.2 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-23

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1860	2.7	Neg.	50%		ML		
		SO1861	2.7	Neg.	100%			Clayey SILT, dark yellow brown (10YR 4/4), trace fine sand, wood fragments up to 2" dia., soft, wet.	
35	-25	SO1862	2.7	Neg.	NA			Grades to very dark gray brown (10YR 3/2)	
		SO1863	2.4	Neg.	80%			Grades to 5-10% sand.	
		SO1864	2.4	Neg.	100%		SP	Very fine to fine SAND, trace silt and fine organics, wet, no odor.	
40	-30						ML	Slightly clayey SILT, olive yellow (2.5Y 6/6), firm, moist to wet.	
		SO1865	2.0	Neg.	100%		SP	Very fine to fine SAND, olive brown (2.5Y 4/3), trace silt and fine organics, rare pieces of wood, wet, no odor.	
		SO1866	NA	Neg.	100%		ML	SILT, olive yellow, firm, moist to wet.	
							Rx	BASALT, black, massive.	
45	-35							Refusal at 42.4 ft below barge deck.	
								Groundwater sample GW02180301 collected 25-29 ft below deck.	
								Groundwater sample GW02180302 collected 38-42 ft below deck.	
								Note: Sample interval for SO1857 is 25-29 ft below deck.	
50	-40								
55	-45								
60									

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date February 18, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 10.2 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 2 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-24

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)	DEPTH (feet)	ELEVATION (feet)
0	10							Barge Deck		0	10
								Willamette River surface (estimated).			
5	5									5	5
10	0							Mudline at 9.4 ft below barge deck. No soil samples collected at 9.4-20 ft below deck.		10	0
15	-5									15	-5

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 7, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.0 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 1 of 2

Project No: 8601192.001 0634

Project: ATOFINA

Client: ATOFINA Chemicals, Inc.

Location: Portland, OR

Borehole: WB-24

Ground Surface: Barge Deck

Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	-10	SO1972	316	Neg.	100%		ML	Slightly clayey SILT, olive brown (2.5Y 4/3), 10-20% clay, abundant hairline organics, wet, moderate odor. Slightly silty fine to medium SAND layer 21.3-21.6 ft below deck, olive brown (2.5Y 4/3), slightly micaceous, 10-20% silt, wet, strong odor, slight sheen. Similar layers (1" thick) at 22 and 22.5 ft below deck. At 22.9 ft, slightly clayey SILT, very dark gray, no hairline organics, odor decreases with depth, rare wood fragments.	
		SO1973	337	Neg.	100%				
24									
	-15	SO1974	23.9	Neg.	90%				
		SO1975	9.5	Neg.	50%		SP	Fine to medium SAND, dark gray brown (2.5Y 4/2), trace of red grains, rare wood fragments, faint odor decreasing with depth.	
29		SO1976	4.2	Neg.	50%			2" thick fine to medium sandy SILT layer, dark gray brown (2.5Y 4/2), 10-20% sand, wet.	
	-20	SO1977	10.5	Neg.	NA				
34								Boring terminated at 32 ft below barge deck. No groundwater samples collected.	
	-25								

Drilled By: Cascade Drilling

Drill Method: Direct Push

Drill Date March 7, 2003

Well Casing Elevation: NA

Barge Deck Elevation: 10.0 ft

Borehole Diameter: Varies

Datum: City of Portland Datum - 1929

Sheet: 2 of 2

Project No: 8601192.001 0634
Project: ATOFINA
Client: ATOFINA Chemicals, Inc.
Location: Portland, OR

Borehole: WB-25

Ground Surface: Barge Deck
Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
	10							Barge Deck	
0								Willamette River surface.	
5	5								
10	0							Mudline at 14.3 ft below barge deck.	
15	-5	SO1978*	1.5	Neg.	100%		ML	Clayey SILT, dark olive gray (5Y 3/2), 10-20% clay, very soft, trace hairline organics, abundant white clay laminations up to1/8" thick , wet.	
		SO1980	0.0	Neg.	100%		SM	Silty very fine to fine SAND layer, dark olive gray (5Y 3/2), 20-30% silt, wet.	
								Clayey SILT as above with 20-30% clay.	
		SO1981	0.2	Neg.	100%		SM	Silty very fine to fine SAND layer, dark olive gray (5Y 3/2), 20-30% silt, wet.	
20	-10						ML	Grading to SILT, dark olive gray (5Y 3/2), trace of clay and very fine sand, soft, wet.	

Drilled By: Cascade Drilling
Drill Method: Direct Push
Drill Date March 7-10, 2003

Well Casing Elevation: NA
Barge Deck Elevation: 9.9 ft
Borehole Diameter: Varies

Datum: City of Portland Datum - 1929
Sheet: 1 of 2

Project No: 8601192.001 0634	**Borehole: WB-25**
Project: ATOFINA	
Client: ATOFINA Chemicals, Inc.	Ground Surface: Barge Deck
Location: Portland, OR	Logged By: David Lamadrid

DEPTH (feet)	ELEVATION (feet)	SAMPLE NUMBER	OVM (ppm)	SUDAN IV	RECOVERY	INTERVAL	GROUP SYMBOL	LITHOLOGIC DESCRIPTION	BACKFILL (Bentonite grout)
		SO1982	0.1	Neg.	60%		ML	SILT, dark olive gray (5Y 3/2), trace of clay and very fine sand, soft, wet.	
								Clayey SILT, dark olive gray (5Y 3/2), some black mottling, 10-20% clay, trace wood fragments, slight odor.	
	-15								
26		SO1983	1.0	Neg.	40%		SM / SP	Silty very fine to fine SAND, very dark gray (5Y 3/1), 20-30% silt, wet, slight odor.	
		SO1984	1.0	Neg.	30%			Grades to very fine to fine SAND, very dark gray (5Y3/1), trace of red grains, 20-30% silt, wet, slight odor.	
	-20	SO1985	8.5	Neg.	45%		SP/ ML	Bedded very fine to fine SAND, black (5Y 2.5/1), and clayey SILT, olive gray (5Y 4/2), beds up to 3" thick, trace red grains in sand, rare wood fragments, weak odor decreases with depth.	
31		SO1986	4.4	Neg.	100%				
		SO1987	0.0	Neg.	40%				
	-25	SO1988	0.0	Neg.	50%		SP / Rx	Fine to medium SAND, olive gray (5Y 4/2), mostly fine sand, slightly micaceous, wet, faint odor.	
36								BASALT: black (5Y 2.5/1), slightly vesicular, indurated, faint odor.	
								Refusal on basalt at 36.0 ft below barge deck.	
								*Duplicate soil sample SO1979 collected on this interval.	
								Groundwater sample GW03100301 collected at 26-30 ft below deck.	
	-30							Groundwater sample GW03100302 collected at 34-36 ft below deck.	
41									

Drilled By: Cascade Drilling	Well Casing Elevation: NA	Datum: City of Portland Datum - 1929
Drill Method: Direct Push	Barge Deck Elevation: 9.9 ft	
Drill Date March 7-10, 2003	Borehole Diameter: Varies	Sheet: 2 of 2

Oregon
Theodore R. Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
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Portland, OR 97201-4987
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November 3, 2003

CERTIFIED MAIL

RECEIVED
NOV 05 2003
By

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

Ms. Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210

Re: Draft Work Plan for City Outfall 22C Evaluation
Wacker Siltronic Corporation Property
ECSI No. 183

Dear Bob and Cathryn:

The Oregon Department of Environmental Quality (DEQ) received Hahn and Associates, Inc. (HAI) October 13, 2003 draft work plan for the evaluation of the off-site ditch and City Outfall 22C. The work plan is not approved. In accordance with Section 6B(2)(b) of DEQ Order No. ECVC-NWR-00-27 the work plan should be modified to correct the following deficiencies.

1. Add columns in the screening criteria table (e.g., Table 1) for ambient water quality criteria (AWQC) and DEQ Level II Screening Values (SLVs) that do not employ a multiplier. Contaminant concentrations in the discharge from City Outfall 22C that are interpreted to be groundwater are to be screened directly against AWQC and SLVs. Concentrations measured during a "storm event" (i.e., discharge from this outfall representative of stormwater) which in this case is a combination of groundwater and stormwater, are to be screened employing the multiplier of 5.

2. Modify the work plan scope of work to include:
   - Collection of an effluent sample from City Outfall 22C during a dry interval (i.e., at least 7 days subsequent to the previous storm event) during the dry season (Summer/Fall). This sample was requested in DEQ's September 9, 2003 letter to confirm the levels of contaminants measured at Outfall 22C during dry weather and low groundwater conditions.
   - Collection of surface water samples from the Northwest Drainage Pond (NDP) during the wet and dry season dry interval sampling event at Outfall 22C. While there are a number of existing shallow monitoring wells on the Wacker Siltronics property that could potentially be utilized to determine the contaminant levels in

groundwater discharging to the drainage ditch, the NDP and the City Outfall 22C sewer line (see DEQ scope of work in September 9, 2003 letter), testing both the NDP and the outfall effluent during dry intervals is a reasonable starting point.

- Collect surface (upper 6 inches) sediment from the NDP and at a point midway between the NDP and proposed sample station 03 in the off-site drainage ditch. The previous request by DEQ to characterize the ditch/pond sediment was made to determine if contaminated sediments are present that could potentially be flushed to the Willamette River during a large storm event.

3. Test water/effluent samples for volatile organic compounds, semivolatile organic compounds, total and amenable cyanide and total metals (antimony[1], barium[1], chromium[1], iron[1], manganese[1], mercury[1], nickel[1], selenium[1], silver[1], thallium[1], zinc[1], lead[2] arsenic[2], copper[2] and cadmium[2]).

4. Test sediment samples for semivolatile organic compounds, total and amenable cyanide and metals (antimony[1], barium[1], chromium[1], iron[1], manganese[1], mercury[1], nickel[1], selenium[1], silver[1], thallium[1], zinc[1], lead[2] arsenic[2], copper[2] and cadmium[2]).

While we agree that it is important to quantify the contaminant load entering the off-site ditch system as proposed in the draft plan. DEQ does want to clarify that it will not consider contaminants detected in stormwater leaving the Gasco site (proposed sample station 04) to be "background". Also, additional evaluation of contaminant levels detected in water exiting North Doane Lake (proposed sample location) may be necessary before DEQ can agree to the "background" designation as the nature and extent of shallow groundwater impacts from Gasco-related wastes in this area has not been determined.

Please correct the above deficiencies and resubmit the work plan within 10 calendar days of receipt of this letter. If you have any questions or wish to discus alternative sampling or characterization strategies, please contact me at (503) 229-5538.

Sincerely,

Matt McClincy
Project Manager
Cleanup & Portland Harbor

cc: Rod Struck, DEQ NWR
Jim Anderson, DEQ NWR
Rob Ede, Hahn & Associates
Tom Schadt, Anchor Environmental
Jim Maul, MFA

1. Metals included in June 1, 2001, Hahn and Associates, Inc., Final Focused Remedial Investigation Work Plan Wacker Siltronic Corporation Property 7200 NW Front Avenue Portland, Oregon

2. Metals exceeding screening levels modified Table 1, Hahn and Associates, Inc., October 13, 2003, Draft Work Plan for City Outfall 22C

8128.01.01

BARBIERI & ASSOCIATES, INC.
PROFESSIONAL ENGINEERING AND SURVEYING
7017 NE HWY 99 SUITE 204
VANCOUVER, WA. 98665
360-695-1001
FAX 360-695-6182

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To: JAMES PEAVE

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Message: SURVEY EST FOR 7200 NW FRONT AVE

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BARBIERI & ASSOCIATES, INC.
PROFESSIONAL ENGINEERING & SURVEYING
7017 NE Highway 99, Suite 204
Vancouver, Washington 98665
(360) 695-1001

10-16-03

James Peave
Maul Foster & Alongi, Inc.
3121 Moody Avenue, Suite 200
Portland, Or 97289

RE: Cost Estimate for Surveying Services

Project location: 7200 NW Front Avenue Portland, Or.

Our fee for requested items shall be $1,300.00 not to exceed $2,000.00, provided that there is an existing baseline on site that contains any required datum's if necessary. However, I regret to say that Barbieri & Associates, Inc. does not have any certified HAZWOPR personnel at this time.

If you have any questions please call. I look forward to working with you on this project.

Yours very truly,

John Barbieri, PE, PLS

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PROFESSIONAL ENGINEERING & SURVEYING

7017 NE Highway 99, Suite 204
Vancouver, Washington 98665
(360) 695-1001

HOURLY BILLING RATES
2003

CODE	JOB DESCRIPTION	HOURLY RATE
A	ENGINEER	$ 72.00
B	SURVEYOR	65.00
C	ENGINEER TECHNICIAN	52.00
D	SURVEY TECHNICIAN	50.00
E	COMPUTER TECHNICIAN/DRAFTSMAN	50.00
F	DRAFTSMAN	45.00
G	2-MAN FIELD CREW	116.50
H	2-MAN FIELD CREW OVERTIME	136.00
I	3-MAN FIELD CREW	147.00
J	3-MAN FIELD CREW OVERTIME	172.00
K	4-MAN FIELD CREW	178.00
L	4-MAN FIELD CREW OVERTIME	210.00
M	INSPECTOR	50.00
N	LEGAL DESCRIPTIONS	70.00/HR. MIN.
O	SECRETARIAL	30.00
P	GPS RECEIVER	20.00/REC.
Q	GPS INSTRUMENT PERSON	45.00
R	GPS INSTR. PERSON OVERTIME	60.00
S	GPS SURVEYOR	65.00

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8128.01.06 Task 05

Project No: ~~0028.01.02~~
5 DIGITS

File To Folder: COMM/CORRESPONDANCE

September 9, 2003

RECEIVED
SEP 12 2003
By

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

Ms. Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210

Re: Off-Site Ditch Evaluation, Phase I Site Characterization and Source Control Evaluation, Wacker Siltronic Corporation Property
ECSI No. 183

Dear Bob and Cathryn:

The Oregon Department of Environmental Quality (DEQ) received Hahn and Associates, Inc. (HAI) August 13, 2003 letter responding to DEQ's July 7, 2003 letter regarding the status of the Focused Remedial Investigation on the Wacker Siltronic Corporation site. Unfortunately, DEQ does not agree with a number of conclusions or project recommendations made in the letter.

Off-Site Ditch Evaluation

- DEQ does not agree that the existing data are sufficient to support a source control evaluation.
- DEQ does not agree that available data from City Outfall 22C do not exceed screening criteria or background values.

The AMEC Earth and Environmental, Inc. (AMEC) Outfall data represent dry weather and low groundwater flow conditions. Additional data are necessary to characterize wet weather (stormwater) and high groundwater flow (December/January) conditions and to better evaluate whether contaminants from the Wacker site are currently discharging to the Willamette River above screening criteria or may do so in the future.

DEQ requires that a work plan be submitted within 30 days of receipt of this letter that is sufficient to determine the following:

- Contaminant concentrations in Outfall 22C effluent during wet weather (first flush stormwater flow),
- Contaminant concentrations in Outfall 22C effluent during high groundwater conditions (i.e., groundwater flow),
- Confirm contaminant concentrations in Outfall 22C effluent during dry weather, low groundwater conditions.
- Contaminant levels in groundwater discharging to the drainage ditch, Northwest Drainage Pond (NDP), and City Outfall 22C sewer line,
- The presence of contaminated ditch/pond sediment. Ditch or pond sediment may be impacted from either stormwater migration from the Koppers portion of the Gasco facility to the drainage ditch or Gasco waste potentially incorporated into the banks of the drainage ditch.
- Cyanide concentrations in sediment, groundwater and surface water in addition to volatile organic compounds, semivolatile organic compounds, and metals.

If NW Natural does not anticipate having obtained an access agreement with Burlington Northern Santa Fe Railway within the next 30 days, please advise DEQ of this as soon as possible.

City of Portland Outfall 22C Source Control Evaluation

- The DEQ source control screening criteria is still draft, although DEQ agrees that the screening criteria identified are appropriate for groundwater discharges to the Willamette River. However, criteria that are protective of both aquatic life (i.e., Ambient Water Quality Criteria (AWQC) chronic values or DEQ Level II screening level values (SLVs) if AWQC are not available) and human consumption of fish (AWQC) need to be part of the screening. For example if no AWQC chronic value exists for a contaminant, both the DEQ SLV and AWQC for fish consumption values should be used. DEQ is currently using 5 times the acute AWQC or 5 times the SLV if a AWQC are not available to screen stormwater discharges. Please note that these criteria do not address bioaccumulating compounds. DEQ should be consulted if the screening includes bioaccumulating compounds.

- Fluorene was detected in the Outfall 22C sample collected by AMEC at 6.26 ug/L which exceeds the DEQ SLV of 3.9. No chronic AWQC is available for Fluorene.

- Benzo(a)anthracene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene were detected above AWQC in the NDP. Although these compounds were not detected at the Outfall 22C sample, the analytical detection limits for these compounds exceeded the AWQC. In the case of benzo(a)anthracene and benzo(b)fluoranthene, the detection limit was more than twice the AWQC.

- The AMEC monitoring did not include cyanide.

- Some of the AWQC for metals referenced in the evaluation are hardness dependant and need to be adjusted accordingly. The hardness of the lower Willamette River is 25 mg/L (DEQ Water Quality Program).

- Establishing background values for metals in site groundwater or stormwater requires more evaluation than presented in the Hahn and Associates, Inc. response letter.

- Polynuclear aromatic hydrocarbons and cyanide have been detected in soil and groundwater samples from the referenced background monitoring well (MW-9-29) on the nearby Gasco site raising concerns about its use as a background well. Also, it appears to have been completed in a silt unit suggesting the possibility that detected metals may be the result of turbid samples. In addition, DEQ does not use metals data collected from well points (e.g., P-7) to establish background concentrations. Monitoring wells are required to collect representative and reproducible groundwater data and as follow up when groundwater contaminant concentrations exceed screening values in well points.

- The comparison of contaminants in what is interpreted to be groundwater with referenced values for rooftop or urban stormwater is not appropriate.

Phase I Site Characterization Report

The site characterization report should include a discussion of field evidence of three categories of contamination: observed or interpreted non-aqueous phase liquid (NAPL), residual NAPL, and lower level impacted environmental media. Wacker Siltronic Corporation should be specifically queried regarding their observations of soil and subsurface conditions during facility development and operation, and this information included in the site-wide summary.

Technical Memorandum on Source Control Measures

DEQ will consider the pending Technical Memorandum on Source Control Measures a draft document, or an interim evaluation, pending our review of the Phase I Site Characterization Report and concurrence with the adequacy of the site characterization for the Focused Remedial Investigation

Please be advised that recent trichloroethene (TCE) investigation results encountered high levels of TCE and degradation products in the vadose zone and shallow groundwater in the former locations of the TCE underground storage tanks (USTs). Apparent Gasco-related tars and oils were also encountered at this location. DEQ is requiring Wacker Siltronics to construct shallow monitoring wells in the former UST location and down gradient. Because of the presence of both Gasco-related wastes and TCE, DEQ will also require that these monitoring wells be sampled for Gasco-related contaminants quarterly for at least one year once they are constructed. As noted in the HAI letter, the Technical Memorandum on Source Control Measures will require updating pending additional site characterization.

Please contact me at (503) 229-5538 should you have any questions.

Sincerely,

Matt McClincy
Project Manager
Cleanup & Portland Harbor

cc: Rod Struck, DEQ NWR
Jim Anderson, DEQ NWR
Rob Ede, Hahn & Associates
Tom Schadt, Anchor Environmental
Jim Maul, MFA

Jim Maul: Wacker 8128.01.05.07.06 Task 7

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July 7, 2003

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

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JUL 10 2003
By

Re: Status of Focused Remedial Investigation on the Wacker Siltronic Corporation Site
ECSI No. 183

Dear Mr. Wyatt:

I have recently completed a review of the focused remedial investigation (RI) Northwest Natural is performing on the Wacker Siltronics Site as part of my efforts to come up to speed on the project. This letter summarizes the Oregon Department of Environmental Quality (DEQ) position on the status of this work along with comments regarding the schedule and elements to be considered in the pending Technical Memorandum on Source Control Measures.

Off-Site Ditch Evaluation

The June 1, 2001 Focused Remedial Investigation Work Plan requires Northwest Natural to ascertain the potential occurrence of contaminant migration in groundwater from the Wacker Site to the adjacent off-site drainage ditch near the southern and western property boundaries. Northwest Natural proposed to accomplish this by visually inspecting the drainage ditch for groundwater seeps, surveying the elevation of the ditch and comparing the ditch elevation to groundwater surface elevations. The work plan indicates that Northwest Natural will develop and provide DEQ options regarding a sampling scheme of sufficient scope to allow determination of site-related impacts to the Willamette River via the ditch if it is determined there is potential for groundwater discharge to the ditch. As noted in monthly project progress reports submitted on behalf of Northwest Natural by Hahn and Associates, Inc., Northwest Natural has been unable to obtain approval from Burlington Northern Santa Fe Railway (BNSF) to access the property to perform the proposed drainage ditch assessment.

The RI of the adjacent Rhone-Poulenc facility has included the southern portion of the drainage ditch. The drainage ditch feeds the Northwest Drainage Pond (NDP) which drains to an 84 inch concrete pipe that discharges to the Willamette River at City Outfall 22C. The Rhone-Poulenc RI work surveyed the water elevation in the NDP and compared it to groundwater elevations measured in the adjacent monitoring wells. In a recent groundwater characterization report[1],

[1] AMEC, March 28, 2003, "Final Groundwater Characterization Report RPAC – Portland Site"

AMEC Earth & Environmental, Inc. concluded that groundwater discharges to the NDP year-round. Surface water samples from the NDP and outfall 22C were collected and tested as part of the Rhone-Poulenc RI. Laboratory results[2] detected contaminants typically associated with GASCO waste (e.g., benzene, toluene, polynuclear aromatic hydrocarbons, and dibenzofuran). Based on this information, DEQ concludes that the drainage ditch provides a complete pathway to the Willamette River for groundwater contaminants from the Wacker Site. As a result, DEQ is requiring that Northwest Natural provide a proposal, within 30 days of receipt of this letter, to determine if contaminants from the Wacker Site are impacting, or have the potential to impact, the Willamette River and sediments via the drainage ditch.

It is anticipated that access to BNSF property to survey the drainage ditch and to implement the requested evaluation will still be required. As such, it is important that Northwest Natural obtain access to the BNSF property in a timely manner. It appears that progress regarding the access agreement is being made based on our recent discussions. Please continue to keep DEQ informed as to the status of access to the BNSF property.

Phase I Site Characteristic Summary Report

Northwest Natural should proceed with the preparation of the Phase I Site Characteristic Summary Report and provide it to the DEQ within the next 90 days. Future investigation of the drainage ditch can be provided to DEQ either as a separate document or as part of the Technical Memorandum on Source Control Measures.

Source Control Evaluation

The schedule for the submittal of the Technical Memorandum on Source Control Measures should be revised to allow for consideration of the results of TCE groundwater assessment work that will be implemented by Wacker under their DEQ approved work plan dated June 10, 2003 and potentially the results of the expanded assessment of the drainage ditch requested in this letter.

The June 1, 2001 Focused Remedial Investigation Work Plan specified construction of a well cluster (i.e., two monitoring wells) in the central portion of the site. This well cluster has not yet been constructed. The pending TCE groundwater assessment may fill this data gap, and at a minimum will provide more data on contaminant distribution in site groundwater.

DEQ is also aware that the City of Portland has completed a relatively detailed sediment study at outfall 22C, and DEQ anticipates receipt of this data in the near future. This data should be considered in the drainage ditch evaluation if the schedule permits. DEQ will keep you appraised on the status of this data.

Field evidence of hazardous substances has been observed in a number of the borings on the Wacker Site. This information, from both recent and past boring logs, should be summarized on

[2] AMEC, February 4, 2003, "Remaining Remedial Investigation Technical Memorandum RPAC – Portland Site"

a site figure and appropriate cross-sections and incorporated into the conceptual model presented in the Source Control Memorandum.

Please contact me at (503) 229-5538 if you have any questions or would like to schedule a meeting to discuss options for investigation of the drainage ditch.

Sincerely,

Matt McClincy
Project Manager
Cleanup & Portland Harbor

cc: Michael E. Rosen, DEQ NWR
Rod Struck, DEQ NWR
Rob Ede, Hahn & Associates
Tom Schadt, Anchor Environmental
Cathryn Young, Wacker Siltronic
Jim Maul, MFA

8|28.01.06

Oregon
Theodore R. Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

June 18, 2003

Ms. Cathryn Young
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210

RECEIVED
JUN 20 2003
By

Re: Final Work Plan Groundwater Assessment
Wacker Siltronic Corporation Site
ECSI No. 183

Dear Cathryn:

Thank you for updating the work plan for the groundwater assessment as requested by the Oregon Department of Environmental Quality (DEQ) in our May 21, 2003 letter. The updated work plan "*Final Work Plan Groundwater Assessment*" dated June 10, 2003 is approved. The work plan was submitted by Maul Foster Alongi (MFA) on behalf of Wacker Siltronic Corporation (Wacker) and was received by DEQ on June 12, 2003.

Along with the updated work plan, MFA provided information requested by DEQ on the shallow monitoring well in the containment area for the former Trichloroethene stripper and recommended that the monitoring well be abandoned. The subject monitoring well should not be immediately abandoned. DEQ requests the following actions be completed prior to making a decision to abandon this monitoring well:

- Groundwater elevation measurements should be obtained from this well during the upcoming field investigation (i.e., Geoprobe™ and well installation activities) and during the initial rounds of monthly groundwater elevation monitoring.
- An interface probe should be used to determine if measurable non-aqueous phase liquid (NAPL) is present in the well, based on MFA's observation of a "...viscous, dark brown substance with a strong coal tar-like odor" coating on a weighted tape.
- The well should be redeveloped to remove any accumulated silt.
- The well should be sampled along with the new wells during the 1st quarter. This sample should be analyzed at a minimum for volatile organic compounds (VOCs), cyanide (total), semivolatile organic compounds (SVOCs), and diesel range total petroleum hydrocarbons (TPH-Dx).

Following review of this information, Wacker and DEQ should discuss whether this well should be abandoned and if so, the appropriate methodology for abandonment (i.e., overdrilling; pressure grouting).

Please keep me informed of the schedule for the pending field work as DEQ project staff anticipates observing the work associated with a number of the borings. Should you have any questions, please contact me at (503) 229-5538

Sincerely,

Matt McClincy
Project Manager
Cleanup and Portland Harbor Section

cc: Rod Struck, NWR/DEQ
Jim Maul, Maul Foster Alongi
Bob Wyatt, NW Natural

April 10, 2007

0-61M-107030/Phase 15

Thomas E. Roick
Project Manager, Cleanup & Portland Harbor
Department of Environmental Quality
2020 SW 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Dear Mr. Roick:

Re: Quarterly Progress Report for RI/FS
First Quarter, 2007 Progress Report
RP - Portland Site

On behalf of SLLI, AMEC Earth & Environmental, Inc. (AMEC) is submitting to the Oregon Department of Environmental Quality (DEQ) one hard copy of the First Quarter, 2007 Progress Report associated with the Remedial Investigation/Feasibility Study (RI/FS) at the Rhône-Poulenc (RP) Portland Site (RP Site). This quarterly report includes activities conducted during the first quarter of calendar year 2007 (January 1 through March 31), and is prepared as specified by the Consent Order (No. WMCSR-NWR-99-07) executed between RP and DEQ in July 1999 (the Order).

CURRENT REPORTING ACTIVITIES

North Doane Lake

Analytical testing of fish tissue samples continued using the composting strategy negotiated with DEQ. Fish tissue analytical results were received, reviewed, and validated.

Outfall 22B

On-going follow up interim remedial action measure (IRAM) repair activities are still being completed. A Final Outfall 22B IRAM Plan Third Addendum was submitted on January 26 in order to expand the scope of repairs on the outfall.

Lake Area Hydrologic Investigation

The Lake Area Hydrologic Investigation (LAHI) Technical Memorandum (TM) was submitted to DEQ on March 7. The LAHI TM presents the data from the two field sampling events that were performed in the Fall of 2006.

Expanded Lake Area Geophysical Survey

The Expanded Lake Area Geophysical Survey Report, describing the work completed on behalf of SLLI by Earth Dynamics, was submitted to DEQ on February 14, 2007.

Lake Area Bioremediation Pilot Study and Colloid Evaluation Activities

Ongoing field activities and water quality monitoring and sampling were performed in support of the pilot study. On March 28 a letter was submitted to DEQ requesting approval of an alternative oxygen source, dilute hydrogen peroxide, for use in the pilot study.

Source Control Evaluation (SCE)

Soil and groundwater analytical results were received, reviewed, and validated.

North Front Avenue Interim Source Control Measure (ISCM)

Two letters requesting permission for Slug Tests to be Conducted in Support of the North Front Avenue ISCM were submitted to DEQ on February 26 and March 1.

SIGNIFICANT PROBLEMS ENCOUNTERED

Access

After 18 months of negotiations, Arkema and SLLI reached agreement for access. SLLI signed recently the access agreement and is now awaiting signatures from Arkema in order to proceed with the Source Control Program, specifically completion of the Stage 1 SCE beach wells installation and groundwater sampling.

Permitting - Stage 1 SCE

Although SLLI and the City of Portland have reached agreement on the permitting requirements for installation of three monitoring well clusters on the Willamette River beach, access to the beach to collect topographic data and finalize the permitting process has been prevented by denial of access to Arkema's property. SLLI expects to have the agreement signed in time to coordinate completion of the exploration program during the next permitted in-water work window by the Division of State Lands and United States Army Corps of Engineers, which starts on July 1.

Pending DEQ Responses

SLLI currently is awaiting responses from DEQ on the following documents submitted to DEQ more than 45 days ago:

- Draft NDL Level III/IV Ecological Risk Assessment Analysis Plan for Piscivorous Birds and Mammals (submitted April 5, 2006).

ACTIVITIES PLANNED FOR THE NEXT REPORTING PERIOD

The activities currently planned for the next quarterly reporting period (Second Quarter 2007) include the following (not in chronological order):

- Submit a NDL Fish Tissue Sampling TM;

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- Continue permitting activities for the West Doane Lake (WDL) IRAM;
- Submit the NDL Draft Human Health Risk Assessment;
- Submit a response to DEQ's November 2006 comments regarding the Final Deterministic Baseline Human Health Risk Assessment;
- Submit an updated Project Schedule;
- Submit the WDL Engineering Evaluation/Cost Analysis (EE/CA) and Treatability Study;
- Implement remaining scope items from the Outfall 22B IRAM Work Plan and related addenda;
- Submit a Final Historical Drainage Ditch and Lake Area Drainage Ditch (HDD/LADD) Investigation Report in response to DEQ's comments;
- Continue the Lake Area Bioremediation Pilot Study;
- Submit the Summer 2006 Groundwater Data Submittal;
- Submit the Spring 2007 Groundwater Monitoring Work Plan;
- Submit the Stage 2 Source Control Evaluation TM; and
- Submit the NFA ISCM Work Plan.

If you have any questions, please call Roger Gresh at (503) 639-3400.

Sincerely,

AMEC Earth & Environmental, Inc.

Michelle Peterson, R.G.
Senior Geologist

Roger Gresh, P.G.
Project Manager

MP/lp

c: S. Dearden, sanofi-aventis US, Inc.
R. Ferguson, SLLI
J. Benedict, CHBH&L
C. Collins, ESCO Corp.
M. Morford, Stoel Rives, LLP
J. Peale, Maul Foster & Alongi
T. McCue, Siltronic Corporation
L. Patterson, Arkema, Inc
C. Powers, Ater Wynne LLP
J. Snyder, Stoel Rives LLP
A. Pardini, Schnitzer Investment Corp.
J. Baird, Air Liquide America Corp.
B. Sheppard, BNSF
D. Blount, Landye Bennett Blumstein LLP

SCOEPA00012996

RECEIVED
JUL 13 2006
DEPT OF ENVIRONMENTAL QUALITY
NORTHWEST REGION

FIRST ADDENDUM
TO
VOLUNTARY AGREEMENT
FOR
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
DEQ NO. WMCVC-NWR-94-13

The Oregon Department of Environmental Quality (DEQ) and NW Natural (NWN) agree to amend Voluntary Agreement No. WMCVC-NWR-94-13 dated August 8, 1994 (Agreement), as follows. All other terms of the Agreement remain in effect and apply to this First Addendum.

1. Recital I.B is amended, to read:

   "The NWN Site is a "facility" within the meaning of ORS 465.200(13). The NWN Site includes property located at 7540 N.W. St. Helens Road, Portland, Oregon, currently owned by NWN (NWN Property), as well as adjacent property located at 7200 N.W. Front Avenue, Portland, Oregon, currently owned by Siltronic Corporation (Siltronic Property), to the extent the Siltronic Property is the location of or otherwise affected by wastes associated with manufactured gas process (MGP) operations on the NWN Site. This facility is generally referred to in this First Addendum as the "NWN Site". The general location of the NWN Site is shown on Attachment AA to the First Addendum."

2. Recital I.C is amended, to add:

   "Waste management areas extended onto the northern portion of what is now the Siltronic Property, in areas of low elevation prone to flooding. The tar ponds at the NWN Property were periodically excavated and redeposited onto what is now the Siltronic Property. MGP operations ceased in 1956. NWN's predecessor sold the Siltronic Property to Victor Rosenfeld and H.A. Anderson in 1962. Thereafter, wastes associated with the MGP operations within the northern Siltronic Property area may have been redistributed across portions of the Siltronic Property when that property was filled between 1966 and 1975. Wastes within tar ponds on the NWN Property were used as fill or redistributed on the NWN Property when the eastern corner of the NWN Property was filled during the 1972/1973 time-frame."

3. Recital I.D is amended, to add:

   "Investigations conducted to date on the Siltronic Property indicate that MGP waste (e.g., tar and oil, lampblack, and spent oxide) are present in subsurface soil and groundwater across the Siltronic Property, with the primary accumulation located on the northern portion of the property in the area of the former Gasco waste effluent ponds and the adjacent lowland. Dense nonaqueous phase liquid (DNAPL) in the vicinity of the former waste effluent ponds has been observed in four groundwater

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monitoring wells on the Siltronic Property. Observed thicknesses ranged from two feet in monitoring well WS-10-27 to 12.5 feet in monitoring well WS-15-85. Approximately three to four feet of DNAPL is present in monitoring wells located adjacent to the Willamette River (WS-11-125 and WS-14-125). The location of the referenced monitoring wells is identified on Attachment BB to the First Addendum. Up to 25,000 ug/L benzene, 495,000 ug/L naphthalene, and 4,441 ug/L cyanide have been detected in groundwater at the Siltronic Property. Concentrations in soil have been detected up to: 35,432 mg/kg total PAH; 230 mg/kg dibenzofuran; 218 mg/kg benzene; and 15,000 mg/kg cyanide.

Investigations at the Siltronic Property have further identified elevated concentrations of chlorinated solvents in soil and groundwater. The chlorinated solvent contamination is being addressed by Siltronic Corporation and is outside the scope of this Agreement."

4. A new Recital I.G is added, reading:

"The NWN Site is located within or adjacent to the Portland Harbor Superfund Site, which site was placed on the federal National Priorities List by the U.S. Environmental Protection Agency (EPA) in December 2000. By memorandum of understanding, EPA is the lead agency for implementing investigation and cleanup of in-water sediments contamination in the Willamette River in the Portland Harbor Superfund Site, and DEQ is the lead agency for implementing investigations and source control at upland facilities. This Agreement as amended is consistent with DEQ's responsibilities at the Portland Harbor Superfund Site. Evaluation of the portions of the NWN Site located on the Siltronic Property as a potential source of contaminants to the Portland Harbor Superfund Site is also the subject of DEQ Order No. ECVC-NWR-00-27 issued by DEQ to NWN and Wacker Siltronic Corporation on October 4, 2000. DEQ separately issued Order No. VC-NWR-03-16 to Wacker Siltronic Corporation on February 5, 2004. This Agreement as amended does not supersede or affect obligations imposed under DEQ Orders No. ECVC-NWR-00-27 and VC-NWR-03-16."

5. A new Recital I. H is added, reading:

"By entering into this First Addendum, NWN does not admit liability or responsibility for conditions that may be present at the NWN Site, including hazardous substance releases at or to the Siltronic Property resulting from or exacerbated by the acts or omissions of parties other than NWN."

6. Section II.A.2 is deleted, and replaced with:

"2. <u>DEQ Review and Approval</u>

(a) Where DEQ review and approval is required for any plan or activity under the Agreement as amended, NWN may not proceed to implement the plan or activity until

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DEQ approval is received. Any DEQ delay in granting or denying approval correspondingly extends the time for completion by NWN. For purposes of the Agreement as amended, "day" means calendar day unless otherwise specified.

(b) After review of any plan, report, or other item required to be submitted for DEQ approval under the Agreement as amended, DEQ shall in writing: (1) approve the deliverable in whole or in part; or (2) disapprove the deliverable in whole or in part and notify NWN of deficiencies and/or request modifications to cure the deficiencies.

(c) DEQ approvals, rejections, modifications, or identification of deficiencies shall be given as soon as practicable and state DEQ's reasons with reasonable specificity.

(d) In the event of DEQ disapproval or request for modification, NWN shall correct the deficiencies and resubmit the revised report or other item for approval within 30 days of receipt of the DEQ notice or within such other time as specified in the DEQ notice.

(e) In the event a deficiency identified by DEQ is not addressed by NWN in the revised deliverable, DEQ may modify the deliverable to cure the deficiency.

(f) In the event of approval or modification of the deliverable by DEQ, NWN shall implement the action required by the plan, report, or other item, as so approved or modified, or, as to any DEQ modifications, invoke dispute resolution under Section II.M of the Agreement."

7. Section II.A.3 is deleted, and replaced with:

"3. Additional Measures

(a) NWN may elect at any time during the term of the Agreement as amended to undertake measures, beyond those required under the Agreement and the SOW, necessary to address the release or threatened release of hazardous substances at the facility. Such additional measures (including but not limited to engineering or institutional controls and other removal or remedial measures) are subject to prior approval by DEQ, which approval shall be granted if DEQ determines that the additional measures will not compromise the validity of the RI/FS, will not threaten human health or the environment, and will comply with applicable laws.

(b) DEQ may determine that, in addition to work specified in the SOW or an approved work plan, additional work is necessary to complete the RI/FS in satisfaction of the SOW and OAR Chapter 340 Division 122, or is necessary to address unanticipated threats to human health or the environment. DEQ may require that such additional work be incorporated into the applicable work plan by modification or be performed in accordance with a DEQ-specified schedule. NWN shall modify the work plan or implement the additional work in accordance with DEQ's directions and schedule, or invoke dispute resolution under Section II.M of the Agreement within 14 days of receipt of DEQ's directions."

8. A new Section II.A.4 is added, reading:

"4. Source Control Measures

For any unpermitted discharge or release of hazardous substances at the NWN Property to the Willamette River or river sediments identified in the remedial investigation, NWN shall identify and evaluate source control measures in accordance with the SOW and the terms and schedule of a DEQ-approved work plan. DEQ will review and approve source control measures pursuant to OAR 340-122-0070 and in consultation with EPA. Upon DEQ approval of a source control measure, NWN shall develop a source control work plan in accordance with DEQ's directions and, upon DEQ approval, implement the work plan."

9. Section II. D is amended to update the current DEQ and NWN project managers:

DEQ Project Manager	NW Natural Project Manager
[To Be Determined]	Robert J. Wyatt
Department of Environmental Quality	NW Natural
Northwest Region	220 N.W. Second Avenue
2020 SW Fourth Avenue, Suite 400	Portland, Oregon 97209
Portland, Oregon 97201	(503) 226-4211 Ext. 5425

10. Section II.N.3. is amended, to add:

"Except as expressly provided in this Agreement, NWN reserves all rights, claims, and defenses relating to the NWN Site."

11. A new Section II.S is added, reading:

"S. Stipulated Penalties

1. Subject to Sections II.K and M, upon any violation by NWN of any requirement of this Agreement as amended, and upon NWN's receipt from DEQ of written notice of violation, NWN shall pay the stipulated penalties set forth in the following schedule:

(a) Up to $5,000 for the first week of violation or delay and up to $ 2,500 per day of violation or delay thereafter, for failure to provide access or records in accordance with Section II.C or G.

(b) Up to $ 2,500 for the first week of violation or delay and up to $ 1,000 per day of violation or delay thereafter, for:

(i) failure to submit a final work plan, addressing DEQ's comments on the draft work plan or incorporating DEQ modifications to the work plan, in accordance with the SOW's schedule and terms;

(ii) failure to perform work in accordance with an approved work plan's schedule and terms;

(iii) failure to perform additional work required by DEQ under Section II.A.3; or

(iv) failure to submit a final report, addressing DEQ's comments on the draft report or incorporating DEQ modifications to the report, in accordance with an approved work plan's schedule and terms.

(c) Up to $500 for the first week of violation or delay and up to $500 per day of violation or delay thereafter, for:

(i) failure to submit a draft work plan in accordance with the SOW's schedule and terms;

(ii) failure to submit progress reports in accordance with Section II.H; or

(iii) any other violation of the Agreement as amended, SOW, or an approved work plan.

2. Within 30 days of receipt of DEQ's written notice of violation, NWN either shall pay the amount of such stipulated penalty assessed, by check made payable to the "State of Oregon, Hazardous Substance Remedial Action Fund", or request a contested case regarding the penalty assessment in accordance with Section II.T.3. NWN shall pay simple interest of 9% per annum on the unpaid balance of any stipulated penalties, which interest shall begin to accrue at the end of the 30-day payment period. Any unpaid amounts that are not the subject of a pending contested case, or that have been determined owing after a contested case, are a liquidated debt collectible under ORS 293.250 and other applicable law.

3. In assessing a penalty under this subsection, the Director may consider the factors set forth in OAR 340-12-045. NWN may request a contested case hearing regarding the penalty assessment in accordance with OAR Chapter 340 Division 11. The scope of any such hearing must be consistent with the stipulations set forth in Section 2 of the Agreement, must be limited to the occurrence or non-occurrence of the alleged violation, and may not review the amount of the penalty assessed. Penalties may not accrue pending any contested case regarding the alleged violation. Violations arising out of the same facts or circumstances or based on the same deadline are considered as one violation per day."

12. The Scope of Work (Attachment B to the Agreement) is amended in Section I.A.1.i., by revising the first sentence to read:

SCOEPA00013001

"Determine the magnitude, nature, and extent of apparent MGP waste-related contamination at the NW Natural (NWN) Site."

13. The Scope of Work is amended in Section I.A.2, by adding the following objective:

    "viii. Identify hot spots of contamination, if any, at the facility."

14. The Scope of Work is amended in Section I.B, by adding:

    "This schedule is applicable to the RI/FS for the portion of the NWN Site on the Siltronic Property. NWN shall compile and evaluate existing data on MGP-related constituents and provide to DEQ an outline of data needs to complete the remedial investigation for the portion of the NWN Site on the Siltronic Property including an RI proposal and schedule for the RI, within 120 days of execution of the First Addendum."

15. The Scope of Work is amended in Section I.B, by adding:

    "NWN shall provide DEQ with a work plan to identify and evaluate source control measures at the NWN Property. The work described in the work plan shall be consistent with the source control approach described in the December 2005 Portland Harbor Joint Source Control Strategy".

16. For deliverables submitted after the date of execution of this First Addendum, the Scope of Work is amended in Section III.F, by deleting the entire section and replacing it with:

    "F. Endangerment Assessment Work Plan

    1. HUMAN HEALTH RISK ASSESSMENT PLAN

    Objective: To evaluate the collective demographic, geographic, physical, chemical, and biological factors at the site, for the purposes of characterizing current and reasonably likely future risks to human health as a result of a threatened or actual release(s) of a hazardous substance. To document the magnitude of the potential risk at the site; support risk management decisions; and establish remedial action goals, if necessary.

    Scope: The Human Health Risk Assessment shall evaluate risk in the context of current and reasonably likely future land and water uses, and in the absence of any actions to control or mitigate these risks (i.e., under an assumption of no action). The human health risk assessment portion of the work plan shall be developed based on the requirements specified in OAR 340-122-0084; DEQ guidance; and, as appropriate, the Risk Assessment Guidance for Superfund - Human Health Evaluation Manual Part A, United States Environmental Protection Agency (EPA), Interim Final, July 1989, (RAGS-HHEM); Human Health Evaluation Manual, Supplemental Guidance:

SCOEPA00013002

"Standard Default Exposure Factors", EPA, March 1991,(HHE-SG); and the Exposure Factors Handbook, EPA, 1996. A suggested outline for the human health evaluation is given in Exhibit 9-1 of the RAGS-HHEM. The work plan shall use this outline as a framework for discussing the methodologies and assumptions to be used in assessing the potential human health risks at the site.

Procedure: The work plan shall describe the different tasks involved in preparing the Human Health Risk Assessment. The Human Health Risk Assessment can be completed using either deterministic or probabilistic methodologies. If probabilistic methodologies are to be used, NWN shall discuss risk protocol with DEQ before the commencement of a probabilistic risk assessment. If deterministic methodologies will be used, then the Human Health Risk Assessment shall include an estimate of both the central tendency exposure (CTE) and the reasonable maximum exposure (RME) expected to occur under both current and future land use conditions. In general, RME exposures shall be based on the 90th percentile exposure case. Additional guidance on quantifying the RME is given in Chapter 6 of the RAGS-HHEM, SRAGS, and HHE-SG. Quantifying the potential risks associated with the RME shall be the overall goal of the risk assessment.

2. ECOLOGICAL RISK ASSESSMENT PLAN

Objective: To evaluate the collective demographic, geographic, physical, chemical, and biological factors at the site, for the purposes of characterizing current and reasonably likely future risks to the environment as a result of a threatened or actual release(s) of a hazardous substance; document the magnitude of the potential risk at a site; support risk management decisions; and establish remedial action goals, if necessary.

Scope: The Ecological Risk Assessment shall evaluate risk in the context of current and reasonably likely future land and water uses in the absence of any actions to control or mitigate these risks (i.e., under an assumption of no action). The Ecological Risk Assessment shall use a tiered approach (with four levels) to produce a focused and cost-effective assessment of risk. The Ecological Risk Assessment Work Plan shall be developed based on the requirements specified in OAR 340-122-0084; DEQ guidance; and, as appropriate, Proposed Guidelines for Ecological Risk Assessment, EPA, September 1996; Framework for Ecological Risk Assessment, EPA, February 1992; and Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual, Interim Final, EPA, March 1989 (RAGS-EEM).

Procedure: The plan shall describe the different tasks involved in preparing the ecological risk assessment. Ecological risk assessments may include a Level I Scoping plan; a Level II Screening plan; and a Level III Baseline plan or Level IV Field Baseline plan. The Level III and Level IV baseline plans shall include an exposure analysis, an ecological response analysis, a risk characterization and an uncertainty analysis as required by OAR 340-122-0084(3). The ecological risk assessment can be completed using either deterministic or probabilistic methodologies. If probabilistic methodologies are to be used, NWN shall discuss risk protocol with DEQ before the

SCOEPA00013003

commencement of a probabilistic risk assessment. If deterministic methodologies are to be used, then the ecological risk assessment shall include an estimate of both the central tendency exposure (CTE) and the reasonable maximum exposure (RME) expected to occur. Estimating the potential risks associated with the RME shall be the overall goal of the risk assessment."

STIPULATED, AGREED, AND APPROVED FOR ISSUANCE:

NW Natural

By: Sandra K. Hart Date: 7-13-06
(Signature)

Sandra K. Hart
(Name)

Director Risk Environment & Land
(Title)

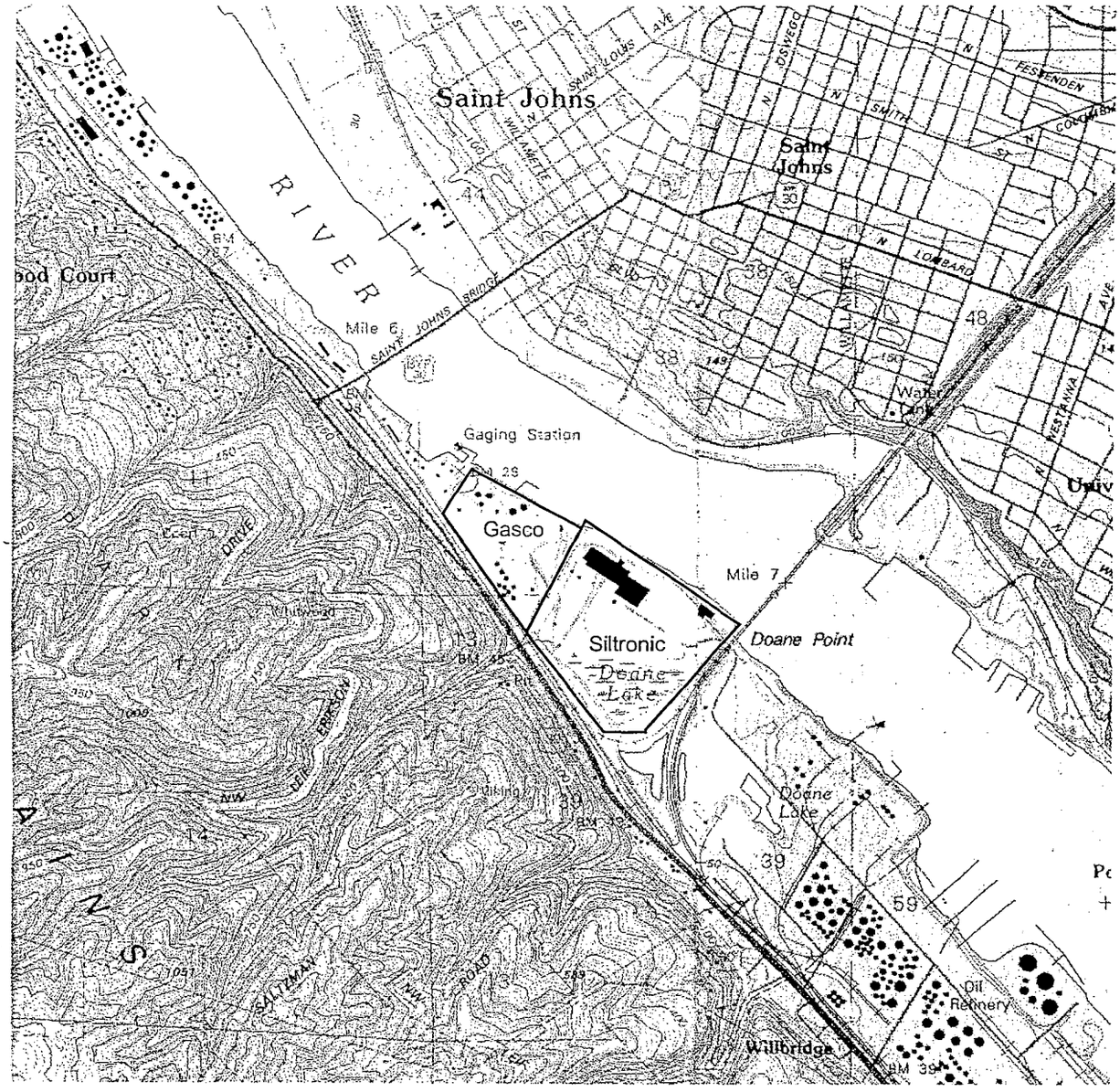
OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

By: Dick Pedersen Date: 7/19/06
(Signature)

Dick Pedersen
(Name)

Regional Administrator
(Title)

SCOEPA00013004



Note: Base Map from Linnton (1990) and Portland (1990), Oregon, USGS 7.5-Minute Quadrangles

N

0 2,000 4,000

Approximate Scale in Feet
Contour Interval = 10 feet

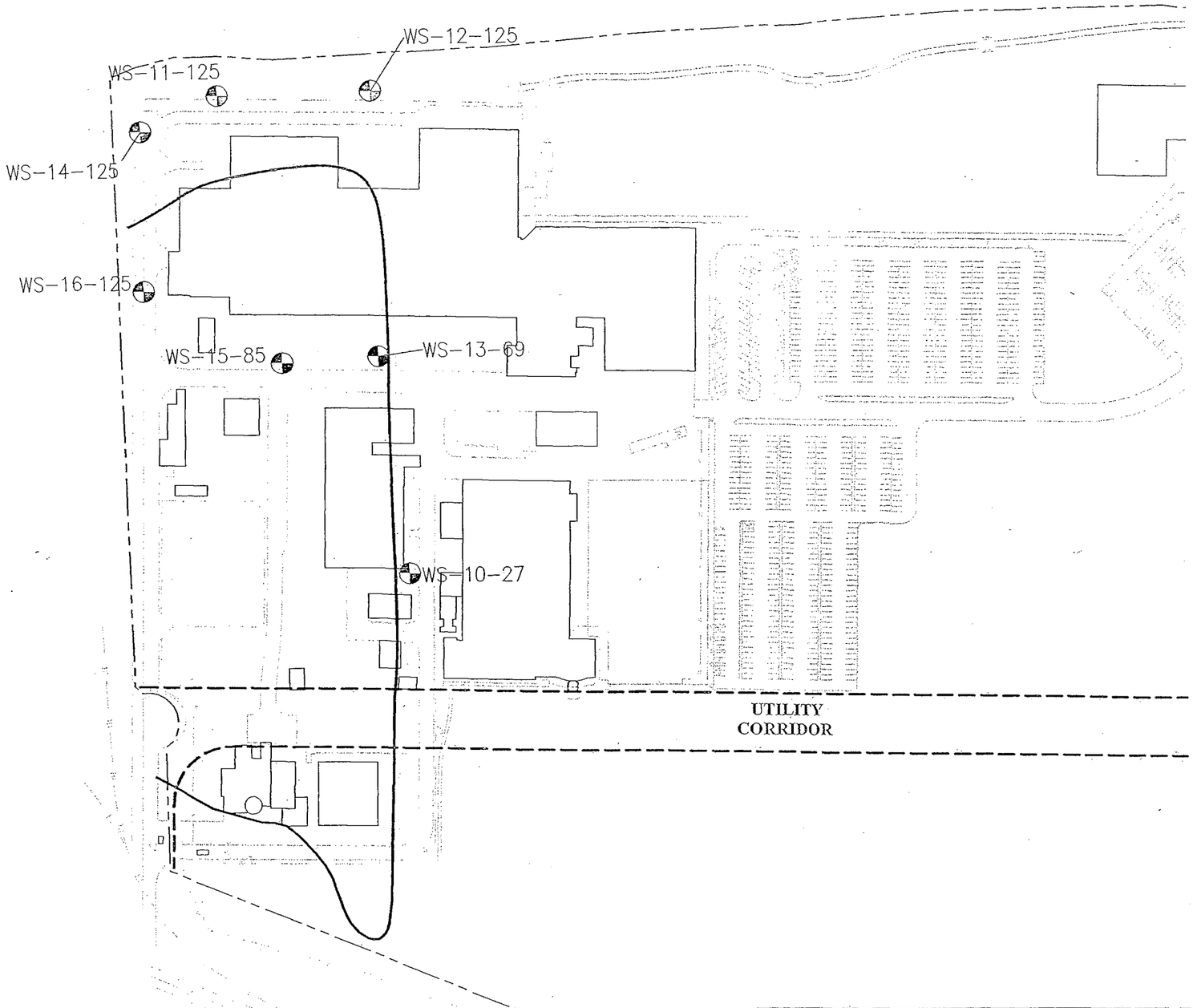
Attachment AA

NW Natural Site Location Map

Site Includes

NW Natural Gasco Facility
7540 N.W. St. Helens Road

Siltronic Corporation Property
7200 N.W. Front Avenue
Portland, Oregon



LEGEND:
- PROPERTY BOUNDARY
- MONITORING WELL LOCATION
- FORMER WASTE DISPOSAL LAGOON
- OLYMPIC PIPELINE RIGHT OF WAY

PLANT NORTH

TRUE NORTH

0 200 400
FEET

Vancouver: (360) 694-2691
Portland: (971) 544-2139
MAUL FOSTER ALONGI INC.

DATE 09/29/05
DWN. DLG
APPR. JGP
REVIS.
PROJECT NO. 8128.01.08

Attachment BB
Monitoring Well Location Map
Siltronic Corporation Property

File: G:\8128.01 SILTRONIC CORPORATION\08_MGP DNAPL\FIG 02_FORMER DISPOSAL AND MW.DWG Last edited: OCT. 04, 2005 @ 4:50 p.m. by: dglaus Xrefs: Site

LAYOUT: 1

TASK #?

04

Project Number 8128.01.08

This document should be filed in this folder:

- ☐ Administrative
- ☑ Correspondence In
- ☐ Correspondence Out
- ☐ Working
- ☐ CADD
- ☐ Health & Safety

DATE	TIME	CALLER	PROBLEM
11/5 (WEDNESDAY)			NO CALLS
11/6 (THURSDAY)	4:30P	Mike Pilkington	SOD W tank - Tank is full and overflowing — pump has been removed by maintenance and not replaced. Evidently rain water from a high water table had entered the disconnected pump suction piping filling the tank. The production waste flow into the tank caused constant overflow. Brought in Rod Bashor and John Dilger to reinstall the Sandpiper pump. Brought in both VW&R and Speedy Way to haul waste away. Pump installed by 7pm — shut production down for 1½ hrs to eliminate overflow prior to pump replacement. Inadequate safety gear available!!!

Project: _____ Task: _____

On Site Work: Yes ☐ No ☐

Initials: _____ Date: _____

12-25-80 1130 AM Grand	SODT Full Plus SOPW Pump on SODT not working. Hose Blown off Pump in hole Slicing had 5 machines down CALLed in Jim McCleary + DAVE Stalker CALLed Rich Boston to get tanker TANKER arrive AT 4:00 PM HAD Bruce Stevens Check all equipment to see if any thing was Running he CALLed Back and said everything OK
12-25-80 4:00 Grand	Slicing Supervisor said He had 5 machine down Elect. CALLed Mike Myers to Come in. He work Gonio meter and the Slicing machines He CALLed AT 1030 Said He needed help I CALLed Bob Crawford in to Help him
12-26-80	CALL in Ted Berntsen to get SODT Pump to work CALL in Rob schedil to repair tank on 8:10 Jim McCleary here to help.

Coverage Dec. 2-8

Standby Director: Dr. Russ Beeper 229-2775

Maint. Supervisor: Richard Johnson

Equip. Tech: Curtis Miller 642-9013

Fac. Tech: Tom Voigt 1-538-0218

Electronic Tech: Mike Myers 286-0810

Date	Time	Caller	Problem
11-3	1852	Doug Pittman	CZ 22 - Leak 2nd grey crystal in a row. Curtis Miller called in
11-3	1915	Doug Pittman	FZ 106 - RF disturbed problem Mike Myers called in.
11-4	0340	Ken Stewart	FZ 103 - RF disturbed problem Mike Myers called in.
11-4	0530	Mike Myers	CZ 25 down - 300 Amp fuse blown - non in warehouse can't locate any in the ET shops.
11-4	0930	Curtis Miller	Slicing Mach. Breakaway bolt - Can't locate the warehouse number for part or find any in the shop. He was given Emil Dogru and Chris Christianson home phone number for help.
11-4	1535	Doug Pittman	Outbake oven - Low vacuum tripped out needs to be reset by the E.T. Called in Mike Myers.
11-6	0430	Chuck Wear	Fire Alarm - Zone 3 Alarm is a spare possible short.
11-6	0445	Chuck Wear	Fire Alarm - Zone 3 Alarm ET feels module is shorting out. Day shift will look into it.
11-7	2100	Jeff Jones	TCE Stripper - Overflow of TCE into the street due to malfunction of stripper. Jeff and the oncoming Facilities Operator will contain and clean up the spill. Approx. 50 gal spilled according to Jeff.
11-7	2300	Jeff Jones	TCE spill - Spill contained and cleaned up.

End of Coverage

COVERAGE 12-28-84 TO 1-3-85

DIRECTOR: JIM HARPER
SUPERVISOR: GARY PENDLETON
CALIBRATION: ORLIN BERTSCH
EQUIPMENT: CALY HERNANDEZ
FACILITY: TED BERNSTEN
INST: RICHARD NICHOLS

DATE	TIME	CALLER	PROBLEM
12/28	18:40	SLOTKE	CHILLER #9 - PRESSURE TAP BROKEN ON CIRCUIT BREAKER. TED going in.
12/29	02:00	Q.A.	NEGATIVE AIR FLOW. TED going in.
12/29	15:40	QA.	AIRFLOW + COOLING PROBLEMS. going in myself. (PROBLEMS WITH GLYCOL SYSTEM).
12/29	19:00	Q.A.	NO AIR (FAN) IN DARK ROOM. SLOTKE comming in.
12/29	21:00	QA.	ELECTRICAL PROBLEM - HEPA FILTER FAN. Tom Voigt going in.
12/30	02:00	Grouing	CZ-21 NO POWER. RICHARD going in.
12/30	08:00	FACILITIES	SOD-A OVERFLOW. WILDEN PUMP DOESN'T WORK. TED going in.
12/30	12:30	MAINT.	INST. AIR PROBLEM. TED WILL TAKE CARE OF IT.
12/31			NO CALLS
1/1	00:50	FACILITIES	TCE ERUPTION - STRIPPER. ATTEMPTED TO CALL GREG CARR + DAVE FURRY. NO ANSWERS. CALLED DON CRANE, JOHN PITTMAN, JIM HARPER. (WAS ABLE TO REACH GREG AT 18:20)
1/2			NO CALLS
1/3			NO CALLS

END OF COVERAGE

SCOEPA00013011

Original

MAUL
FOSTER
ALONGI INC.
ENVIRONMENTAL & ENGINEERING CONSULTANTS
3121 SW Moody Avenue, Suite 200 | Portland, Oregon 97239 | Phone 971.544.2139 | Fax 971.544.2140 | www.MFAinc.org

CELEBRATING 10 YEARS 1996-2006

March 9, 2007
Project No. 8128.01.08

Mr. Dana Bayuk
Oregon Department of Environmental Quality
2020 SW 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Re: Monthly Progress Report— February 2007
Siltronic Corporation
7200 NW Front Avenue, Portland, OR
ECSI #183

Dear Dana:

Maul Foster & Alongi, Inc. (MFA) has prepared this progress report (Report) in accordance with the requirements of the *Order Requiring Remedial Investigation (RI) and Source Control Measures* (the Order), Oregon Department of Environmental Quality (DEQ) No. VC-NWR-03-16, issued to Siltronic Corporation (Siltronic) on February 9, 2004. The reporting period for this Report is February 1, 2007, through February 28, 2007. The next report is due April 10, 2007.

This Report also provides an update on work (using the same time frames) in accordance with the *Final Work Plan—Groundwater Assessment* (MFA, 2003a), since that work is relevant to and necessary for completion of the RI. The report organization follows that of the previous progress reports.

1 Actions Taken Under the Order Since the Previous Progress Report

Communications and Submittals

On February 22, 2007, DEQ provided conditional approval of the Workplan Addendum for Hydraulic Conductivity Testing, which was submitted on January 26, 2007.

On February 22, 2007, DEQ provided feedback via email regarding the coordination of stormwater sampling by MFA (in support of DEQ's source control program) with stormwater sampling by the Lower Willamette Group (in support of the Portland Harbor RI/FS).

Fieldwork

Groundwater elevations were measured on February 19, 2007, as reported in Table 1 (attached).[1]

Groundwater samples were collected from the monitoring wells in the riverbank and source zone pilot study areas February 19-23, 2007. Quarterly groundwater samples were also collected from the remaining monitoring wells during this time.

Stormwater samples in support of the DEQ source control program were collected on February 14, 2007.

2 Actions to Be Taken in the Next Two Months

MFA will measure groundwater elevations in mid-March.

The pilot study monitoring will continue such that samples from the riverbank and source zone pilot study areas will be collected in March. MFA will submit an amendment to the Pilot Study Work Plan requesting approval for extension of the pilot study sampling through May 2007.

The cores for the desorption bench testing have been sampled for initial concentrations of VOCs in soil, and the contained groundwater. Flow rates through the cores have been improved following modification of the setup.

MFA anticipates implementing the hydraulic conductivity testing in early March.

MFA anticipates submitting the results of the stormwater pathway evaluation (catchbasin solids sampling and stormwater sampling), which will include information regarding the stormwater system layout and rationale for sampling locations, in March 2007.

MFA anticipates submitting the draft RI Report to DEQ in April, 2007. In the interest of facilitating DEQ review of the draft RI Report, MFA suggests that a roll-out meeting be held to preview the data and conclusions in early April.

[1] Elevation measurements from October 2003 through December 2006 were provided in previous monthly progress reports.

3 Test Results and Data Received Since the Previous Progress Report

MFA has received the results for the January pilot study sampling, and preliminary results for the desorption bench testing. The data are being reviewed.

MFA anticipates receiving the results for the February pilot study and quarterly sampling, and stormwater sampling, in early March.

4 Problems Experienced Since the Previous Progress Report

No problems were experienced during the Reporting Period.

Please call either of us at (971) 544-2139 if you have questions or comments.

Sincerely,

Maul Foster & Alongi, Inc.

James G.D. Peale, R.G.
Senior Hydrogeologist

James J. Maul, R.G.
Principal Hydrogeologist

Attachments: Table 1—Groundwater Elevations—January-February 2007

cc: Matt McClincy, DEQ
Tom McCue, Siltronic
Chris Reive, Jordan Schrader
Alan Gladstone, Davis Rothwell Earle & Xochihua, P.C.

R:\8128.01 Siltronic Corp\Correspondence\08_PR 3.09.07\Lf-D. Bayuk.doc

TABLE

Table 1
Groundwater Elevations
January 2007 - February 2007
Siltronic Corporation
Portland, Oregon

PERIOD: From 01/24/2007 thru 02/19/2007 - Inclusive

SITE	DATE	MP ELEVATION (feet)	TIME	DEPTH TO WATER (feet)	DELTA WATER ELEV (feet)	WATER ELEV. (feet)
WR-STAGE	1/24/2007	0.00	10:15	-7.91	NA	7.91
WR-STAGE	2/19/2007	0.00	11:15	-7.91	0.00	7.91
WS-10-27	1/24/2007	33.45	11:06	11.98	NA	21.47
WS-10-27	2/19/2007	33.45	12:46	12.35	-0.37	21.10
WS-11-125	1/24/2007	31.98	10:00	24.08	NA	7.90
WS-11-125	2/19/2007	31.98	10:45	23.79	0.29	8.19
WS-11-161	1/24/2007	32.00	9:54	24.02	NA	7.98
WS-11-161	2/19/2007	32.00	10:43	23.70	0.32	8.30
WS-12-125	1/24/2007	32.91	9:48	24.89	NA	8.02
WS-12-125	2/19/2007	32.91	10:25	24.53	0.36	8.38
WS-12-161	1/24/2007	32.92	9:47	24.99	NA	7.93
WS-12-161	2/19/2007	32.92	10:23	24.61	0.38	8.31
WS-13-105	1/24/2007	33.30	10:47	24.93	NA	8.37
WS-13-105	2/19/2007	33.30	11:47	24.15	0.78	9.15
WS-13-69	1/24/2007	33.32	10:48	24.88	NA	8.44
WS-13-69	2/19/2007	33.32	11:47	24.35	0.53	8.97
WS-14-125	1/24/2007	32.21	10:28	24.21	NA	8.00
WS-14-125	2/19/2007	32.21	11:15	24.04	0.17	8.17
WS-14-161	1/24/2007	32.27	10:27	24.24	NA	8.03
WS-14-161	2/19/2007	32.27	11:13	24.06	0.18	8.21
WS-15-140	1/24/2007	33.02	10:42	24.84	NA	8.18
WS-15-140	2/19/2007	33.02	11:24	24.24	0.60	8.78
WS-15-85	1/24/2007	32.98	10:43	24.90	NA	8.08
WS-15-85	2/19/2007	32.98	11:25	24.04	0.86	8.94
WS-16-125	1/24/2007	32.93	10:33	24.98	NA	7.95
WS-16-125	2/19/2007	32.93	11:20	24.70	0.28	8.23
WS-16-161	1/24/2007	33.03	10:32	24.96	NA	8.07
WS-16-161	2/19/2007	33.03	11:18	24.59	0.37	8.44
WS-17-52	1/24/2007	33.68	11:04	18.81	NA	14.87
WS-17-52	2/19/2007	33.68	12:02	19.31	-0.50	14.37
WS-17-94	1/24/2007	33.78	11:03	25.15	NA	8.63
WS-17-94	2/19/2007	33.78	12:01	24.35	0.80	9.43
WS-18-101	1/24/2007	34.14	10:52	25.97	NA	8.17

Elevations in feet relative to Mean Sea Level (MSL)
MP - Measuring Point

Table 1
Groundwater Elevations
January 2007 - February 2007
Siltronic Corporation
Portland, Oregon

PERIOD: From 01/24/2007 thru 02/19/2007 - Inclusive

SITE	DATE	MP ELEVATION (feet)	TIME	DEPTH TO WATER (feet)	DELTA WATER ELEV (feet)	WATER ELEV. (feet)
WS-18-101	2/19/2007	34.14	11:49	25.59	0.38	8.55
WS-18-71	1/24/2007	34.18	10:51	24.64	NA	9.54
WS-18-71	2/19/2007	34.18	11:50	24.89	-0.25	9.29
WS-19-101	1/24/2007	33.98	10:59	25.76	NA	8.22
WS-19-101	2/19/2007	33.98	11:51	25.19	0.57	8.79
WS-19-71	1/24/2007	33.87	10:58	25.34	NA	8.53
WS-19-71	2/19/2007	33.87	11:52	25.47	-0.13	8.40
WS-20-112	1/24/2007	31.79	10:02	23.70	NA	8.09
WS-20-112	2/19/2007	31.79	10:57	23.29	0.41	8.50
WS-21-112	1/24/2007	34.05	10:21	25.67	NA	8.38
WS-21-112	2/19/2007	34.05	11:05	25.21	0.46	8.84
WS-22-112	1/24/2007	33.01	10:18	25.47	NA	7.54
WS-22-112	2/19/2007	33.01	11:03	24.27	1.20	8.74
WS-8-33	1/24/2007	32.96	9:43	24.39	NA	8.57
WS-8-33	2/19/2007	32.96	10:20	25.22	-0.83	7.74
WS-8-59	1/24/2007	32.84	9:45	24.92	NA	7.92
WS-8-59	2/19/2007	32.84	10:21	24.48	0.44	8.36
WS-9-34	1/24/2007	32.28	9:37	22.05	NA	10.23
WS-9-34	2/19/2007	32.28	10:15	22.65	-0.60	9.63

Elevations in feet relative to Mean Sea Level (MSL)
MP - Measuring Point

To File in PDX

MAUL FOSTER ALONGI INC.
ENVIRONMENTAL & ENGINEERING CONSULTANTS
3121 SW Moody Avenue, Suite 200 | Portland, Oregon 97239 | Phone 971.544.2139 | Fax 971.544.2140 | www.MFAinc.org

CELEBRATING 10 YEARS 1996-2006

October 10, 2006
Project No. 8128.01.08/10

Mr. Dana Bayuk
Oregon Department of Environmental Quality
2020 SW 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Re: Monthly Progress Report— September 2006
Siltronic Corporation
7200 NW Front Avenue, Portland, OR
ECSI #183

Dear Dana:

Maul Foster & Alongi, Inc. (MFA) has prepared this progress report (Report) in accordance with the requirements of the *Order Requiring Remedial Investigation (RI) and Source Control Measures* (the Order), Oregon Department of Environmental Quality (DEQ) No. VC-NWR-03-16, issued to Siltronic Corporation (Siltronic) on February 9, 2004. The reporting period for this Report is September 1, 2006, through October 1, 2006. The next report is due November 10, 2006.

This Report also provides an update on work (using the same time frames) in accordance with the *Final Work Plan—Groundwater Assessment* (MFA, 2003a), since that work is relevant to and necessary for completion of the RI. The report organization follows that of the previous progress reports.

1 Actions Taken Under the Order Since the Previous Progress Report

Communications and Submittals

On September 15, 2006 MFA submitted a workplan for evaluating the desorption of TCE from MGP DNAPL, as requested by DEQ. DEQ responded with an email (dated September 27, 2006) that provided a series of questions regarding the approach, and suggested that a meeting schedule for October 2, 2006 be used in part to discuss the questions.

Fieldwork

Groundwater elevations were measured on September 25, 2006, and reported in Table 1 (attached).[1]

Groundwater samples were collected from the new and existing monitoring wells in the source zone pilot study area (SZPSA) and in the riverbank pilot study area (RPSA) between September 25-27, 2006.

Soil cores for the TCE desorption bench test were collected on September 28, 2006.

AMEC initiated drilling in support of their Stage 2 Source Control evaluation work on September 25, 2006. Drilling was suspended later that day due to mechanical difficulties and scheduled to resume in early October.

2 Actions to Be Taken in the Next Two Months

MFA will measure groundwater elevations in mid-October.

The pilot study monitoring will continue in accordance with the schedule in the PSWP.

MFA anticipates meeting with DEQ and EPA during late October to provide an update regarding pilot study implementation.

MFA anticipates submitting work plans to DEQ for the outfall backfill evaluation and the stormwater pathway evaluation in mid-October. Field work for these activities could be initiated in October, contingent upon DEQ approval.

MFA anticipates submitting the draft RI Report to DEQ within the next two months.

3 Test Results and Data Received Since the Previous Progress Report

MFA has received the results for the August pilot study and quarterly groundwater sampling. The data are being reviewed.

[1] Elevation measurements from October 2003 through December 2005 were provided in previous monthly progress reports.

MFA anticipates receiving the results for the September pilot study sampling in mid-October.

4 Problems Experienced Since the Previous Progress Report

No problems were experienced during the reporting period.

Please call either of us at (971) 544-2139 if you have questions or comments.

Sincerely,

Maul Foster & Alongi, Inc.

James G.D. Peale, R.G.
Senior Hydrogeologist

Ted Wall, P.E.
Principal Engineer

Attachments: Table 1—Groundwater Elevations—January 2006 – September 2006

cc: Matt McClincy, DEQ
Tom McCue, Siltronic
Chris Reive, Jordan Schrader
Alan Gladstone, Davis Rothwell Earle & Xochihua, P.C.

TABLE

Table 1
Groundwater Elevations
January 2006 - September 2006
Siltronic Corporation
Portland, Oregon

PERIOD: From 01/16/2006 thru 09/25/2006 - Inclusive

SITE	DATE	MP ELEVATION (feet)	TIME	DEPTH TO WATER (feet)	DELTA WATER ELEV (feet)	WATER ELEV. (feet)
WR-STAGE	1/16/2006	0.00	10:45	-13.55	NA	13.55
WR-STAGE	2/14/2006	0.00	10:45	-7.22	-6.33	7.22
WR-STAGE	3/30/2006	0.00	11:45	-7.00	-0.22	7.00
WR-STAGE	4/12/2006	0.00	10:45	-12.37	5.37	12.37
WR-STAGE	5/8/2006	0.00	15:45	-9.93	-2.44	9.93
WR-STAGE	6/13/2006	0.00	9:45	-12.29	2.36	12.29
WR-STAGE	7/28/2006	0.00	9:45	-6.16	-6.13	6.16
WR-STAGE	8/21/2006	0.00	9:45	-4.63	-1.53	4.63
WR-STAGE	9/25/2006	0.00	9:45	-4.22	-0.41	4.22
WS-10-27	1/16/2006	33.45	11:25	11.53	NA	21.92
WS-10-27	2/14/2006	33.45	11:19	11.25	0.28	22.20
WS-10-27	3/30/2006	33.45	12:35	12.00	-0.75	21.45
WS-10-27	4/12/2006	33.45	10:50	12.01	-0.01	21.44
WS-10-27	5/8/2006	33.45	16:25	12.12	-0.11	21.33
WS-10-27	6/13/2006	33.45	10:25	12.38	-0.26	21.07
WS-10-27	7/28/2006	33.45	10:15	13.41	-1.03	20.04
WS-10-27	8/21/2006	33.45	10:18	13.97	-0.56	19.48
WS-10-27	9/25/2006	33.45	10:16	14.70	-0.73	18.75
WS-11-125	1/16/2006	31.98	10:19	18.26	NA	13.72
WS-11-125	2/14/2006	31.98	10:37	24.34	-6.08	7.64
WS-11-125	3/30/2006	31.98	11:14	24.40	-0.06	7.58
WS-11-125	4/12/2006	31.98	9:58	19.43	4.97	12.55
WS-11-125	5/8/2006	31.98	15:26	21.95	-2.52	10.03
WS-11-125	6/13/2006	31.98	10:05	19.59	2.36	12.39
WS-11-125	7/28/2006	31.98	9:12	25.40	-5.81	6.58
WS-11-125	8/21/2006	31.98	9:39	26.87	-1.47	5.11
WS-11-125	9/25/2006	31.98	9:15	27.34	-0.47	4.64
WS-11-161	1/16/2006	32.00	10:17	18.25	NA	13.75
WS-11-161	2/14/2006	32.00	10:35	24.38	-6.13	7.62
WS-11-161	3/30/2006	32.00	11:16	24.46	-0.08	7.54
WS-11-161	4/12/2006	32.00	9:56	19.41	5.05	12.59
WS-11-161	5/8/2006	32.00	15:25	22.00	-2.59	10.00
WS-11-161	6/13/2006	32.00	9:00	19.50	2.50	12.50
WS-11-161	7/28/2006	32.00	9:10	25.40	-5.90	6.60
WS-11-161	8/21/2006	32.00	9:37	26.92	-1.52	5.08
WS-11-161	9/25/2006	32.00	9:13	27.34	-0.42	4.66
WS-12-125	1/16/2006	32.91	10:08	19.14	NA	13.77
WS-12-125	2/14/2006	32.91	10:30	25.17	-6.03	7.74
WS-12-125	3/30/2006	32.91	11:05	25.23	-0.06	7.68
WS-12-125	4/12/2006	32.91	9:50	20.30	4.93	12.61
WS-12-125	5/8/2006	32.91	15:19	22.80	-2.50	10.11
WS-12-125	6/13/2006	32.91	8:45	20.42	2.38	12.49
WS-12-125	7/28/2006	32.91	9:06	26.23	-5.81	6.68

Elevations is feet relative to mean sea level.
MP - measuring point.

Table 1
Groundwater Elevations
January 2006 - September 2006
Siltronic Corporation
Portland, Oregon

PERIOD: From 01/16/2006 thru 09/25/2006 - Inclusive

SITE	DATE	MP ELEVATION (feet)	TIME	DEPTH TO WATER (feet)	DELTA WATER ELEV (feet)	WATER ELEV. (feet)
WS-12-125	8/21/2006	32.91	9:32	27.70	-1.47	5.21
WS-12-125	9/25/2006	32.91	9:09	28.21	-0.51	4.70
WS-12-161	1/16/2006	32.92	10:06	18.91	NA	14.01
WS-12-161	2/14/2006	32.92	10:31	25.14	-6.23	7.78
WS-12-161	3/30/2006	32.92	11:07	25.20	-0.06	7.72
WS-12-161	4/12/2006	32.92	9:52	20.25	4.95	12.67
WS-12-161	5/8/2006	32.92	15:18	22.78	-2.53	10.14
WS-12-161	6/13/2006	32.92	8:50	20.38	2.40	12.54
WS-12-161	7/28/2006	32.92	9:04	26.19	-5.81	6.73
WS-12-161	8/21/2006	32.92	9:30	26.67	-0.48	6.25
WS-12-161	9/25/2006	32.92	9:08	28.18	-1.51	4.74
WS-13-105	1/16/2006	33.30	11:03	19.79	NA	13.51
WS-13-105	2/14/2006	33.30	11:05	24.52	-4.73	8.78
WS-13-105	3/30/2006	33.30	11:57	24.62	-0.10	8.68
WS-13-105	4/12/2006	33.30	10:29	20.62	4.00	12.68
WS-13-105	5/8/2006	33.30	16:03	22.26	-1.64	11.04
WS-13-105	6/13/2006	33.30	9:48	20.35	1.91	12.95
WS-13-105	7/28/2006	33.30	9:58	26.26	-5.91	7.04
WS-13-105	8/21/2006	33.30	10:07	27.09	-0.83	6.21
WS-13-105	9/25/2006	33.30	9:55	28.31	-1.22	4.99
WS-13-69	1/16/2006	33.32	11:06	18.56	NA	14.76
WS-13-69	2/14/2006	33.32	11:06	24.47	-5.91	8.85
WS-13-69	3/30/2006	33.32	12:00	24.81	-0.34	8.51
WS-13-69	4/12/2006	33.32	10:31	21.25	3.56	12.07
WS-13-69	5/8/2006	33.32	16:04	22.27	-1.02	11.05
WS-13-69	6/13/2006	33.32	9:50	20.46	1.81	12.86
WS-13-69	7/28/2006	33.32	10:00	26.35	-5.89	6.97
WS-13-69	8/21/2006	33.32	10:09	27.12	-0.77	6.20
WS-13-69	9/25/2006	33.32	9:58	28.36	-1.24	4.96
WS-14-125	2/14/2006	32.21	10:50	24.64	NA	7.57
WS-14-125	3/30/2006	32.21	11:27	24.77	-0.13	7.44
WS-14-125	4/12/2006	32.21	10:09	19.65	5.12	12.56
WS-14-125	5/8/2006	32.21	15:39	22.18	-2.53	10.03
WS-14-125	6/13/2006	32.21	10:00	19.85	2.33	12.36
WS-14-125	7/28/2006	32.21	9:38	25.80	-5.95	6.41
WS-14-125	8/21/2006	32.21	9:50	27.22	-1.42	4.99
WS-14-125	9/25/2006	32.21	9:32	27.71	-0.49	4.50
WS-14-161	2/14/2006	32.27	10:49	24.68	NA	7.59
WS-14-161	3/30/2006	32.27	11:29	24.80	-0.12	7.47
WS-14-161	4/12/2006	32.27	10:07	19.69	5.11	12.58
WS-14-161	5/8/2006	32.27	15:36	22.20	-2.51	10.07
WS-14-161	6/13/2006	32.27	9:15	19.81	2.39	12.46

Elevations is feet relative to mean sea level.
MP - measuring point.

Table 1
Groundwater Elevations
January 2006 - September 2006
Siltronic Corporation
Portland, Oregon

PERIOD: From 01/16/2006 thru 09/25/2006 - Inclusive

SITE	DATE	MP ELEVATION (feet)	TIME	DEPTH TO WATER (feet)	DELTA WATER ELEV (feet)	WATER ELEV. (feet)
WS-14-161	7/28/2006	32.27	9:36	25.82	-6.01	6.45
WS-14-161	8/21/2006	32.27	9:48	27.29	-1.47	4.98
WS-14-161	9/25/2006	32.27	9:30	27.75	-0.46	4.52
WS-15-140	1/16/2006	33.02	10:46	18.16	NA	14.86
WS-15-140	2/14/2006	33.02	10:57	24.74	-6.58	8.28
WS-15-140	3/30/2006	33.02	11:43	24.77	-0.03	8.25
WS-15-140	4/12/2006	33.02	10:20	20.48	4.29	12.54
WS-15-140	5/8/2006	33.02	15:52	22.64	-2.16	10.38
WS-15-140	6/13/2006	33.02	9:30	20.31	2.33	12.71
WS-15-140	7/28/2006	33.02	9:49	26.07	-5.76	6.95
WS-15-140	8/21/2006	33.02	10:02	27.26	-1.19	5.76
WS-15-140	9/25/2006	33.02	9:50	28.11	-0.85	4.91
WS-15-85	2/14/2006	32.98	10:58	24.48	NA	8.50
WS-15-85	3/30/2006	32.98	11:45	24.48	0.00	8.50
WS-15-85	4/12/2006	32.98	10:23	20.55	3.93	12.43
WS-15-85	5/8/2006	32.98	15:55	22.46	-1.91	10.52
WS-15-85	6/13/2006	32.98	10:15	20.31	2.15	12.67
WS-15-85	8/21/2006	32.98	10:05	26.82	-6.51	6.16
WS-15-85	9/25/2006	32.98	9:52	28.44	-1.62	4.54
WS-16-125	1/16/2006	32.93	10:37	19.56	NA	13.37
WS-16-125	2/14/2006	32.93	10:45	25.25	-5.69	7.68
WS-16-125	3/30/2006	32.93	11:36	25.32	-0.07	7.61
WS-16-125	4/12/2006	32.93	10:15	20.39	4.93	12.54
WS-16-125	5/8/2006	32.93	15:46	22.81	-2.42	10.12
WS-16-125	6/13/2006	32.93	9:20	20.51	2.30	12.42
WS-16-125	7/28/2006	32.93	9:44	26.43	-5.92	6.50
WS-16-125	8/21/2006	32.93	9:57	27.80	-1.37	5.13
WS-16-125	9/25/2006	32.93	9:47	28.44	-0.64	4.49
WS-16-161	1/16/2006	33.03	10:35	19.12	NA	13.91
WS-16-161	2/14/2006	33.03	10:44	25.09	-5.97	7.94
WS-16-161	3/30/2006	33.03	11:34	25.07	0.02	7.96
WS-16-161	4/12/2006	33.03	10:13	20.46	4.61	12.57
WS-16-161	5/8/2006	33.03	15:45	22.79	-2.33	10.24
WS-16-161	6/13/2006	33.03	9:25	20.42	2.37	12.61
WS-16-161	7/28/2006	33.03	9:42	26.23	-5.81	6.80
WS-16-161	8/21/2006	33.03	9:55	27.58	-1.35	5.45
WS-16-161	9/25/2006	33.03	9:45	28.34	-0.76	4.69
WS-17-52	1/16/2006	33.68	11:16	17.21	NA	16.47
WS-17-52	2/14/2006	33.68	11:11	17.52	-0.31	16.16
WS-17-52	3/30/2006	33.68	12:22	17.82	-0.30	15.86
WS-17-52	4/12/2006	33.68	10:40	18.17	-0.35	15.51
WS-17-52	5/8/2006	33.68	16:11	17.85	0.32	15.83

Elevations is feet relative to mean sea level.
MP - measuring point.

Table 1
Groundwater Elevations
January 2006 - September 2006
Siltronic Corporation
Portland, Oregon

PERIOD: From 01/16/2006 thru 09/25/2006 - Inclusive

SITE	DATE	MP ELEVATION (feet)	TIME	DEPTH TO WATER (feet)	DELTA WATER ELEV (feet)	WATER ELEV. (feet)
WS-17-52	6/13/2006	33.68	9:40	16.84	1.01	16.84
WS-17-52	7/28/2006	33.68	10:04	19.84	-3.00	13.84
WS-17-52	8/21/2006	33.68	10:15	20.68	-0.84	13.00
WS-17-52	9/25/2006	33.68	10:12	21.57	-0.89	12.11
WS-17-94	1/16/2006	33.78	11:15	19.00	NA	14.78
WS-17-94	2/14/2006	33.78	11:10	24.61	-5.61	9.17
WS-17-94	3/30/2006	33.78	12:20	24.66	-0.05	9.12
WS-17-94	4/12/2006	33.78	10:42	20.79	3.87	12.99
WS-17-94	5/8/2006	33.78	16:12	22.69	-1.90	11.09
WS-17-94	6/13/2006	33.78	9:42	20.66	2.03	13.12
WS-17-94	7/28/2006	33.78	10:06	26.40	-5.74	7.38
WS-17-94	8/21/2006	33.78	10:12	27.15	-0.75	6.63
WS-17-94	9/25/2006	33.78	10:10	28.54	-1.39	5.24
WS-18-101	9/25/2006	34.14	10:02	29.26	NA	4.88
WS-18-71	9/25/2006	34.18	10:04	28.67	NA	5.51
WS-19-101	9/25/2006	33.98	9:59	29.38	NA	4.60
WS-19-71	9/25/2006	33.87	10:00	28.53	NA	5.34
WS-20-112	9/25/2006	31.79	9:20	26.73	NA	5.06
WS-21-112	9/25/2006	34.05	9:38	29.01	NA	5.04
WS-22-112	9/25/2006	33.01	9:40	28.21	NA	4.80
WS-8-33	1/16/2006	32.96	10:02	17.87	NA	15.09
WS-8-33	2/14/2006	32.96	10:22	23.15	-5.28	9.81
WS-8-33	3/30/2006	32.96	10:58	25.19	-2.04	7.77
WS-8-33	4/12/2006	32.96	9:42	22.48	2.71	10.48
WS-8-33	5/8/2006	32.96	15:12	21.90	0.58	11.06
WS-8-33	6/13/2006	32.96	8:30	20.40	1.50	12.56
WS-8-33	7/28/2006	32.96	8:58	26.18	-5.78	6.78
WS-8-33	8/21/2006	32.96	9:25	27.22	-1.04	5.74
WS-8-33	9/25/2006	32.96	9:04	28.16	-0.94	4.80
WS-8-59	2/14/2006	32.84	10:25	24.91	NA	7.93
WS-8-59	3/30/2006	32.84	11:00	25.08	-0.17	7.76
WS-8-59	4/12/2006	32.84	9:44	20.41	4.67	12.43
WS-8-59	5/8/2006	32.84	15:10	22.70	-2.29	10.14
WS-8-59	6/13/2006	32.84	8:35	20.37	2.33	12.47
WS-8-59	7/28/2006	32.84	9:00	26.18	-5.81	6.66
WS-8-59	8/21/2006	32.84	9:27	27.48	-1.30	5.36
WS-8-59	9/25/2006	32.84	9:02	28.17	-0.69	4.67

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Siltronic Corporation
Portland, Oregon

PERIOD: From 01/16/2006 thru 09/25/2006 - Inclusive

SITE	DATE	MP ELEVATION (feet)	TIME	DEPTH TO WATER (feet)	DELTA WATER ELEV (feet)	WATER ELEV. (feet)
WS-9-34	1/16/2006	32.28	9:53	16.94	NA	15.34
WS-9-34	2/14/2006	32.28	10:14	20.97	-4.03	11.31
WS-9-34	3/30/2006	32.28	10:50	23.56	-2.59	8.72
WS-9-34	4/12/2006	32.28	9:35	20.84	2.72	11.44
WS-9-34	5/8/2006	32.28	15:02	20.52	0.32	11.76
WS-9-34	6/13/2006	32.28	8:20	19.50	1.02	12.78
WS-9-34	7/28/2006	32.28	8:51	23.72	-4.22	8.56
WS-9-34	8/21/2006	32.28	9:15	24.64	-0.92	7.64
WS-9-34	9/25/2006	32.28	8:56	25.36	-0.72	6.92

Elevations is feet relative to mean sea level.
MP - measuring point.

JORDAN SCHRADER

ATTORNEYS AT LAW

Fax Transmittal Cover

To:	James Peale, RG	From:	Chris Reive
	Maul Foster & Alongi, Inc.	Matter #:	**46454/29619**
Fax:	**1.971.544.2140**	Total Pages:	**13**
Phone:	1.971.544.2139 x 2118	Date:	April 1, 2004
Re:	*Siltronic Corporation/Portland Harbor*	cc:	

☐ FYI ☐ As requested ☐ Please review and reply Originals ☐ will ☒ will not follow

Comments/Description of documents being faxed:

See attached March 15, 2004 letter from Robert Ede at Hahn and Associates, Inc.

Project No: 8128.01.01

File To Folder: NWN Docs

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HAHN AND ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

March 15, 2004

Mr. Matt McClincy
Oregon Department of Environmental Quality
Voluntary Cleanup and Site Assessment Section
2020 SW 4th Avenue, Suite 400
Portland Oregon 97201

HAI Project No. 5237

SUBJECT: **Response to Comments and Final Work Plan for City Outfall 22C Evaluation, Phase I Site Characterization and Source Control Evaluation, Wacker Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon**

Dear Mr. McClincy:

At the request of NW Natural, Hahn and Associates, Inc. (HAI) has prepared this Work Plan for additional characterization activities relating to City Outfall 22C, as originally requested by the Oregon Department of Environmental Quality (DEQ) in correspondence dated September 9, 2003 (Mr. Matt McClincy to Mr. Bob Wyatt and Ms. Cathryn Young). The Work Plan included herein has been revised in response to DEQ's November 3, 2003 comments generated from review of HAI's October 13, 2003 draft Work Plan. A response to DEQ's November 3, 2003 comments are provided below, followed by the revised Work Plan.

Response to DEQ Comments

1) Add columns in the screening criteria table (e.g., Table 1) for ambient water quality criteria (AWQC) and DEQ Level II Screening Values (SLVs) that do not employ a multiplier. Contaminant concentrations in the discharge from City Outfall 22C that are interpreted to be groundwater are to be screened directly against AWQC and SLVs. Concentrations measured during a "storm event" (i.e., discharge from this outfall representative of stormwater) which in this case is a combination of groundwater and stormwater, are to be screened employing the multiplier of 5.

   Response: DEQ requests that screening values employed in the initial evaluation of discharges from Outfall 22C be based on the source of the water being discharged (i.e., stormwater vs. groundwater). Because the water is discharging to the river at a single outfall, which the stormwater multiplier was designed to account for[1], it would seem more reasonable to screen all water discharging from

[1] "[I]t should be noted that piped discharges to surface water are fundamentally different than groundwater discharges. Groundwater discharges have the potential to exert toxic effects on the benthic community with little or no dilution.

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Outfall 22C using the same criteria, including the multiplier. This screening approach would likely be more effective in focusing follow-up evaluation to those COIs where such evaluation is truly merited.

Regardless, the screening approach as requested by DEQ in its November 3, 2003 correspondence will be used. It is noted that all screening levels are used for comparative purposes only and will focus further evaluation needs. Screening levels are in no way indicative of cleanup goals or of actual risk.

2) Modify the work plan scope of work to include:

- Collection of an effluent sample from City Outfall 22C during a dry interval (i.e., at least 7 days subsequent to the previous storm event) during the dry season (Summer/Fall). This sample was requested in DEQ's September 9, 2003 letter to confirm the levels of contaminants measured at Outfall 22C during dry weather and low groundwater conditions.

  Response: HAI included the collection of a dry season / storm sampling event in the October 13, 2003 Work Plan. The Work Plan has been revised to update the dry season sampling to a non-storm sampling event.

- Collection of surface water samples from the Northwest Drainage Pond (NDP) during the wet and dry season interval sampling event at Outfall 22C. While there are a number of existing shallow monitoring wells on the Wacker Siltronic property that could potentially be utilized to determine the contaminant levels in groundwater discharging to the drainage ditch, the NDP, and the City Outfall 22C sewer line (see DEQ scope of work in September 9, 2003 letter), testing both the NDP and the outfall effluent during dry intervals is a starting point.

  Response: The requested modification is agreed to.

- Collect surface (upper 6 inches) sediment from the NDP and at a point midway between the NDP and proposed sample station 03 in the off-site drainage ditch. The previous request by DEQ to characterize the ditch/pond sediment was made to determine if contaminated sediments are present that could potentially be flushed to the Willamette River during a large storm event.

  Response: The requested modification is agreed to.

However, piped discharges are typically diluted through rapid mixing with the waters of the receiving body." Joint Source Control Strategy for Portland Harbor, §4.6.3 (draft April 15, 2003).

3) Test water/effluent samples for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total and amenable cyanide and total metals (antimony, barium, chromium, iron, manganese, mercury, nickel, selenium, silver, thallium, zinc, leas, arsenic, copper, and cadmium).

   Response: The requested analytes are all contaminants of interest as identified within the approved RI Work Plan (HAI, 2001), and will be included in the scope of work for further investigation.

4) Test sediment samples for semi volatile organic compounds, total and amenable cyanide, and metals (antimony, barium, chromium, iron, manganese, mercury, nickel, selenium, silver, thallium, zinc, lead, arsenic, copper, and cadmium).

   Response: The requested analytes are all contaminants of interest as identified within the approved RI Work Plan (HAI, 2001), and will be included in the scope of work for further investigation.

5) While we agree that it is important to quantify the contaminant load entering the off-site ditch system as proposed in the draft plan, DEQ does want to clarify that it will not consider contaminants detected in stormwater leaving the Gasco site (proposed sample station 04) to be "background". Also, additional evaluation of contaminant levels detected in water exiting North Doane Lake may be necessary before DEQ can agree to the "background" designation as the nature and extent of shallow groundwater impacts from Gasco-related wastes in this area has not been determined.

   Response: Because discharge from Outfall 22C is derived from a watershed of 1,008 acres occupied by industrial, commercial, residential, as well as green space uses, there is an obvious need to evaluate COI distribution, as possible, from the various points of entry to the unnamed ditch adjacent to the Wacker site. NW Natural is not suggesting that water entering the ditch from off-site properties is representative of naturally-occurring background. Instead, data regarding COIs entering the ditch/outfall 22C from off-site properties would act as control samples, thereby assisting in the interpretation of COI origin.

As discussed during our meeting of November 26, 2003, we understand that additional investigation activities involving Outfall 22C, and including the NDP, are to be conducted by AMEC Earth and Environmental, Inc. (AMEC) as part of the adjacent property Rhone-Poulenc RI. Further, we understand that the City of Portland may have completed sampling or clean-out work related to the off-site drainage ditch / Outfall 22C. NW Natural is currently inquiring as to the nature of the work by the City of Portland. Should results of additional investigation activities from the City of Portland and/or AMEC become available that would duplicate the work proposed herein, we understand that NW Natural would have the option of omitting the duplicative tasks from the Work Plan.

WORK PLAN FOR ADDITIONAL SOURCE CHARACTERIZATION - CITY OUTFALL 22C

Outfall Surface Water Sample Collection

Stormwater / effluent samples will be collected from City Outfall 22C and three up-stream locations on three occasions, as described below

1) During the wet season (Winter/Spring) at the time of a storm event that is greater than 0.1 inches in magnitude, and that occurs at least 72 hours from the previous measurable (greater than 0.1 inches rainfall) storm event.

2) During the dry season (Summer/Fall) at a time when base flow should consist predominantly of groundwater (i.e., a non-storm event).

3) During the wet season (Winter/Spring) during a dry interval (i.e., at least 7 days subsequent to the previous storm event).

During each sampling event, representative grab samples of the water discharging from City Outfall 22C (Station -01)will be obtained by hand by directly filling sample containers from the outfall pipe. At the same time, grab samples will be collected in the same manner of water discharging from the two culvert pipes located at the northwestern end of the BNSF ditch [e.g., the Koppers Industries, Inc. culvert and the NW St. Helens Road culvert (Stations -03 and -04)], and from North Doane Lake at the entrance to the pipe leading to the NDP (Station -02). The proposed sampling locations are depicted on Figure 1.

NDP Surface Water Samples

During the dry season event and the wet season dry interval event, one surface water grab sample will be collected from the NDP (Station -05 on Figure 1) by hand by directly filling sample containers.

Sediment Samples

During the first outfall sampling event, sediment samples will be collected from the NDP as well as from a location midway between the NDP and the two culvert pipes located at the northwestern end of the BNSF ditch (Figure 1). Sediment samples will be collected from below the water line from the upper 6-inches of material with the use of a decontaminated stainless steel hand trowel.

Analytical Methods

All surface water samples will be analyzed for contaminants of interest as identified within the approved RI Work Plan (HAI, 2001). Specifically surface water samples will be analyzed for VOCs by EPA Method 8260B, while all surface water and sediment

samples will be analyzed for SVOCs by EPA Method 8270C and/or 8270 SIM, for total and amenable cyanide by EPA Method 9010, and for 15 total metals (see Tables 2 and 3) by EPA Method 200.7, 245.1, and 7000 Series. Target Laboratory Reporting Levels for primary contaminants of interest are provided in Tables 2 (water) and 3 (sediment). All sample management and analyses will be as provided within the approved RI Work Plan (HAI, 2001).

Quality Control Samples

All sample management and analyses will be as provided within the approved RI Work Plan (HAI, 2001). With regard to this evaluation, one duplicate water sample will be collected and analyzed for PAHs and inorganic COIs during each sampling event. Further, one field blank per sampling event will be collected and analyzed for PAHs during each surface water sampling event.

Schedule

The proposed work activities may commence once access has been obtained from BNSF. At this time, representatives of BNSF have returned an updated access agreement to NW Natural with their edits for review and approval. However, this current draft agreement is based on previous scope of work, which did not include sample collection. As discussed with a BNSF representative, a revised scope of work, to include physical collection of environmental samples, would require execution of a different type of access agreement. Once approval with regard to a scope of work has been received, all efforts will be made to expedite execution of the appropriate access agreement.

Should you have any questions concerning the above, please contact the undersigned.

Sincerely,

Robert Ede, R.G.
Associate

rede@hahnasoc.com

c: Mr. Bob Wyatt, NW Natural
Ms. Patty Dost, Schwabe, Williamson & Wyatt
Mr. Carl Stivers, Anchor Environmental LLC
Ms. Cathryn Young, Wacker Siltronic
Mr. Rod Struck, DEQ Northwest Region

TABLE 1 – Summary of Surface Water Testing Results, Detections Only

Analytical Parameters	Laboratory Analytical Testing Results in ug/L (ppb)		Screening Levels[2] in ug/L					
Sample Location ==>	Northwest Drainage Pond	City Outfall 22C	Ambient Water Quality Criteria[2]	Ambient Water Quality Criteria[2]	DEQ Level II Screening Level[3]	Ambient Water Quality Criteria x 5	Ambient Water Quality Criteria x 5	DEQ Level II Screening Level
Sample Number ==>	NDP-101-W	CO-22C-01						
Sampled By [1] ==>	AMEC	AMEC						
Sample Date ==>	13-Aug-02	13-Aug-02	(Human)	(Aquatic-CCC)	Values	(Human)	(Aquatic-CCC)	Values x 5
General Chemistry by EPA 160.2, 2340B, 300, 310.1			(for comparison with non-stormwater)			(for comparison with stormwater)		
Total Suspended Solids	93,000.	47,000.	#	#	#	#	#	#
Hardness	110,000.	290,000.	#	#	#	#	#	#
Chloride	14,000.	30,800.	#	230,000.	#	#	1,150,000.	#
Sulfate	1,560.	4,710.	#	#	#	#	#	#
Alkalinity	160,000.	360,000.	#	20,000.	#	#	100,000	#
Volatile Organic Compounds (VOCs) by EPA 8260B								
Acetone	2.95	3.56	#	#	1,500.	#	#	7,500.
Benzene	1.47	3.15	51.	#	130.	255.	#	650.
Chlorobenzene	0.5 U	0.605	21,000.	#	50.	105,000.	#	250.
Iso-Propylbenzene	0.5 U	0.577	#	#	#	#	#	#
Naphthalene	5.88	13.4	#	#	620.	#	#	3,100
Toluene	0.583	0.5 U	200,000.	#	9.8	1,000,000.	#	49.
Semi-Volatile Organic Compounds (SVOCs) by EPA 8270C								
Acenaphthene	8.53	32.5	990.	#	520.	4,950.	#	2,600
Acenaphthylene	0.0144 U	0.182	#	#	#	#	#	#
Anthracene	0.184	0.456	40,000.	#	13.	200,000.	#	65.
Benz(a)anthracene	0.141	0.0422 U	0.018	#	0.027	0.09	#	0.135
Benzo(ghi)perylene	0.183	0.0328 U	#	#	#	#	#	#
Benzo(b)fluoranthene	0.453	0.0365 U	0.018	#	#	0.09	#	#
Chrysene	0.25	0.024 U	0.018	#	#	0.09	#	#
Dibenzofuran	1.01	1.72	#	#	3.7	#	#	18.5
Fluoranthene	1.59	2.05	140	#	6.18	700.	#	30.8
Fluorene	1.18	6.26	5,300.	#	3.9	26,500.	#	19.5
Indeno(1,2,3-cd)pyrene	0.136	0.0288 U	0.018	#	#	0.09	#	#
Naphthalene	0.0211 U	0.688	#	#	620.	#	#	3,100.
Phenanthrene	0.0211 U	0.243	#	#	6.3	#	#	31.5
Pyrene	1.57	2.03	4,000.	#	#	20,000.	#	#

TABLE 1 – Summary of Surface Water Testing Results, Detections Only

Analytical Parameters	Laboratory Analytical Testing Results in ug/L (ppb)		Screening Levels[4] in ug/L					
Sample Location ==>	Northwest Drainage Pond	City Outfall 22C	Ambient Water Quality Criteria[2] (Human)	Ambient Water Quality Criteria[2] (Aquatic-CCC)	DEQ Level II Screening Level[3] Values	Ambient Water Quality Criteria x 5 (Human)	Ambient Water Quality Criteria x 5 (Aquatic-CCC)	DEQ Level II Screening Level Values x 5
Sample Number ==>	NDP-101-W	CO-22C-01						
Sampled By[1] ==>	AMEC	AMEC						
Sample Date ==>	13-Aug-02	13-Aug-02						
Total Metals by EPA 6010 or 6020								
Arsenic	11.6 J	1.14 J	0.14	150.	150.	0.7	750	750.
Aluminum	1,780.	9 U	#	#	87.	#	#	435.
Barium	98.4	56.9	1,000.	#	4.	5,000.	#	20.
Boron	121.	73.7	#	#	1.6	#	#	8
Cadmium[4]	0.016	0.0071 U	#	0.09	2.2	#	0.45	11.
Calcium	27,200.	70,800.	#	#	116,000.	#	#	580,000.
Chromium	4.04	0.0354 U	#	11.	11.	#	55	55
Cobalt	9.52	2.74	#	#	23.	#	#	115.
Copper[4]	11.1	45.	1,300.	2.7	9.	6,500.	13.5	45.
Iron	22,300.	19,100.	300.	1,000.	1,000.	1,500.	5,000.	5,000.
Lead[4]	5.2	0.082 U	#	0.54	2.5	#	2.7	12.5
Magnesium	9,380.	26,700.	#	#	82,000.	#	#	410,000.
Manganese	2,650.	3,470.	100	#	120.	500.	#	600
Molybdenum	44.1	13.6	#	#	370.	#	#	1,850.
Nickel[4]	4.41	2.23	4,600	16.1	52.	23,000.	80.5	260.
Potassium	2,270.	4,770.	#	#	53,000.	#	#	265,000
Silicon Dioxide	35,400.	42,600.	#	#	#	#	#	#
Silver	0.8 U	1.18	#	3.2	0.12	#	16.	
Sodium	25,300.	36,100.	#	#	680,000.	#	#	3,400,000.
Vanadium	21. J	0.726 U	#	#	20.	#	#	100.
Zinc[4]	345.	7.64 U	26,000.	36.5	120.	130,000.	182.5	600.

Note: 1 = AMEC Earth & Environmental, Inc., *Remaining Remedial Investigation Technical Memorandum, RPAC-Portland Site*, February 4, 2003.
2 = Lowest value provided in the Ambient Water Quality Criteria (EPA 822-R-02-047, November 2002) based on Fresh Acute, Fresh Chronic (Aquatic Life Protection) and Fish Consumption Only (Human Health) Pathway.
3 = Where no AWQC are available, DEQ Level II Screening Level Values for Ecological Risk Assessment were used. Revised December 2001
4 = AWQC adjusted based on a hardness of 25 parts per million.
5 = Screening levels are used for comparative purposes only.
Bold = Concentration exceeds Reference Level
AWQC = Ambient Water Quality Criteria
DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
J = estimated concentration
ppb = parts per billion
U = not detected above concentration indicated
ug/l = micrograms/liter
= Reference Level not established

TABLE 2 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Water Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/L (ppb)	Screening Levels[1] in ug/L		
		Ambient Water Quality Criteria[2] (Human)	Ambient Water Quality Criteria[2] (Aquatic-CCC)	DEQ Level II Screening Level Values[3]
Volatile Organic Compounds (VOCs) by EPA 8260B				
Acetone	25.	#	#	1,500.
Benzene	1.	51.	#	130.
Chlorobenzene	1.	21,000.	#	50.
Ethylbenzene	1.	29,000.	#	7.3
Naphthalene	2.	#	#	620.
Toluene	1.	200,000.	#	9.8
Xylenes, total	2.	#	#	13.
Semi-Volatile Organic Compounds (SVOCs) by EPA 8270C or 8270 SIM				
Acenaphthene	0.02	990.	#	520.
Acenapthylene	0.02	#	#	#
Anthracene	0.02	40,000.	#	13.
Benz(a)anthracene	0.02 (MDL = 0.01)	0.018	#	0.027
Benzo(a)pyrene	0.02 (MDL = 0.01)	0.018	#	0.014
Benzo(ghi)perylene	0.02	#	#	#
Benzo(b)fluoranthene	0.02 (MDL = 0.01)	0.018	#	#
Benzo(k)fluoranthene	0.02 (MDL = 0.01)	0.018	#	#
Carbazole	10.	#	#	#
Chrysene	0.02 (MDL = 0.01)	0.018	#	#
Dibenzofuran	0.02	#	#	3.7
Fluoranthene	0.02	140.	#	6.16
Fluorene	0.02	5,300.	#	3.9
Indeno(1,2,3-cd)pyrene	0.02 (MDL = 0.01)	0.018	#	#
2-Methylnaphthalene	0.02	#	#	#
Naphthalene	0.02	#	#	620.
Phenanthrene	0.02	#	#	6.3
Pyrene	0.02	4,000.	#	#
Cyanide by EPA 9010				
Total Cyanides	5.	220,000.	5.2	5.2
Amenable Cyanide	5.	#	#	#

TABLE 2 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Water Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/L (ppb)	Screening Levels[1] in ug/L		
		Ambient Water Quality Criteria[2] (Human)	Ambient Water Quality Criteria[2] (Aquatic-CCC)	DEQ Level II Screening Level Values[3]
Total Metals by EPA 6010 or 6020				
Antimony	0.5	640.	#	1,000.
Arsenic	1. (MDL=0.9)	0.14	150	150.
Barium	1.	1,000.	#	4.
Cadmium[4]	0.1 (MDL = 0.03)	#	0.09	2.2
Chromium	1.	#	11.	11.
Copper[4]	2.	1,300.	2.7	9.
Iron	100.	300.	1,000.	1,000.
Lead[4]	1. (MDL = 0.04)	#	0.54	2.5
Manganese	10.	100.	#	120.
Mercury	0.2	#	0.77	0.77
Nickel[4]	2.	4,600.	16.1	52.
Selenium	1.	4,200.	5.	5.
Silver	1. (MDL = 0.08)	#	3.2	0.12
Thallium	1.	6.3	#	40.
Vanadium	5.	#	#	20.

Note:

1 = Screening levels are used for comparative purposes only.

2 = Lowest value provided in the Ambient Water Quality Criteria (EPA 822-R-02-047, November 2002) based on Fresh Acute Fresh Cronic (Aquatic Life Protection) and Fish Consumption Only (Human Health) Pathway.

3 = Where no AWQC are available, DEQ Level II Screening Level Values for Ecological Risk Assessment were used, Revised December 2001.

4 = AWQC adjusted based on a hardness of 25 parts per million.

AWQC = Ambient Water Quality Criteria
DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
MDL = method detection limit
ppb = parts per billion

ug/l = micrograms/liter
= Reference Level not established

TABLE 3 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Soil or Sediment Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/kg (ppb)	Screening Levels[1] in ug/kg DEQ Level II Screening Level Values[2]
Semi-Volatile Organic Compounds (SVOCs) by EPA 8270C or 8270 SIM		
Acenaphthene	13.4	290.
Acenapthylene	13.4	160.
Anthracene	13.4	57.
Benz(a)anthracene	13.4	32.
Benzo(a)pyrene	13.4	32.
Benzo(ghi)perylene	13.4	300.
Benzo(b)fluoranthene	13.4	#
Benzo(k)fluoranthene	13.4	27.
Carbazole	330. (MDL = 22.)	140.
Chrysene	13.4	57.
Dibenzofuran	13.4	5,100.
Fluoranthene	13.4	111.
Fluorene	13.4	77.
Indeno(1,2,3-cd)pyrene	13.4	17.
2-Methylnaphthalene	13.4	#
Naphthalene	13.4	176.
Phenanthrene	13.4	42.
Pyrene	13.4	53.
Cyanide by EPA 9010		
Total Cyanides	0.25	#
Amenable Cyanide	0.25	#

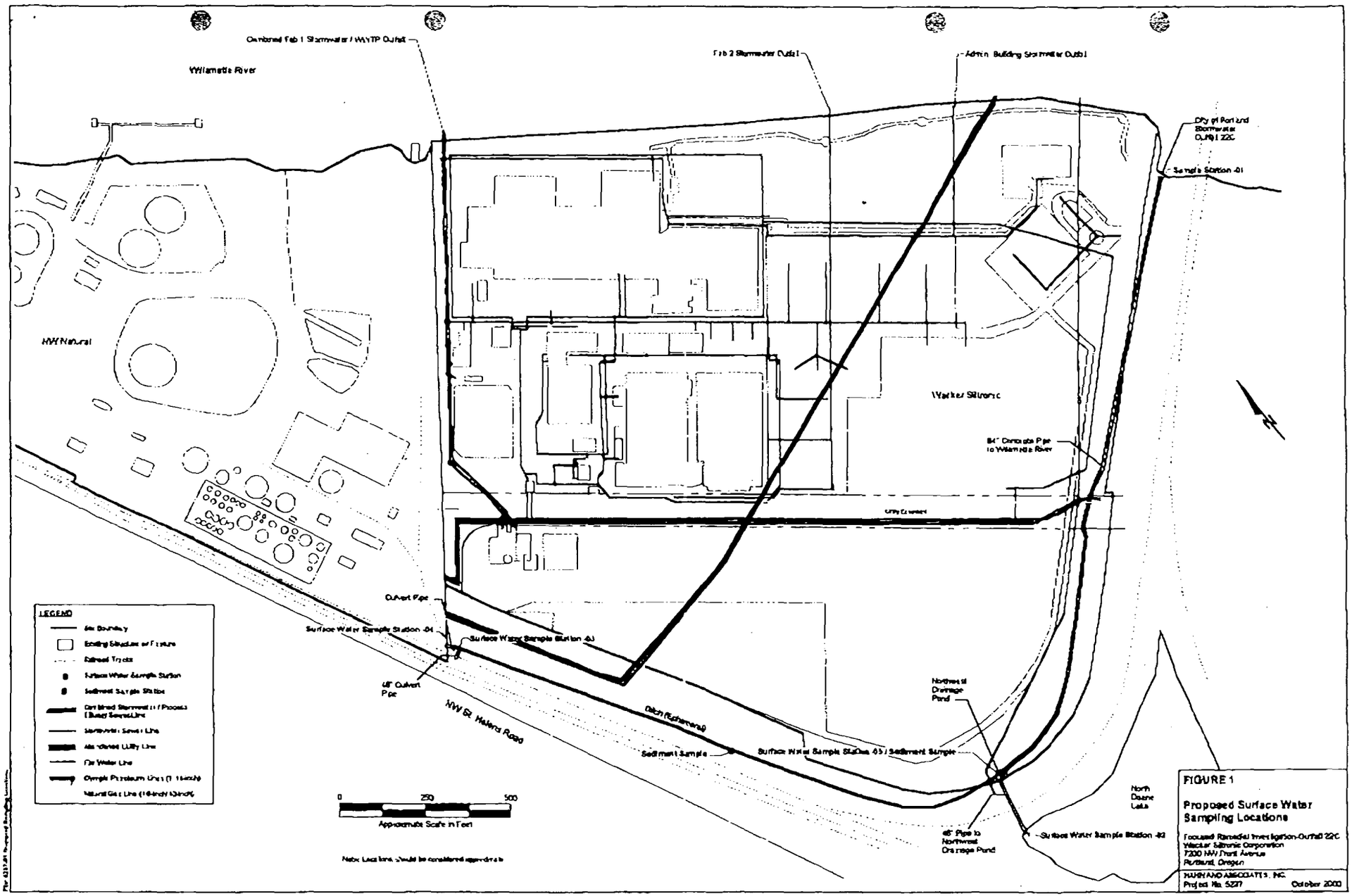
TABLE 3 – Laboratory Reporting Levels for Constiuents of Interest with Potentially Applicable Screening Levels[1] - Soil or Sediment Samples

Analytical Parameters	Laboratory Method Reporting Levels in ug/kg (ppb)	Screening Levels[1] in ug/kg DEQ Level II Screening Level Values[2]
Total Metals by EPA 6010 or 6020		
Antimony	500.	3,000.
Arsenic	500.	4,000.
Barium	500.	#
Cadmium	500. (MDL=200.)	3.
Chromium	500.	3,700.
Copper	2,000.	10,000.
Iron	10,000.	#
Lead	500.	3,500.
Manganese	500.	1,100,000.
Mercury	100.	200.
Nickel	1,000.	1,800.
Selenium	500. (MDL=200.)	100.
Silver	500.	4,500.
Thallium	500.	700.
Vanadium	500.	#

Note: 1 = Screening levels are used for comparative purposes only.
2 = DEQ Level II Screening Level Values for Ecological Risk Assessment Lowest Freshwater or Bioaccumulation, Revised December 2001

DEQ = Oregon Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
ppb = parts per billion
MDL = method detection limit

ug/kg = micrograms/kilogram
= Reference Level not established


Willamette River
Combined Feb 1 Stormwater / WWTP Outfall
Feb 2 Stormwater Outfall
Admin. Building Stormwater Outfall
City of Portland Stormwater Outfall 22C
Sample Station -01
NW Natural
Wacker Siltronic
84" Concrete Pipe to Willamette River
City Easement
Culvert Pipe
Surface Water Sample Station -04
Surface Water Sample Station -03
48" Culvert Pipe
NW St. Helens Road
Ditch Refinement
Sediment Sample
Surface Water Sample Station -03 / Sediment Sample
Northwest Drainage Pond
48" Pipe to Northwest Drainage Pond
Surface Water Sample Station -02
North Doane Lake
LEGEND
Site Boundary
Existing Structure or Feature
Railroad Tracks
Surface Water Sample Station
Sediment Sample Station
Combined Stormwater / Process / Sanitary Sewer Line
Sanitary Sewer Line
Abandoned Utility Line
Fire Water Line
Olympic Petroleum Line (11-inch)
Natural Gas Line (16-inch/12-inch)
0
250
500
Approximate Scale in Feet
Note: Locations should be considered approximate
FIGURE 1
Proposed Surface Water Sampling Locations
Focused Remedial Investigation-Outfall 22C
Wacker Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon
HAHN AND ASSOCIATES, INC.
Project No. 5227
October 2000

8128.01.08 102

ANCHOR ENVIRONMENTAL, L.L.C.

Anchor Environmental, L.L.C.
1423 3rd Avenue, Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131

Memorandum

To: Dana Bayuk, Oregon Department of Environmental Quality

From: Carl Stivers, Anchor Environmental, L.L.C

cc: David Gillingham, Anchor Environmental, L.L.C

Date: November 30, 2007

Re: Response to DEQ Comments on the Source Control Data Gaps Work Plan for the NW Natural "Gasco" Site

On behalf of NW Natural Gasco (NWNG), Anchor Environmental LLC submitted the Source Control Data Gaps Work Plan dated July 2007. In the Oregon Department of Environmental Quality (DEQ) letter dated August 15, 2007, DEQ provided approval of the Data Gaps Work Plan with the exception of Section 2 Stormwater Sampling Scope.

This memo provides a response to comments regarding the unapproved Section 2 only. DEQ has requested re-submittal of only Section 2 of the Data Gaps Work Plan as a separate document. This comment response memo was prepared to clarify how the document was revised in relation to DEQ's individual comments and also reflects additional discussion with DEQ regarding the content of the comments.

General Comments

Comment 1. It appears that the site has been organized into areas A through E based on operations, landuse, or by leasehold (see Figure 1) rather than by storm water drainage basin. If this is the case, figures should be provided that clearly show storm water drainage basin boundaries for the NWNG Property. Additional boundary lines may also be needed to delineate storm water sub-basins within the larger drainage areas (e.g., southern portion of Area C).

Response. Figure 1 of Section 2 divides the site into stormwater drainage basins. Drainage basins A, B, D, and E also generally happen to correspond to leasehold and

operations at the site. Figures 1to 3 have been revised to consistently show actual drainage basins with separate leasehold delineations indicated.

Comment 2. Directional arrows need to be added to selected figures (e.g., Figure 2) to indicate the direction of runoff on all portions of the site. This information is necessary to assess drainage patterns in the vicinity of each catch basin and/or infiltration area.

Response. The site is generally flat with some portions of the edge along the river shore sloping slightly towards the river. During heavy rainfall it is probable that some rainfall near the river flows toward the river but generally, stormwater on the site infiltrates in place with the exception of the developed portions of the site that include the gravel parking facilities, paved areas, and the storage tank berms. Drainage patterns are not readily discernable for the entire site due to the very flat topography, and thus, directional arrows could not be added to the figures with any confidence.

Comment 3. More detailed information is needed on the types of facilities and the associated operations/activities taking place on the site that could be potential sources of contaminants to the storm water system. If the sampling plan includes only a subset of catch basins, a justification must be provided that describes how these sampling locations are representative of all types of potential sources on the site. The work plan should provide justification for the sumps and/or catch basins selected for the sediment sampling and analytical program.

Response. Rather than spend a considerable time compiling and summarizing the considerable information on specific multiple site uses for addition to the work plan, Anchor met with DEQ on October 31, 2007 to go over all the available information at the site to agree on those sumps and/or catch basins most appropriate for sampling. Document revisions reflect those discussions and meeting agreements. Some additional text has been added to the work plan to better describe the activities and conveyances for each area.

Comment 4. Sections 2.3 and 2.4.1, and Table 1 of the work plan provide contradictory information as to what NWNG is proposing as the suite of analyses for storm water system

sediment samples. For clarification, DEQ expects all sediment samples to be analyzed for the chemicals of interest (COI) for the Gasco Site[1], plus polychlorinated biphenyls (PCBs), phthalates, grain-size, and total organic carbon (TOC). If NWNG utilizes catch basin filter inserts at the Gasco Site, then sediment samples should be collected from above and below the insert for analysis. Based on the results of analyzing sediment samples, a storm water sampling and analytical program will be developed prior to the onset of seasonal precipitation consistent with the Joint Source Control Strategy[2] (JSCS).

Response. For clarification, it is agreed that Section 2.3 was in error and was changed to indicate that catch basin sediments will be analyzed for site specific chemicals of interest (COI) for the Gasco site as well as polychlorinated biphenyls (PCBs), phthalates, grain size, and total organic carbon (TOC). This clarification also addresses concerns by the City of Portland that all site-specific analytes including TPH be analyzed.

Available information does not indicate that filter inserts are utilized in catch basins on the site. If in fact there are filter inserts in catch basins on the site at any of the agreed to sampling locations, Anchor agrees to collect a sample from above the filter membrane.

The intention of the Data Gaps Work Plan is to collect stormwater sediment samples as soon as possible and prior to the end of the rainy season.

Comment 5. DEQ has concluded that storm water leaving the Koppers Industrial, Inc. (KI) leasehold on the NWNG Property represents a source of COI (e.g., PAHs) to Doane Creek. As mentioned above, Doane Creek ultimately discharges to the Willamette River via OF-22C. Given this information, DEQ considers characterizing storm water discharges from KI to be an essential element of the NWNG Property storm water pathway evaluation. There are two catch basins located in the southern portion of the NWNG Property that: 1) receive

[1] Gasco Site COI include BTEX compounds (benzene, toluene, ethylbenzene, xylenes); polycyclic aromatic hydrocarbons, plus 2-methynapthalene, carbazole, and dibenzofuran; diesel-range and oil-range petroleum hydrocarbons; cyanide (total, amenable, and free forms), and metals (i.e., aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.).

storm water runoff from the KI leasehold and/or vicinity; 2) are separate from KI's storm water system; and 3) are the last storm water system components to contribute storm water to the Doane Creek culvert. These catch basins are not currently included in the sampling program. Based on the information summarized above, DEQ will require both catch basins to be included in the sediment sampling program for the storm water pathway evaluation.

Response. Anchor discussed these catch basins in the southern portion of the Site with DEQ per the October 31, 2007 meeting described above and the agreed to sampling stations are reflected in the revised Section 2 document.

Comment 6. The work plan does not mention dry weather flow in the storm water conveyances, or the potential for buried utilities to act as preferential pathways for shallow groundwater. These topics need to be discussed so they can be included or eliminated as considerations for the storm water pathway evaluation.

Response. Anchor agrees that dry weather flow should be discussed to the extent existing information is available and this has been added to the document.

Comment 7. Lastly, the work plan should indicate that the reporting procedures laid out in DEQ's instructions for catch basin and storm water sampling will be followed.

Response. Anchor agrees that reporting procedures consistent with DEQ's instructions for catch basin and stormwater sampling will be followed, and the Data Gaps Work Plan has been revised to include the following reporting requirements for catch basin and stormwater sampling events:

- An event summary including rain gauge information as appropriate
- Analytical results including copies of laboratory reports and chain-of-custody documentation. Results will be tabulated to facilitate review by DEQ.
- Data summary

[2] EPA and DEQ, 2005, "Portland Harbor Joint Source Control Strategy – Final," December (note Table 3-1 revised July 16, 2007), a guidance document prepared jointly by the US Environmental Protection Agency and Oregon Department of Environmental Quality.

Specific Comments

Comment 8. Section 1. NWNG implies in the last paragraph that upon completion of the work described in the Data Gaps Work Plan, "...then source control data gaps will be filled for the site and source control evaluation and designs can proceed and be completed for the project." For clarification, although not discussed in the Data Gaps Work Plan and not identified as a data gap in the Source Control Data Gaps Evaluation, DEQ has informed NWNG that erodible soils in segments 1 and 2: 1) are a high priority for source control; and 2) will be incorporated into, and addressed during DNAPL/groundwater source control measures planning, design, and implementation.

Response. It was agreed through the Groundwater/DNAPL Focused Feasibility Study (GWFFS) planning discussions with DEQ that potential bank erosion would be addressed in the GWFFS (per GWFFS, Appendix F). The upland FS will integrate all source controls with upland remedial actions. Therefore, this work plan does not actually address the bank erosion issue, and it is still our intention that data collection for source control evaluation at the Gasco site proper will be complete upon completion of the following work:

- All Phase 2 offshore groundwater work, including seepage meters, TZW tidal analyses, and surface water data collection.
- Upland data collection related to sources described in the approved other section of the subject work plan and sampling of additional Segment 2 groundwater wells recently installed.
- Stormwater data collection per this revised work plan.

It remains our opinion that the existing data set is sufficient for the assessment of bank erosion soils and the evaluation of these data for the determination of interim bank stabilization engineering alternatives as presented in the GWFFS. Consequently, we have not revised the sentence quoted in the comment.

Comment 9. Section 2.1. NWNG's storm water conveyance system maintenance program and schedule should be described in this section of the work plan.

Response. This information has been added to the work plan in Section 2.1 Background and Context in paragraphs 7 through 10.

Comment 10. Section 2.3.1. As discussed under General Comments, DEQ recommends NWNG revise storm water system sampling locations to focus efforts on catch basins or sumps that are: 1) representative of the various site operations/activities occurring at the Gasco Site; and 2) components of conveyances that route storm water to Doane Creek and/or the Willamette River. In general, sediment sampling sites should be located as close as practicable to potential sources of contamination to the conveyance system(s). Sampling results are used to identify potential sources that may need to be controlled. Oil/water separators and sumps that are located further from potential sources are not ideal for sampling because sediments entering the storm water system may be intercepted and trapped prior to getting to further downstream locations. Storm water samples on the other hand are typically collected closer to the boundary of a drainage basin or outfall as these locations would better represent contaminant concentrations that are actually leaving the site via storm water.

DEQ's is providing feedback on NWNG's current proposed locations to assist in revising the scope of work. Our feedback should be considered preliminary because more information is needed before final decisions on sampling locations can be made.

- Area A (SS-4): DEQ needs more information on the direction and pattern of storm water flow and site activities before approving this location for sampling.
- Area B (SS-2): Can potentially be removed from the list of sampling locations as storm water discharges to sanitary sewer (i.e., not representative of storm water discharging to Willamette River).
- Area C
  - For the portion of Area C adjacent to the river on the southeast corner of the site, no sampling is needed because storm water does not discharge into the river.
  - For the portion of the area in the northwestern portion of the site, Figure 2 indicates there are four catch basins located southeast of the former Gasco office. These catch basins apparently drain into a linear section of storm water pipe which connects to the conveyance lines draining areas B and E, and ultimately discharging (untreated) at Outfall 107. Figures 1 through 3 should be reviewed

and revised as appropriate (e.g., Area E should be expanded to include the four catch basins).

- Area D (SS-1): The sampling location for this area should be changed to obtain a more representative sample of sediments entering the storm water system. Additionally, DEQ will require additional information regarding the direction/pattern of storm water flow and site activities/operations for Area D to determine whether the catch basin should be sampled.
- Area E
  - Revise the boundary of the drainage basin to include the conveyance piping and four catch basins mentioned above. If a sample from this area is needed to represent activities occurring in this area, an approach to consider is to collect one sample from this lateral by compositing sediments from the four catch basins on that line.
  - Rather than sampling SS-3, alternative catch basin sampling locations should be considered if they provide more representative data regarding the different types of activity taking place in this area. More information on operations/activities and flow direction is needed to evaluation sampling options.

Response. The document was revised to reflect sampling stations agreed to during the October 31, 2007 meeting with DEQ on this subject.

Comment 11. Section 2.3.2. NWNG should clarify whether there is any overland flow from the site directly to the river.

Response. Anchor has added a discussion of whether there is any overland flow from the site directly to the river to the Work Plan. As stated in the general comments, the site is generally flat and much of the stormwater falling on the undeveloped portions of the site simply infiltrates into the ground. There are some portions of the site in Area C in the southeastern corner of the site that slopes towards the river and some rain falling in this area must flow towards the river during heavy storm events, but the exact extent of this area is unknown.

Comment 12. Section 2.4.1. For clarification, if insufficient sediment is available in any of the designated sampling locations to complete all of the laboratory analyses, analysis of site COI, PCBs, and phthalates should be prioritized over physical tests (e.g., grain-size, total solids, TOC).

Response. Anchor agrees with DEQ that if insufficient sediment is available in any of the designated sampling locations, then the laboratory analysis will be prioritized to the analysis of Site COIs, PCBs, and phthalates. Section 2.4.1 of the work plan has been changed to specify that the priority order of analysis will be Site COIs, PCBs, and phthalates followed by conventional analysis of TOC, total solids, and grain size.

Comment 13. Tables 1 and 2. NWNG should be advised that DEQ updated Table 3-1 of the JSCS in July 2007 (see http://www.deq.state.or.us/lq/cu/nwr/PortlandHarbor/docs/JSCSFinalTable03_1.pdf). For example, the bioaccumulation screening level values for sediment now reflect the DEQ's 2007 guidance document on this subject.

Response. Anchor has revised Tables 1 and 2 of the work plan to reflect changes in Table 3-1 of the JSCS to reflect the July 16, 2007 revisions.

Comment 14. Figure 2. This figure shows that treated water from basin B is discharged through Outfall 107; however the text in Section 2.3.2 and Figure 3 indicates that this water discharges to the sanitary sewer. The figure should be reviewed and revised as appropriate.

Response. The intent was that Figure 2 agrees with text in Section 2.3.2 and Figure 3 to indicate that water from Basin B is pumped through the permitted treatment facility and then discharged to the sanitary sewer. However, Anchor has revised the figures in an attempt to more clearly identify that water from Area B drains to the sanitary sewer.

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By AMF

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SCHWABE, WILLIAMSON & WYATT
ATTORNEYS AT LAW

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Direct Line: (503) 796-2449
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November 27, 2006

Tom McCue
Environmental Manager
Siltronic Corporation
7200 NW Front Avenue
Portland, OR 97210-3676

Alan Gladstone
Davis Rothwell Earle & Xochihua, P.C.
1900 Wells Fargo Center
1300 SW 5th Ave.
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James Peale
Hydrogeologist
Maul Foster Alongi
3121 SW Moody
Portland, OR 97239

Re: *Revised Final Gasco Section 2 Data Gaps Field Sampling Plan; Revised Final Response to Comments*

Dear Tom, Alan, and James:

Enclosed for each of you are copies of the above-referenced Plan and Response to DEQ Comments.

Sincerely,

SCHWABE, WILLIAMSON & WYATT, P.C.

John N. Gootherts
Secretary to Patricia M. Dost

PMD:jng
Enclosures

8128.01.08 /02

Oregon
Theodore Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

OCT 10 2007

AMF

October 9, 2007

Also Sent Via E-mail

Mr. Robert J. Wyatt
Northwest Natural Gas Company
220 N.W. Second Avenue
Portland, OR 97209

Re: Approval for Disposal of Petroleum-Contaminated Soil Produced from Pipeline Integrity Work
NW Natural Gas Company – Former Gasco Facility
Portland, Oregon
ECSI #84

Dear Mr. Wyatt:

The Department of Environmental Quality (DEQ) has reviewed the "Disposal of Petroleum-Contaminated Soil, NW Natural – Gasco Facility, 7900 NW St. Helens Road, Portland, Oregon" dated September 18, 2007 (PCS Disposal Request). The PCS Disposal Request was prepared by the Northwest Natural Gas Company (NWNG) to inform DEQ of plans to dispose of a stockpile of approximately 700 cubic yards of impacted soil off-site.

DEQ understands from our review of the PCS Disposal Request and discussions with NWNG that:

- NWNG conducted federally-mandated pipeline integrity testing work at the former Gasco site from September 2006 through July 2007. In late January and early February 2007, NWNG removed approximately 3,864 tons of impacted soils produced during pipeline work to the Riverbend RCRA Subtitle D landfill (~3,329 tons) and the Waste Management, Inc. Subtitle C landfill (~535 tons)[1]. The stockpiled soil referenced in the PCS Disposal Request represents the balance of material produced during pipeline integrity testing work at the former Gasco site.
- For sampling purposes, the stockpile was divided into three sections. Samples were collected from near the top, middle, and bottom of each section (i.e., three from each section). The three samples were combined into a single composite sample for that section (three composite samples total). A single discrete sample was also collected from each stockpile section.
- Composite samples were analyzed for gasoline-range, diesel-range, and oil range petroleum hydrocarbons; metals (i.e., arsenic, barium, cadmium, chromium, lead, selenium silver,

[1] NWNG's December 13, 2006 proposal for managing this impacted soil was approved by DEQ via a letter dated January 9, 2007. NWNG documented offsite disposal in an information package received by DEQ on February 22, 2007.

mercury); total cyanide, and free liquids. The discrete samples were analyzed volatile organic compounds.

- NWNG has determined from the analytical testing that stockpiled soil can be transported to a land disposal facility that meets RCRA Subtitle D design requirements and is permitted to accept the material.

Given the information summarized above DEQ concurs with NWNG's determinatation and approves the PCS Disposal Request. Prior to removing stockpiled soil, DEQ recommends the material loading and transport procedures be modified to include berming the perimeter of the lined loading pad. This modification is especially warranted if material loading occurs during inclement weather.

In addition to approving the PCS Disposal Request, this letter provides written confirmation that DEQ approved a request made by NWNG to treat water produced during pipeline integrity excavation work performed on property owned by the Siltronic Corporation (Siltronic). NWNG requested approval to treat up to 1,000 gallons of water produced during excavation work conducted at "Dig X" (i.e., the excavation located near the Siltronic wastewater treatment plant). The request to treat excavation water and the results of analyzing the water were provided to DEQ in an August 22, 2007 e-mail. Subsequent to reviewing the e-mail, on August 23, 2007 DEQ verbally approved routing the water through NWNG's on-site granular activated carbon treatment units prior to discharge to the municipal sanitary system under permit with the City of Portland.

Please don't hesitate to contact me if you have any questions regarding this letter.

Sincerely,

Dana Bayuk
Project Manager
Portland Harbor Section

Cc: Sandy Hart, NWNG
Tom McCue, Siltronic
Patty Dost, Schwabe Williamson & Wyatt
Alan Gladstone, Davis Rothwell Earle & Xochihua
Rob Ede, Hahn & Associates
James Peale, Maul Foster & Alongi, Inc.
Henning Larsen, NWR/SRS
ECSI No. 84 File
ECSI No. 183 File

DEQ-DC1

8128.01.08/02

HAHN AND ASSOCIATES, INC.
ENVIRONMENTAL CONSULTANTS

RECEIVED
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By

MEMORANDUM

DATE: August 20, 2007

TO: Mr. Dana Bayuk
Oregon Department of Environmental Quality
Portland, Oregon

FROM: Mr. Rob Ede
Hahn and Associates, Inc.
Portland, Oregon

HAI Project No. 2708 / 5237

SUBJECT: Direct Push Laser-Induced Fluorescence-TarGOST Bench Scale Testing
NW Natural Gasco Property
Portland, Oregon

Cc: Mr. Bob Wyatt, NW Natural
Mr. Carl Stivers, Anchor Environmental
Mr. John Edwards, Anchor Environmental
Ms. Patty Dost, Schwabe Williamson & Wyatt
Mr. Henning Larsen, DEQ
Mr. Tom McCue, Siltronic Corporation
Mr. James Peale, Maul, Foster and Alongi

DEQ has required that NW Natural utilize subsurface logging tools as an alternative to direct visual identification and screening of soil core for dense non-aqueous phase liquid (DNAPL) within the Gasco and Siltronic Shoreline "Segment 1" (running from approximately the shoreline docks at Gasco upstream across the approximate northern 400 feet of the Siltronic shoreline). In response, evaluation for the presence of DNAPL at both the NW Natural Gasco property and the adjacent Siltronic Corporation property has previously been proposed using a direct push-delivered laser-induced fluorescence (LIF) instrument that logs the fluorescence of polynuclear aromatic hydrocarbons (PAHs) at depth. The LIF instrument known as the Tar-specific Green Optical Screening Tool (TarGOST) has been proposed for use as described within in a July 2007 Workplan[1] (Gasco Property) and a July 25, 2007 Workplan[2] (Siltronic). DEQ approved implementation of the TarGOST logging as described within the referenced Workplans on both the Gasco and Siltronic properties in their correspondence dated August 15, 2007 (Dana Bayuk to Bob Wyatt). The objective of the TarGOST work is to provide enhanced delineation of DNAPL along the shoreline adjacent to the Willamette River to assist in ongoing source control evaluations.

---

[1] Anchor Environmental LLC and Hahn and Associates, Inc. (2007). *Source Control Data Gaps Workplan*, Gasco Property, Portland, Oregon 7900 NW St. Helens Road, Portland, Oregon, July 2007 HAI Project 2708).

[2] Hahn and Associates, Inc. (2007). *Remedial Investigation Workplan*, Historical Manufactured Gas Plant Activities, Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon, July 25, 2007 (HAI Project 5237).

SCOEPA00013054

This memorandum provides a description of bench-scale testing using site-specific soil and DNAPL samples, and based on those results, provides a recommendation for moving forward with the primary TarGOST installations at the Gasco and Siltronic properties as proposed in the referenced workplans.

1.0 Background

TarGOST is a direct push-delivered laser-induced fluorescence (LIF) instrument that logs the fluorescence of polynuclear aromatic hydrocarbons (PAHs) at depth. The technology was developed with the objective being the identification of NAPL found at former MGP and wood treating sites by sensing the fluorescence of PAHs in NAPL.

In the presence of PAH-containing oil or tar within the soil matrix, the PAHs will absorb light and are delivered into an electronically excited state. As the PAHs return to the ground state they will fluoresce (they emit red-shifted light). The red-shifted light is collected by a mirror and delivered to the surface by a return fiber optic cable. These measurements occur very rapidly – on the order of one every 10 nanoseconds.

The intensity and waveform shape of the returned red-shifted light may be used to qualitatively ascertain the magnitude of PAH presence across the depths evaluated. High resolution depth-encoded data are presented on vertical logs in real time and are viewed as the TarGOST is pushed into the subsurface.

The intensity and quality of the red-shifted light is meant to provide an indication of the type and magnitude of the PAH containing materials present. The greatest intensity red-shifts are delivered across zones containing DNAPL. As reported by the technology developer, Dakota Technologies (Dakota), of Fargo, North Dakota, the TarGOST can be used to differentiate zones with DNAPL from zones without DNAPL, and may provide a qualitative indication of the magnitude of DNAPL present.

Due to uncertainties with regard to the type of TarGOST response that might be achieved in soils from the Gasco or Siltronic property (either false positives or false negatives), a stepwise approach to testing this technology was proposed within the referenced workplans so that the applicability of the TarGOST technology to site-specific residuals and soils could be evaluated. The evaluation was proposed as a step-wise progression – continuing to move forward as long as the technology appears to be working effectively. The steps described for this evaluation are: 1) bench-scale testing with site-specific samples, 2) site deployment with installation of a minimum set of "primary" locations, 3) continued deployment with installation of "secondary" locations. A description of the bench-scale testing, the purpose of this memorandum, is provided below.

2.0 Bench Scale TarGOST Testing

Selected samples from available core maintained in storage on-site at Gasco or from drilling activities occurring at the time of the study (well MW-13-61R) were shipped to Dakota on June 8, 2007. The samples provided to Dakota, as described below in Table 1, included soil samples with no evidence of impact; soil samples with a petroleum-like or other odor; soil samples containing apparent tar and lampblack (solid residuals); soil samples containing DNAPL; as well as straight DNAPL with no soil matrix.

The primary objective of the bench testing was to confirm that an appropriate TarGOST response is gained from samples known to contain DNAPL, while samples with no visual impact or with non-DNAPL related impact (e.g., solid tar, pencil pitch, or odor), would not result a response similar to that caused by DNAPL presence.

The bench testing conducted by Dakota included placement of the provided samples on the TarGOST window with the fluorescence response (as % of a standardized reference emitter) posted on an output log. The reference emitter (RE) is a known and stable material that is applied to the window before each sounding to serve as a calibration tool prior to data collection such that all measurements are normalized to a known standard. In essence, this procedure allows a consistent reading between soundings regardless of laser energy drift or other changes that would cause a difference in raw signal over time. The fluorescence of the downhole data, relative to the RE, is plotted as a function of depth. Prior to use, the response from the empty TarGOST unit window (no sample) provides an indication of the "background" light scatter that will be anticipated during a run.

For the bench scale testing, Dakota ran the provided samples on the TarGOST unit in 4 groups – resulting in 4 separate response logs. The logs, as provided by Dakota (Attached) simulate a typical TarGOST response log – with the grab samples representing different "depths" on the log.

A description of the samples (boring location and depth; physical description; and resulting TarGOST response (relative to the RE), are summarized on the following Table and have similarly been annotated (by HAI) on the attached logs. For reference, in addition to TarGOST response to each provided sample, Dakota also provides the TarGOST response to a clean window to represent typical of background light scatter.

Table 1 TarGOST Bench Testing

Sample	Description	TarGOST Response (% Reference Emitter)
Clean Window	No sample	8%
MW-13R@16.5'	Sand, no odor, no sheen	5.6%
MW-13R@21.5'	Sand, grey, petroleum odor	4.0%
MW-13-R@23.5'	Sand, brown oil saturated	415.9%
MW-13R@57'	Sand, grey, no odor, no sheen	4.8%
Clean Window	No sample	5.9%
MW-11-31 Oil	DNAPL-no soil matrix	187.1%
MW-20@16.5-17'	Carbon pitch-black, granular (lampblack?),	2.4%
MW-19@20-21'	Carbon pitch (lampblack?)	4.3%
MW-19@21.3-22'	tar and carbon pitch (lampblack?)	4.8%
Clean Window	No sample	9.0%
PW-01 Oil	DNAPL-no soil matrix	461.2%
MW-6 Oil	DNAPL-no soil matrix	2,297.4%
MW-16-45 Oil	DNAPL-no soil matrix	569.8%
B-55	Solid carbon pitch (lampblack?)	5.1%
GS-00@16-19.5'	sand, black and brown, with carbon pitch (lampblack?)_	3.4%
GS-04@109-111.5	Sand, grey, "sweet" odor	3.0%
GS-07@183-185'	Sandy silt, grey, no odor, no sheen	2.1%
GS-08@5-6'	Tar (solid), strong odor	12.3%
GS-10@5-8'	Silt, strong odor, oily blebs	24.7%

As depicted Table 1, and as graphically depicted on the attached logs, based on the bench scale testing of individual soils it was generally possible to discern samples of DNAPL, or soil containing DNAPL, from those that did not. Samples containing no evidence of impact, or samples containing black granular carbon pitch material, typically had a response similar to the clean window (e.g., no increased response).

The sample of soil collected from the known zone of DNAPL presence at a depth of 23.5 feet bgs at MW-13R had a signal response of 415.9%. Straight DNAPL (no soil matrix) from the Gasco site had signal responses from a low of 187.1% (MW-11-31) to a high of 2,291% (MW-6-31).

The solid tar as present in sample GS-8 provided a subdued response (12.3%) – greater than the clean window (9%), and slightly less than sample GS-10 that contained DNAPL blebs (24.7%). Although a slightly stronger signal resulted from the soil containing DNAPL blebs, the relative similarity in signal strength (same order of magnitude)

suggests that there could be uncertainty with regard to the discernment of tar zones from certain zones containing minor amounts of DNAPL.

3.0 Recommendations

The relative similarity of response between the single tar sample (GS-08@5-6') and the single oily bleb sample (GS-10@5-8') suggests that conditions could exist where differentiation between tar and DNAPL may not be possible, and as such, and in accordance with the referenced work plans, NW Natural does not propose to utilize the TarGOST to evaluate conditions within the surficial fill where solid residuals such as tar may be present at certain locations.

With an understanding of the limitations, it is recommended that the field implementation phase of the TarGOST investigation (Primary boring locations) proceed. Based on the results of the site-specific work, a determination as to continue with those locations designated in the workplans as "secondary" will be made and reviewed with DEQ. The on-site TarGOST work is scheduled to commence on August 23, and anticipated to continue through the end of August.

Attachments: 1

1) Dakota Technologies, Inc. TarGOST Bench Test Response Logs

ATTACHMENT 1

TarGOST® Response Logs
Site-Specific Samples from NW Natural, Gasco Property

HAHN AND ASSOCIATES, INC.
Environmental Management
434 NW Sixth Avenue, Suite 203 • Portland OR 97209
(503) 796-0717 • Fax (503) 227-2209

Laboratory: DAKOTA TECHNOLOGIES
Lab Project No.:

CHAIN OF CUSTODY

Chain of Custody No.:

Project Manager: ROB ADE
Project No.: 2708-5237
Project Name: TarGOST TRIAL
Collected by:

Liquid with Sediment Sample: ____ Test Filtrate ____ Test Sediment ____ Test Both
Multi-Phase Sample: ____ Test One (which) ____ Test Separately ____ Shake

Samples Received at 4C (Y or N):
Appropriate Containers Used (Y or N):
Provide Verbal Results (Y or N):
Provide Preliminary Fax Results:

Sample Number Prefix:

SAMPLES FOR LIF-TarGOST Response Demo

Lab ID	Sample #	Date	Time	Sample Description	Soil	Water	Other	Number of Containers	Analyses to be Performed									RUSH	Remarks
				MW-6-OIL			X												
				MW-11-OIL			X												
				PW01-OIL			X												
				MW16-OIL			X												
				GS00 16-19.5'	X														
				GS01-109-111.5'	X														
				GS07-63-1.5'	X														
				GS08 5'-6'	X														
				GS10 5-8'	X														
				B-55	X														
				MW-19-20-21	X														
				MW19-21.3-22	X														
				MW-20 16.5-17	X														
				MW-BGR-65'	X														
				MW-BGR-21.5'	X														
				MW-BGR-23.5'	X														
				MW-BGR-57'	X														

Relinquished by	Company	Date	Time	Received by	Company
[illegible]	HAHN & ASSOC	6-8-07			
Relinquished by	Company	Date	Time	Received by	Company
Relinquished by	Company	Date	Time	Received by	Company

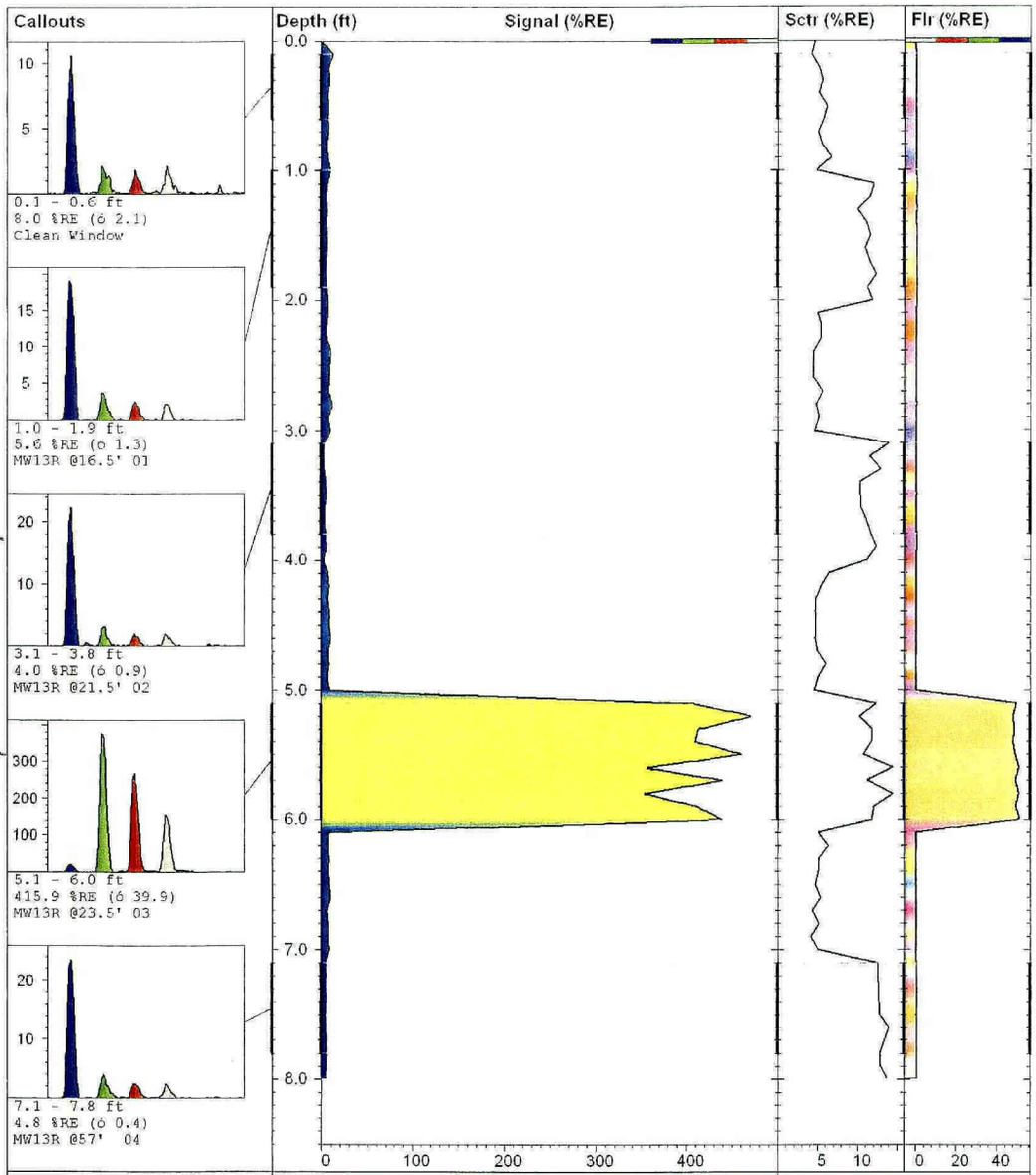
CLEAN WINDOW

MW-13R@ 16.5'
- SAND
- NO ODOR
- NO DISCOLOR

MW-13R@ 21.5'
- SAND
- GREY
- PETROLEUM ODOR

MW-13R@ 23.5'
- Saturated with brown DNAPL
- Sand

MW-13R@ 57'
- Sand
- GREY
- NO ODOR



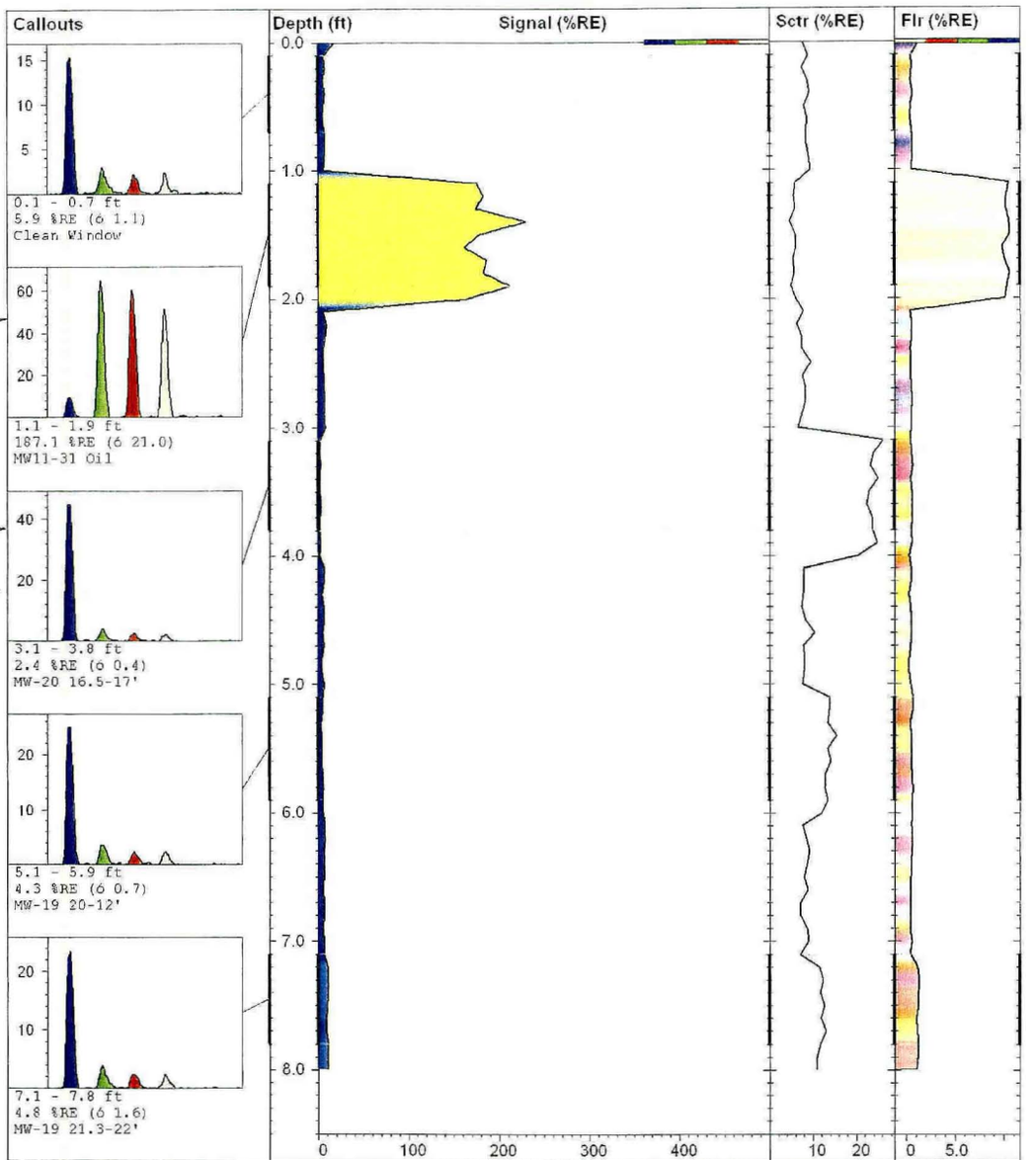
Clean window

DNAPL from well MW-11-31

MW-20E 16.5-17' Black, granular carbon pitch (lampblack?)

MW-19 20-21' lampblack?

MW-19 21.3-22' Tar/Lampblack

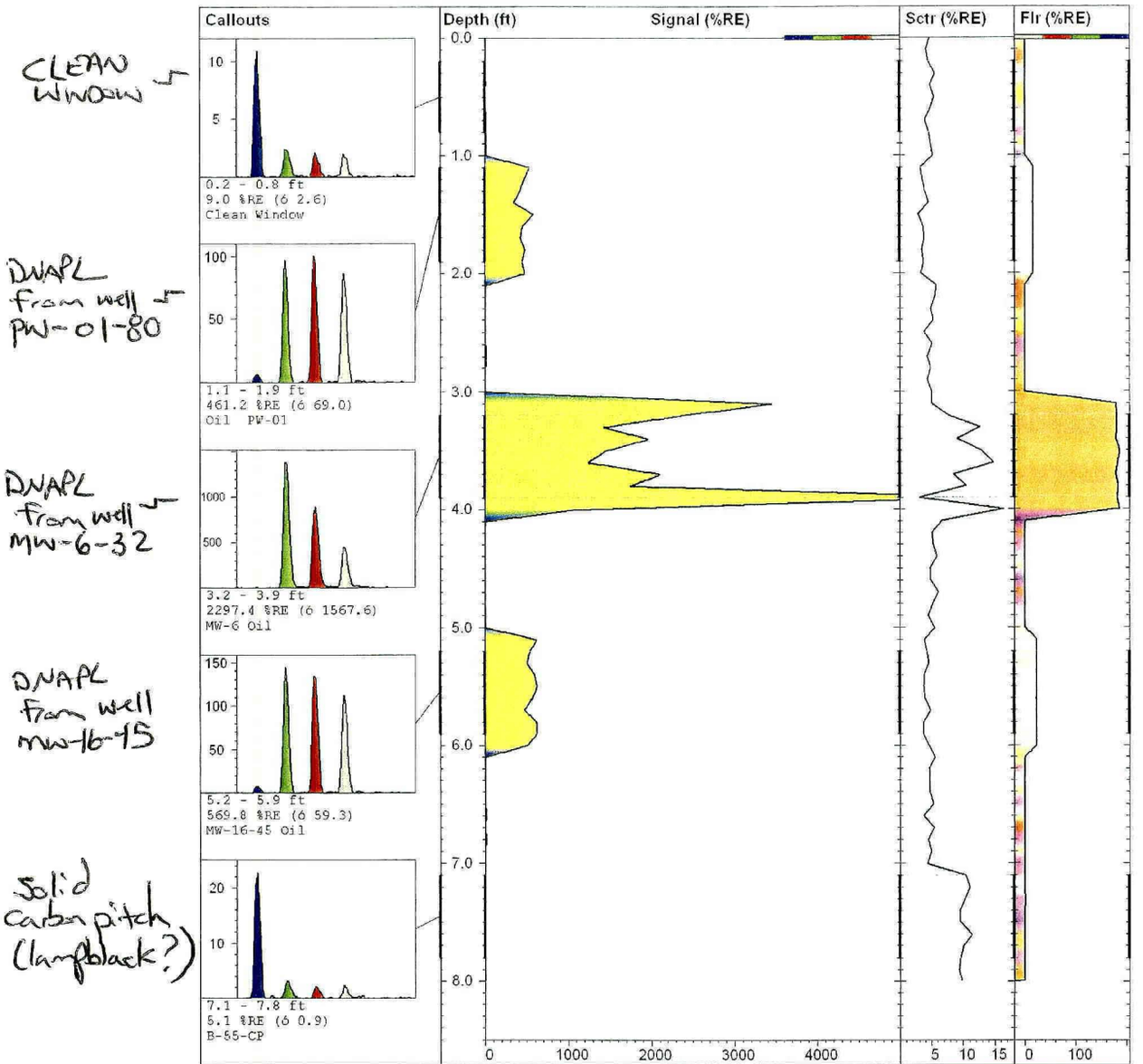


Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com

Group 2

TarGOST By Dakota
www.DakotaTechnologies.com

Site: NW Natural/Gas Co	*Latitude / System:* Unavailable / NAD83	*Final depth:* 8.00 ft
Client: HAI	*Longitude:* Unavailable	*Max signal:* 229.8 % @ 1.40 ft
Job:	*Operator/Unit:* T. Rudolph/DTI02	*Date & Time:* 7/12/2007 1:48:09 PM



Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com

Group 3		TarGOST By Dakota www.DakotaTechnologies.com
Site: NW Natural/Gas Co	*Latitude / System:* Unavailable / NAD83	*Final depth:* 8.00 ft
Client: HAI	*Longitude:* Unavailable	*Max signal:* 6061.7 % @ 3.90 ft
Job:	*Operator/Unit:* T. Rudolph/DTI02	*Date & Time:* 7/13/2007 8:13:23 AM

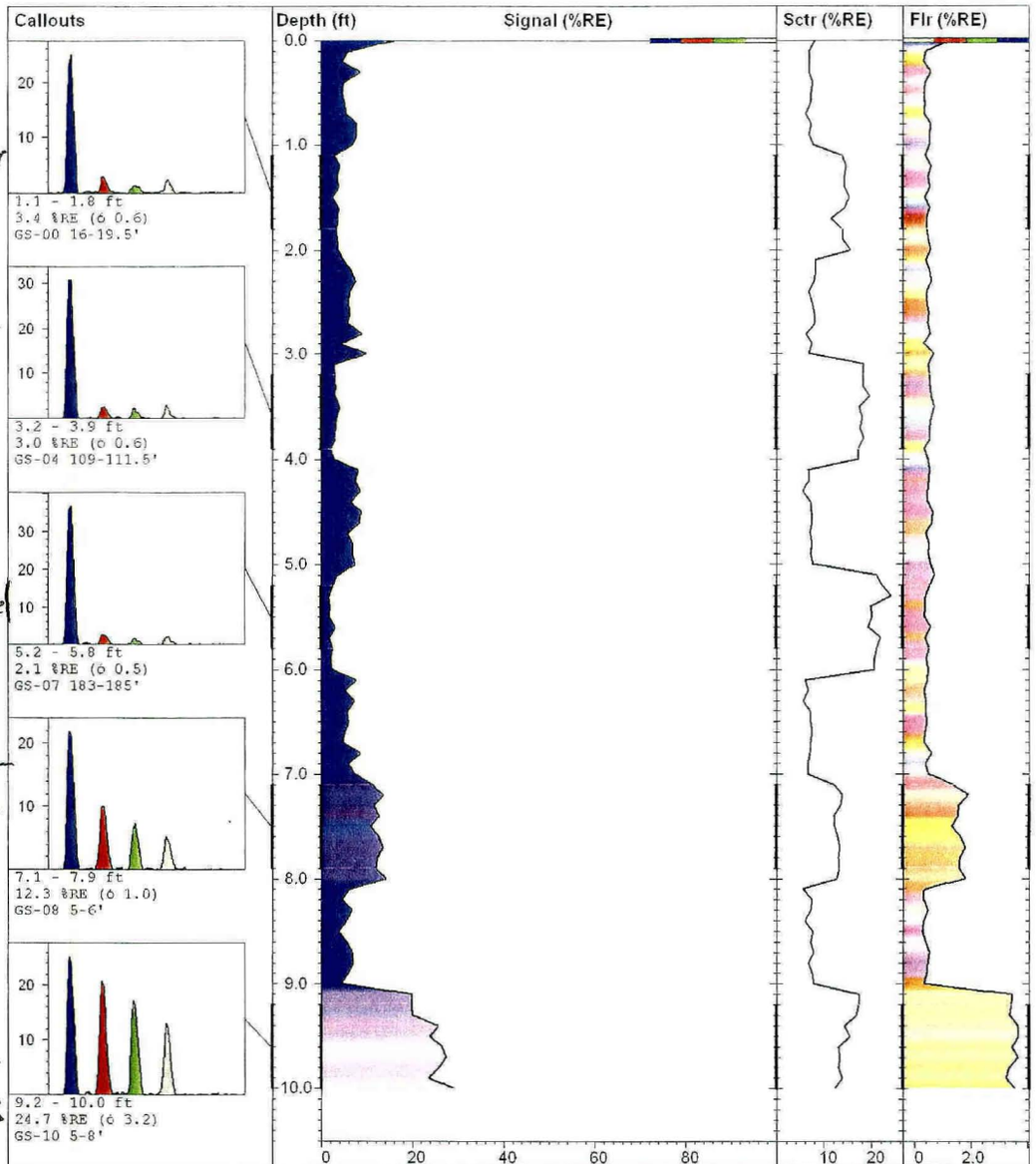
GS-00
16-19.5'
Sand
Brown/Black
petroleum odor
lampblack?

GS-04
109-111.5'
Fine Sand
Grey
Sweet odor

GS-07
183-185'
- Grey Sandy
Silt with Gravel
- No odor

GS-08
5.5-6.0'
· Tar (solid)
· strong odor

GS-10
5-8'
· Silt
· strong odor
· oily blebs



Dakota Technologies, Inc.
Fargo, ND (701)237-4908
www.DakotaTechnologies.com

Group 4

TarGOST By Dakota
www.DakotaTechnologies.com

Site: NW Natural/Gas Co	*Latitude / System:* Unavailable / NAD83	*Final depth:* 10.00 ft
Client: HAI	*Longitude:* Unavailable	*Max signal:* 29.3 % @ 10.00 ft
Job:	*Operator/Unit:* T. Rudolph/DTI02	*Date & Time:* 7/13/2007 8:26:43 AM

8128.01.08/02

Oregon
Theodore Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

July 18, 2007

JUL 30 2007

AMF

Mr. Robert J. Wyatt
Northwest Natural Gas Company
220 N.W. Second Avenue
Portland, OR 97209

Re: Approval for Disposal of Petroleum-Contaminated Soil NW Natural Gas Company Pipeline Integrity Work on the Siltronic Corporation Property Portland, Oregon

Dear Mr. Wyatt:

The Oregon Department of Environmental Quality (DEQ) has reviewed the "Disposal of Petroleum-Contaminated Soil, NW Natural – Utility Easement Area, Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon" dated June 18, 2007, and the amended scope of work dated July 10, 2007 (the Amendment). The Amendment replaces the scope of work attached (Attachment 1) to the June 18th document. DEQ collectively refers to the June 18th document and the Amendment as the "PCS Disposal Request" in this letter.

The PCS Disposal Request was prepared by the Hahn and Associates, Inc. (HAI) on behalf of the Northwest Natural Gas Company (NWNG). The document informs DEQ of NWNG's plans to excavate an estimated 200 cubic yards of potentially impacted soil for off-site disposal. The impacted soil will be excavated as part of the gas pipeline integrity work NWNG is conducting at selected locations on property owned by the Siltronic Corporation (Siltronic Property).

According to the PCS Disposal Request nine excavations have been be located on the Siltronic Property along NWNG's gas pipeline. For planning purposes, in May 2007 nine pre-excavation borings were advanced within 10 feet of each of the proposed excavations. Given the history of site use and development, and for purposes of characterizing soil samples for disposal, one or two samples collected from each boring were submitted for analysis of gasoline-range, diesel-range, and oil-range petroleum hydrocarbons; volatile organic compounds, polycyclic aromatic hydrocarbons, metals, cyanide, and free liquids. Based the results of these analyses, excavated soil has been accepted by, and will be transported to, a land disposal facility that meets RCRA Subtitle D design requirements and is permitted to accept the impacted soil.

Based on our review of the PCS Disposal Request, DEQ acknowledges our requirements for NWNG to: 1) have knowledgeable personnel in the field monitoring and overseeing excavation work, and 2) provide a plan for contingency contaminated soil management have been incorporated into the document (see Section 2.5).

Excavation activities on the Siltronic Property were initiated during the week beginning July 16th. DEQ verbally approved NWNG moving forward with pipeline integrity work during a telephone conversation with Rob Ede of HAI on July 12th. This letter provides our written approval of the PCS Disposal Request.

Upon completion of the pipeline integrity project, DEQ expects NWNG to provide a written summary of the completed work, including, but not limited to: 1) copies of gate receipts from the facilities receiving excavated material; 2) laboratory reports for any additional soil samples submitted for analysis; and 3) representative photographs of excavation and soil handling and management activities.

Please don't hesitate to contact me if you have any questions regarding this letter.

Sincerely,

Dana Bayuk
Project Manager
Portland Harbor Section

Cc: Sandy Hart, NWNG
Patty Dost, Schwabe Williamson & Wyatt
Rob Ede, Hahn & Associates
Tom McCue, Siltronic
Alan Gladstone, Davis Rothwell Earle & Xochihua
James Peale, Maul Foster & Alongi, Inc.
Henning Larsen, NWR/SRS
ECSI No. 84 File
ECSI No. 183 File

DEQ-DC1

Project Number 8128.01.08/2 TASK

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Oregon
Theodore Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
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July 3, 2007

Also Sent Via E-mail

Mr. Robert J. Wyatt
Northwest Natural Gas Company
220 N.W. Second Avenue
Portland, OR 97209

Re: Addendum to Phase 2 Offshore Field Sampling
Groundwater Source Evaluation
Northwest Natural Gas Company Site
Portland, Oregon
ECSI #84

JUL 06 2007

AMF

Dear Mr. Wyatt:

The Oregon Department of Environmental Quality (DEQ) previously reviewed and commented (DEQ correspondence, June 28, 2007) on "Phase 1 Report and Phase 2 Field Sampling Approach, GASCO Siltronic Groundwater Source Evaluation". The plan was prepared by Anchor Environmental, LLC (Anchor) on behalf of the Northwest Natural Gas Company (NWNG). DEQ commented on various aspects of the plan including sample locations, depths, collection methods and analytical parameters. In response to DEQ comments, Anchor submitted an addendum, dated July 2, 2007, revising and augmenting the original field sampling plan.

A review of the Anchor addendum found that all of DEQ comments were satisfactorily addressed. DEQ approves of the Phase 2 offshore field sampling plan and addendum, and requests that NWNG move forward with its implementation. DEQ expects further discussion regarding Step 2 of the Phase 2 sampling program will occur as the results from the Step 1 work become available. In addition, DEQ is looking forward to reviewing Anchor's plan for collecting water column samples.

DEQ appreciates the efforts NWNG is making to conduct offshore drilling and sampling work.

Between July 2rd and July 6th I will be out of the office and all questions regarding this matter should be directed to Henning Larsen (503/229-5527). I am returning to the office on July 9th and will be available for questions at that time.

Sincerely,

Henning Larsen for Dana Bayuk

Dana Bayuk
Project Manager
Portland Harbor Section

Cc: Sandy Hart, NWNG
Patty Dost, Schwabe Williamson & Wyatt
Rob Ede, Hahn & Associates
John Edwards, Anchor Environmental
Carl Stivers, Anchor Environmental
Tom McCue, Siltronic
Alan Gladstone, Davis Rothwell Earle & Xochihua
James Peale, Maul Foster & Alongi, Inc.
Cinde Donoghue, Environment International
Eric Blischke, EPA
Chip Humphries, EPA
Rene Fuentes, EPA
Kristine Koch, EPA
Sean Sheldrake, EPA
Henning Larsen, DEQ/SRS
Jim Anderson, DEQ/PHS
Matt McClincy, DEQ/PHS
ECSI No. 84 File

Project Number TASK 8128.01.08/2

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MAUL
FOSTER
ALONGI INC.
ENVIRONMENTAL & ENGINEERING CONSULTANTS
3121 SW Moody Avenue, Suite 200 | Portland, Oregon 97239 | Phone 971.544.2139 | Fax 971.544.2140 | www.MFAinc.org

June 8, 2007
Project No. 8128.01.08

Mr. Dana Bayuk
Oregon Department of Environmental Quality
2020 SW 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Re: *Groundwater/NAPL Pilot Program Extraction Well and Performance Evaluation Design Report* (Anchor Environmental, LLC)
Northwest Natural, Inc.
Portland, OR
ECSI #84

Dear Dana:

Maul Foster & Alongi, Inc. (MFA) has reviewed the above-referenced report (the Design Report) submitted to the Oregon Department of Environmental Quality (DEQ) in early May, 2007. This letter is prompted by concerns regarding migration of trichloroethene (TCE) and its degradation products (dichloroethene isomers and vinyl chloride) from the Siltronic Corporation (Siltronic) property towards the Northwest Natural, Inc. (NWN) property. The following comments document Siltronic's concerns and propose a minor modification to the Design Report.

The Design Report proposes a pumping test using a pair of wells (PW-4-85 and PW-4-118) to be installed on the NWN property, approximately 150 feet west of monitoring well WS-14-125 on the Siltronic property. As described in the Siltronic Remedial Investigation Report (MFA, 2007), TCE and its degradation products have been non-detect or detected at low concentrations in WS-14-125. As such, this well represents the west-lateral extent of TCE and its degradation products in groundwater on the Siltronic property.

The Design Report shows that the estimated hydraulic capture zones for PW-4-85 and PW-4-118 extend on to the Siltronic property and overlap the estimated lateral extent of TCE and its degradation products in groundwater. Based on the capture zones, it appears that groundwater extraction from the PW-4 wells could modify the hydraulic gradient and increase the lateral extent of TCE and its degradation products.

SCOEPA00013071

It is understood that increasing the lateral extent of the TCE plume is not a desirable outcome for Siltronic, NWN, or DEQ. As part of the data collection effort, the Design Report proposes monitoring groundwater elevations in WS-14-125 and WS-11-161 prior to and during the aquifer test.

Siltronic agrees that groundwater elevation monitoring is appropriate. Siltronic suggests that NWN collect groundwater samples from WS-14-125 before, during and after the pumping test in order to quantify changes in concentrations of TCE and its degradation products. The samples should be analyzed for volatile organic compounds (VOCs) by USEPA Method 8260. The data from the sampling could quantify the extent to which (if any) the TCE plume has been modified by the groundwater extraction.

Siltronic appreciates NWN's commitment to groundwater source control and anticipates that the proposed modification to the Design Report will not delay implementation.

Please call either of us at (971) 544-2139 if you have questions or comments.

Sincerely,

Maul Foster & Alongi, Inc.

James G.D. Peale, R.G.
Senior Hydrogeologist

James J. Maul, R.G.
Principal Hydrogeologist

cc: Tom McCue, Siltronic
Chris Reive, Jordan Schrader
Alan Gladstone and William Earle, Davis Rothwell Earle & Xochihua, P.C.
John Edwards, Anchor Environmental LLC
Robert Wyatt, NWN
Henning Larsen, DEQ

Project Number /TASK 8128.01.08/02

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Oregon
Theodore Kulongoski, Governor

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Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

June 13, 2007 *Also Sent Via E-mail*

Mr. Robert J. Wyatt
Northwest Natural Gas Company
220 N.W. Second Avenue
Portland, OR 97209

JUN 15 2007
AMF

Subject: **Proposed Groundwater/NAPL Pilot Program**
Northwest Natural Gas Company Site
Portland, Oregon
ECSI No. 84

Dear Mr. Wyatt:

The Department of Environmental Quality (DEQ) has reviewed the "Groundwater/NAPL Pilot Program, Extraction Well and Performance Evaluation Design Report" dated May 2007 (Pilot Program). Anchor Environmental, LLC (Anchor) prepared the Pilot Program on behalf of the Northwest Natural Gas Company (NWNG). The Pilot Program provides an updated approach for assessing groundwater extraction wells as a source control technology in the southeast corner of property owned by NWNG (NWNG Property).

DEQ has determined that source control is required along entire shoreline of the NWNG Property and the northern portion of the property owned by the Siltronic Corporation (Siltronic Property). The portion of the shoreline identified as the highest priority for source control (Segment 1) extends from downstream of the "Tar Body Removal Area" (TBRA) on the NWNG Property, to upstream of the "lowland effluent overflow pond area" (EPOA) on the Siltronic Property. Segment 1 coincides with the:

- Heaviest impacts associated with NWNG's former manufactured gas plant (MGP) operations, including dense non-aqueous phase liquid (DNAPL) and contaminated groundwater, identified near the river; and
- The portion of the Siltronic Property where groundwater contamination caused by Siltronic has commingled with MGP-related groundwater contamination and DNAPL.

The segment of NWNG's shoreline between the TBRA and NWNG's downstream property line with US Moorings (Segment 2) is considered a high priority for source control due to the presence and concentrations of cyanide in soil and groundwater.

DEQ is requiring that source control measures be implemented along segments 1 and 2 to prevent migration of DNAPL, contaminated groundwater, and erodible soils to the Willamette River. A third shoreline segment (Segment 3) extends from upstream of the EPOA to the upstream Siltronic Property line. A source control evaluation of this segment is ongoing.

NWNG is currently investigating segments 1 and 2 to develop the data necessary for evaluating source control measures for the groundwater/DNAPL focused feasibility study (FFS). NWNG and DEQ have discussed source control measures technologies and agree that:

- Extraction wells and vertical barriers are a proven containment technologies;
- Implementation of these technologies on the NWNG and Siltronic properties is feasible; and

- Extraction wells and vertical barriers are technologies that will be carried forward into the FFS.

The Pilot Program focuses on further evaluating the influence of pumping extraction wells on DNAPL and contaminated groundwater in the fill and alluvial water-bearing zones (WBZs) of Segment 1 in the southeastern corner of the NWNG Property.

DEQ's comments are provided below and document discussions and agreements reached regarding the scope of work, and clarify our expectations regarding source control data needs and/or the objectives of the Pilot Program.

GENERAL COMMENTS

Scope of Work

The Pilot Program provides an updated approach for assessing groundwater extraction wells as a source control technology in the southeast corner of the NWNG Property. The scope of work for the Pilot Program does not: 1) consider the location (relative to the extraction wells and river), depth, and/or alignment of a vertical barrier, and 2) does not propose a sampling scheme to support a preliminary evaluation of the treatibility of extracted groundwater. DEQ considers this information essential for preparing the FFS.

During a telephone discussion on May 18th, DEQ informed Anchor that: 1) due to the risk of having to decommission and replace the extraction wells during construction of a vertical barrier, and 2) lacking a proposal for a preliminary treatibility evaluation, the scope of work for the Pilot Program should be substantially modified as described below.

- Previously NWNG constructed and tested an extraction well (PW-01-80) that provided data regarding the hydraulic properties and groundwater chemistry of the upper 80 feet of the alluvial WBZ[1]. Based on selected data from existing and new monitoring wells (monitoring well clusters MW-18, MW-19, and MW-20), and near shore borings located along segments 1 and 2, an apparent concentration break occurs at a depth of approximately 125 feet below ground surface (bgs). Accordingly, the Pilot Program proposed installing five extraction wells screened between 75 feet and 118 feet bgs.

  Based on recent discussions with Anchor, the Pilot Program will now include the drilling, installation, and testing of only the PW-04 extraction well pair. The PW-04 pair was selected because they are located at or near the concentration break interpreted by NWNG and within a highly contaminated portion of the alluvial WBZ. In addition, DNAPL was observed during drilling of the MW-20 boring in close proximity to, and within the screened interval of PW-04-85.

The data collection objectives for testing PW-04 will include, but are not necessarily limited to the following:

- Evaluating the performance of the paired well design;
- Providing estimates of the hydraulic properties of the alluvial WBZ influenced by pumping PW-04, to a depth of approximately 120 feet bgs near the middle of Segment 1;
- Evaluating the horizontal and vertical capture zone of PW-04;

[1] Hahn and Associates, Inc., 2005, "Aquifer Test Evaluation Report, NW Natural – Gasco Facility, 7900 NW St. Helens Road, Portland, Oregon," October 14, a report prepared on behalf of the Northwest Natural Gas Company.

- Assessing DNAPL and contaminated groundwater capture in an area of known groundwater contamination where DNAPL has been observed; and
- Collecting information on contaminant levels in the extracted water.

This information will supplement previous work completed in Segment 1 (e.g., PW-01-80 aquifer test, near shore borings, geologic interpretations, and grain-size analyses), and provide information regarding deeper portions of the alluvial WBZ (e.g., 75 feet to 118 feet bgs). Additionally, DEQ understands from NWNG that the Pilot Program as modified above will provide information that can be applied to Segment 2.

DEQ further understands that the modified Pilot Plan will support the modeling work described in Section 5.0, including evaluating the locations, numbers, and depths of extraction wells and the adequacy of the existing monitoring well network. Ultimately work completed in segments 1 and 2 must provide sufficient information to fully support the numerical simulations of hydraulic containment using various extraction well/vertical barrier combinations that will be performed during the FFS.

Segment 2

To date, site characterization work and source control work has focused on Segment 1. As discussed above, DEQ is also requiring source control to be conducted in Segment 2. The scope of work does not recommend any work to evaluate the hydraulic properties or groundwater treatibility for Segment 2. The Pilot Plan is deficient in this respect.

DEQ concludes that because of the unusual inorganic chemistry of groundwater, additional work will be needed within Segment 2 to support the FFS. The general groundwater chemistry in Segment 2 (e.g., levels of dissolved iron and manganese) could prove to be a significant factor in the long term operation and maintenance of extraction wells (e.g., encrustation, fouling, localized reduction in formation transmissivity, increased maintenance time) and treatment system components (e.g., encrustation, fouling, clogging, increased maintenance time).

DEQ is reviewing NWNG's proposal to drill and install monitoring wells along Segment 2. Subsequent to receiving the results from the initial groundwater monitoring event at these wells, DEQ expects NWNG to present an approach for assessing the hydraulic properties and treatibility for Segment 2 that will fully support groundwater modeling and the FFS. Postponing the FFS, or submitting an incomplete FFS due to lack of representative information for Segment 2 will not be acceptable.

Depth of Extraction Wells

NWNG has identified benzene, naphthalene, and cyanide (i.e., total, amenable, and free forms) as "key constituents" to use in assessing groundwater contamination associated with MGP waste. Based on the vertical distribution of benzene and naphthalene, NWNG has interpreted a break in contaminant concentrations at a depth of about 125 feet bgs (approximately -100 feet mean sea level). The depths of the extraction wells proposed in the Pilot Program are based on this interpretation.

NWNG should be advised that DEQ does not consider the three chemicals referenced above to be adequate for delineating the nature and extent of contamination. For example, relevant ecological criteria for toluene, ethylbenzene, and xylenes are lower than benzene. DEQ expects NWNG to fully evaluate the nature and extent all MGP waste chemicals of interest (COI) in the FFS. As such, it is premature for

NWNG to place vertical limits on hydraulic containment within the alluvial WBZ.

SPECIFIC COMMENTS

Introduction. The second paragraph implies that NWNG considers hydraulic containment using extraction wells to be a viable stand-alone source control measure alternative. As DEQ has indicated previously, extraction wells alone are unlikely to meet the source control objectives (i.e., prevent DNAPL migration to the river; prevent recontamination of the river). In addition, NWNG should be advised that the U.S. Environmental Protection Agency has indicated to DEQ that extraction wells alone will probably not be compatible with the removal-based Early Action being contemplated off-shore of the NWNG and Siltronic properties.

Section 2.3. DEQ concurs with NWNG that based on grain-size analyses, the grain-size of the alluvial unit increases with depth. DEQ's review suggests that the alluvial unit can be organized into three "zones" based on grain-size. The third zone consists of mixtures of medium and coarse sand, and gravel at depth.

As shown in Figure 3, the stratigraphy of the alluvial unit may be difficult to correlate based on visual observations made during drilling. The three "zones" preliminarily identified by NWNG and DEQ provide an alternative method for interpreting and depicting the subsurface geology across segments 1, 2, and 3.

Section 3.2. Subsequent to submittal of the Pilot Program and upon further consideration of the inorganic groundwater chemistry, NWNG proposed modifying the extraction well screen and filter pack specifications in an e-mail sent May 18th (i.e., all wells to have screens with 0.035-inch slots and filter packs consisting of 10/20 sand). This letter provides DEQ's approval of the material specifications change.

Section 4.1. The aquifer test plan is presented in this section of the Pilot Program. DEQ's comments are provided below numbered consistent with the Pilot Program.

1. The totalizing flow meter should also provide measurements of instantaneous discharge, and should be checked and calibrated prior to initiating performance testing.

2. NWNG revised Table 5 after the May 18th telephone discussion regarding the change in the Pilot Program scope of work. The revised version of the table was sent via e-mail on May 25th and provides NWNG's recommended network of installations to monitor the PW-04 performance tests. Ten monitoring wells are included in the network ranging in depth from 32 feet to 180 feet bgs. This letter provides DEQ's approval of the revised table.

4. Additional information is needed regarding the strategy NWNG will use to evaluate and account for tidal fluctuations in observation and extraction wells during performance testing.

5. As discussed under General Comments, an objective of the testing plan is two evaluate the performance of the dual extraction well design. As such, DEQ expects that PW-04-85 and PW-04-118 will be performance tested individually and jointly.

6. The proposed approach for collecting samples during extraction well performance testing is inadequate. DEQ expects groundwater samples to be collected at the extraction well being tested at 10 minutes, 100 minutes, 1,000 minutes, and at the end of the pumping period. Groundwater samples should be analyzed for the principal site COI, including total/amenable/free cyanide and selected treatibility parameters (e.g., iron and manganese). The results of the June 2007 groundwater event scheduled for later this month can be utilized for pre-test groundwater chemistry. In addition, DEQ understands that per agreements made with Siltronic, NWNG is going to collect groundwater samples from monitoring wells in the WS-14 cluster for analysis of volatile organic compounds.

Section 4.2. In addition to the interference factors listed in this section, the change from a storativity to specific yield as groundwater levels are drawn down below the silt unit could influence the data collected during performance tests.

Section 5.1. The second paragraph indicates the model domain extends to the east side of the Willamette River. DEQ assumes the NWNG meant the west bank of the river.

The third paragraph describes the model grid. Hydraulic property assignments are not provided. Without this information DEQ cannot complete our review of this section or figures 11, 12a, and 12b. DEQ expects this information to be fully documented in a future submittal.

Section 5.3. As indicated in our comment to Section 5.1, lacking information about the hydraulic properties used in the model, DEQ cannot comment on the representativeness of the figures referenced in this section.

Section 5.4. In addition to DNAPL migration to the river, DNAPL movement into deeper intervals of the alluvial WBZ is also of concern to DEQ. Migration into deeper intervals could result in the relocation of sources of dissolved-phase contamination into depth intervals not considered during source control measures planning. DEQ expects this scenario to be further evaluated in the FFS.

NWNG notes that studies at other sites have determined that, "...hydraulic gradients of at least 1 are required to mobilize *residual NAPL* (italics added for emphasis) in alluvial sands similar to those present in the alluvium...." There is ample evidence based on sample testing (measured DNAPL saturation of approximately 50%), observations made in the field during drilling, accumulation of DNAPL in monitoring wells, and the appearance of DNAPL in areas where it was not previously observed, to conclude that mobile DNAPL occurs on the NWNG and Siltronic properties. Where saturation levels are greater than residual and/or DNAPL is mobile, hydraulic gradients of less than 1 can cause DNAPL movement.

DEQ will expect NWNG to assess potential DNAPL mobility under reasonable site-specific conditions. NWNG's assessment should emphasize the potential for DNAPL to migrate vertically. Information available from other sites can assist with this work, especially if the physical and chemical properties of the DNAPL and material properties of the subsurface are similar to those observed at segments 1 and 2.

An important objective of the performance test and subsequent groundwater modeling will be to determine the adequacy of the existing monitoring well network with respect to demonstrating horizontal and vertical containment. DEQ anticipates that recommendations for additional monitoring wells, if needed, will be made based on the limits and locations of capture zones and stagnation points predicted from groundwater modeling.

NEXT STEPS

DEQ is not requesting NWNG to revise and resubmit the Pilot Program. This letter serves to document the scope of work and DEQ expectations under the condition that: 1) our comments to Section 4 are responded to, or incorporated into the PW-04 performance testing plan, as appropriate; and 2) our remaining comments are addressed in future deliverables, notably the FFS.

DEQ appreciates NWNG's work to evaluate and address MGP waste and associated contamination on the NWNG and Siltronic properties. Please don't hesitate to contact me if you have questions regarding this letter.

Sincerely,

Dana Bayuk
Project Manager
Portland Harbor Section

Cc: Sandy Hart, NWNG
Patty Dost, Schwabe Williamson & Wyatt
Rob Ede, Hahn & Associates
John Edwards, Anchor Environmental
Carl Stivers, Anchor Environmental
Tom McCue, Siltronic
Alan Gladstone, Davis Rothwell Earle & Xochihua
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ECSI No. 84 File
ECSI No. 183 File

8128.01.08/02

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May 31, 2006

RECEIVED
JUN 01 2006
By

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

Subject: **Groundwater Source Control Pilot Plan**
Gasco/Siltronic Groundwater Source Evaluation
ECSI #84

Dear Bob:

The Department of Environmental Quality (DEQ) reviewed the April, 2006 Groundwater Source Control Pilot Plan prepared by Anchor Environmental, LLC. The plan is not approved as written. NWN must provide DEQ with the capture zone analysis that was performed to determine the well locations and screened intervals.

General Comments:

The plan, similar to the Preliminary Identification of Technologies and Alternatives for Groundwater Source Control, discusses source control as if the determination has not yet been made that source control is required across the entire stretch of the Northwest Natural property and most of the Siltronic property, if not all of it. It also discussed the collection of in-water data to be used in the development of source control objectives. The requirement for source control is based on exceedances of JSCS screening level values at the Riverbank. This requirement is met along the entire riverbank of the NWN and Siltronic properties. Source control objectives, at this point in time, are to prevent discharge to the River above the JSCS screening values including preventing NAPL from discharging to the River. DEQ does not want to discourage the collection of in-water data as it will be valuable in further understanding the contaminant distribution at the site. However, we do not want to give the impression that this data can, at this time, be used to determine source control objectives. There may be a point in the future on the project, after the in-water risk assessment or record of decision is completed, where source control objectives may be revisited.

Although DEQ understands that the alternatives are focused on source control through containment, there should also be consideration of source reduction in the upland. This may appropriately take place during the upland FS, however, it could also be considered at this point as additional source control measures.

This plan does not adequately justify the locations for the extraction wells, or the screen length. The horizontal extent for capture has been described, but not demonstrated. The vertical goal for

extraction has not been described. This plan should already have some form of modeling or capture zone analysis that can be used to estimate the locations and screen depths for the wells. I assume that NWN conducted this exercise, but it needs to be shared with DEQ prior to receiving acceptance on well locations. Between the well logs, aquifer test and hydrograph data; there is sufficient data to estimate hydraulic capture. DEQ agrees that after the initial wells are and tested, the model/capture zones can be recalibrated to reflect the new information. However, sufficient data exists to construct the model and use it to predict capture zones, well placement, screened intervals, and monitoring locations (i.e. do we need additional monitoring points). DEQ was expecting this work plan to provide that level of information.

Specific Comments

1. Section 1.1 Define "required hydraulic containment" consists of both vertically and horizontally.
2. Section 1.1 Third Bullet. DEQ has already made the determination that source control is required along the entire riverfront of the NWN and Siltronic properties. The work "possible" should be removed.
3. Section 3. Paragraph 2. Based on the hydrographs from wells along the riverbank completed in the surficial fill, some of these show a small response to tidal changes in the River.
4. Section 4. DEQ agrees that the Gasco Upstream Zone should be a priority as that is where the highest mass flux to the river occurs. However, the Gasco downstream zone has elevated cyanide concentrations that are also observed in transition zone water within the river. Thus, after the pilot study, DEQ will expect hydraulic control to be implemented in both of these zones concurrently (on schedule as October -December 2007). Change the Gasco Upstream Zone to extend to P-5 on the Siltronic property (about 800 feet onto the Siltronic Property) instead of to WS-12.
5. Section 5. The potential for NAPL mobility should be added to the last bullet. DEQ is not only concerned about the potential for dissolved phase loading to the river from the development, but also to the potential for mobilizing NAPL to the river through upland activities. This concern was previously discussed with NWN.
6. Section 5.1 See general comments above regarding site-specific risk-based goals for source control. Add a bullet "Prevent migration of NAPL to the River".
7. Section 5.1. First paragraph page 8. See comment 5. DEQ is also concern about additional NAPL mobility that could be caused from upland activities. If heavy equipment is operating, it will cause ground vibrations. Vibration has been shown to mobilize NAPL. Thus, DEQ requires that containment is in-place and demonstrated sufficient prior to redevelopment. In the case of hydraulic containment, the demonstration will involve showing via water levels from monitoring wells in conjunction with the groundwater model that capture has been achieved and that this capture also prevents NAPL migration to the river.

8. Section 5.7. Monitored natural attenuation should be removed as a source control alternative. It may be considered in the FS, though not likely as a stand alone remedial action.
9. Section 5.7. GWSC-3. Give justification for the 80-foot length of the proposed barrier wall for that alternative.
10. Section 5.8. Page 15. Containment musty also prevent NAPL migration. Need to better describe the methodology for demonstrating containment.
11. Section 5.8. Page 15. See general comment regarding use of off-shore data. Again, DEQ does not want to discourage the collection of the off-shore data. However, off-shore data will not be used to determine source control objectives at this point in time.
12. Section 6.1. The 25-foot setback will be beneficial as it will leave room for installation of a barrier wall. If the purpose were complete containment using hydraulic methods, DEQ would not want the Greenway permit requirement to preclude placing wells closer to the River. DEQ would be available to work cooperatively with the City to meet their requirements while achieving required remedy components.
13. Section 6.2. NWN will need to demonstrate containment prior to redevelopment.
14. Section 6.3. Are the viscosities listed reflective of groundwater temperatures (about 55 degrees F)? NWN needs to ensure that the selected pump can handle the viscosity of the MGP-NAPL. If sufficient NAPL enters the pumping wells, considerations should be given to installing an additional NAPL pump (conduct 2 phase pumping). The well design should allow for this as a possibility – thus the wells may need to be a larger diameter than 6-inches. Prior to approval of the work plan, DEQ requires that the calculations are shown that estimate capture. The anticipation of capture is not sufficient for DEQ to approve well placement. 3-dimensional capture zones should be estimated. These estimations can be refined after pumping wells are installed and start-up commences.
15. Section 6.4. Change the Gasco Upstream Source Control Zone to extend to P-5 on the Siltronic Property.
16. Section 7.1 NWN needs to provide DEQ with calculations showing the estimated capture. Will PW-2A be able to pump at 20 gpm?
17. Section 7.2 Is the HDPE compatible with MGP-waste? Will the totalizer selected be able to handle NAPL globules? What kind of submersible pump will be used? Will it emulsify the NAPL? NWN should select a pump that will not emulsify the oil. DEQ understands that this information will be in the SAP – but wanted to make sure you are aware of our thoughts/concerns regarding equipment.
18. Section 7.3. Remove the word "likely" for the oil/water separator. The system will need to have an oil/water separator, in fact, NWN should consider installing an oil sorbent media vessel following the O/W separator to remove any remaining NAPL so that it does not prematurely foul the GAC beds. The oil/water separator should be able to handle the potential for both LNAPL and DNAPL.
19. Section 7.3. Last sentence. The discharge limits for the system will be JSCS screening values at the end of pipe.

20. Section 9.1 NWN should have already conducted capture zone modeling prior to determining the locations, number and depths of the extraction wells for the pilot study.
21. Figure 5. Include the available transition zone data from the Lower Willamette Group in these figures.

This report should be revised to incorporate DEQ comments and provide the justification for well placement. Submit the SAP concurrently with the revised work plan as not to get behind in our schedule. Submit the revised work plan and SAP within 3 weeks of receiving this letter.

Please call me at (503) 229-5538 if you have any questions.

Sincerely,

Heidi Blischke

Heidi Blischke, R.G.
Project Manager
Lower Willamette Section

Cc: Jim Anderson, DEQ NWR
Matt McClincy, DEQ NWR
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Kristine Koch, EPA Region X
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Project Number / TASK 8128.01.08/02

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May 29, 2007

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Re: *GW / NAPL Pilot Program Extraction Wells and Performance Evaluation Design Report; Data Summary Report: Year 0 Event 3 Long-Term Pilot Cap Monitoring*

Dear Alan, Tom, and James:

Enclosed are two CDs containing the above-referenced reports from Anchor Environmental.

Very truly yours,

SCHWABE, WILLIAMSON & WYATT, P.C.

John N. Gootherts
Secretary to Patricia M. Dost

PMD:jng
Enclosures

8128.01.08/02

Oregon

Theodore Kulongoski, Governor

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RECEIVED
MAY 31 2006
By

May 26, 2006

Mr. Bob Wyatt
Northwest Natural
220 NW Second Avenue
Portland, OR 97209

Subject: **DEQ Comments on the Summary Report – Former MGP Operations and Dense Non-Aqueous Liquid Occurrence Northwest Natural and Siltronic Properties**
ECSI #84

Dear Bob:

The Department of Environmental Quality (DEQ) has reviewed the November 7, 2005 Report titled *Summary Report – Former MGP Operations and Dense Non-Aqueous Liquid Occurrence* prepared by Hahn and Associates, Inc. In general the Summary Report presents a condensed general overview of both sites and attempts to draw conclusions about the occurrence and distribution of residual, immobile free-phase, and mobile free phase NAPL based on visual observations made during drilling and the appearance of NAPL in monitoring wells. The report does a good job pulling together available information on NAPL occurrence and distribution. Clearly much work was put into constructing the cross sections and plan view figures which were very helpful aids in visualizing the subsurface NAPL distribution.

DEQ does not require that this document be revised and re-submitted. DEQ's comments will be attached to the report so that our interpretation of the data is in the administrative record. DEQ finds that NAPL migration to the River is a complete pathway and expects NWN to move forward with source control alternatives analysis followed by source control implementation. DEQ expects NWN to adhere to the schedule presented to DEQ for the Groundwater and NAPL Source Control Focused Feasibility Study to be submitted in March of 2007 following the conclusion of the hydraulic containment pilot study. Source control design is scheduled to be completed in September 2007 and implementation by December 2007.

General Comments:

DEQ recognizes that this report was developed with the objective of evaluating whether the MGP-related NAPL could be a current or future source to sediments within the Willamette River. However, as part of the overall RI/FS for the GASCO and Siltronic properties, NWN will also need to evaluate exposure pathways and the risk associated with complete upland pathways. At that time, the full extent of MGP-related waste will need to be investigated. As part of the RI/FS, a conceptual model including NAPL occurrence, transport and fate; should be developed and associated NAPL data gaps should be identified.

The report has multiple references to the MGP-waste within GASCO management area that lies within 400 feet of the Siltronic property. DEQ does not recognize this as a boundary in determining the extent of the MGP-related waste. The full extent of MGP-related waste and maximum extent that MGP-related constituents migrate or could potentially migrate will become the final "locality of facility" for the site. The terminology of "400-foot wide low land area" is misleading as aerial photos show ponds/lagoons with constructed berms, roads and clearly man-made depressions (the circular depression area with roads extending from the lagoons to the depression).

The report uses the terminology "appears to be residual" without defining how that determination has been made. The only location where physical mobility testing was conducted shows that the NAPL saturation is greater than 50% and the NAPL is mobile. If field descriptions are to be used to estimate mobility, enough physical testing should be conducted so that the field descriptions can be correlated to the physical testing results with some level of confidence. It is clear that the field descriptions do not relate well to the potential for mobility as in some locations where just a sheen and or strong odor were observed – such as in WS-15 (70-85 ft bgs) and WS014-125, NAPL accumulated in the wells. MGP-NAPL can continue to migrate slowly for hundreds of years due to its relatively low density, moderate viscosity and ability to coat grains (wettability). This will be important to recognize when developing the remedial alternative in the FS or EE/CA.

In general the terminology with respect to describing the NAPL should be well-defined and consistent. NWN uses both source terminology mixed with observed contamination terminology. Both can be useful, however, physical characteristics should always be provided – such as LNAPL, DNAPL, oil saturated, visual globules of oil, strong sheen, moderate sheen, slight sheen, odor, etc. While the source description such as pencil pitch, tar, oil, oily emulsions should be a secondary description. In all cases terms should be well-defined, used consistently and correlated to physical data.

DEQ's specific comments point out a number of locations where NAPL migration could be occurring or where delineation of NAPL may not be as complete as NWN finds. DEQ has also noted that in some locations, such as WS-14-125, where the logs record only sheen and strong odor reported in the field during drilling, that feet of NAPL have entered the well. The point being that the DNAPL is mobile and not completely delineated, however, complete delineation may not be feasible. DEQ has concluded that there is significant NAPL in the ground, much of which is mobile. DEQ finds that additional efforts to further delineate the NAPL to demonstrate whether source control is required are not warranted and that NWN's efforts should move towards understanding the mobility of the NAPL and data needs for the FS or EE/CA stage to evaluate remedial alternatives for source control. Thus DEQ's comments regarding mobility or delineation are not meant to be specifically addressed, but to serve as preponderance of evidence that fully understanding the distribution of NAPL in the subsurface through advancement of additional borings is not required to conclude that the NAPL is mobile and source control must be implemented.

DEQ agrees that the majority of the NAPL mass found within the shallow River sediments likely migrated through overland flow of NAPL on the historic ground surface along low areas and through ditches. However, there are deeper sheens in the in-water borings, such as in GP-25 where a heavy sheen was observed at 17-18 feet below the sediment surface (bss) and sheen was observed between 27 and 35 feet bss. These deeper occurrences suggest that migration from the upland into the River sediment has occurred and may continue to occur.

Sheen was observed in WS-11 close to the water table. This could be an indication that there is also migration from within the surficial fill into the River sediments as that horizon can easily be interpreted to correlate with the near surface sediment in GP-25 where oil is present. Thus, although DEQ agrees that the bulk of the near surface oil observed in shallow sediment is from overland flow, there is also evidence that subsurface migration has also occurred.

Because it is very difficult to fully characterize NAPL distribution, another method is to use the groundwater data to estimate NAPL distribution. This is an indirect technique and should be used only in addition to the other existing data. Contouring chemicals such as naphthalene and benzene, using 1% of the effective solubility can give an estimate of where NAPL may be present. As I mention below, there are other cost-effective methods to obtain good information regarding NAPL distribution in the subsurface using indirect methods. Several lines of evidence should be used to delineate NAPL as no individual method is without significant uncertainty.

DEQ has made the determination that NAPL migration to the River is a complete pathway and that source control is required. Source control to prevent NAPL migration to the River as a pathway should be evaluated for the stretch of Riverbank between SS-5 on the GASCO property and P-5 on the Siltronic Property. As DEQ has stated previously, DEQ does not believe that hydraulic containment alone will be sufficient to prevent NAPL migration to the River. We are, however, allowing NWN to attempt to demonstrate that hydraulic control can be achieved and demonstrated with the pilot study as DEQ believes that if hydraulic control can not be demonstrated the data will be valuable in design of other containment alternatives (contingency measures).

Future investigative work should focus on developing information to support selection and design of source control measures. NWN has delineated general areas of where NAPL occurs; however, our understanding of the distribution of the NAPL within these areas and its mobility is poor. To get a better understanding of the nature of the distribution of NAPL and stratigraphy in the subsurface, NWN should use a method such as cone penetrometer (CPT) with laser-induced fluorescence (LIF) and a membrane interface probe (MIP). CPTs with LIF and MIP capability should be advanced to basalt at regular intervals along the water front between SS-5 and P-5. DEQ does not find advancing additional borings or wells without understanding where to target the borings/wells will further our understanding of the site. Wells and screened intervals should then be targets based on the LIF/MIP results. DEQ would be glad to entertain other technologies for better understanding the distribution of NAPL.

Specific Comments:

1. Section 1.1. Gasco Property. The report states that the NAPL is primarily well away from the river in the surficial fill. The logs for B-32 and B-33 record a tar matrix within the surficial fill. This area where former ponds existed and tar is present in the surficial fill should be shown on Figure 8. B-58, B-57, B-9 and MW-03 logs indicate sheen, tarry and oily material in the surficial fill unit. These borings are proximal to the River.

2. Section 1.1.1. Approximately 600 gallons of NAPL have been removed from MW-06-32 completed within the surficial fill. There is a large body of NAPL that potentially has significant migration potential located beneath the former process area. DEQ agrees that the silt layer does provide some protection of the deeper alluvial zone directly beneath the process area and due to the silt ridge, some lateral migration protection. The continuity based on the existing boring make the ridge appear to be fairly continuous, however, cross section C-C' does not show a silt high. In fact, it shows no data underneath the LNG Tank Containment Basin and lack of the silt unit in the direction of the River. Based on this cross section, the NAPL appears to have the ability to migrate laterally along the top of the silt towards the river. The report does not provide DEQ with data to support that the NAPL within the surficial fill will not migrate along the silt layer in the direction of the River and/or into the alluvial zone where the silt is either absent or thin closer to the River. There are limited borings between the process area and the Riverfront. Logs for MW-03-56, and B-9 show tarry material in the surficial fill unit. B-57 and B-58 show tar overlying oily material in the surficial fill and alluvial zones. NWN has not clearly demonstrated that the NAPL from the process area has not and will not migrate towards the river. DEQ is not proposing the need for additional borings to further delineate the NAPL but is attempting to demonstrate the difficulty in determining the full extent of NAPL where it could migrate. Another characteristic of the MGP-NAPL and silt is that due to the neutral wettability the NAPL may not require any entry pressure to penetrate the silt. Thus, one could expect the NAPL to enter the silt and remain as a long-term source to groundwater.

3. Section 1.1.1. It will be important as part of the source control to reduce the NAPL saturation to residual in the process area to reduce the risk of migration. This is another area where LIF coupled with MIP or another method of better delineating the subsurface distribution of NAPL should be used to assist in the development of the FS.

4. Section 1.2.2. The deeper extent of NAPL on the Siltronic property likely has more to do with the geology (i.e. thin silt layer and potential lack of silt layer) than with TCE content of the MGP-NAPL. If NWN is attempting to argue that the TCE has caused the deep migration of the MGP-NAPL, then NWN needs to collect the appropriate data (NAPL mobility data including but not limited to NAPL composition, NAPL viscosity, NAPL specific gravity, wettability, interfacial tensions, and NAPL saturations) and

calculate whether and how much the TCE would increase the vertical migration of the MGP-NAPL. Based on the small amount of TCE in the MGP-NAPL measured by Siltronic (59 mg/L), it is unlikely that the NAPL's deeper migration is due solely to the TCE.

DEQ agrees that NAPL from the B-32 and B-33 area could have migrated along the silt towards WS-15 (based on the elevation of the top of the silt). NAPL from B-32 could also have migrated towards P-1. On the Siltronic property near P-1, the silt is only 1 foot thick and at WS-15, the silt is only 3 feet thick. Thus, the geology is also conducive for migration of the NAPL onto the Siltronic property and vertical NAPL migration in areas where the silt is either thin or absent. The specific gravity of the MGP-NAPL measured from Siltronic wells is consistently higher than that measured for NAPL from GASCO property wells. What is not clears is whether this is due to TCE partitioning into the NAPL or because the NAPL on the Siltronic property was a waste product and thus weathered or a different mixture from the NAPL in the GASCO former process area.

5. Section 1.2.1. NAPL within the surficial fill at WS-10-27 is not completely delineated. DEQ agrees that the silt in that location may limit the NAPL's vertical migration; however, the NAPL could be migrating along the silt in the direction of WS-15-85. The log for GP-22 records staining in the surficial fill unit. Based on what was observed in WS-14-125 where sheen was observed during drilling, the staining and sheen identified in GP-22 could be migration from the WS-10-27 location or it could be due to material placed closer to GP-22.

6. Section 1.2.2. The vertical gradient beneath the River at the Siltronic and Gasco sites is not well understood. DEQ disagrees with the statement that the upland NAPL is wholly disconnected from the in-water sediment oily contamination. In-water boring B-25 downgradient of the upland area has a heavy sheen between 17 and 18 feet below the sediment surface. This does not appear to have migrated vertically and could likely have migrated from the upland area. DEQ also disagrees with the conclusion that NAPL identified at upland near shore locations is not a future migration threat to the River.

7. Section 1.3. The NAPL found in PW-01-80 is not below the depth of the River and could migrate laterally into the River sediments. Whether this NAPL would migrate upward into the River is not understood. DEQ agrees that NAPL for analysis of mobility data should be collected from PW-01-80. Cores should also be collected from the vicinity to understand the NAPL saturation. The critical gradient for NAPL to migrate upward into the river should be calculated.

8. Section 1.3 The second bulleted item recommends collecting and analyzing NAPL from monitoring wells WS-10-27, WS-11-125, WS-14-124 and WS-15-85. This has already been done and is documented in MFA's December 6, 2005 letter providing Siltronic's comments to the DNAPL Summary Report.

9. Section 1.3 The third bullet item recommends a push-probe near B-1-8 to confirm previous observation of NAPL, and if present whether it represents a potential source of deeper NAPL in the Alluvial Unit. This may or may not be achieved with additional borings. DEQ's conceptual model for the source of NAPL to the alluvial unit is from the vicinity of WS-15 where the silt layer is thin and potentially absent in areas. Historic MGP waste management practices and geologic conditions promote the historic accumulation of NAPL and downward vertical migration of MGP NAPL in this portion of the site.

10. Section E-1 to E-2 and E-2 to E-3. The boring log for WS-16-125/160 is not the same in both figures. They appear to have slightly different geologic interpretations. This is true for a number of borings and especially as the NAPL information was pulled forward from the Phase 1 report to this DNAPL Summary Report. It is understandable that in pulling together so much information, mistakes will be made. However, some of the NAPL interpretations appear to be re-interpreted information on the degree of mobility. (i.e. B-32 is interpreted in the Phase I report as about 5 feet of tar and about 35 feet of oil while in the DNAPL Summary Report, it is interpreted as 20 feet of tar and 20 feet of oil and WS-14 has oil shown on the Phase I cross section log and only tar shown on the NAPL Summary Report cross section log). In the future, interpretations should be based on the original boring logs and changes in interpretation should be explained.

11. Section 5.2.1 Gasco Property. DEQ agrees that the very viscous tar is not highly mobile. NWN makes a point of differentiating the tar from the NAPL based on mobility in numerous places within the text. Although, to differentiate between tar and DNAPL (oil), physical parameters should be established that dictate mobility – such as viscosity and specific gravity. Many of the descriptions of tar in the boring logs indicate that oil is present within the tar when the tar is cracked open. Is this the result of fractionation? Some of the tar must be mobile as it is found at depths greater than 60 feet below ground surface in the former effluent pond area (B-33 shown on E1-E2 section). What is the conceptual model for this tar? How did it get into and below the silt unit if the tar is not mobile? The extent of tar should be shown on Figures 8, 9, and 10 in addition to the DNAPL. So, although DEQ agrees there is a large amount of not highly mobile tar at the site, there may be packets of more oily material within the tar bodies and some fraction of tar appears to have mobility.

12. Section 5.2.1 Aerial Photograph review shows that there are 2 ponds, not just one as stated in the text, which straddled the property boundaries.

13. Section 5.2.2 Former Depression or Excavation. Based on aerial photo review, it appears that there was a road to this depression and that trees were cleared to produce the depression. DEQ finds that this area was used for the disposal of MGP-waste. This is an area that could use additional investigative work. It appears that B-3 may be within or

proximal to the excavation, however, it is not clear how NWN came to the conclusion that there is no DNAPL beneath the tar in this area.

14. Section 5.2.2. This section does not discuss that 34,000 cubic-yard pile of spent oxide which was stored on the property. Unless NWN can produce documentation of the disposal of this spent oxide, DEQ assumes that the spent oxide was spread across the Siltronic property.

15. Section 5.3.1. The silt appears to prevent vertical migration in the former process area but the NAPL could potentially migrate laterally along the top of the silt. There is a depression in the silt surface, however, the lateral continuity of the depression and whether there is a pathway through the silt ridge is difficult to demonstrate. Thus, although the process area NAPL appears to be primarily pooled within the silt surface low area, there may be channels through the silt ridge or the NAPL could pool to heights that allow it to migrate laterally over the silt ridge towards the River or towards an area where the silt is either thin or absent. Thus, controlling the potentially mobile NAPL in the process area by reducing the saturations to residual is important to source control.

16. Section 5.3.2. Filling Activities. MGP-waste in the fill could have come from a variety of places such as the large spent oxide pile on the Siltronic property, MGP-waste within the 400-foot area that was regularly mucked out, near-by MGP-impacted river sediments from NWN operations, or from the GASCO site itself.

17. Section 5.3.2 A 1979 release from the Olympic Pipeline is identified as a potential source of NAPL on the Siltronic Property. NWN should be advised that analysis of NAPL from WS-10-27 indicates MGP NAPL occurs in the vicinity of the pipeline release. The CSM should be updated accordingly in subsequent reports.

18. Section 7.2 NWN indicates that the overall low point in the top of the Silt Unit occurs on the Siltronic Property in the vicinity of WS-15 nest of monitoring wells (-8 feet msl). It should be noted that the low point near WS-15:

    a. Is approximately located beneath the "former tar settling ponds" specifically the smaller rectangular pond – see Figure 3, and
    b. Corresponds to an area where the silt is thin (about 3 feet thick at WS-15).

    Over 10 feet of MGP-NAPL has accumulated in WS-15-85 since it was installed (completed in the Alluvial Unit). The low point between WS-15 and the River is not 9-12 feet MSL as reported in the text, but 2.5 feet MSL as shown in Figure 6. This area is both a place where NAPL appears to have migrated through the silt unit and also has the potential to flow towards the river if the mobile NAPL accumulated to an elevation above 2.5 feet MSL.

19. Section 8.2. DEQ disagrees with the NWN interpretation that "...fine-grained silt materials impede near-shore discharge of groundwater to the river from both surficial fill and upper portions of the alluvial unit." Fill material overlies the uplands portion of the Silt Unit. Hydrogeologic sections near and upstream of the NWNG/Siltronic property line 1) show the stratigraphy of the Fill Unit near the river consists principally of sand and silty sand (e.g., see hydrogeologic sections E2-E3, F-F', G-G'), and 2) indicates impacted groundwater in the fill could migrate directly to the river.

    Regarding groundwater in the Alluvial Unit, uplands and in-water work documented in the Supplemental Investigation Report[1] (SI Report) found that: 1) releases of trichloroethene (TCE) and its degradation products from Siltronic's former underground storage tank (UST) system have contaminated groundwater in the Alluvial Unit; 2) groundwater in the Alluvial Unit is a complete pathway from the uplands to the Willamette River; and 3) TCE and its degradation products are present in transition zone water (TZW) immediately beneath the river at concentrations that exceed relevant screening criteria. Based on data provided in the SI Report DEQ concludes items 2) and 3) also apply to MGP contamination.

    The Summary Report references interpretations presented by Siltronic in the SI Report regarding downward vertical gradients operating beneath the Willamette River. DEQ commented on this interpretation in a letter to Siltronic dated October 25, 2005. The October 25th letter should be referred to for DEQ's analysis, discussion, and interpretation(s) of the data. In short, the SI Report limits discussions and interpretations of vertical gradients to measurements made during in-river push-probe drilling and sampling work. DEQ considers this data suspect and disagrees with Siltronic's interpretation of the data.

    With the high mobility of the NAPL found in MW-16, it is likely that this NAPL migrates in stringers along sandier lenses within the silt. The fact that many of the borings do not encounter evidence of NAPL, does not mean that there are no NAPL flowpaths to the River.

20. Section 8.3. Columbia River Basalt Group. NWN should present what data was used to make the conclusion that the upper portion of the fractured basalt is not impacted. DEQ finds that the lack of benzene concentrations in deep groundwater is good indirect evidence that NAPL has not yet migrated to the basalt.

21. Section 9.0. Dense Non-Aqueous Phase Liquid. Much of the description of NAPL mobility is based on the oil being the non-wetting fluid. In the case of MGP-NAPL as mentioned in the report, the NAPL is of neutral wettability. Thus, it can continue to migrate at very low saturations. Residual saturation is a relative term. There is

[1] Maul, Foster, and Alongi, Inc., 2005, "Supplemental Investigation Report, Siltronic Corporation Facility, 7200 NW Front Avenue, Portland, Oregon", September 8, a report prepared on behalf of Siltronic Corporation.

irreducible saturation which is immobile. Residual saturation is immobile under a given set of conditions. If the conditions change, such as higher gradients, lower pressure, etc. DNAPL could flow into a well – but not necessarily be mobile in the formation because by emplacing a well into the formation, you introduce an area of lower pressure. Thus, although NAPL in a well may be used to suspect mobility, it does not necessarily mean it is mobile in the formation. DEQ does not have confidence in the visual field descriptions being adequate to characterize the NAPL as being mobile or not. This is based on NAPL entering wells in feet of thickness where only sheens or strong odors have been observed in the field. Thus the maps Figures 8 through 10 where NAPL is depicted based on an assumed mobility from the field log description, is interpreted by DEQ to present the occurrence of NAPL of which all may have mobility.

22. Section 9.1.1. The viscosities should be reported based on 55 degrees. These should be corrected for temperature.

23. Section 9.1.1. Last paragraph. DEQ agrees that valuable information can be derived from observing how the NAPL enters a well. However, there are many factors affecting NAPL mobility thus it may not be the viscosity that is the controlling factor on whether the DNAPL re-enters the well. If the flowpath of NAPL to the well has been cut off by pumping and now there is water in the pathway, it can take NAPL a long time to re-establish the flowpath to the well. Viscosity will be one factor affecting its ability to re-enter the well – but wettability, saturation, gradient, and other factors will also determine how and whether the NAPL re-enters the well.

24. Section 9.1.2. Check the numbers for the diesel-range hydrocarbons for WS-16-125. In the text, it is 593,000 ppm while in Table 4, it is 347 ppm. I think the table is reporting the 4/27/06 data and should be 347,000 ppm while the text is reporting the 1/28/2004 data.

25. Section 9.2. In general, the cross sections and plan view maps do a good job depicting where NAPL is present. It would be helpful to see the tar depicted on the plan view maps, as it is on the cross-sections. DEQ does not agree that tar is always immobile. There is likely some fraction of the tar that has mobility as discussed above. There are a few places where the interpretation between cross-sections is different such as WS-11 on A1-A2 is different than WS-11 on F-F'. Sometimes, sheens are not shown on the cross-sections while sheen can be indicative of a thin stringer of mobile NAPL. As I mentioned in the general comments, it is impossible to completely understand the distribution and pathways of NAPL. NWN has collected a large amount of data and done a good job describing the NAPL distribution. In general DEQ agrees with the interpretations of distribution, although only in a few cases do we agree with the interpretation of mobility. DEQ finds that the statements about NAPL mobility, i.e. the conclusion that nearly all of the upland NAPL is either residual or immobile, are too definitive. The only mobility testing conducted at the site (MW-16) showed the NAPL to

be highly mobile. There is sufficient evidence of NAPL in in-water borings as sheens at depths below the surface sediments and upland NAPL in wells close to the River that NAPL migration to the River must be considered a complete pathway.

26. Section 9.2.2.1. The NAPL in WS-10-27 could potentially be migrating towards WS-16 along the silt layer. Once NAPL enters the ground and begins to migrate, it can be difficult identify the migration pathways which can be tortuous.

27. Section 9.2.2.1. It would be helpful if the depths of the NAPL at WS-11 and WS-145 were given in elevation to better be compared to the river bottom. DEQ agrees that NAPL at that depth would not likely migrate into the river. As previously noted, gradients should be calculated to confirm this position. However, there are likely stringers of NAPL at shallower depths that were not intercepted by the existing monitoring well network. It does not appear that there is a large pool of NAPL migrating to the river, however, there is evidence of small stringers of NAPL migrating to the River by the sheens observed in in-water borings that are located lateral to upland sheens. Because of the large amount of NAPL in the River sediments off of the site, it is difficult to obtain direct evidence of NAPL migration into the river from the upland.

28. Section 9.2.2.1 The specific gravity of the MGP-NAPL on the Siltronic property ranges from 1.12 to 1.09 g/cc (Siltronic Letter to DEQ dated December 6, 2005). This is slightly higher than the 1.05 to 1.09 reported for the NAPL from the GASCO property. This does not appear to be due to the small amount of TCE that partitioned into the NAPL (59 ppm TCE in the NAPL) but is more likely due to the original NAPL composition or through weathering. If NWN believes it is due to the partitioning of TCE into the MGP-NAPL, then sufficient data should be collected to calculate the difference in specific gravity due to the presence of the TCE.

29. Section 9.2.2.1 DEQ agrees that the lateral and vertical extent have been identified sufficiently to move the project forward to source control. The dissolved constituent concentrations in groundwater area good indicators of where product may be present or nearby. A percentage (1-10%) of the effective solubility of selected constituents could be used to more completely delineate where product may be present. The lack of to low dissolved concentrations observed at the top of the basalt is a good indication that NAPL has not migrated vertically as deep as the basalt (at least in the areas where dissolved concentrations have been measured at the basalt interface). Additional delineation using CPT coupled with LIF and MIP would be useful in source control design.

30. Section 9.2.2.2 Oil identified in soils at the former Western Transportation area could reasonably be explained as the result of the apparent redistribution of MGP wastes which is prevalent across the Siltronic property. Redistribution of MGP wastes should be considered as a potential source material for the oil and staining observes as well as from the Western Transportation operations.

31. Cross section in general. Water levels measured during drilling should not be presented as the static water table. The borings were advanced in various seasons over many years. It is ok to show the water levels from drilling on the logs, however, these should not be connected and used to imply gradient. Water levels collected from a given point in time from monitoring wells can be connected and used to indicate the water table and gradients at a given point in time.

32. Section 9.2.2.2 MGP-NAPL identified in the WS-1, WS-2, WS-6, and WS-7 areas may migrate to the ditch that runs along the property boundary to the River. DEQ is expecting the results from the investigation of this as a potential migration pathway to the River from NWN. MGP-NAPL in this area has been reported (by the consultants for Rhone Poulenc) to be seeping into North Doane Lake.

33. Section 9.3 DEQ has requested in the past and requests again that NWN determine the approximate volume of waste by-products that were discharged into the River and low-lying areas of the site. This should be provided in a separate tech memo.

34. Section 9.3 DEQ disagrees that movement of NAPL to river sediments has not been observed. Active seeping may not be observed, however, that is likely due to the large amount of NAPL already in the sediments and NAPL that potentially discharges to the River may occur below bank area where it is not readily observed. There is evidence of sheens in the in-water borings at depths of 16 and 17 feet below the mud line in locations lateral to where sheens are observed in upland borings.

35. Section 9.3.1 Although there is no direct evidence that the NAPL in MW-16-45 seeps into the River sediment, because of its high mobility and the occurrence of horizontal sandy lenses within the silt wedge, it is highly likely that migration of the NAPL into the River sediment has occurred and will continue to occur. DEQ appreciates NWN's understanding the need to control the potential migration of additional NAPL to the River.

36. Section 9.3.2 It will be difficult to demonstrate that NAPL from PW-1-80 does not migrate to the River. Additional borings may suggest that there are not thick laterally continuous pathways of NAPL migrating to the river, however, proving that NAPL does not migrate in thin stringers can not easily be shown by borings. Thus, DEQ expects NWN to accept DEQ's interpretation that NAPL from PW-1-80 is likely migrating to the river and move forward with source control.

37. Section 9.3.3 DEQ agrees that the NAPL identified at 100+ feet bgs will not likely migrate to the River. We do not however agree that there is sufficient investigation to demonstrate that NAPL at shallower depths does not migrate to the river. In fact given the quantity of NAPL in the surficial fill and alluvial zone, DEQ believes it is likely that

NAPL migrates to the River along the stratified silt and silty sand lenses. Borings GP-5 and GP-6 show elevated benzene concentrations at the base suggesting that there may be NAPL nearby. The stratigraphy consists of lenses of silt and silty sands. It is very likely that NAPL from underneath the FAB 1 Building may migrate along these lenses moving laterally and downward in a tortuous path. Therefore, coming to a conclusion that NAPL does not migrate in shallower zones because NAPL was found at -75 feet MSL is not a realistic conclusion based only on the fact that the borings advanced did not identify NAPL. GP-33 shows oily material in the surficial fill and dredge –induced sheen occurred in the River directly lateral to the oily material. This is suggestive of a connection between the upland NAPL and in-water sheen. The NAPL in the upland must be isolated from the river so that potential migration of NAPL is prevented prior to in-water remediation. Again DEQ agrees that there are not large volumes of NAPL migrating to the River along a clear stratigraphic layer. However, because of the volume of NAPL, potential high mobility, and the highly stratified geology, there are most likely stringers of NAPL that have and may continue to migrate to the River.

38. DEQ agrees that it is likely that the NAPL in the former process area rests on the silt. However, given the high mobility of the NAPL, it would be difficult to definitively conclude that the NAPL does not migrate laterally towards the River and potentially into the alluvial zone closer to the River. Thus, this area should also be targeted to either remove the NAPL or reduce the saturations to residual saturations to control the NAPL from potential migration.

39. **Table 1.** It is unclear how the information provided in this table was used in assessing the occurrence of DNAPL. In other words, do any of the "By-products or Wastes" mentioned in Table 1 correspond to terms in Table 2?

    DEQ suggests that in future submittals, information regarding by-product and/or waste type be added to Table 2 for completeness.

    Table 2. DEQ has a number of comments regarding Table 2 as follows.
    - The "Study Area" column appears to use a mixture of terms based on existing site features (e.g., Office Area, FAMM), current or former operations areas (e.g.,Retorts/Koppers), or former waste management/disposal areas (e.g., Tar Pond, Spent Oxide).
    - The Soil Boring Log Summary uses terms that are not defined (e.g., light sheen, heavy sheen, oil saturation). It is also unclear why terms were selected for use in the table. For example "Carbon Pitch" (a material associated with Koppers operations) heads a column, but Lampblack or Spent Oxide are not included in the table. Calling out carbon pitch suggests that it represents a more significant material, possibly as a source of contamination and/or volumetrically, than those generated by historic MGP operations.

- The table notes refer to "DNAPL" and "solid pitch." It does not appear that either term was used in the body of the table.

DEQ suggests that the table be modified in future submittals so that Study Area names correspond more directly to waste management/disposal areas under investigation, and the nomenclature used for observations made during drilling be revised consistent with our general comment above.

40. **Appendix A, Hydrogeologic Section A2-A3'.** The geology for Boring GP-37 is missing and should be added to the section.

DEQ expects where specific requests are made that a separate letter or tech memo should be submitted. Please contact me at (503) 229-5556 if you have any questions.

Sincerely,

Heidi Blischke

Heidi Blischke, R.G.
Project Manager/Hydrogeologist
Lower Willamette Section

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May 2, 2007 *Also Sent Via E-mail*

Mr. Robert J. Wyatt
Northwest Natural Gas Company
220 N.W. Second Avenue
Portland, OR 97209

Subject: Proposal for Remedial Investigation of Manufactured Gas Plant Waste, Siltronic Corporation Property/Source Control Work, Northwest Natural Gas Company and Siltronic Properties

Dear Mr. Wyatt:

The Department of Environmental Quality (DEQ) has reviewed the "Remedial Investigation Proposal, Historical Manufactured Gas Plant Activities – Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon" dated November 17, 2006 (RI Proposal). Hahn and Associates, Inc. (HAI) prepared the RI Proposal on behalf of the Northwest Natural Gas Company (NWNG). The RI Proposal presents NWNG's approach to assessing the nature and extent of manufactured gas plant (MGP) waste and associated contamination on property owned by the Siltronic Corporation (Siltronic).

The overall goals of the remedial investigation (RI) of MGP waste on property owned by NWNG (NWNG Property, aka the Gasco Site) and Siltronic (Siltronic Property) are stipulated in Voluntary Agreement DEQ No. WMCVC-NWR-94-13 dated August 8, 1994 (the Agreement) and the first addendum to the Agreement dated July 19, 2006. The RI Proposal focuses on collecting data to further evaluate potentially complete and/or significant human health and ecological exposure pathways in the uplands portions of the Siltronic Property and to offsite areas.

DEQ acknowledges the RI Proposal does not recommend investigatory activities in the Willamette River. NWNG is involved in an ongoing phased investigation of MGP waste and the relationship of upland groundwater plumes in the Willamette River off-shore of their and Siltronic's properties. This work is being done to support the Portland Harbor in-water RI and feasibility study (FS) being performed by the Lower Willamette Group. The results of the in-water work will also provide information to: 1) further assess uplands contaminant transport pathways as potential sources of contamination to the river; 2) support uplands source control measures evaluations for both facilities; and 3) assist planning of in-water work being contemplated by the US Environmental Protection Agency (EPA).

The RI Proposal also does not propose to directly assess sources of impacts to Doane Creek originating from the NWNG Property. The NWNG Property storm water system, including the portion that drains to Doane Creek, is being assessed separately. NWNG is currently preparing a

work plan for that purpose. It should also be noted that Siltronic is currently assessing the facility storm water conveyance system as a potential contaminant transport pathway to the river.

DEQ's comments to the RI Proposal are provided below. The "General Comments" clarify our expectations regarding the priorities of the Siltronic Property RI, and identify information and/or data needs not included in the RI Proposal. Consistent with sections 4 and 5 of the RI Proposal, DEQ's "Data Needs and Characterization Approach Comments" are organized by media and provide information for NWNG to incorporate into the scope of work for the RI work plan. DEQ has also included "Additional Comments" that provide our understanding and position on the items indicated. Although not specifically identified in this letter, DEQ's comments reflect our review of the RI Proposal and the OF-22C Outfall Report[1], and consideration of the Source Control Data Gaps Evaluation[2]. In addition, DEQ's May 26, 2006 comments to the DNAPL Summary Report[3] apply to the Siltronic Property RI. The DNAPL Summary Report provides NW Natural's interpretations regarding the distribution of DNAPL on the NW Natural and Siltronic properties. Lastly, although the focus of this letter is on the RI Proposal, DEQ has included comments about incorporating source control work on both the NWNG and Siltronic properties into the Siltronic Property RI field program.

DEQ considers the RI Proposal to be a scoping document and not subject to approval. DEQ expects our comments provided in this letter, and our comments to the DNAPL Summary Report related to the Siltronic Property, to be incorporated into the RI work plan for the Siltronic Property.

GENERAL COMMENTS

Siltronic Property RI Priorities

As mentioned above, the RI Proposal presents an approach to further evaluate potentially complete and/or significant exposure pathways at the Siltronic Property and to offsite areas. To achieve these objectives, DEQ considers it essential for the Siltronic Property RI to characterize: 1) soil and groundwater in portions of the Siltronic Property where data is limited; 2) the occurrence of MGP waste, 3) the nature and extent of DNAPL, and 4) the mobility potential of DNAPL. Characterization MGP waste and associated contamination is especially needed in areas where there is the potential for horizontal movement of DNAPL to surface water bodies (e.g., southern and northern corners of property) or away from source areas (e.g., from the Koppers Industries, Inc. [KI] leasehold to WS-10-27 vicinity), and/or downward vertical

[1] Hahn and Associates, Inc., 2006, "City of Portland Outfall 22C Drainage Sampling Activities, Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon", June 2, a report prepared on behalf of Northwest Natural Gas Company.
[2] Anchor Environmental, LLC, 2006, "Gasco Source Control Data Gaps Evalution, NW Natural 'Gasco' Site", November, a report prepared on behalf of Northwest Natural Gas Company.
[3] Hahn and Associates, Inc., 2006, "Summary Report – Former MGP Operations and Dense Non-Aqueous Liquid Occurrence," November 7, a report prepared on behalf of the Northwest Natural Gas Company.

migration into, or deeper within, the alluvial WBZ (e.g., beneath "former lowland effluent pond overflow area" [EPOA]).

To date, NWNG has primarily relied on direct observations made during drilling to develop interpretations regarding the occurrence and potential mobility of DNAPL. As DEQ has indicated in previous correspondence, relying on direct observations limits NWNG's ability to characterize DNAPL. The Siltronic Property RI should utilize alternative methods to identify geologic influences on the distribution and movement of DNAPL, in conjunction with subsurface logging tools designed to assess subsurface material types and the presence, types, and properties of DNAPL. With these objectives in mind, DEQ will require NWNG to employ geophysical methods (e.g., ground-penetrating radar) in conjunction with cone penetrometer (CPT) and laser-induced fluorescence (LIF) logging systems (i.e., "tar-specific green optical screening tool" [TARGOST®]) at the site. DEQ envisions geophysical methods being used to further assess the thickness of the surficial fill and the configuration of the top of the silt. The CPT/LIF tools can provide information regarding the types of DNAPL present (tar or oil) and the relationship between geologic material and the occurrence of DNAPL in the surficial fill and alluvial WBZs.

Source Control Work, NWNG and Siltronic Properties

DEQ has determined that source control is required along the length of the NWNG Property and the northern portion of the Siltronic Property. Although further delineation is needed, the segment extending from downstream of the "Tar Body Removal Area" (TBRA) on the NWNG Property, to upstream of the EPOA on Siltronic Property (Segment 1), is considered the "highest" priority for source control. This segment coincides with the heaviest MGP-related impacts, including DNAPL and contaminated groundwater, identified near the river. It also includes the portion of the Siltronic Property where groundwater contamination caused by Siltronic has commingled with MGP-related groundwater contamination and DNAPL. The segment of NWNG's shoreline between the TBRA and NWNG's downstream property line with US Moorings (Segment 2) is considered a high priority for source control due to the presence and concentrations of cyanide in soil and groundwater. A third segment (Segment 3) extends from upstream of the EPOA to the upstream Siltronic Property line. DEQ considers source control to be warranted in Segment 3 due to exceedances of Joint Source Control Strategy[4] (JSCS) screening values at or near the riverbank.

DEQ is requiring that source control measures be implemented along segments 1 and 2 to prevent migration of DNAPL, contaminated groundwater, and erodible soils to the Willamette River. Characterization of MGP related contamination in segments 1 and 2 is critical for planning source control measures. To expedite source control measures evaluations, DEQ will expect NWNG to perform work in segments 1 and 2 on NWNG Property concurrently with the Siltronic Property RI. The general data needs for both segments are summarized below.

[4] EPA and DEQ, 2005, "Portland Harbor Joint Source Control Strategy – Final" December, a guidance document prepared jointly by the US Environmental Protection Agency and Oregon Department of Environmental Quality.

- Segment 1 - DEQ expects NWNG to use geophysical and CPT/LIF methods to further evaluate the distribution and mobility of DNAPL. Determining the vertical extent of DNAPL in the alluvial WBZ is considered a primary objective of this work.
- Segment 2 – Available data for Segment 2 is limited. NWNG should conduct soil and groundwater sampling to assess the nature and extent of MGP related contamination, particularly cyanide. Monitoring wells should be installed in the surficial fill WBZ and at multiple depth intervals within the alluvial WBZ to evaluate groundwater contamination and support source control measures evaluations.

Because of the potential for DNAPL migration and greater contaminant mass flux to the river, data collection and source control measures evaluations in segments 1 and 2 have been prioritized over source control work in Segment 3. Accordingly, an evaluation of source control along Segment 3 is proceeding on a separate schedule.

In general, and consistent with agreements reached between NWNG and DEQ, any uplands work considered supportive of source control will be given priority in the RI field schedule. For clarification, DEQ considers this applicable to data collection activities conducted within 200 feet of the shoreline.

Consistency of Nomenclature

Different companies have performed numerous environmental investigations on behalf of NWNG and Siltronic. These investigations have generally been performed independently employing a variety of drilling and sampling methods. As such, descriptions of subsurface material, DNAPL, and contamination based on visual observations are inconsistent between the two sites.

The RI Work Plan should propose a consistent nomenclature for the stratigraphic and hydrostratigraphic units that occur at both sites. In addition, the sources, types, and characteristics of MGP waste should be more clearly defined. As DEQ has indicated previously, the physicals characteristics of contamination observed in the field (e.g., color, presence and amount of DNAPL [saturated, visual globules], degree of sheen and/or odor [strong, moderate, light]) should be given preference to terms implying a historic operational source (e.g., spent oxide, lamp black, pencil pitch).

DATA NEEDS AND CHARACTERIZATION APPROACH COMMENTS

Groundwater

- Work completed in Doane Creek suggests that shallow groundwater discharges into the stream channel. DEQ recommends that piezometers be installed in selected push-probe borings located near the creek. Staff gages should be located along the creek near the piezometers to provide surface water elevation data. DEQ expects piezometers and staff gages to be installed during the first phase of drilling work so that a dataset for evaluating the interconnection between shallow groundwater and Doane Creek can be built.

DEQ-DC1

- Groundwater samples collected during the Siltronic Property RI should be analyzed for chemicals associated with onsite and offsite sources of contamination other than MGP waste. Chemicals that should be analyzed for should include, but not necessarily be limited to: trichloroethene and its breakdown products and isomers of dichlorobenzene (e.g., 1,2-dichlorobenzene, 1,4-dichlorobenzene).

- The silt unit occurs between the surficial water-bearing zone (WBZ), and the alluvial WBZ and is described as being, "...a laterally extensive fine-grained low conductivity silt unit, the properties of which preclude it from being characterized as water-bearing zone." DEQ considers the configuration of the top of the silt and its thickness to be highly variable based on observations made during drilling. Additionally, assessments of the hydraulic properties of the silt unit are limited. Because of its importance as a potential impediment to downward vertical migration of DNAPL and/or contaminated groundwater into the alluvial WBZ, DEQ considers collecting additional information on the occurrence, thickness, and hydraulic properties of the silt unit to be an objective of the Siltronic Property RI.

- NWNG indicates that, "A thin layer consisting of medium to coarse-grained sandy gravel has been observed at the base of the alluvial deposits at both the Siltronic and Gasco properties." During drilling completed by NWNG in January 2007 just off-shore of the two properties, the gravel was observed to be over 15 feet thick. Based on the work completed to date it appears that the occurrence of gravel corresponds to a depression in the basalt surface that projects into the uplands of the Siltronic Property. Visually the gravel appears to represent some of the most permeable material in the alluvial WBZ. Furthermore, the influence of the gravel on contaminant migration, if any, is currently unknown.

  DEQ considers the gravel to be a component of the alluvial WBZ warranting additional evaluation. NWNG has proposed that selected RI borings be advanced to the top of the basalt. Where observed, DEQ will expect groundwater samples from the gravel to be collected for analysis.

- As noted by NWNG, a groundwater divide has been observed in the surficial fill WBZ. The divide is oriented roughly parallel to the utility easement that crosses the Siltronic Property. The presence, location and orientation of the divide suggest the utility easement could be influencing groundwater flow in the surficial WBZ. The Siltronic Property RI should assess this scenario further.

- The excavation depression under the south end of the Fab 1 Building represents a source of DNAPL and soil and/or groundwater contamination. To the extent space limitations and access restrictions allow, additional borings should be located on the southeastern and northwestern sides of the building to further assess the MGP waste, DNAPL, and soil and groundwater contamination associated with the feature.

DEQ-DC1

- MGP waste occurs near and under Doane Creek in the western corner (i.e., the former spent oxide pile) and southeastern side (i.e., "dark colored fill") of the Siltronic Property. In addition to the push-probe borings shown along the top of the stream bank, monitoring wells should be installed during the first phase of drilling to monitor groundwater in the surficial fill WBZ at these locations.

Soil

- DEQ views the proposed grid approach described in the in the RI Proposal as the reconnaissance phase of a more comprehensive effort to determine the extent, magnitude, and potential risks associated with MGP waste and soil contamination on the Siltronic Property. DEQ anticipates additional soil sampling will be needed to delineate the full extent and magnitude of contamination.

- Based on previous agreements made with DEQ for the NWNG Property, 12 feet below ground surface (bgs) is considered the depth limit for purposes of evaluating the excavation worker exposure scenario. To date, sampling and analysis of unsaturated soil at the Siltronic Property has not been a data collection priority and is incomplete. In addition, the depth of excavation for the NWNG Property may not be applicable to the Siltronic Property given that some underground piping is greater than 15 feet bgs and there is the potential for future development of the site. Given this information, DEQ considers it premature to place limits on the collection and use of soil data for the Siltronic Property RI.

- To meet the data collection priority of characterizing the nature and extent of MGP waste, DEQ expects NWNG to increase the density of soil samples in areas where this material is suspected of being placed (e.g., near B-105, in the western corner of the Siltronic Property, between P-33 and P-27 and between P-27 and P-20).

- In addition to areas where MGP waste is suspected of being placed, there are areas of the Siltronic Property where available historic information and/or data has identified impacts that warrant more sampling than recommended in the RI Proposal, including the areas described below.
  - Limited soil sampling conducted near the top of the riverbank at borings P-1 through P-8 detected total cyanide concentrations at concentrations as high as 15,000 milligrams per kilogram (mg/kg). This data suggests the potential for erodible soils to be a complete contaminant transport pathway to the river.
  - A surface soil sample collected near Outfall 2 detected concentrations of total cyanide (13,900 mg/kg) and diesel-range (3,720 mg/kg) and oil-range petroleum hydrocarbons (4,700 mg/kg) suggesting impacted fill was used in the vicinity of the outfall. Alternatively, the data could suggest that impacted shallow groundwater is potentially discharging onto the riverbank at the outfall. These scenarios should be assessed further.
  - The former Western Transportion operational area represents a potential source of contamination near the river that has not been systematically evaluated.

DEQ-DC1

The RI work plan should propose sampling schemes to either fully assess each area for potential contamination (the former Western Transportation area), or characterize the nature and extent of contamination detected previously (Outfall 2, cyanide detections).

- DEQ recommends that NWNG look forward to how soil data will be statistically used in the baseline risk assessment to inform the sampling program with regard to the geographic areas being investigated and the size and density of the data set(s) required to support data analysis. NWNG should initiate this process by elaborating on the soil sampling strategy in the RI work plan and explain how the data will be utilized in the human health risk assessment (HHRA) and ecological risk assessment (ERA).

DNAPL

- The fourth bulleted item in Section 3.5.3 indicates that because DNAPL identified in monitoring wells WS-11-125 and WS-14-125 occurs below the base of the river, migration into the river is not a concern. DEQ agrees that the potential for DNAPL to migrate into the river decreases as its depth of occurrence below the river increases.

  As noted in our General Comments, the horizontal and vertical extent of DNAPL near the river on the NWNG and Siltronic properties has not been characterized. In addition, the depth below which DNAPL will not migrate into the river has not been determined. DEQ considers these items to be essential data needs for the Siltronic Property RI and for planning and design of DNAPL/groundwater pathway source control measures.

Surface Water

- The RI Proposal indicates that groundwater samples will be collected from the site's monitoring well network and analyzed for free cyanide. DEQ recognizes this data is important for screening under the JSCS and for completing the upland HHRA. However, for purposes of quantifying ecological risk, DEQ expects that further work will be performed to speciate cyanide compounds in shallow sediments and in surface water collected in Doane Creek.

- It is unclear from the RI Proposal whether NWNG includes potential exposure of human and/or ecological receptors to sediment within Doane Creek. Many of the COI associated with MGP impacts have an affinity for organic carbon. Sampling and analysis of surface water for these chemicals will not account for contaminant mass sorbed to sediment and deposited in the stream channel. Additionally, sediment transport within surface water systems is not necessarily accounted for by assessing surface water alone as contaminated sediment can accumulate where hydraulic drops occur (e.g., slackwater areas, ponds). Given this information, sediment should be identified as a separate potential contaminant source from surface water in Doane Creek. To support the HHRA and ERA, the RI Work Plan should include collecting sediment samples for analysis from within the Doane Creek channel and the Northwest Drainage Pond.

Air

- The RI proposal suggests that a sufficient amount of data has been collected to characterize potential risks from the vapor intrusion (VI) pathway. DEQ concurs that previous indoor air quality investigations suggest existing structures on the Siltronic property are not experiencing significant vapor intrusion. However, this conclusion cannot be reliably extrapolated to any and all future commercial uses and/or development of the site. Given the existing dataset for volatile organic compounds in shallow soils is limited, and that NWNG will be collecting soil samples in areas of the Siltronic Property where sampling has previously not been performed, it is premature to eliminate the volatilization pathways from consideration in the RI.

ADDITIONAL COMMENTS

Section 3.2. In addition to MGP-related wastes from effluent pond overflow areas and spent oxide material, NWNG should include lamp black in the list of potential contaminant sources placed on the Siltronic Property.

Section 3.3. The nested table of "Contaminants of Interest" should include diesel-range and oil-range petroleum hydrocarbons, total cyanide, amenable cyanide, and vanadium.

Section 3.5.1. NWNG is currently designing a pilot study to evaluate the influence of pumping four groundwater extraction wells in the eastern corner of the NWNG Property. As mentioned above, NWNG is also evaluating MGP waste and contamination in the Willamette River off-shore of the NWNG and Siltronic properties. This section of the RI Proposal seems to imply that full-scale implementation of uplands DNAPL and contaminated groundwater source control measures on the NWNG and Siltronic properties is contingent on the results of the above-referenced work. This is not the case. DEQ has determined that uplands DNAPL/groundwater source control measures will be implemented. The ongoing pilot study and in-water investigations will provide information to support analysis and design of source control measures.

DEQ understands from the second paragraph that NWNG has identified benzene, naphthalene, and total cyanide as "key constituents" to use in assessing groundwater contamination associated with MGP waste. NWNG should provide the rational for selecting these analytes as being key in the RI Work Plan. NWNG should also be advised that DEQ does not consider these three chemicals adequate for delineating the nature and extent of contamination. For example, relevant ecological criteria for toluene, ethylbenzene, and xylenes are lower than benzene. DEQ expects NWNG to fully evaluate the nature and extent all MGP waste chemicals of interest (COI) in the Siltronic Property RI.

Section 3.5.4. DEQ agrees with NWNG's observation that multiple sources of impacts to Doane Creek occur upstream of the piped section. Based on review of the surface water data collected from Doane Creek, DEQ concludes that storm water leaving the KI leasehold on NWNG Property represents a consistent source of COI associated with NWNG (e.g., PAHs). Samples

DEQ-DC!

collected during catch basin clean-out work conducted by the City of Portland[5] in the NW Front Avenue right-of-way immediately south of the NWNG Property, confirm KI as a source of PAHs to the storm water system. DEQ expects that storm water impacts to Doane Creek associated with KI will be further evaluated as part of the storm water pathway assessment of the NWNG Property

Section 3.6. In addition to the human health exposure pathways described in this section of the RI Proposal, NWNG should include recreational users of Willamette River (e.g., fisherman).

Sections 3.6 and 3.7. The RI Proposal indicates that other than surface water recharge, there are no existing or reasonably likely future beneficial uses of groundwater in the vicinity of the Siltronic Property. DEQ does not agree with this determination. At a minimum DEQ considers groundwater in the vicinity of the Siltronic Property to be suitable for irrigation and industrial use.

In addition, NWNG should be advised that for purposes of source control, the JSCS considers the Willamette River a potential drinking water source and provides "applicable or relevant and appropriate requirements" accordingly. Given the status of the project and consistent with the JSCS, NWNG should include federal maximum contaminant levels and EPA Region 6 tap-water preliminary remediation goals as groundwater screening criteria in the Siltronic Property RI Work Plan.

Figures 24 and 25. DEQ considers the preliminary human health and ecological conceptual site models (CSMs) to be incomplete. The human health and ecological CSMs should be revised to show: 1) a direct pathway between uplands/riverbank erodible soils and the Willamette River; and 2) that sediment is a separate potential contaminant source from surface water in Doane Creek. NWNG should also be advised that impacted storm water and/or shallow groundwater discharging onto banks or beaches along Doane Creek and/or the Willamette River above mean high water, represent a potential risk of exposure to ecological receptors (e.g., mammals, birds) via direct contact. The figures should be revised accordingly.

Figures 6, 8, 9, 11, and 12 through 19. These figures graphically illustrate geologic information (e.g., elevation of the top of the silt) or analytical data (e.g., benzene concentrations) using contouring methods. On certain figures (e.g., Figure 8, Figure 12) data availability and/or variability appears to have resulted in irregular or erroneous contours. Examples are provided below.

- Figure 8 – based on available data it appears the 6 foot and 9 foot contours should be drawn to surround the "window" in the silt unit.
- Figure 12 - variability in detected benzene concentrations in the vicinity of monitoring wells WS-13-69/105 and push-probe GW-3 resulted questionable contouring.

[5] City of Portland, 2007, "City Outfall 22C – Inline Solids Sampling in the Vicinity of Koppers Industries, Inc.", March 23, a technical memorandum prepared by Bureau of Environmental Services.

- Figure 12 - the lack of benzene data in the northern end of the NWNG Property prompted the northern end of 5 microgram/liter isoconcentration contour to be artificially shortened (i.e., should be extended to include MW-01-22 and B-1)

DEQ recommends that these types of figures be reviewed for the work plan, and that contours be hand drawn where contouring software inadequately depicts data distributions.

NEXT STEPS

Subsequent to NWNG's review of this letter, NWNG and DEQ should arrange to meet at the earliest opportunity to discuss DEQ's comments and the scope of work for the Siltronic Property RI, and source control work on both properties. Our next monthly meeting is scheduled for May 21st, however DEQ can meet earlier in the month to facilitate NWNG's timely preparation of the work plan.

DEQ appreciates NWNG's work to evaluate and address MGP waste and associated contamination on the NWNG and Siltronic properties. Please don't hesitate to contact me if you have questions regarding this letter.

Sincerely,

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ECSI No. 84 File
ECSI No. 183 File

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