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EMAIL REGARDING SUMMARY OF IN SITU RECIRCULATION WELL REPAIRS AT  
OPERABLE UNIT 4 (OU 4) INTERIM REMEDIAL ACTION NTC ORLANDO FL  
8/17/1999  
BECHTEL



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June 30, 2000

Ms. Barbara Nwokike  
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2155 Eagle Drive  
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Subject: Operable Unit 4 - Interim Remedial Action (IRA)  
Quarterly Performance Monitoring and Ground Water Quality Report, Naval  
Training Center, Orlando, Florida  
CTO 0017, Contract No. N62467-98-D-0995

Dear Ms. Nwokike::

CH2M HILL Constructors, Inc (CCI) is pleased to submit the attached technical memorandum describing the results of the quarterly UVB system performance and ground water quality monitoring at Operable Unit 4 (OU-4) at Area C of the Naval Training Center (NTC) in Orlando, Florida.

CCI appreciates the opportunity to be of continued service to the Southern Division Naval Facilities Engineering Command and looks forward to discussing this report with you at your convenience. Please feel free to call me at (813) 874-0777 if you have any questions or comments.

Sincerely,

CH2M HILL CONSTRUCTORS, Inc.

Steven N. Tsangaris, P.E.  
Project Manager

c: Orlando Partnering Team  
Fernando Ferreira, CH2M HILL



TECHNICAL MEMORANDUM

## Summary of Quarterly Monitoring Activities and Results, Operable Unit 4, Area C, Naval Training Center, Orlando, Florida

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PREPARED BY: Steve Tsangaris - CCI

CONTRACT: Navy Contract # N62467-98-D-0995

CTO: CTO 0017, Naval Training Center (NTC) Orlando

DATE: June 30, 2000

### Purpose

The purpose of this memorandum is to present the results of the quarterly groundwater sampling and UVB system performance and maintenance completed by CH2M HILL Constructors, Inc (CCI) at Operable Unit 4 (OU-4) in April/May 2000. The April 2000 sampling represents the seventh sampling event to be completed at OU-4 under the *Interim Remedial Action (IRA): Conceptual Design and Performance Specification, Operable Unit 4, Naval Training Center, Orlando, Florida* (ABB Environmental Services, May 1997). This is the second quarterly sampling event/UVB system performance monitoring performed by CCI.

Field activities were performed in accordance with the *Work Plan Addendum 1-A for the Operation and Maintenance of UVB Wells at OU-4 and Long Term Monitoring at OU-1* (CH2M HILL Constructors, Inc 1999), the *Basewide Work Plan* (CCI, 1999), the *Project Operations Plan (POP) for Site Investigations and Remedial Investigations* (ABB ES, 1997), and the *Performance Monitoring and Sampling Plan (PM&SP)* found in Appendix B of the *IRA Conceptual Design and Performance Specification* document. A brief discussion on the site history and conditions at OU-4, including a technical description of the UVB recirculation system, can also be found in that document.

## Summary of Field Activities

Field tasks completed as part of the quarterly monitoring at OU-4 included a comprehensive O&M of the UVB wells to evaluate system deficiencies, the collection of groundwater level elevations, and the collection and laboratory analysis of groundwater samples from 12 locations at the site. A detailed description of each of these field tasks is presented below.

Continued efforts to re-balance and maintain the two UVB wells during this reporting period have failed. During the April 2000 sampling event, the system was not operating. Consequently, influent and effluent samples and air emission samples were not collected as part of the quarterly monitoring.

### Groundwater Level Elevation Measurements

Groundwater level measurements were collected from each of the sampled monitoring wells prior to sample collection. Each well was sounded for total depth and depth to groundwater level using an electronic water level indicator. Measurements were recorded on the data sheets included in Appendix A. A summary of the groundwater elevation measurements is included in Table 1.

### Groundwater Sampling

Monitoring well sampling at the site began on April 19, 2000, and was completed on April 21, 2000. A total of 12 monitoring points were sampled, including nine (9) monitoring wells and three (3) drive points. The list of wells/drive points sampled during this sampling event at OU-4 is presented in Table 1. Sampling locations are shown on Figure 1.

Each well/drive point was purged and sampled with a peristaltic pump using the low-flow method described in the POP. Monitoring wells were purged a minimum of three wells volumes prior to sampling. Conductivity, pH, temperature, turbidity, oxygen reduction potential, and dissolved oxygen readings were collected during well purging efforts. The wells were pumped until the column of water was free of visible sediment and the conductivity, pH, temperature, turbidity, oxygen reduction potential, and dissolved oxygen readings stabilized. Attempts were also made to purge wells so that turbidity remained below 10 NTU's for two consecutive readings. Appendix A contains the monitoring well/drive point purging information.

Following purging, groundwater samples were collected for laboratory analyses for TCL volatiles (EPA Method 8260B), total and dissolved calcium, iron, and manganese, alkalinity (EPA Method 310.1), hardness (EPA Method 130.2), iron bacteria (EPA Method 9240B), total plate count (EPA Method 9215B), total dissolved solids (EPA Method 160.1), total suspended solids (EPA Method 160.2), and sulfate (EPA Method 9056). All samples were immediately placed on ice in coolers following collection, logged into the chain-of-custody, and subsequently hand delivered to Accutest Laboratories in Orlando, Florida for analysis.

### UVB System O&M/Hydraulic Performance

During the week of May 1, 2000, a comprehensive site visit to perform O&M activities on the two UVB wells was completed by CCI. The following tasks were performed during this site visit:

- Disassembly of both UVB wells for inspection of internal components.
- Re-development of both upper and lower screens at UVB-1 and UVB-2.
- Steam pressure cleaning of the pre-pack casing and other internal components from both UVB wells.
- Video-taping of both UVB wells including upper/lower screens and casing.
- Hand cleaning the submersible influent pumps from UVB-1 and UVB-2
- Completing upper screen withdrawal rate step tests and lower screen injection tests at both UVB wells.

A detailed description of the above bullet items completed as part of the comprehensive O&M site visit is provided in a technical memorandum included as Appendix B.

## Problems Encountered

No problems were encountered during the monitoring activities.

## Summary of Monitoring Results

### UVB System O&M/Hydraulic Performance

Evaluation of the system condition included determining if the equipment's components were in working order, and performing maintenance on equipment as needed. This was performed by disassembling the stripping unit, removing the submersible pump (with the associated piping and sensors), disconnecting the equalization tank, and removing the 6" well liner assembly (including the packer) for each of the treatment wells. The electrical connections and controls were evaluated as part of this system component condition evaluation.

Hydraulic tests were performed on the two UVB treatment wells at the site. The purpose of the tests was to determine the hydraulic environment surrounding the four screen intervals (upper and lower screen interval in each UVB well). This was accomplished by assessing the physical characteristics and capacity of groundwater extraction and re-injection in each of the individual screens. These values were then used to employ mathematical modeling to predict the site-specific theoretical UVB zones of influence (ZOI) and timeframes, over which the effective circulation zone should develop. The results were compared to the objectives of the IRA to evaluate the system's effectiveness.

Video recording of the well was used to evaluate the physical condition of the well joints, upper and lower screens and confirm as-built information on the treatment well's 10 inch stainless steel outer casing. This effort was performed by Deep Venture Video Logging located in Perry, Florida. Both of the UVB wells were logged from approximately 1 foot below the top of casing and within a foot and a half of the bottom of each well.

### Water Level Elevations

Groundwater elevation data are presented in Table 1. Figures 2 and 3 illustrate groundwater elevation data and contours for the shallow and intermediate zones of the surficial aquifer at the site, respectively.

Similar to data collected during previous sampling events, groundwater flow direction as interpreted from the April 2000 data indicates groundwater flow in the westerly direction towards Lake Druid in each of the monitored zones of the surficial aquifer.

## Data Validation

Independent data validation was completed on all sample analyses in accordance with USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review. The data were validated for completeness, holding time compliance, calibration compliance, laboratory blank contamination, surrogate spike recoveries, matrix spike recoveries, internal standard response, sample quantification, and detection limits. Qualifiers resulting from the validation process are shown with the analytical results provided in Tables 2 and 3.

## Analytical Results

A summary of detected analytical concentrations from the OU-4 April 2000 sampling event are presented on Table 2. A complete listing of the April 2000 data is presented in Table 3. Historical analytical data with associated graphs are presented in Appendix C.

Monitoring well OLD-13-07A is situated hydraulically upgradient of the UVB wells within the suspected source area, and was sampled to evaluate groundwater quality migrating westerly towards the UVB wells. Laboratory analytical data indicates a total VOC concentration of 5570  $\mu\text{g}/\text{l}$ , which is slightly higher than the concentrations of 3113  $\mu\text{g}/\text{l}$  noted during the last sampling event in January 2000. This total VOC concentration, although up slightly from the last event, still exhibits a predominantly downward trend in concentrations from values observed during sampling events in 1997 and 1998. The overall downward trend in total VOC concentrations over the last two years at OLD-13-07A may be attributed to natural attenuation of the source area plume, destruction of the source area plume as part of the permanganate pilot study, or data fluctuations due to seasonal and/or geochemical anomalies.

Monitoring well OLD-13-09A is situated approximately 100 feet due west of UVB-1, near the edge of Lake Druid. Laboratory analytical results at this sampling point indicate a total VOC concentration of 9,080  $\mu\text{g}/\text{l}$ , an increase over the concentration of 2,647  $\mu\text{g}/\text{l}$  noted during the January 2000 sampling event. Historical total VOC groundwater concentrations for this well have increased over the last four sampling events. The increase in total VOC concentrations observed during this event appears to be related to on-going interruptions in service at UVB-1 which have minimized system performance.

Monitoring well OLD-13-22B is located approximately 20 feet south of UVB-1, and is screened from 27 to 32 feet below ground surface. The total VOC concentration in this well decreased from 1734  $\mu\text{g}/\text{l}$  in January 2000 to 1525  $\mu\text{g}/\text{l}$  for the April 2000 sampling event. The concentration observed during this event remains close to the concentrations observed during sampling events in 1998 and 1999, and provides no apparent upward or downward trend in groundwater quality. Fluctuations in observed concentrations at this location may be attributed to the interruptions in service noted at the UVB wells since installation in 1997.

Laboratory data from monitoring well OLD-13-15A identified a decrease in total VOC concentrations from the previous sampling event in January 2000. However, the total VOC concentrations of 3,359  $\mu\text{g}/\text{l}$  still represents an increase over historical concentrations observed at that location.

Data from monitoring well OLD-13-23B, situated approximately 50 feet west and hydraulically downgradient of both UVB-1 and UVB-2, indicated an increase in total VOC concentrations from 152  $\mu\text{g}/\text{l}$  in January 2000 to 848  $\mu\text{g}/\text{l}$  in April 2000. The value of 848  $\mu\text{g}/\text{l}$  observed at OLD-13-23B is still far below levels observed at this sampling point in 1998, but does show an increase over values noted in January 2000.

Laboratory analytical results for Lake Druid drive point well DP-2 indicates the third consecutive event with relatively stable total VOC concentrations. The total VOC concentration of 192  $\mu\text{g}/\text{l}$  in April 2000 is essentially equal to the value of 198  $\mu\text{g}/\text{l}$  observed in January 2000. The graph of historical data for this sampling location indicates a downward trend in total VOC levels since 1997.

Total VOC concentrations at drive point well DP-3 increased from 1616  $\mu\text{g}/\text{l}$  in January 2000 to 2699  $\mu\text{g}/\text{l}$  in April 2000, continuing a fluctuating trend in total VOC concentrations at this monitoring location. Total VOC concentrations at drive point well DP-1 also increased slightly during this event, but the historical concentrations indicate no clear upward or downward trend.

## Conclusions and Recommendations

Laboratory analytical data from the April 2000 sampling event indicate that VOC concentrations generally remained constant or slightly increased since the previous sampling event in monitoring wells downgradient of the UVB recirculation wells. The increases are likely a result of difficulties maintaining the hydraulic performance of the system.

Based on the data collected during the O&M activities (described in detail in Appendix B), the UVB equipment, in general, is in good working condition. However, the lower screen intervals and the lithologic formation surrounding these intervals are severely limiting reinjection of treated effluent. Consequently, it is unlikely that the current operation of the UVB system will meet the IRA objectives of plume containment.

During the May 2000 Orlando Partnering Team (OPT) meeting, the OPT reached consensus to upgrade the existing treatment system at the site. The upgraded system will utilize the existing UVB wells as recovery wells, and a shallow tray air stripper will be installed to treat contaminated groundwater. Treated effluent will be discharged to the City of Orlando sanitary sewer. System startup is currently scheduled for late August 2000.

The next quarterly sampling event at the site will be conducted in July 2000.

## **TABLES**

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TABLE 1

OU-4 Groundwater Level Elevations, April 19, 2000

*Summary of Second Quarter 2000 Monitoring Activities and Results, Naval Training Center, Orlando, Florida*

Well Identifier	Well Depth (ft bls)	Screened Interval Elevation <sup>1</sup> (ft msl)	Top-of-Casing Elevation <sup>1</sup> (ft msl)	Depth to water (ft btoc)	Water-Level Elevation <sup>1</sup> (ft msl)
OLD-13-07A	18.5	90.5 to 105.5	108.71	6.15	102.56
OLD-13-09A	11.0	92.5 to 102.5	105.99	4.85	101.14
OLD-13-12A	11.5	93.4 to 103.4	107.17	5.42	101.75
OLD-13-15A	12.5	93.7 to 103.7	108.74	6.96	101.78
OLD-13-21B	32	74.4 to 79.4	108.67	6.51	102.16
OLD-13-22B	32	72.8 to 77.8	107.05	5.31	101.74
OLD-13-23B	31	73.2 to 78.2	106.37	5.11	101.26
OLD-13-24A	12.7	92.2 to 102.2	106.85	5.70	101.15
OLD-13-25B	23.5	81.3 to 86.3	107.00	5.74	101.26
OLD-13-DP1	NA	98.0 to 99.0	104.01	2.91	101.10
OLD-13-DP2	NA	98.8 to 99.8	104.78	4.39	100.39
OLD-13-DP3	NA	99.2 to 100.2	105.15	4.64	100.51

<sup>1</sup> U.S. Geological Survey, North American Datum, 1929

Notes: btoc = below top-of-casing

Bls = below land surface

ft = feet

Msl = mean sea level

**Table 2**  
**Summary of Detected Contaminants - April 2000 Sampling Results**  
**OU-4, NTC Orlando**

Station ID:	OLD-13-07A	OLD-13-09A	OLD-13-12A	OLD-13-15A	
Client Sample ID:	017-OLD-13-07A-Q1-00	017-OLD-13-09A-Q1-00	017-OLD-13-12A-Q1-00	017-OLD-13-15A-Q1-00	
Lab Sample ID:	F6308-5	F6317-1	F6308-1	F6308-3	
Date Collected:	04/19/2000	04/20/2000	04/19/2000	04/19/2000	
Parameter	Units				
<b>Inorganics/Misc Parameters</b>					
<b>Metals</b>					
Calcium	ug/l	42600	6010	13300	4630
Calcium, dissolved	ug/l	41400	5830	13100	4600
Iron	ug/l				
Iron, dissolved	ug/l				
Manganese	ug/l				
Manganese, dissolved	ug/l				
<b>Miscellaneous</b>					
Alkalinity, Total	mg/l	755	20.6	33.2	23.2
Hardness, Total	mg/l	117	22.1	39.3	15.5
Iron Bacteria	organ	POSITIVE			
Plate Count, Total	CFU/m	80	4	4	6
Solids, Total Dissolved	mg/l	1180	45	34	68
Sulfate	mg/l	6.9	12.4	5.3	12.9
<b>Volatile Organic Constituents</b>					
1,1-Dichloroethylene	ug/l				2.8
Carbon disulfide	ug/l				14.4
cis-1,2-Dichloroethylene	ug/l	76.5 J	2600	20.3	3250
Tetrachloroethylene	ug/l	5230	3230		
trans-1,2-Dichloroethylene	ug/l		29.8		41.1
Trichloroethylene	ug/l	264	3220		65.3 J
Vinyl chloride	ug/l				

**Notes:**

- No values indicate that parameter was not detected.
- "J" qualifier indicates an estimated value.
- "U" qualifier indicates a non-detection.

**Table 2**  
**Summary of Detected Contaminants - April 2000 Sampling Results**  
**OU-4, NTC Orlando**

StationID:	OLD-13-21B	OLD-13-22B	OLD-13-23B	OLD-13-24A	
Client Sample ID:	017-OLD-13-21B-Q1-00	017-OLD-13-22B-Q1-00	017-OLD-13-23B-Q1-00	017-OLD-13-24A-Q1-00	
Lab Sample ID:	F6308-4	F6308-2	F6317-4	F6317-6	
Date Collected:	04/19/2000	04/19/2000	04/20/2000	04/20/2000	
Parameter	Units				
<b>Inorganics/Misc Parameters</b>					
<b>Metals</b>					
Calcium	ug/l	3280	3540	2790	9460
Calcium, dissolved	ug/l	3080	3930	2770	9960
Iron	ug/l	457	480	846	166 U
Iron, dissolved	ug/l	442	512	762	121 U
Manganese	ug/l				
Manganese, dissolved	ug/l				
<b>Miscellaneous</b>					
Alkalinity, Total	mg/l				24.3
Hardness, Total	mg/l	13.5	13.4	14.5	27.9
Iron Bacteria	organ			POSITIVE	POSITIVE
Plate Count, Total	CFU/m	2		146	6
Solids, Total Dissolved	mg/l	33	39	29	31
Sulfate	mg/l	15.3	15.9	12.8	8
<b>Volatile Organic Constituents</b>					
1,1-Dichloroethylene	ug/l				
Carbon disulfide	ug/l				
cis-1,2-Dichloroethylene	ug/l	725	1240	698	45.7
Tetrachloroethylene	ug/l	15.4	8.6		
trans-1,2-Dichloroethylene	ug/l	8.1	13.6	7.5 J	1.2 J
Trichloroethylene	ug/l	428	263	142	28.6
Vinyl chloride	ug/l				

**Notes:**

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- "U" qualifier indicates a non-detection.

**Table 2**  
**Summary of Detected Contaminants - April 2000 Sampling Results**  
**OU-4, NTC Orlando**

StationID:		OLD-13-25B	OLD-13-DP1	OLD-13-DP2	OLD-13-DP3
Client Sample ID:		017-OLD-13-25B-Q1-00	017-OLD-13-DP1-Q1-00	017-OLD-13-DP2-Q1-00	017-OLD-13-DP3-Q1-00
Lab Sample ID:		F6317-5	F6328-1	F6328-2	F6328-3
Date Collected:		04/20/2000	04/21/2000	04/21/2000	04/21/2000
Parameter	Units				
<b>Inorganics/Misc Parameters</b>					
<b>Metals</b>					
Calcium	ug/l	7380		1670	2770
Calcium, dissolved	ug/l	6480		1880	2730
Iron	ug/l		253 J	229 J	214 J
Iron, dissolved	ug/l		274 J	230 J	
Manganese	ug/l				
Manganese, dissolved	ug/l				
<b>Miscellaneous</b>					
Alkalinity, Total	mg/l	7.4	20.6	5.3	13.7
Hardness, Total	mg/l	23.6		6	10.3
Iron Bacteria	organ	POSITIVE			
Plate Count, Total	CFU/m	7			
Solids, Total Dissolved	mg/l	134	59	45	67
Sulfate	mg/l	64.9	10	14.7	24.5
<b>Volatile Organic Constituents</b>					
1,1-Dichloroethylene	ug/l		0.93 J		1.8 J
Carbon disulfide	ug/l				
cis-1,2-Dichloroethylene	ug/l	28.8	1590		2640
Tetrachloroethylene	ug/l	57.5		13.5	
trans-1,2-Dichloroethylene	ug/l		12.2	0.67 J	32.2
Trichloroethylene	ug/l	35.4		33.1	24.8
Vinyl chloride	ug/l		1.2	15.9	

**Notes:**

- No values indicate that parameter was not detected.
- "J" qualifier indicates an estimated value.
- "U" qualifier indicates a non-detection.

**Table 3**  
**Summary of Analytical Results April 2000 Sampling Event**  
**OU-4, NTC Orlando**

Station ID:	OLD-13-07A	OLD-13-09A	OLD-13-12A	OLD-13-15A	
Client Sample ID:	017-OLD-13-07A-Q1-00	017-OLD-13-09A-Q1-00	017-OLD-13-12A-Q1-00	017-OLD-13-15A-Q1-00	
Lab Sample ID:	F6308-5	F6317-1	F6308-1	F6308-3	
Date Collected:	04/19/2000	04/20/2000	04/19/2000	04/19/2000	
Parameter	Units				
<b>Inorganics/Misc Parameters</b>					
<b>Metals</b>					
Calcium	ug/l	42600	6010	13300	4630
Calcium, dissolved	ug/l	41400	5830	13100	4600
Iron	ug/l	103 U	124 U	50.8 U	52.8 U
Iron, dissolved	ug/l	82.4 U	89.8 U	39.5 U	37.3 U
Manganese	ug/l	0.71 U	0.76 U	0.41 U	2.1 U
Manganese, dissolved	ug/l	0.82 U	0.75 U	0.58 U	2.1 U
<b>Miscellaneous</b>					
Alkalinity, Total	mg/l	755	20.6	33.2	23.2
Hardness, Total	mg/l	117	22.1	39.3	15.5
Iron Bacteria	organ	POSITIVE	NEGATIVE	NEGATIVE	NEGATIVE
Plate Count, Total	CFU/m	80	4	4	6
Solids, Total Dissolved	mg/l	1180	45	34	68
Solids, Total Suspended	mg/l	4 U	4 U	4 U	4 U
Sulfate	mg/l	6.9	12.4	5.3	12.9
<b>Volatile Organic Constituents</b>					
1,1,1-Trichloroethane	ug/l	100 U	20 U	2 U	2 U
1,1,2,2-Tetrachloroethane	ug/l	100 U	20 U	2 U	2 U
1,1,2-Trichloroethane	ug/l	100 U	20 U	2 U	2 U
1,1-Dichloroethane	ug/l	100 U	20 U	2 U	2 U
1,1-Dichloroethylene	ug/l	100 U	20 U	2 U	2.8
1,2-Dichloroethane	ug/l	100 U	20 U	2 U	2 U
1,2-Dichloropropane	ug/l	100 U	20 U	2 U	2 U
2-Hexanone	ug/l	500 U	100 U	10 U	10 U
4-Methyl-2-pentanone	ug/l	500 U	100 U	10 U	10 U
Acetone	ug/l	2500 U	500 U	50 U	50 U
Benzene	ug/l	50 U	10 U	1 U	1 U
Bromodichloromethane	ug/l	100 U	20 U	2 U	2 U
Bromoform	ug/l	100 U	20 U	2 U	2 U
Carbon disulfide	ug/l	500 U	100 U	10 U	14.4
Carbon tetrachloride	ug/l	100 U	20 U	2 U	2 U
Chlorobenzene	ug/l	100 U	20 U	2 U	2 U
Chloroethane	ug/l	250 U	50 U	5 U	5 U
Chloroform	ug/l	100 U	20 U	2 U	2 U
cis-1,2-Dichloroethylene	ug/l	76.5 U	2600	20.3	3250

**Table 3**  
**Summary of Analytical Results April 2000 Sampling Event**  
**OU-4, NTC Orlando**

Station ID:		OLD-13-07A	OLD-13-09A	OLD-13-12A	OLD-13-15A
Client Sample ID:		017-OLD-13-07A-Q1-00	017-OLD-13-09A-Q1-00	017-OLD-13-12A-Q1-00	017-OLD-13-15A-Q1-00
Lab Sample ID:		F6308-5	F6317-1	F6308-1	F6308-3
Date Collected:		04/19/2000	04/20/2000	04/19/2000	04/19/2000
cis-1,3-Dichloropropene	ug/l	100 U	20 U	2 U	2 U
Dibromochloromethane	ug/l	100 U	20 U	2 U	2 U
Ethylbenzene	ug/l	100 U	20 U	2 U	2 U
Methyl bromide	ug/l	250 U	50 U	5 U	5 U
Methyl chloride	ug/l	250 U	50 U	5 U	5 U
Methyl ethyl ketone	ug/l	500 U	100 U	10 U	10 U
Methylene chloride	ug/l	250 U	50 U	5 U	5 U
Styrene	ug/l	100 U	20 U	2 U	2 U
Tetrachloroethylene	ug/l	5230	3230	2 U	2 U
Toluene	ug/l	100 U	20 U	2 U	2 U
trans-1,2-Dichloroethylene	ug/l	100 U	29.8	2 U	41.1
trans-1,3-Dichloropropene	ug/l	100 U	20 U	2 U	2 U
Trichloroethylene	ug/l	264	3220	2 U	65.3 J
Vinyl chloride	ug/l	50 U	10 U	1 U	1 U
Xylene (total)	ug/l	300 U	60 U	6 U	6 U

**Notes:**

- Values in shaded cells indicate detections.
- "J" qualifier indicates an estimated value.
- "U" qualifier indicates a non-detection.

**Table 3**  
**Summary of Analytical Results April 2000 Sampling Event**  
**OU-4, NTC Orlando**

Station ID:		OLD-13-21B	OLD-13-22B	OLD-13-23B	OLD-13-24A
Client Sample ID:		017-OLD-13-21B-Q1-00	017-OLD-13-22B-Q1-00	017-OLD-13-23B-Q1-00	017-OLD-13-24A-Q1-00
Lab Sample ID:		F6308-4	F6308-2	F6317-4	F6317-6
Date Collected:		04/19/2000	04/19/2000	04/20/2000	04/20/2000
Parameter	Units				
<b>Inorganics/Misc Parameters</b>					
<b>Metals</b>					
Calcium	ug/l	3280	3540	2790	9460
Calcium, dissolved	ug/l	3080	3930	2770	9960
Iron	ug/l	457	480	846	166 U
Iron, dissolved	ug/l	442	512	762	121 U
Manganese	ug/l	1 U	0.9 U	1.4 U	0.37 U
Manganese, dissolved	ug/l	1.1 U	1.3 U	1.2 U	0.29 U
<b>Miscellaneous</b>					
Alkalinity, Total	mg/l	5 U	5 U	5 U	24.3
Hardness, Total	mg/l	13.5	13.4	14.5	27.9
Iron Bacteria	organ	NEGATIVE	NEGATIVE	POSITIVE	POSITIVE
Plate Count, Total	CFU/m	2	1 U	146	6
Solids, Total Dissolved	mg/l	33	39	29	31
Solids, Total Suspended	mg/l	4 U	4 U	4 U	4 U
Sulfate	mg/l	15.3	15.9	12.8	8
<b>Volatile Organic Constituents</b>					
1,1,1-Trichloroethane	ug/l	2 U	2 U	20 U	2 U
1,1,2,2-Tetrachloroethane	ug/l	2 U	2 U	20 U	2 U
1,1,2-Trichloroethane	ug/l	2 U	2 U	20 U	2 U
1,1-Dichloroethane	ug/l	2 U	2 U	20 U	2 U
1,1-Dichloroethylene	ug/l	2 U	2 U	20 U	2 U
1,2-Dichloroethane	ug/l	2 U	2 U	20 U	2 U
1,2-Dichloropropane	ug/l	2 U	2 U	20 U	2 U
2-Hexanone	ug/l	10 U	10 U	100 U	10 U
4-Methyl-2-pentanone	ug/l	10 U	10 U	100 U	10 U
Acetone	ug/l	50 U	50 U	500 U	50 U
Benzene	ug/l	1 U	1 U	10 U	1 U
Bromodichloromethane	ug/l	2 U	2 U	20 U	2 U
Bromoform	ug/l	2 U	2 U	20 U	2 U
Carbon disulfide	ug/l	10 U	10 U	100 U	10 U
Carbon tetrachloride	ug/l	2 U	2 U	20 U	2 U
Chlorobenzene	ug/l	2 U	2 U	20 U	2 U
Chloroethane	ug/l	5 U	5 U	50 U	5 U
Chloroform	ug/l	2 U	2 U	20 U	2 U
cis-1,2-Dichloroethylene	ug/l	725	1240	698	45.7

**Table 3**  
**Summary of Analytical Results April 2000 Sampling Event**  
**OU-4, NTC Orlando**

Station ID:		OLD-13-21B	OLD-13-22B	OLD-13-23B	OLD-13-24A
Client Sample ID:		017-OLD-13-21B-Q1-00	017-OLD-13-22B-Q1-00	017-OLD-13-23B-Q1-00	017-OLD-13-24A-Q1-00
Lab Sample ID:		F6308-4	F6308-2	F6317-4	F6317-6
Date Collected:		04/19/2000	04/19/2000	04/20/2000	04/20/2000
cis-1,3-Dichloropropene	ug/l	2 U	2 U	20 U	2 U
Dibromochloromethane	ug/l	2 U	2 U	20 U	2 U
Ethylbenzene	ug/l	2 U	2 U	20 U	2 U
Methyl bromide	ug/l	5 U	5 U	50 U	5 U
Methyl chloride	ug/l	5 U	5 U	50 U	5 U
Methyl ethyl ketone	ug/l	10 U	10 U	100 U	10 U
Methylene chloride	ug/l	5 U	5 U	50 U	5 U
Styrene	ug/l	2 U	2 U	20 U	2 U
Tetrachloroethylene	ug/l	15.4	8.6	20 U	2 U
Toluene	ug/l	2 U	2 U	20 U	2 U
trans-1,2-Dichloroethylene	ug/l	8.1	13.6	7.5 J	1.2 J
trans-1,3-Dichloropropene	ug/l	2 U	2 U	20 U	2 U
Trichloroethylene	ug/l	428	263	142	28.6
Vinyl chloride	ug/l	1 U	1 U	10 U	1 U
Xylene (total)	ug/l	6 U	6 U	60 U	6 U

**Notes:**

- Values in shaded cells indicate detections.
- "J" qualifier indicates an estimated value.
- "U" qualifier indicates a non-detection.

**Table 3**  
**Summary of Analytical Results April 2000 Sampling Event**  
**OU-4, NTC Orlando**

Station ID:	OLD-13-25B	OLD-13-DP1	OLD-13-DP2	OLD-13-DP3	
Client Sample ID:	017-OLD-13-25B-Q1-00	017-OLD-13-DP1-Q1-00	017-OLD-13-DP2-Q1-00	017-OLD-13-DP3-Q1-00	
Lab Sample ID:	F6317-5	F6328-1	F6328-2	F6328-3	
Date Collected:	04/20/2000	04/21/2000	04/21/2000	04/21/2000	
Parameter	Units				
<b>Inorganics/Misc Parameters</b>					
<b>Metals</b>					
Calcium	ug/l	7380	302 U	1670	2770
Calcium, dissolved	ug/l	6480	320 U	1880	2730
Iron	ug/l	87.8 U	253 J	229 J	214 J
Iron, dissolved	ug/l	70.1 U	274 J	230 J	167 U
Manganese	ug/l	0.83 U	0.84 U	2 U	1.9 U
Manganese, dissolved	ug/l	0.57 U	1.4 U	2.9 U	1 U
<b>Miscellaneous</b>					
Alkalinity, Total	mg/l	7.4	20.6	5.3	13.7
Hardness, Total	mg/l	23.6	4 U	6	10.3
Iron Bacteria	organ	POSITIVE			
Plate Count, Total	CFU/m	7			
Solids, Total Dissolved	mg/l	134	59	45	67
Solids, Total Suspended	mg/l	4 U	4 U	4 U	4 U
Sulfate	mg/l	64.9	10	14.7	24.5
<b>Volatile Organic Constituents</b>					
1,1,1-Trichloroethane	ug/l	2 U	2 U	2 U	2 U
1,1,2,2-Tetrachloroethane	ug/l	2 U	2 U	2 U	2 U
1,1,2-Trichloroethane	ug/l	2 U	2 U	2 U	2 U
1,1-Dichloroethane	ug/l	2 U	2 U	2 U	2 U
1,1-Dichloroethylene	ug/l	2 U	0.93 J	2 U	1.8 J
1,2-Dichloroethane	ug/l	2 U	2 U	2 U	2 U
1,2-Dichloropropane	ug/l	2 U	2 U	2 U	2 U
2-Hexanone	ug/l	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	ug/l	10 U	10 U	10 U	10 U
Acetone	ug/l	50 U	50 UJ	50 UJ	50 UJ
Benzene	ug/l	1 U	1 U	1 U	1 U
Bromodichloromethane	ug/l	2 U	2 U	2 U	2 U
Bromoform	ug/l	2 U	2 U	2 U	2 U
Carbon disulfide	ug/l	10 U	10 U	10 U	10 U
Carbon tetrachloride	ug/l	2 U	2 U	2 U	2 U
Chlorobenzene	ug/l	2 U	2 U	2 U	2 U
Chloroethane	ug/l	5 U	5 U	5 U	5 U
Chloroform	ug/l	2 U	2 U	2 U	2 U
cis-1,2-Dichloroethylene	ug/l	28.8	1590	129 J	2640

**Table 3**  
**Summary of Analytical Results April 2000 Sampling Event**  
**OU-4, NTC Orlando**

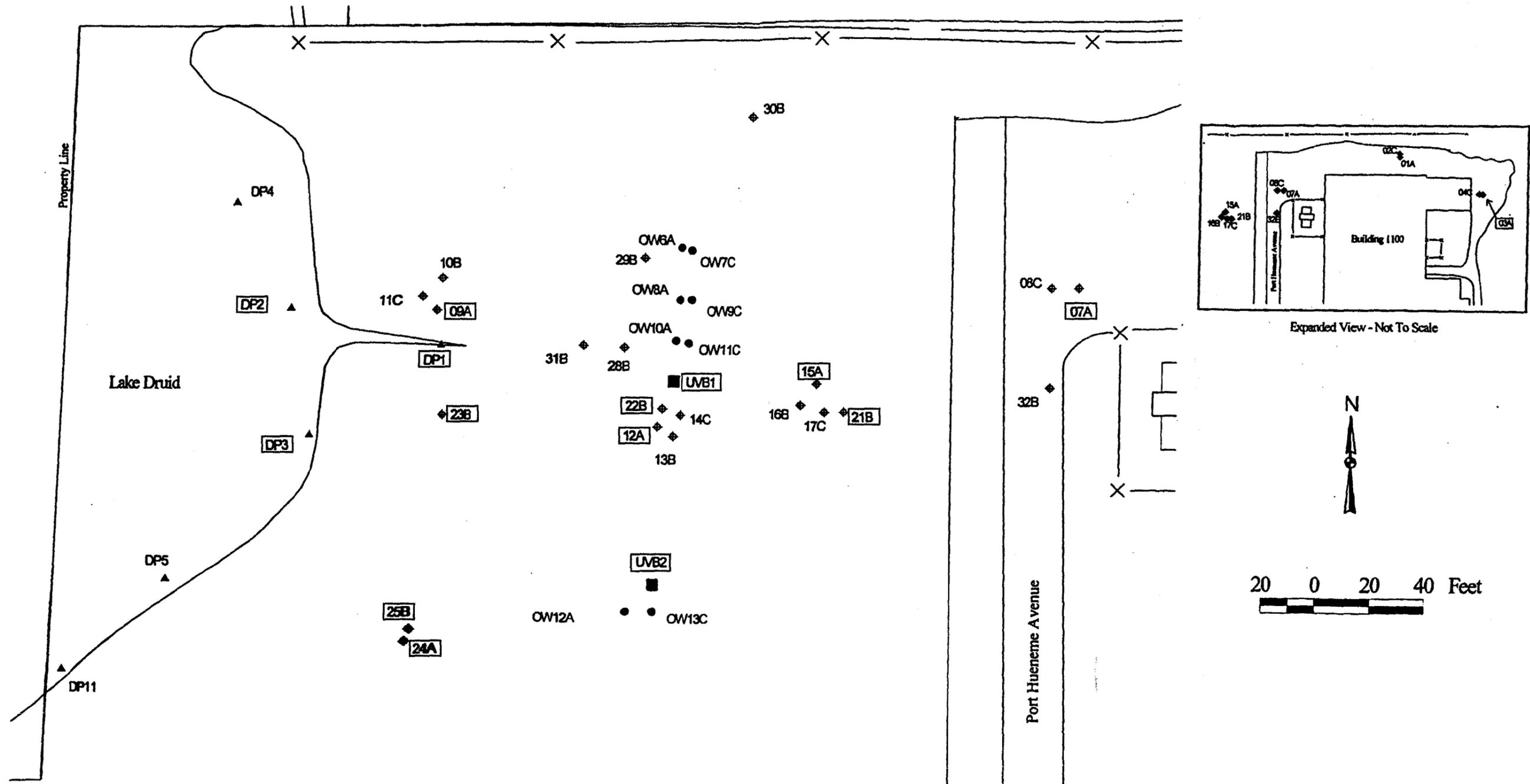
StationID:		OLD-13-25B	OLD-13-DP1	OLD-13-DP2	OLD-13-DP3
Client Sample ID:		017-OLD-13-25B-Q1-00	017-OLD-13-DP1-Q1-00	017-OLD-13-DP2-Q1-00	017-OLD-13-DP3-Q1-00
Lab Sample ID:		F6317-5	F6328-1	F6328-2	F6328-3
Date Collected:		04/20/2000	04/21/2000	04/21/2000	04/21/2000
cis-1,3-Dichloropropene	ug/l	2 U	2 U	2 U	2 U
Dibromochloromethane	ug/l	2 U	2 U	2 U	2 U
Ethylbenzene	ug/l	2 U	2 U	2 U	2 U
Methyl bromide	ug/l	5 U	5 U	5 U	5 U
Methyl chloride	ug/l	5 U	5 U	5 U	5 U
Methyl ethyl ketone	ug/l	10 U	10 U	10 U	10 U
Methylene chloride	ug/l	5 U	5 U	5 U	5 U
Styrene	ug/l	2 U	2 U	2 U	2 U
Tetrachloroethylene	ug/l	57.5	2 U	13.5	2 U
Toluene	ug/l	2 U	2 U	2 U	2 U
trans-1,2-Dichloroethylene	ug/l	2 U	12.2	0.67 J	32.2
trans-1,3-Dichloropropene	ug/l	2 U	2 U	2 U	2 U
Trichloroethylene	ug/l	35.4	2 U	33.1	24.8
Vinyl chloride	ug/l	1 U	1.2	15.9	1 U
Xylene (total)	ug/l	6 U	6 U	6 U	6 U

**Notes:**

- Values in shaded cells indicate detections.
- "J" qualifier indicates an estimated value.
- "U" qualifier indicates a non-detection.

**FIGURES**

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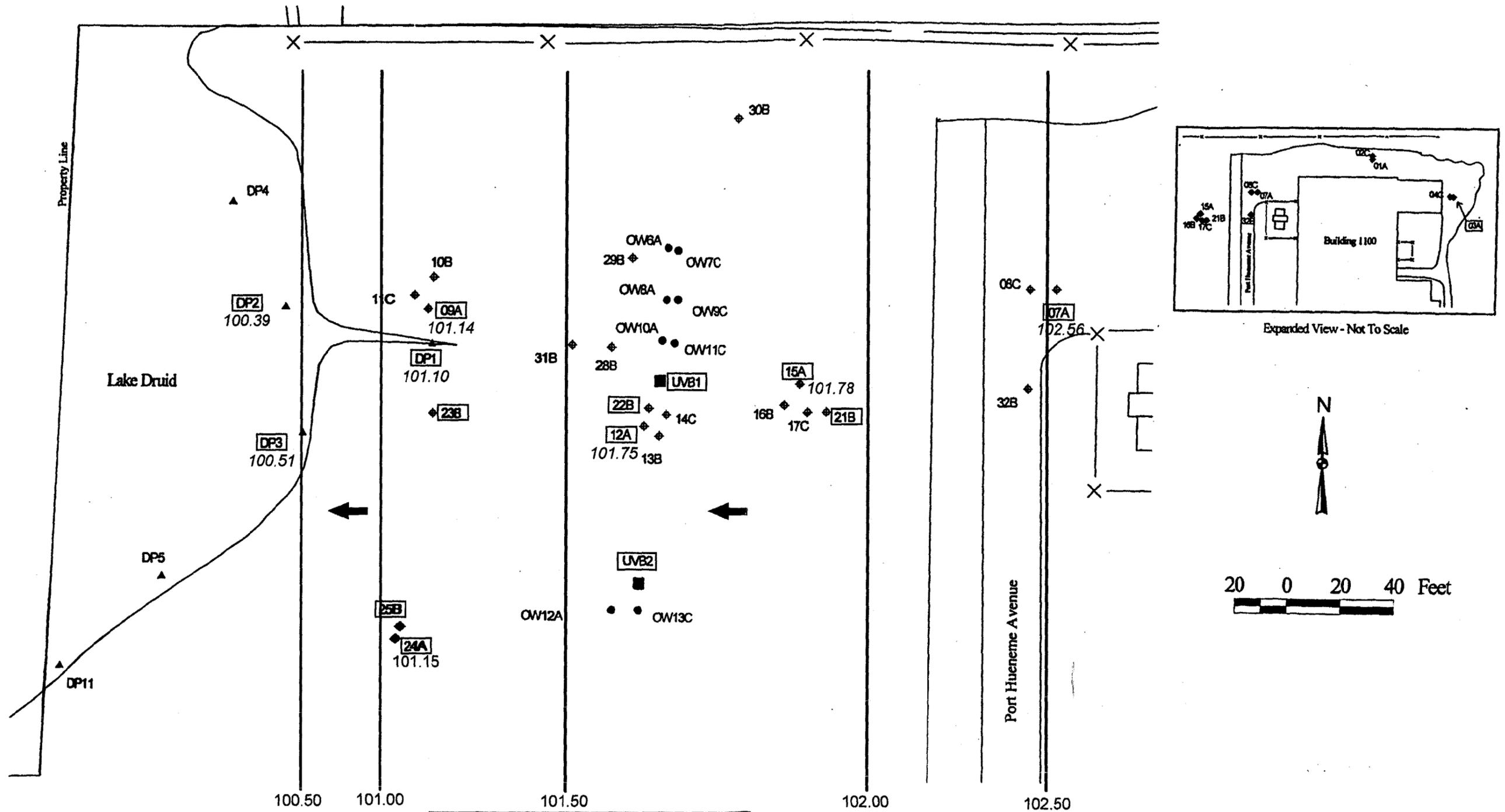
**LEGEND**

- ◆ Monitoring Well Location and Designation
- Observation Well Location and Designation
- ▲ Drive Point Well Location and Designation
- Recirculation Well Location and Designation
- 24A Groundwater Sample Collected During January 2000 Sampling Event

**FIGURE 1**  
OU-4 Site Map



INTERIM REMEDIAL ACTION,  
PERFORMANCE MONITORING  
AND SAMPLING PLAN,  
OPERABLE UNIT 4  
NAVAL TRAINING CENTER  
ORLANDO, FLORIDA

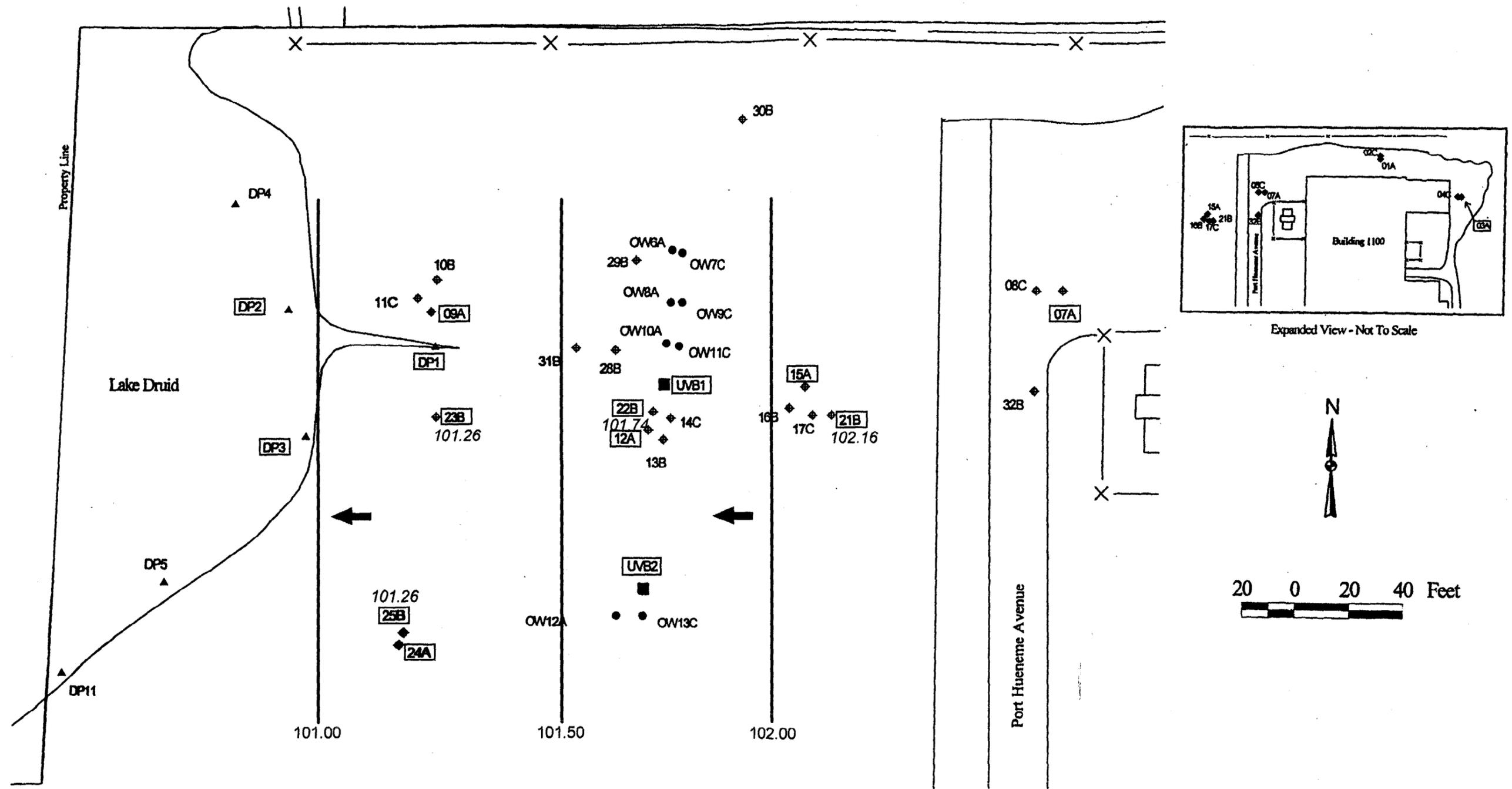


**LEGEND**

- ◆ Monitoring Well Location and Designation
- Observation Well Location and Designation
- ▲ Drive Point Well Location and Designation
- Recirculation Well Location and Designation
- 24A Monitoring Wells Included in Current Monitoring Program
- 101.15 Groundwater Elevation (MSL, USGS North American Datum, 1929)
- 101.00 Groundwater Contour Line (MSL, USGS North American Datum, 1929)
- ← Groundwater Flow Direction

**FIGURE 2**  
**OU-4 Groundwater Flow (Shallow Zone)**


 INTERIM REMEDIAL ACTION,  
 PERFORMANCE MONITORING  
 AND SAMPLING PLAN,  
 OPERABLE UNIT 4  
 NAVAL TRAINING CENTER  
 ORLANDO, FLORIDA



**LEGEND**

- ◆ Monitoring Well Location and Designation
- Observation Well Location and Designation
- ▲ Drive Point Well Location and Designation
- Recirculation Well Location and Designation
- 25B Monitoring Wells Included in Current Monitoring Program
- 101.26 Groundwater Elevation (MSL, USGS North American Datum, 1929)
- 101.00 Groundwater Contour Line (MSL, USGS North American Datum, 1929)
- ← Groundwater Flow Direction

**FIGURE 3**  
**OU-4 Groundwater Flow (Intermediate Zone)**

INTERIM REMEDIAL ACTION,  
 PERFORMANCE MONITORING  
 AND SAMPLING PLAN,  
 OPERABLE UNIT 4  
 NAVAL TRAINING CENTER  
 ORLANDO, FLORIDA

Appendix A

**WELL SAMPLING FIELD SHEET**

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## CH2M HILL WELL SAMPLING FIELD SHEET

PROJECT# 152044.34.21

<b>WELL NUMBER: 017-OLD-13-DP3</b>	<b>SITE: OU-4 Naval Training Center Orlando, FL</b>
<b>FIELD CREW: FJ Ferreira/JJ Ottoson</b> <span style="float: right;">(leave blank if on previous page)</span>	

	DEPTH (FT)	CASING DIA.	GAL/FT OF CASING	
DEPTH TO WATER (FT):	4.64			
WELL DEPTH (FT):	10.7	2 IN.	0.1632	
WATER COLUMN (FT):	6.06	4 IN.	0.6528	
GAL/FT OF CASING	0.1632	6 IN.	1.4688	
CASING VOLUME (GAL)	0.988992	8 IN.	2.611	
NO. OF VOLUMES min.(3)	3	10 IN.	4.0797	
PURGE VOLUME (GAL)	2.966976	12 IN.	5.8748	

METHOD OF PURGING (circle one)			
<b>PUMP: PERISTALTIC</b>	<b>OTHER:</b>	<b>BAILER : TEFLON, SS ,OTHER:</b>	
TIME ON: 1035		BAILER VOL.. (gal)	.25 / .33
FLOW RATE (gpm): 0.125		REQUIRED PULLS:	
PUMP TIME (min): 25		VOL. PURGED (gals):	
VOL. PURGED (gals): 3.125		OTHER:	

FIELD PARAMETERS	FIELD MEASUREMENTS					WITHIN 10% Y / N
	1st	2nd	3rd	4th	5th	
TIME	1043	1052	1100			
VOL. (gal)	1	2	3			
pH (s.units)	5.56	5.44	5.43			
TEMP.(C)	22.3	22.2	22.2			
COND.(mshos/cm)	0.13	0.13	0.13			
DO (mg/l)	1.29	0.85	0.82			
ORP (mv)	-80	-88	-90			
TURB (NTU's)	1.4	0.1	0.7			

SAMPLE PARAMETERS ( **GRAB OR COMPOSITE** ) : Grab Sample  
 FILTERED METALS COLLECTED: Y / N 1.0um,0.45um, OTHER:

**OBSERVATIONS**

**COLOR:** CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , OTHER: **Very light Grey**

**ODOR:** NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL , **SL Musky**

**TURBIDITY:** NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS

**COMMENTS:**

**OTHER:** PLEASE USE BACK OF SHT.FOR SKETCHING MAPS ,WELL LOCATION NOTES ECT. **SEE BACK OF SHT Y / N.**

**Q.C. SAMPLE TYPE:** DUPLICATE , EQUIPMENT BLANK , OTHER :

**Q.C. PARAMETERS:**

**SAMPLE DATE/ TIME: 04/21/2000 / @ 1100**

**SIGNED/SAMPLER:** Ferreira J. Ottoson



# CH2M HILL WELL SAMPLING FIELD SHEET

PROJECT# 152044.34.21

<b>WELL NUMBER: 017-OLD-13-DP1</b>	<b>SITE: OU-4 Naval Training Center Orlando, FL</b>
<b>FIELD CREW: FJ Ferreira/JJ Ottoson</b> <span style="float: right;">(leave blank if on previous page)</span>	

	DEPTH (FT)	CASING DIA.	GAL/FT OF CASING	
DEPTH TO WATER (FT):	2.91			
WELL DEPTH (FT):	5.89	2 IN.	0.1632	
WATER COLUMN (FT):	2.98	4 IN.	0.6528	
GAL/FT OF CASING	0.1632	6 IN.	1.4688	
CASING VOLUME (GAL)	0.486336	8 IN.	2.611	
NO. OF VOLUMES min.(3)	3	10 IN.	4.0797	
PURGE VOLUME (GAL)	1.459008	12 IN.	5.8748	

METHOD OF PURGING (circle one)			
<b>PUMP: PERISTALTIC</b>	<b>OTHER:</b>	<b>BAILER : TEFLON, SS ,OTHER:</b>	
TIME ON: 945		BAILER VOL. (gal)	.25 / .33
FLOW RATE (gpm): 0.125		REQUIRED PULLS:	
PUMP TIME (min): 12		VOL. PURGED (gals):	
VOL. PURGED (gals): 1.5		OTHER:	

FIELD PARAMETERS	FIELD MEASUREMENTS					WITHIN 10% Y / N
	1st	2nd	3rd	4th	5th	
TIME	949	953	957	1000		
VOL. (gal)	0.5	1	1.5	2		
pH (s.units)	6.77	6.48	6.06	6.05		
TEMP.(C)	22.2	21.9	21.8	21.8		
COND.(mshos/cm)	0.12	0.11	0.1	0.1		
DO (mg/l)	1.67	1.56	1.36	1.33		
ORP (mv)	70	-49	-70	-72		
TURB (NTU's)	2.1	0.7	0.2	0.4		

SAMPLE PARAMETERS ( **GRAB OR COMPOSITE** ) : Grab Sample  
 FILTERED METALS COLLECTED: Y / N 1.0um,0.45um, OTHER:

**OBSERVATIONS**

**COLOR:** CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , OTHER:

**ODOR:** NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL ? , UNKNOWN

**TURBIDITY:** NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS

**COMMENTS:**

**OTHER:** PLEASE USE BACK OF SHT.FOR SKETCHING MAPS ,WELL LOCATION NOTES ECT. SEE BACK OF SHT Y / N.

**Q.C. SAMPLE TYPE:** DUPLICATE , EQUIPMENT BLANK , OTHER :

**Q.C. PARAMETERS:**

**SAMPLE DATE/ TIME: 04/21/2000 / @ 1000**

**SIGNED/SAMPLER:** F. J. Ferreira

## CH2M HILL WELL SAMPLING FIELD SHEET

PROJECT# 152044.34.21

<b>WELL NUMBER: 017-OLD-13-22B</b>		<b>SITE: OU-4 Naval Training Center Orlando, FL</b>				
<b>FIELD CREW: FJ Ferreira/JJ Ottoson</b>		(leave blank if on previous page)				
DEPTH TO WATER (FT):	5.31	CASING DIA.		GAL/FT OF CASING		
WELL DEPTH (FT):	34.74	2 IN.		0.1632		
WATER COLUMN (FT):	29.43	4 IN.		0.6528		
GAL/FT OF CASING	0.1632	6 IN.		1.4688		
CASING VOLUME (GAL)	4.802976	8 IN.		2.611		
NO. OF VOLUMES min.(3)	3	10 IN.		4.0797		
PURGE VOLUME (GAL)	14.408928	12 IN.		5.8748		
<b>METHOD OF PURGING (circle one)</b>						
<b>PUMP: PERISTALTIC</b>		<b>OTHER:</b>		<b>BAILER : TEFLON, SS ,OTHER:</b>		
TIME ON:	1145			BAILER VOL.. (gal)	.25 / .33	
FLOW RATE (gpm):	0.125			REQUIRED PULLS:		
PUMP TIME (min):	120			VOL. PURGED (gals):		
VOL. PURGED (gals):	15			OTHER:		
<b>FIELD PARAMETERS</b>	<b>FIELD MEASUREMENTS</b>					<b>WITHIN10% Y / N</b>
	1st	2nd	3rd	4th	5th	6th
TIME	1225	1305	1345			
VOL. (gal)	5	10	15			
pH (s.units)	4.58	4.61	4.61			
TEMP.(C)	23.89	24.02	24.04			
COND.(mshos/cm)	0.123	0.122	0.121			
DO (mg/l)	0.49	0.36	0.35			
ORP (mv)	105	100	98			
TURB (NTU's)	23	6.4	6.2			
SAMPLE PARAMETERS ( GRAB OR COMPOSITE ): Grab Sample						
FILTERED METALS COLLECTED: Y / N 1.0um,0.45um, OTHER:						
<b>OBSERVATIONS</b>						
COLOR: CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , OTHER:						
ODOR: NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL ? , UNKNOWN						
TURBIDITY: NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS						
COMMENTS:						
OTHER: PLEASE USE BACK OF SHT.FOR SKETCHING MAPS ,WELL LOCATION NOTES ECT. SEE BACK OF SHT Y / N.						
Q.C. SAMPLE TYPE: DUPLICATE , EQUIPMENT BLANK , OTHER :						
Q.C. PARAMETERS:						
SAMPLE DATE/ TIME: 04/19/2000			/ @ 1345			

SIGNED/SAMPLER:

## CH2M HILL WELL SAMPLING FIELD SHEET

PROJECT# 152044.34.21

<b>WELL NUMBER: 017-OLD-13-25B</b>		<b>SITE: OU-4 Naval Training Center Orlando, FL</b>				
<b>FIELD CREW: FJ Ferreira/JJ Ottoson</b>		(leave blank if on previous page)				
DEPTH TO WATER (FT):	5.74	CASING DIA.		GAL/FT OF CASING		
WELL DEPTH (FT):	24.97	2 IN.		0.1632		
WATER COLUMN (FT):	19.23	4 IN.		0.6528		
GAL/FT OF CASING	0.1632	6 IN.		1.4688		
CASING VOLUME (GAL)	3.138336	8 IN.		2.611		
NO. OF VOLUMES min.(3)	3	10 IN.		4.0797		
PURGE VOLUME (GAL)	9.415008	12 IN.		5.8748		
<b>METHOD OF PURGING (circle one)</b>						
<b>PUMP: PERISTALTIC</b>		<b>OTHER:</b>		<b>BAILER : TEFLON, SS ,OTHER:</b>		
TIME ON:	1120			BAILER VOL.. (gal)	.25 / .33	
FLOW RATE (gpm):	0.125			REQUIRED PULLS:		
PUMP TIME (min):	80			VOL. PURGED (gals):		
VOL. PURGED (gals):	10			OTHER:		
<b>FIELD PARAMETERS</b>	<b>FIELD MEASUREMENTS</b>					WITHIN 10% Y / N
	1st	2nd	3rd	4th	5th	6th
TIME	1145	1215	1240			
VOL. (gal)	3.5	7	10			
pH (s.units)	5.02	4.83	4.81			
TEMP.(C)	23.7	23.7	23.7			
COND.(mshos/cm)	0.25	0.24	0.23			
DO (mg/l)	0.5	0.46	0.46			
ORP (mv)	-56	-60	-61			
TURB (NTU's)	3.7	10.2	1.7			
SAMPLE PARAMETERS ( GRAB OR COMPOSITE ): Grab Sample						
FILTERED METALS COLLECTED: Y / N 1.0um,0.45um, OTHER:						
<b>OBSERVATIONS</b>						
COLOR: CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , OTHER:						
ODOR: NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL ? , UNKNOWN						
TURBIDITY: NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS						
COMMENTS:						
OTHER: PLEASE USE BACK OF SHT.FOR SKETCHING MAPS ,WELL LOCATION NOTES ECT. SEE BACK OF SHT Y / N.						
Q.C. SAMPLE TYPE: DUPLICATE , EQUIPMENT BLANK , OTHER : DUPLICATE # 1 COLLECTED						
Q.C. PARAMETERS:						
SAMPLE DATE/ TIME: 04/20/2000 / @ 1240						

SIGNED/SAMPLER: Ferreira / Ottoson









# CH2M HILL WELL SAMPLING FIELD SHEET

PROJECT# 152044.34.21

<b>WELL NUMBER: 017-OLD-13-12A</b>		<b>SITE: OU-4 Naval Training Center Orlando, FL</b>				
<b>FIELD CREW: FJ Ferreira/JJ Ottoson</b>		(leave blank if on previous page)				
DEPTH TO WATER (FT):	5.42	CASING DIA.		GAL/FT OF CASING		
WELL DEPTH (FT):	14.11	2 IN.		0.1632		
WATER COLUMN (FT):	8.69	4 IN.		0.6528		
GAL/FT OF CASING	0.1632	6 IN.		1.4688		
CASING VOLUME (GAL)	1.418208	8 IN.		2.611		
NO. OF VOLUMES min.(3)	3	10 IN.		4.0797		
PURGE VOLUME (GAL)	4.254624	12 IN.		5.8748		
<b>METHOD OF PURGING (circle one)</b>						
<b>PUMP: PERISTALTIC</b>		<b>OTHER:</b>		<b>BAILER : TEFLON, SS ,OTHER:</b>		
TIME ON:	1245			BAILER VOL.. (gal)	.25 / .33	
FLOW RATE (gpm):	0.125			REQUIRED PULLS:		
PUMP TIME (min):	45			VOL. PURGED (gals):		
VOL. PURGED (gals):	5.625			OTHER:		
<b>FIELD PARAMETERS</b>	<b>FIELD MEASUREMENTS</b>					WITHIN10% Y / N
	1st	2nd	3rd	4th	5th	6th
TIME	1255	1307	1320	1330		
VOL. (gal)	1.5	3	4	5.5		
pH (s.units)	5.96	5.95	5.98	5.98		
TEMP.(C)	23	22.9	22.8	22.8		
COND.(mshos/cm)	0.09	0.09	0.09	0.09		
DO (mg/l)	0.51	0.41	0.39	0.39		
ORP (mv)	15	-77	-87	-88		
TURB (NTU's)	10	3.1	1	0.8		
SAMPLE PARAMETERS ( GRAB OR COMPOSITE ): Grab Sample						
FILTERED METALS COLLECTED: Y / N 1.0um,0.45um, OTHER:						
<b>OBSERVATIONS</b>						
COLOR: CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , OTHER:						
ODOR: NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL , Musky Odor						
TURBIDITY: NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS						
COMMENTS:						
OTHER: PLEASE USE BACK OF SHT.FOR SKETCHING MAPS ,WELL LOCATION NOTES ECT. SEE BACK OF SHT Y / N.						
Q.C. SAMPLE TYPE: DUPLICATE , EQUIPMENT BLANK , OTHER :						
Q.C. PARAMETERS:						
SAMPLE DATE/ TIME: 04/19/2000 / @ 1330						

SIGNED/SAMPLER:       F. / F.

**CH2M HILL  
WELL SAMPLING FIELD SHEET**

PROJECT# 152044.34.21

<b>WELL NUMBER: 017-OLD-13-09A</b>	<b>SITE: OU-4 Naval Training Center Orlando, FL</b>
<b>FIELD CREW: FJ Ferreira/JJ Ottoson</b> <span style="float:right">(leave blank if on previous page)</span>	

DEPTH TO WATER (FT):	4.85	CASING DIA.		GAL/FT OF CASING	
WELL DEPTH (FT):	13.94	2 IN.		0.1632	
WATER COLUMN (FT):	9.09	4 IN.		0.6528	
GAL/FT OF CASING	0.1632	6 IN.		1.4688	
CASING VOLUME (GAL)	1.483488	8 IN.		2.611	
NO. OF VOLUMES min.(3)	3	10 IN.		4.0797	
PURGE VOLUME (GAL)	4.450464	12 IN.		5.8748	

<b>METHOD OF PURGING (circle one)</b>		
<b>PUMP: PERISTALTIC</b>	<b>OTHER:</b>	<b>BAILER : TEFLON, SS ,OTHER:</b>
TIME ON: 1055		BAILER VOL.. (gal) .25 / .33
FLOW RATE (gpm): 0.125		REQUIRED PULLS:
PUMP TIME (min): 50		VOL. PURGED (gals):
VOL. PURGED (gals): 6.25		OTHER:

FIELD PARAMETERS	FIELD MEASUREMENTS					WITHIN10% Y / N
	1st	2nd	3rd	4th	5th	
TIME	1107	1120	1130	1145		
VOL. (gal)	1.5	3	5	6		
pH (s.units)	5.29	5.3	5.36	5.4		
TEMP.(C)	22.38	22.37	22.37	22.37		
COND.(mshos/cm)	0.106	0.107	0.117	0.114		
DO (mg/l)	0.53	0.52	0.49	0.48		
ORP (mv)	115	112	85	83		
TURB (NTU's)	4	2.7	7.5	5.1		

SAMPLE PARAMETERS ( **GRAB OR COMPOSITE** ): Grab Sample  
 FILTERED METALS COLLECTED: Y / N 1.0um,0.45um, OTHER:

**OBSERVATIONS**

**COLOR:** CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , OTHER:

**ODOR:** NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL , Musky

**TURBIDITY:** NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS

**COMMENTS:**

**OTHER:** PLEASE USE BACK OF SHT.FOR SKETCHING MAPS ,WELL LOCATION NOTES ECT. SEE BACK OF SHT Y / N.

**Q.C. SAMPLE TYPE:** DUPLICATE , EQUIPMENT BLANK , OTHER : DUPLICATE # 2 COLLECTED

**Q.C. PARAMETERS:**

**SAMPLE DATE/ TIME: 04/20/2000 / @ 1145**

**SIGNED/SAMPLER:** FJ Ferreira / JJ Ottoson

## CH2M HILL WELL SAMPLING FIELD SHEET

PROJECT# 152044.34.21

<b>WELL NUMBER: 017-OLD-13-07A</b>	<b>SITE: OU-4 Naval Training Center Orlando, FL</b>
<b>FIELD CREW: FJ Ferreira/JJ Ottoson</b> <span style="float: right;">(leave blank if on previous page)</span>	

	DEPTH (FT)	CASING DIA.	GAL/FT OF CASING	
DEPTH TO WATER (FT):	6.15			
WELL DEPTH (FT):	18.77	2 IN.	0.1632	
WATER COLUMN (FT):	12.62	4 IN.	0.6528	
GAL/FT OF CASING	0.1632	6 IN.	1.4688	
CASING VOLUME (GAL)	2.059584	8 IN.	2.611	
NO. OF VOLUMES min.(3)	3	10 IN.	4.0797	
PURGE VOLUME (GAL)	6.178752	12 IN.	5.8748	

METHOD OF PURGING (circle one)		
PUMP: PERISTALTIC	OTHER:	BAILER : TEFLON, SS ,OTHER:
TIME ON: 1140		BAILER VOL. (gal) .25 / .33
FLOW RATE (gpm): 0.125		REQUIRED PULLS:
PUMP TIME (min): 50		VOL. PURGED (gals):
VOL. PURGED (gals): 8		OTHER:

FIELD PARAMETERS	FIELD MEASUREMENTS					WITHIN 10% Y / N
	1st	2nd	3rd	4th	5th	
TIME	1200	1215	1230	1245		
VOL. (gal)	2	4	6	8		
pH (s.units)	6.62	6.62	6.62	6.6		
TEMP.(C)	23.91	23.91	23.93	23.91		
COND.(ms/cm)	1.57	1.52	1.48	1.51		
DO (mg/l)	0.55	0.51	0.58	0.61		
ORP (mv)	122	97	-10	-12		
TURB (NTU's)	7.7	3.5	6.2	5.9		

SAMPLE PARAMETERS ( GRAB OR COMPOSITE ) : Grab Sample  
 FILTERED METALS COLLECTED: Y / N 1.0um,0.45um, OTHER:

**OBSERVATIONS**

**COLOR:** CLEAR , AMBER , TAN , BROWN , GREY , MILKY WHITE , **OTHER: Light orange tinge**

**ODOR:** NONE , LOW , MEDIUM , HIGH , VERY STRONG , H2S , FUEL LIKE , CHEMICAL ? , UNKNOWN

**TURBIDITY:** NONE , LOW , MEDIUM , HIGH , VERY TURBID. HEAVY SILTS

**COMMENTS:**

**OTHER:** PLEASE USE BACK OF SHT.FOR SKETCHING MAPS ,WELL LOCATION NOTES ECT. SEE BACK OF SHT Y / N.

**Q.C. SAMPLE TYPE:** DUPLICATE , EQUIPMENT BLANK , OTHER :

**Q.C. PARAMETERS:**

**SAMPLE DATE/ TIME: 04/19/2000 / @ 1445**

**SIGNED/SAMPLER:** F. J. Ferreira

Appendix B

**MAINTENANCE VISIT AND  
OPERATIONAL EVALUATION FOR UVB  
TREATMENT WELLS**

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# Maintenance Visit and Operational Evaluation for UVB Treatment Wells at OU-4, Naval Training Center, Orlando, Florida

PREPARED FOR: Orlando Partnering Team

PREPARED BY: Steve Tsangaris/CH2M HILL  
Chris Hood /CH2M HILL  
Susanne Borchert /CH2M HILL

DATE: June 30, 2000

The purpose of this memorandum is to document the operation and maintenance activities performed during May 1 to May 5, 2000 at OU-4. The results of the field activities were used to draw conclusions about the operation effectiveness of the current UVB treatment wells. This document is a qualitative interpretation of the data collected during the May O&M visit.

## Background

Groundwater recirculation wells such as the UVBs depend upon continuous operation to establish a circulation cell. The cell or circulation of groundwater is driven solely by pressure gradients: flow from the positive pressure (=injection) to the negative pressure (=extraction) environment. As the circulation cell develops, contamination is both contained and treated. The treatment of contamination (that is removal of VOCs) depends on the contact time and type between the circulating groundwater and the air from the stripper, thus the condition of the stripper was also evaluated (e.g. the pinhole plate, negative pressure created in the stripping unit). A thorough review of the efficiency of these two basic/major operating elements (circulation and stripping) of the UVB systems was completed during the maintenance visit performed during the first week of May 2000. This evaluation indicated that both the circulation and stripping were not sufficient to meet the operational goals of the system.

## Completed Field Activities

The following activities were completed during the O&M field activities:

- Evaluation of system components condition (stripping assembly, submersible pump, equalization tank, 6" stainless steel well liner, and packer)
- Hydraulic testing on each of the screen intervals in the two treatment wells.
- Down well video taping to evaluate the condition of the external (10") well casing in both of the treatment wells.

Evaluation of the system condition included determining if the equipment's components were in working order, and performing maintenance on the equipment that required it. This was performed by disassembling the stripping unit, removing the submersible pump (with the associated piping and sensors), disconnecting the equalization tank, and removing the 6" well liner assembly (including the packer) for each of the treatment wells. The electrical connections and controls were evaluated as part of this system component condition evaluation.

Hydraulic tests were performed on the two UVB treatment wells at the site. The purpose of the tests was to determine the hydraulic environment surrounding the four screen intervals (upper and lower screen interval in each UVB well). This was accomplished by assessing the physical characteristics and capacity of groundwater extraction and re-injection in each of the individual screens. These values were then used to employ mathematical modeling to predict the site-specific theoretical UVB zones of influence (ZOI) and timeframes, over which the effective circulation zone should develop. The results were compared to the objectives of the IRA to evaluate the system's effectiveness.

Video recording of the well was used to evaluate the physical condition of the well joints, upper and lower screens and confirm as-built information on the treatment well's 10 inch stainless steel outer casing. This effort was performed by Deep Venture Video Logging located in Perry, Florida. Both of the UVB wells were logged from approximately 1 foot below the top of casing and within a foot and a half of the bottom of each well.

## **Results of Field Activities**

The results of the field activities indicate that both UVB wells are limited by the lower screen's ability to release treated groundwater into the formation. This limitation is exacerbated by the current system's set up with higher yields of the upper screens and the high pumping rate capacity of the submersible pumps. Video logging indicated that the overall condition of the outer casing was good however; the condition of the screen intervals varied.

### **UVB-1**

#### **General condition of the treatment well and system components**

The general condition of UVB-1 was good. While disassembling the well components, the submersible pump was removed and was observed to be in good condition. A small amount of iron fouling was visible on the multitrode level probes; however, the pump and the secondary 6" well-screen had essentially no fouling. The exterior condition of the 1" effluent line was good but the inside of the line was coated with a precipitate. A similar precipitate was observed in the bottom of the stripping assembly basin. Furthermore, approximately 1/8" of precipitate had been deposited on the 2" effluent line to the equalization tank. The equalization tank sump pump appears to be in working order (we did not open the tank) however, the pumping capacity appears to be considerably reduced (compared to UVB-2). This is based on filling the tank with potable water and operating the sump pump in the manual mode.

Although there was a minimal amount of precipitation on the well screens, pump and packer, all of the down well equipment was cleaned with a low volume high pressure steam

cleaner. In addition, the stripping equipment was cleaned using the same pressure washer. During the cleaning of this equipment, CCI noticed that the stripping plate's airholes were clogged. The holes in the plate were reamed out using a drill to improve airflow and thus improving the air to water contact.

The condition of the packer was good with very few fine grains found on top of the packer. This indicates that the problem with fine sands penetrating the well sand pack has been eliminated. The packer is functioning properly and was used to separate the upper and lower screens while performing all of the aquifer tests in this well. An electrician from Olsen Electric determined that water had penetrated the control panel. As a consequence, the Grundfos submersible pump was not operational. Other water damage is present in the control panel of UVB-1, but the extent has not been fully determined. The water damaged the Grundfos controller beyond repair; however, the pump was hard wired to operate at 100 percent of it's capacity during aquifer testing.

### Aquifer performance

The goal of the aquifer performance testing was to determine the impact of screen redevelopment, evaluate sedimentation in the wells, determine sustainable extraction rates for each of the screen intervals, and determine sustainable injection rates for the screen intervals. Prior to redevelopment of the treatment wells, the depth to groundwater and the total depth of the well was measured and documented. The total depth corresponded with the as-built drawing value of 49.5 feet (this includes the flange thickness). Each of the well screens were surged and swabbed with a surge block prior to removing groundwater. Both screens were surged by rapidly drawing down the water table and allowing the well to recover. This process was repeated prior to performing aquifer tests.

Sustainable extraction and injection tests were conducted on both the upper and lower screens. This was accomplished by using the inflatable packer around a 4" PVC casing to separate hydraulic access the upper and lower screens. Water was extracted from the annulus space between the 10 inch and 4 inch casing for the upper screen. For the lower screen water was extracted from within the 4 inch casing.

In the upper screen interval of UVB-1, which is set from 3.1 to 14.7 feet below the concrete pad, the extraction test indicated that approximately 10 gpm could be removed continuously from the well with a sustained draw down of 10 feet. Due to time constraints, a falling head injection test was not performed on the upper screen in UVB-1. In the lower screen interval of UVB-1, set from 39.2 to 45.7 feet below the concrete pad, the extraction test indicated that approximately 2 gpm could be continuously removed from the well producing 11 feet of draw down. The falling head injection test that was performed indicated that this section of screen could accept approximately 0.4 gpm with an initial mound (or positive head above the static water level) of 6 feet of water.

Minimal reaction (< 0.5 feet) was observed during either test in the monitoring wells surrounding UVB-1 (two were less than 20 feet away). This was an unexpected result given that the duration and pumping rate for the overall extraction test (over 2 hours in duration, step draw down followed by sustained pumping at between 10 to 20 gpm). No fluctuations in water level during the injection test (2 gpm , for approximately 20 min) were expected to be observed.

### Down Well Video Observations

The results of the down well video for UVB-1 indicated that the well was generally in good condition; however, the injection screen condition was poor. Potable water was added to the well while groundwater was removed from the well to reduce the amount of interference during video taping. This helped produce a clearer view. Specific findings for this well are as follows:

- The top well screen begins at approximately 4.5 feet and ends at 16.0 feet.
- Casing joints are at approximately 22, 31 and 41 feet below the flange.
- Two sections of screen together produce the lower UVB screen: one from approximately 41 to 44 feet, and a second from approximately 44.5 to 49 feet. These two screen sections combine for over 8 feet of screen, different from the 6.5 feet shown in the as-built figure.
- A sump could not be identified at the bottom of the well, which terminated at approximately 49 feet.
- The section of screen from 41 to 44 feet appears to have a light colored precipitant that is clogging approximately 40 to 50 percent of the screen. This same precipitant appears to be clogging some parts of the lower section at 44.5 to 49 feet (however, much less prevalent).
- The sand pack in both screen sections appears to be well developed.
- The condition of the upper screen is very good with no signs of precipitation.

Based on the information collected from the video logging, UVB-1 is in good condition with some precipitant problems in the upper 3 feet of the lower screen.

### UVB-2

#### General condition of the treatment well

The general condition of UVB-2 was not as good as UVB-1. While disassembling the well components, the submersible pump and associated parts were also disassembled. There was a significant amount of precipitation on the pump, multitrode level probes and secondary 6" well-screen. The precipitant appears to be produced by iron fouling and was between 1/16 and 1/8 inch thick on the secondary screen and pump. The condition of the above-ground 1" effluent line and stripping assembly was better than that of UVB-1. Little evidence of precipitant build-up was seen on this equipment. The high capacity operation of the sump pump in the equalization tank confirmed the lack of abundant precipitate in the stabilization tank. The discharge from this pump was 2 to 4 times greater than that of the pump in the UVB-1 equalization tank. This is based on filling the tank with potable water and operating the sump pump in the manual mode.

The precipitant on the well screens, pump and packer, all of the down well equipment was cleaned with a low volume high pressure steam cleaner. In addition, the stripping equipment of the UVB was cleaned using the same pressure washer. During the cleaning of this equipment it was noticed that the stripping plate was clogged in a few areas. The holes in the plate were reamed out using a drill to improve airflow and thus the air to water contact. In addition, the submersible pump was disassembled and all of the impellers were cleaned using isopropyl alcohol. Once the pump was cleaned it was reassembled and was operating properly.

The condition of the packer was very good and very few fine sediment were found on top of the packer. A few fine sand grains were detected at the bottom plate in the secondary screen section. These were removed during the pressure washing of the screen. The packer is functioning properly and was used to separate the upper and lower screens while performing all of the aquifer tests in this well.

### Aquifer performance

The same goals and procedures were followed as those described for UVB-1. The depth to groundwater and the total depth of the well were measured for UVB-2. The total depth was comparable to a total depth of 51 feet on the as-built drawing. Each of the well screens were surged and swabbed prior to removing groundwater. Both screens were surged by rapidly drawing down the water table and allowing the well to recover. This process was repeated prior to the performing aquifer tests.

Sustainable extraction and injection tests were conducted on both the upper and lower screens. This was accomplished by using the inflatable packer and a 4" PVC casing which passed through the packer. Water was extracted from the annulus space between the 10 inch and 4 inch casing for the upper screen. For the lower screen water was extracted from the 4 inch casing.

In the upper screen interval of UVB-2 (3.3 to 15 feet below the concrete pad), the extraction test indicated that approximately 7 gpm could be continuously removed from the well, with 16.6 feet of sustained draw down. The injection test that was performed indicated that this section of screen could accept approximately 1.4 to 2.4 gpm with an initial hydraulic head of 5.5 feet. In the lower screen interval of UVB-2 (from 39.5 to 46.4 feet below the concrete pad), the extraction test indicated that approximately 2.4 gpm could be continuously removed from the well with 7.86 feet of sustained draw down. The injection test that was performed indicated that this section of screen could accept approximately 1 gpm during the falling head test. This is consistent with observations that the 4 inch casing was filling to the top (5.5 feet high) within several minutes at an injection water flow rate of 2 gpm. No data was collected from the surrounding monitoring wells at the site.

### Down Hole Video Observations

The results of the down hole video for UVB-2 indicated that the well was in generally good condition. Potable water was added to the well to help produce clearer viewing, however, success was limited in the deep screen area.

Specific findings for this well are as follows:

- The top well screen begins at approximately 6 feet and ends approximately at 18 feet below the well flange.
- Casing joints are difficult to distinguish.
- The bottom screen was difficult to evaluate due to the clarity of the video.
- A sump could not be identified in the well, and the bottom of the well was encountered at approximately 51 feet.

Based on the information collected from the video logging, the upper screen is good condition.

## Conclusions

Based on the data collected the following conclusions can be drawn:

- The UVB equipment, in general is in good working condition.
- The 6 inch and 10 inch well casings are in good working condition (90% or more of the screen is hydraulically permeable) with the exception of the top 3 feet of the lower screen in UVB-1 (50 to 60 % permeable).
- The specific capacity in the upper screen intervals in both of the treatment wells is higher than that of the lower screen intervals.
- The lower screen intervals and the formation surrounding these are the operational limiting factor for the current groundwater recirculation treatment system.
- The current operation of the two UVB systems cannot meet IRA objectives of plume containment and treatment.

The rationale for the conclusions presented above is based largely on the extraction and infiltration information collected during the aquifer performance testing. One limitation of this data is that the injection data results are falling head results, verses constant head results which would be the case during continuous groundwater circulation. This means that the data obtained were conservative estimates of the specific capacity for the injection rates in the screen intervals. However, when comparing the rates between the upper and lower intervals, the rates in the upper screen sections are two to five times the magnitude of the lower screens.

Operationally, this system could be operated at low flow rates (1 to 2 gallons per minute) to develop a circulation cell. At 2 gallons per minute, the theoretical circulation cell would develop to a maximum radius of influence (ROI) of approximately 40 feet. However, it would require many days of continuous operation to achieve this ROI.

The hydrographic data provided in the latest monitoring report Operable Unit 4 – Interim Remedial Action (IRA) Fourth Quarter 1999 Performance Monitoring and Ground Water Quality Report for the period of September 1, 1999 through January 7, 2000, indicates that the UVB wells have been cycling on and off. This is illustrated by the multiple (and rapid in some cases) fluctuations in the water levels within the treatment wells. Due to the size and capacity of the submersible pumps, the pump kept the equalization tank near the high level sensor. Once the water level dropped below the high level sensor, the pump would turn on to fill the tank to the high level. Then the pump would be off for an extended period while the water was injected into the lower screen. When looking at UVB-1 for example, the pump has had the ability to continuously pump 10 gpm. If this is compared to the injection rates observed for the lower screen of less than 1 gpm, one can see that for every minute the pump is operated the aquifer requires 10 minutes to accept the water. This cycling will never produce a capture zone or allow the circulation cell to develop. Although the controllers were set to operate the submersible pumps at the lower flow rates, the pumps appear to have continued to operate in a cycling mode.

This all leads back to the conclusion that the UVB wells are not meeting and will not meet the objective of containment of the contaminant plume.

## **Recommendations**

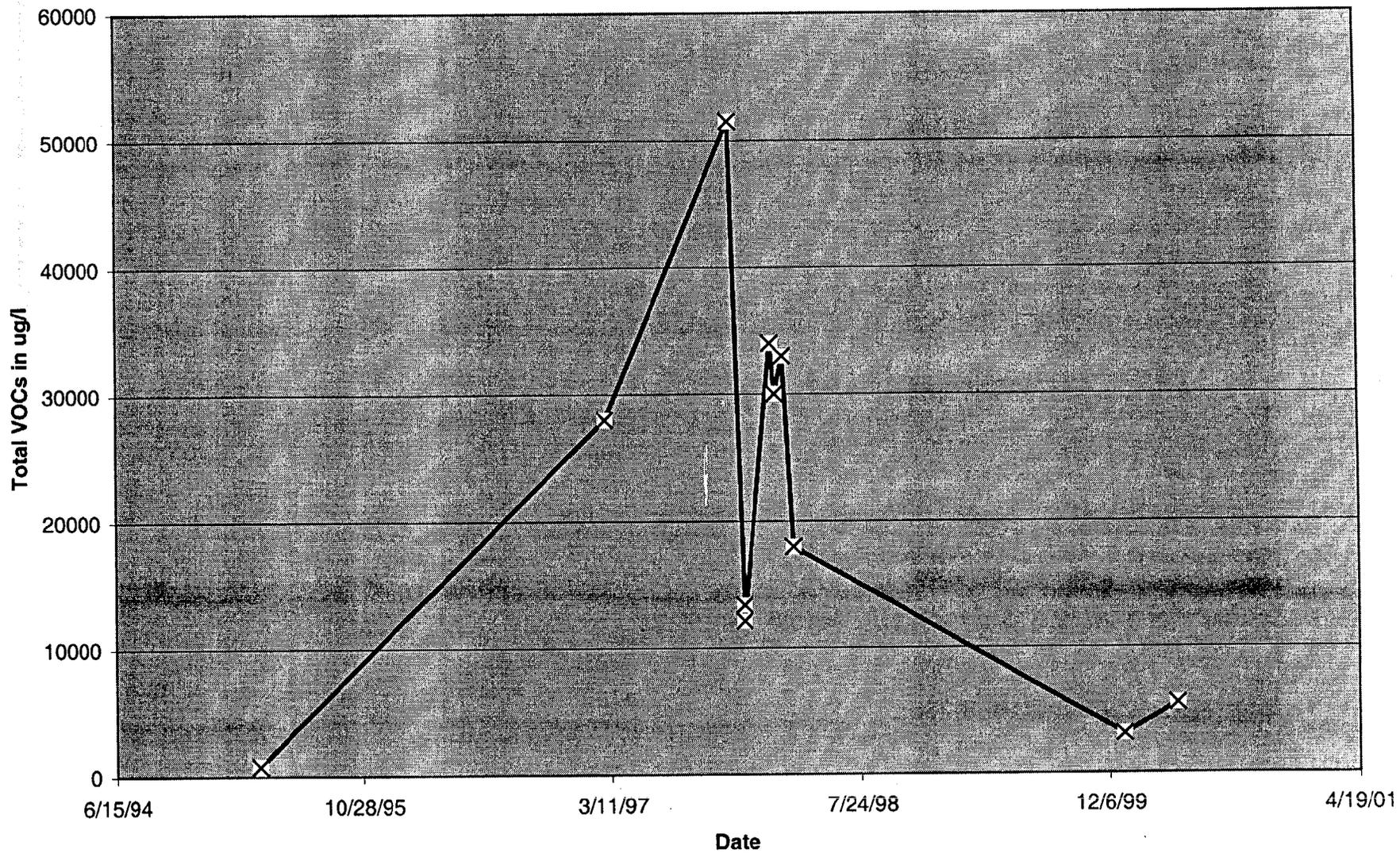
Based on the current limitations of the UVB treatment system and continuing plume migration, it is recommend that an ETR type of configuration be implemented to contain and treat the existing groundwater contamination. This configuration would utilize the existing UVB wells to extract water from both the shallow and the deep portion of the surficial aquifer. This water would be treated and discharged upgradient of the treatment wells. By extracting water from both of the upper and lower screen intervals, both the horizontal and vertical extent of the contamination would be achieved.

Appendix C

# **ANALYTICAL RESULTS**

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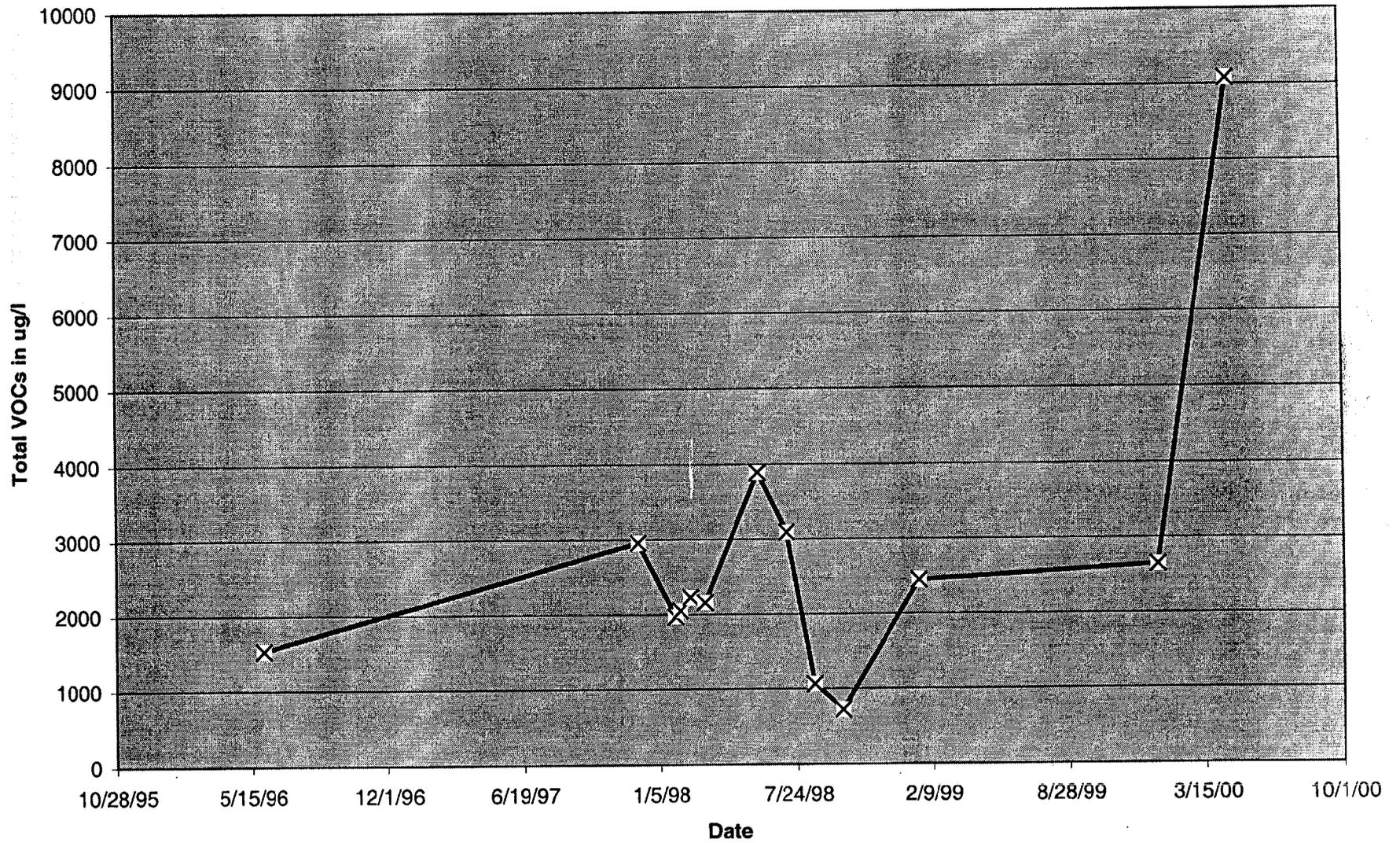
Total VOCs (ug/l) Well OLD-13-07A



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-07A**

	UNITS				Baseline	Baseline	Week 1	Week 2	Week 4	Week 7						
Sample ID		13G00701	13G00702	13G00703F	13G00704	13G00705	13G00706	13G00707	13G00709	13G00710						
Date Sampled		04/01/95	03/01/97	11/06/97	12/04/97	12/04/97	01/27/98	02/05/98	02/20/98	03/12/98	01/05/00	4/19/00				
Source		offsite	offsite	onsite	offsite	offsite	offsite									
PCE	ug/l	680.0	28000.0	49000.0	12300.0	11000.0	34000.0	30000.0	33000.0	18000.0	114.0	5230.0				
TCE	ug/l	52.0	N/D	1400.0	830.0	770.0	<1000	<500	<1000	<500	235.0	264.0				
C-1,2-DCE	ug/l	38.0	N/D	1100.0	260.0	330.0	<1000	<500	<1000	<500	2760.0	76.5				
T-1,2-DCE	ug/l	N/D	N/D	N/D	<5	<5	<1000	<500	<1000	<500	ND	ND				
1,1-DCE	ug/l	N/D	N/D	N/D	<5	<5	<1000	<500	<1000	<500	ND	ND				
VC	ug/l	N/D	N/D	N/D	<5	<5	<1000	<500	<1000	<500	ND	ND				
BENZENE	ug/l	N/D	N/D	N/D			<1000	<500	<1000	<500	ND	ND				
TOLUENE	ug/l	N/D	N/D	N/D			<1000	<500	<1000	<500	ND	ND				
ETHYLBENZ.	ug/l	N/D	N/D	N/D			<1000	<500	<1000	<500	ND	ND				
m/p XYLENE	ug/l	N/D	N/D	N/D			<1000	<500	<1000	<500	ND	ND				
O XYLENE	ug/l	N/D	N/D	N/D			<1000	<500	<1000	<500	ND	ND				
total VOCs	ug/l	770.0	28000.0	51500.0	13390.0	12100.0	34000.0	30000.0	33000.0	18000.0	3109.0	5570.5				

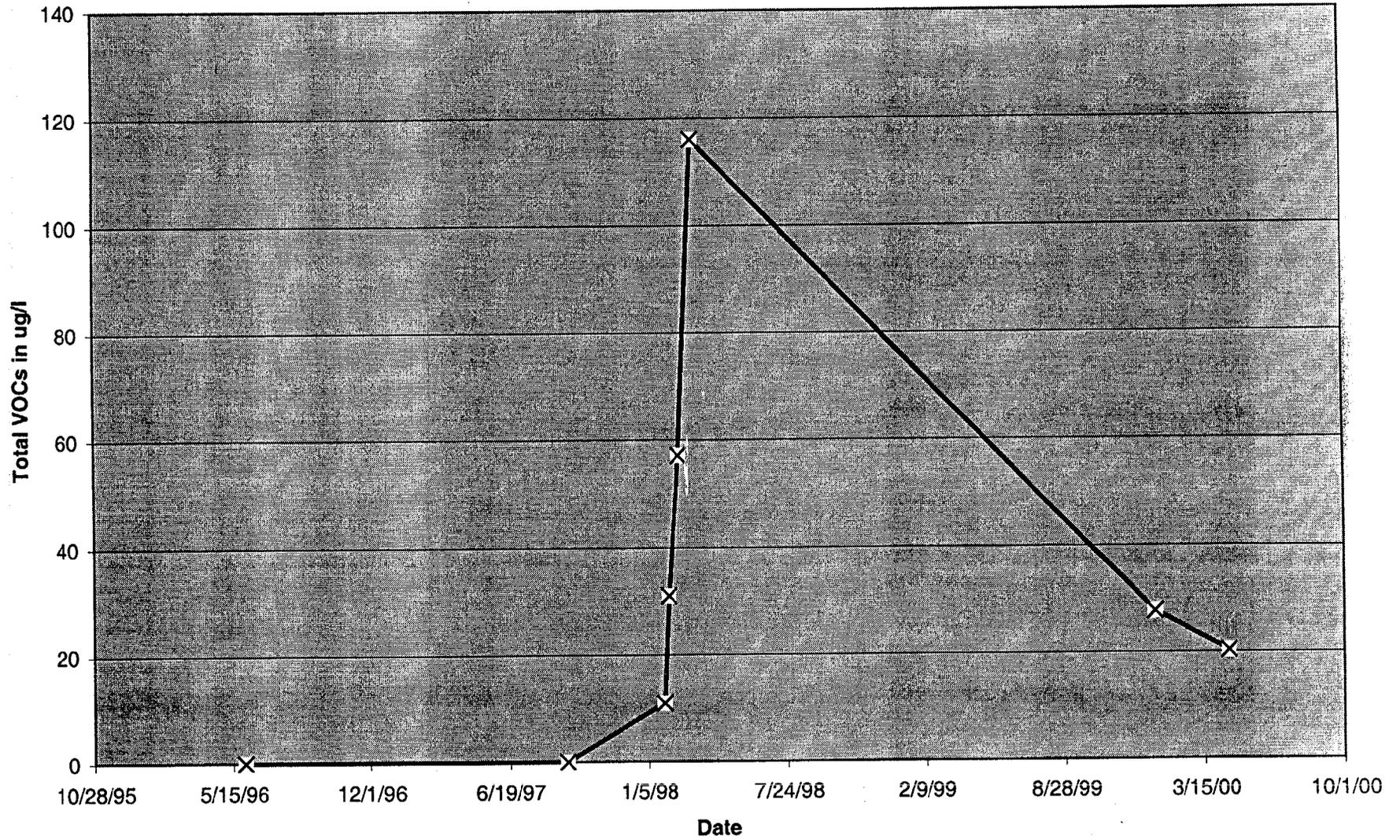
Total VOCs (ug/l) Well OLD-13-09A



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-09A**

	UNITS		Baseline	Week 1	Week 2	Week 4	Week 7	Week 18	Week 24	Week 30	Week 36	Week 52	Week 100	
Sample ID		U4G00901	U4G00902	U4G00903	U4G00904	U4G00905	U4G00906	U4G00908	U4G00909	U4G00910	U4G00911	U4G00912		
Date Sampled		06/01/96	12/05/97	01/28/98	02/04/98	02/19/98	03/12/98	05/29/98	07/09/98	08/18/98	09/29/98	01/20/99	01/05/00	4/20/00
Source		offsite	offsite											
PCE	ug/l	N/D	<5	<50	<50	<50	270.0	<100	< 50	< 50	<20	<50	ND	3230
TCE	ug/l	680.0	360.0	370.0	550.0	530.0	590.0	690.0	490.0	160.0	38.0	450.0	467	3220
C-1,2-DCE	ug/l	850.0	2500.0	1600.0	1500.0	1700.0	1300.0	3200.0	2600.0	900.0	680.0	2000.0	2130	2600
T-1,2-DCE	ug/l	N/D	26.0	<50	<50	<50	<20	<100	< 50	< 50	<20	<50	25.9	29.8
1,1-DCE	ug/l	N/D	<5	<50	<50	<50	<20	<100	< 50	< 50	<20	<50	ND	ND
VC	ug/l	N/D	69.0	<50	<50	<50	<20	<100	< 50	< 50	<20	<50	ND	ND
BENZENE	ug/l	N/D		<50	<50	<50	<20	<100	< 50	< 50	<20	<50	ND	ND
TOLUENE	ug/l	N/D		<50	<50	<50	<20	<100	< 50	< 50	<20	<50	ND	ND
ETHYLBENZ.	ug/l	N/D		<50	<50	<50	<20	<100	< 50	< 50	<20	<50	ND	ND
m/p XYLENE	ug/l	N/D		<50	<50	<50	<20	<100	< 50	< 50	<20	<50	ND	ND
O XYLENE	ug/l	N/D		<50	<50	<50	<20	<100	< 50	< 50	<20	<50	ND	ND
total VOCs	ug/l	1530.0	2955.0	1970.0	2050.0	2230.0	2160.0	3890.0	3090.0	1060.0	718.0	2450.0	2647	9079.8

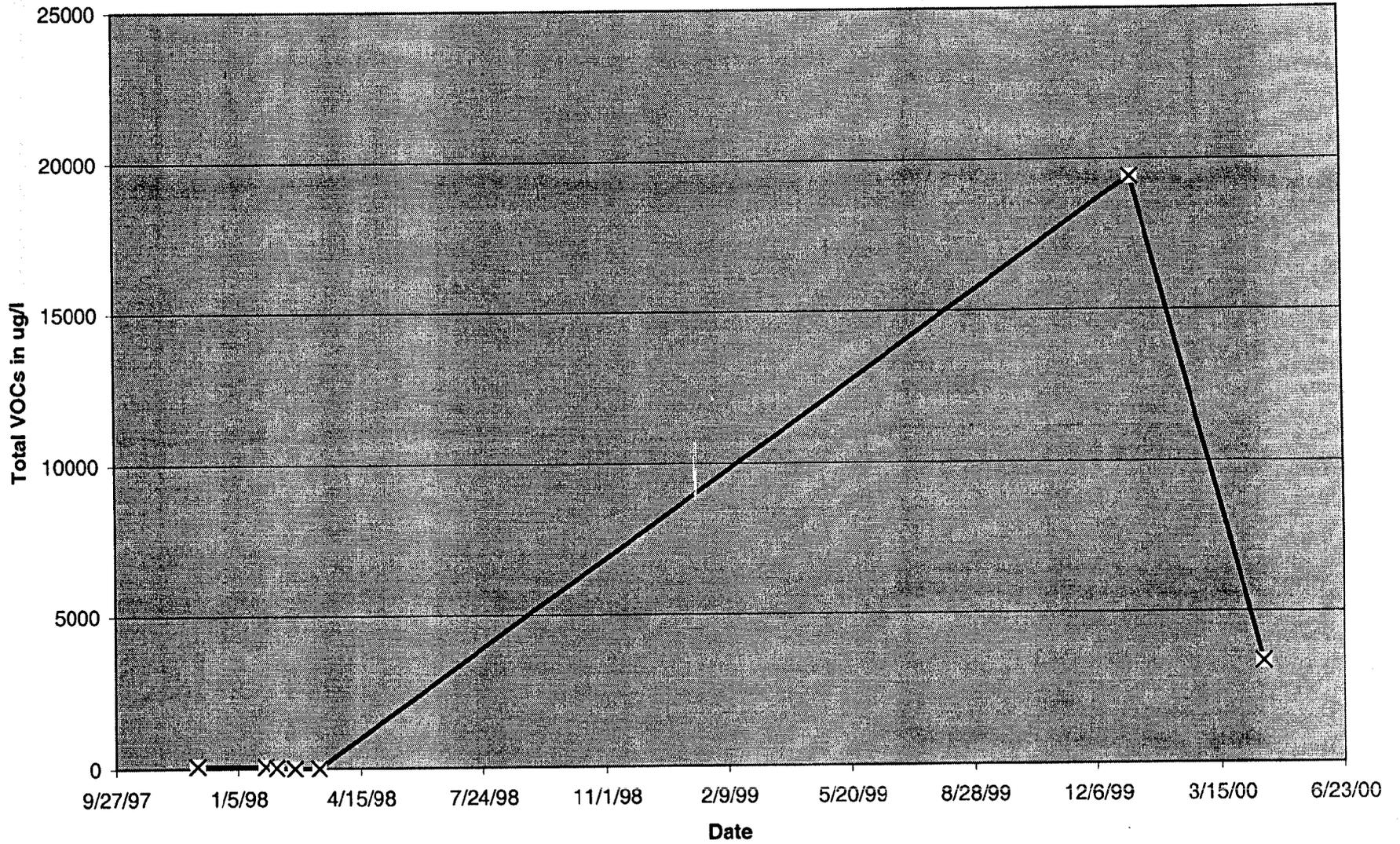
Total VOCs (ug/l) Well OLD-13-12A



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-12A**

	UNITS		Baseline	Week 1	Week 2	Week 4	Week 7						
Sample ID		U4G01201	U4G01202	U4G01203	U4G01204	U4G01205	U4G01206						
Date Sampled		06/01/96	09/10/97	01/28/98	02/04/98	02/19/98	03/12/98	01/04/00	4/19/00				
Source		offsite	offsite	offsite									
PCE	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
TCE	ug/l	N/D	<.5	<1	<1	5.1	26.0	2.7	ND				
C-1,2-DCE	ug/l	N/D	<.5	11.0	31.0	52.0	90.0	25.0	20.3				
T-1,2-DCE	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
1,1-DCE	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
VC	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
BENZENE	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
TOLUENE	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
ETHYLBENZ.	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
m/p XYLENE	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
O XYLENE	ug/l	N/D	<.5	<1	<1	<2.5	<2	ND	ND				
total VOCs	ug/l	0.0	0.0	11.0	31.0	57.1	116.0	27.7	20.3				

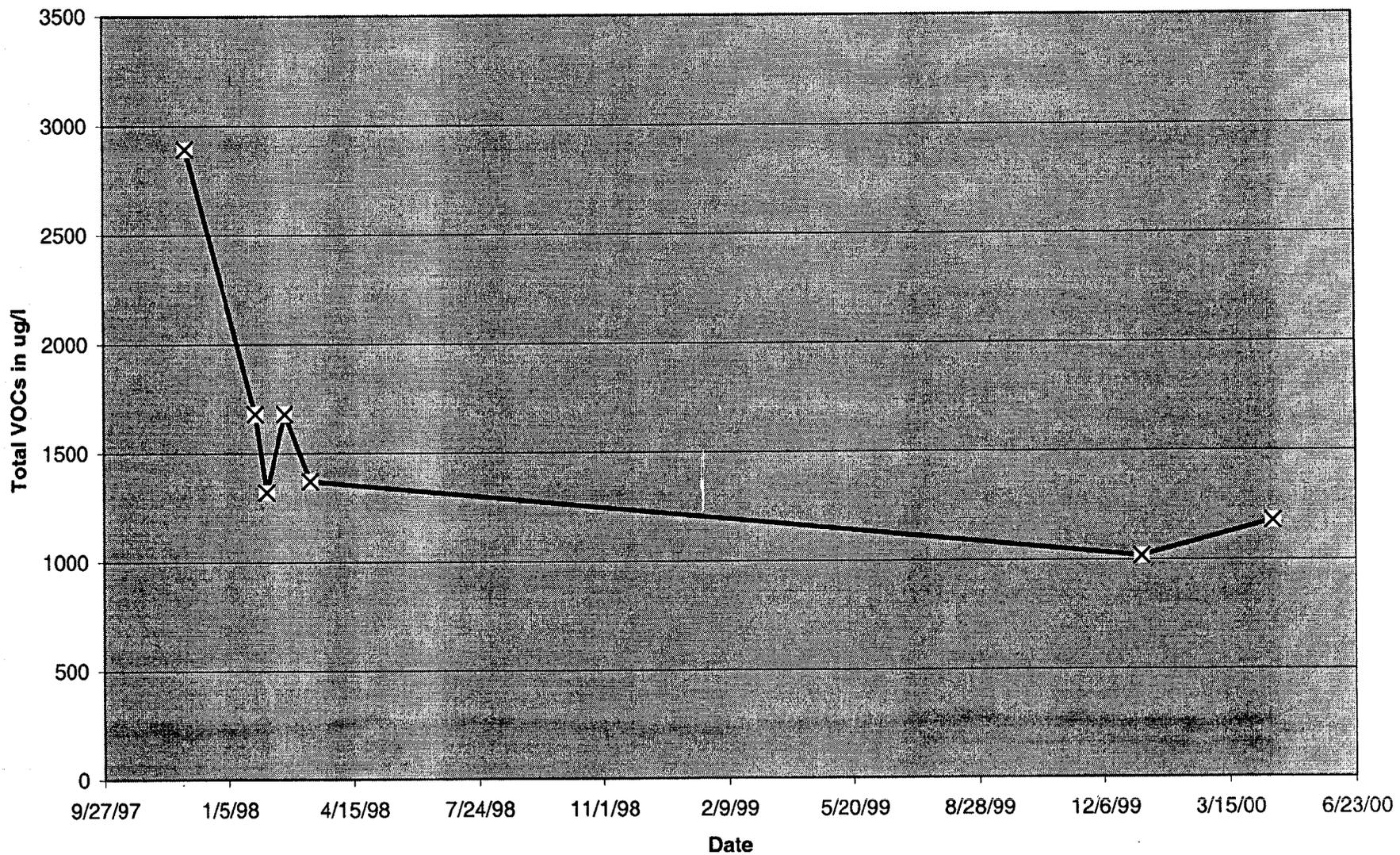
Total VOCs (ug/l) Well OLD-13-15A



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-15A**

	UNITS	Baseline	Week 1	Week 2	Week 4	Week 7					
Sample ID		U4G01501	U4G01502	U4G01503	U4G01504	U4G01505					
Date Sampled		12/3/97	1/27/98	2/5/98	2/20/98	3/12/98	1/5/00	4/19/00			
Source		offsite	offsite	offsite	offsite	offsite	ooffsite	offsite			
PCE	ug/l	7.0	65.0	35.0	<1	2.2	19000.0	ND			
TCE	ug/l	35.0	<5	<2.5	<1	<1	332.0	65.3			
C-1,2-DCE	ug/l	42.0	<5	<2.5	<1	<1	67.8	3250.0			
T-1,2-DCE	ug/l	<5	<5	<2.5	<1	<1	1.4	41.1			
1,1-DCE	ug/l	<5	<5	<2.5	<1	<1	ND	2.8			
VC	ug/l	<5	<5	<2.5	<1	<1	1.4	ND			
BENZENE	ug/l		<5	<2.5	<1	<1	ND	ND			
TOLUENE	ug/l		<5	<2.5	<1	<1	ND	ND			
ETHYLBENZ.	ug/l		<5	<2.5	<1	<1	ND	ND			
m/p XYLENE	ug/l		<5	<2.5	<1	<1	ND	ND			
O XYLENE	ug/l		<5	<2.5	<1	<1	ND	ND			
total VOCs	ug/l	84.0	65.0	35.0	<1	2.2	19403.0	3359.2			

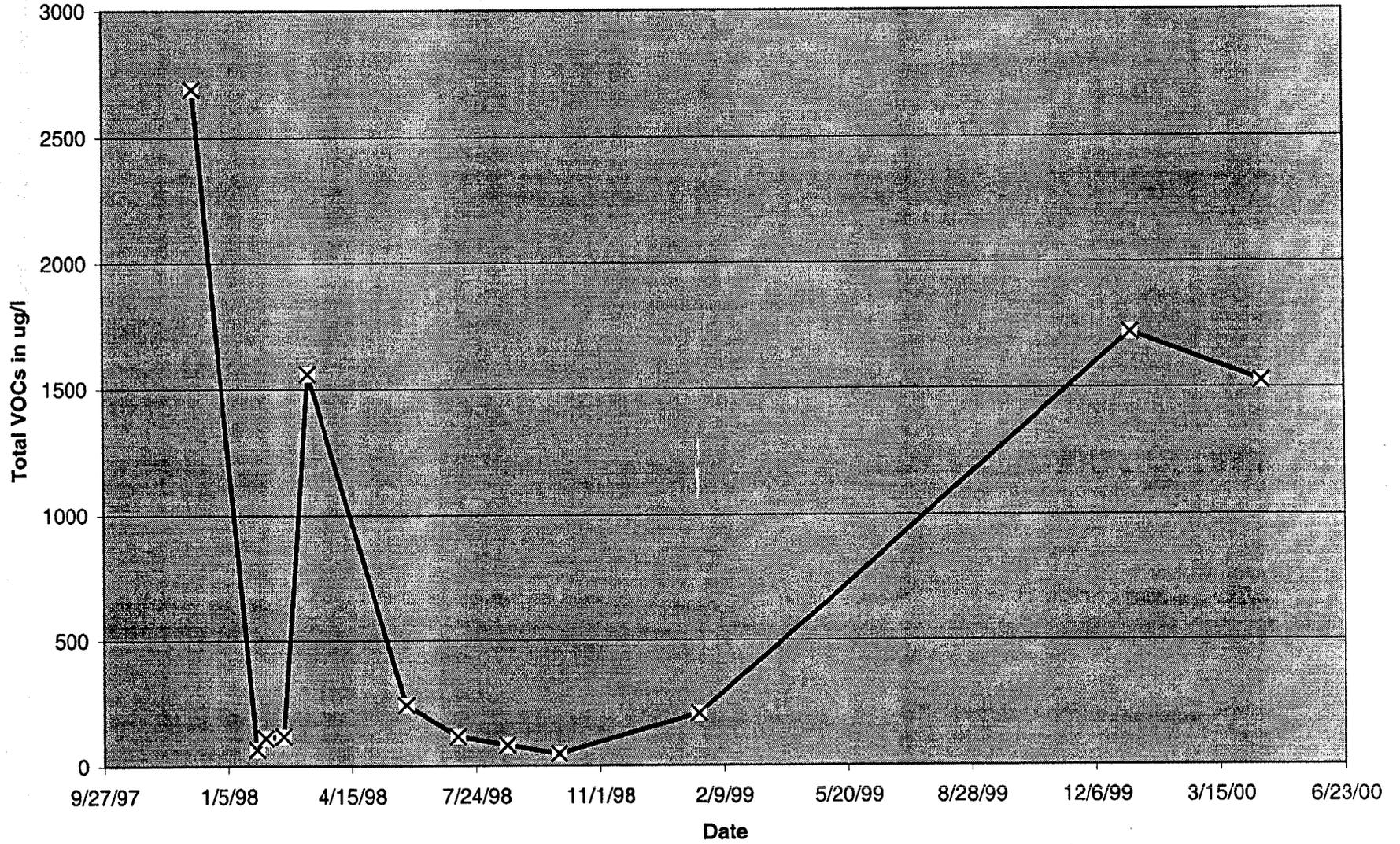
Total VOCs (ug/l) Well OLD-13-21B



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-21B**

	UNITS	Baseline	Week 1	Week 2	Week 4	Week 7					
Sample ID		U4G02101	U4G02102	U4G02103	U4G02104	U4G02105					
Date Sampled		12/3/97	1/27/98	2/5/98	2/20/98	3/12/98	1/5/00	4/19/00			
Source		offsite	offsite	offsite	offsite	offsite	offsite	offsite			
PCE	ug/l	20.0	<20	<20	<50	<20	10.4	15.4			
TCE	ug/l	1200.0	690.0	530.0	680.0	600.0	296.0	428.0			
C-1,2-DCE	ug/l	1640.0	990.0	790.0	1000.0	770.0	700.0	725.0			
T-1,2-DCE	ug/l	31.0	<20	<20	<50	<20	9.1	8.1			
1,1-DCE	ug/l	<5	<20	<20	<50	<20	ND	ND			
VC	ug/l	<5	<20	<20	<50	<20	ND	ND			
BENZENE	ug/l		<20	<20	<50	<20	ND	ND			
TOLUENE	ug/l		<20	<20	<50	<20	ND	ND			
ETHYLBENZ.	ug/l		<20	<20	<50	<20	ND	ND			
m/p XYLENE	ug/l		<20	<20	<50	<20	ND	ND			
O XYLENE	ug/l		<20	<20	<50	<20	ND	ND			
total VOCs	ug/l	2891.0	1680.0	1320.0	1680.0	1370.0	1016.0	1176.5			

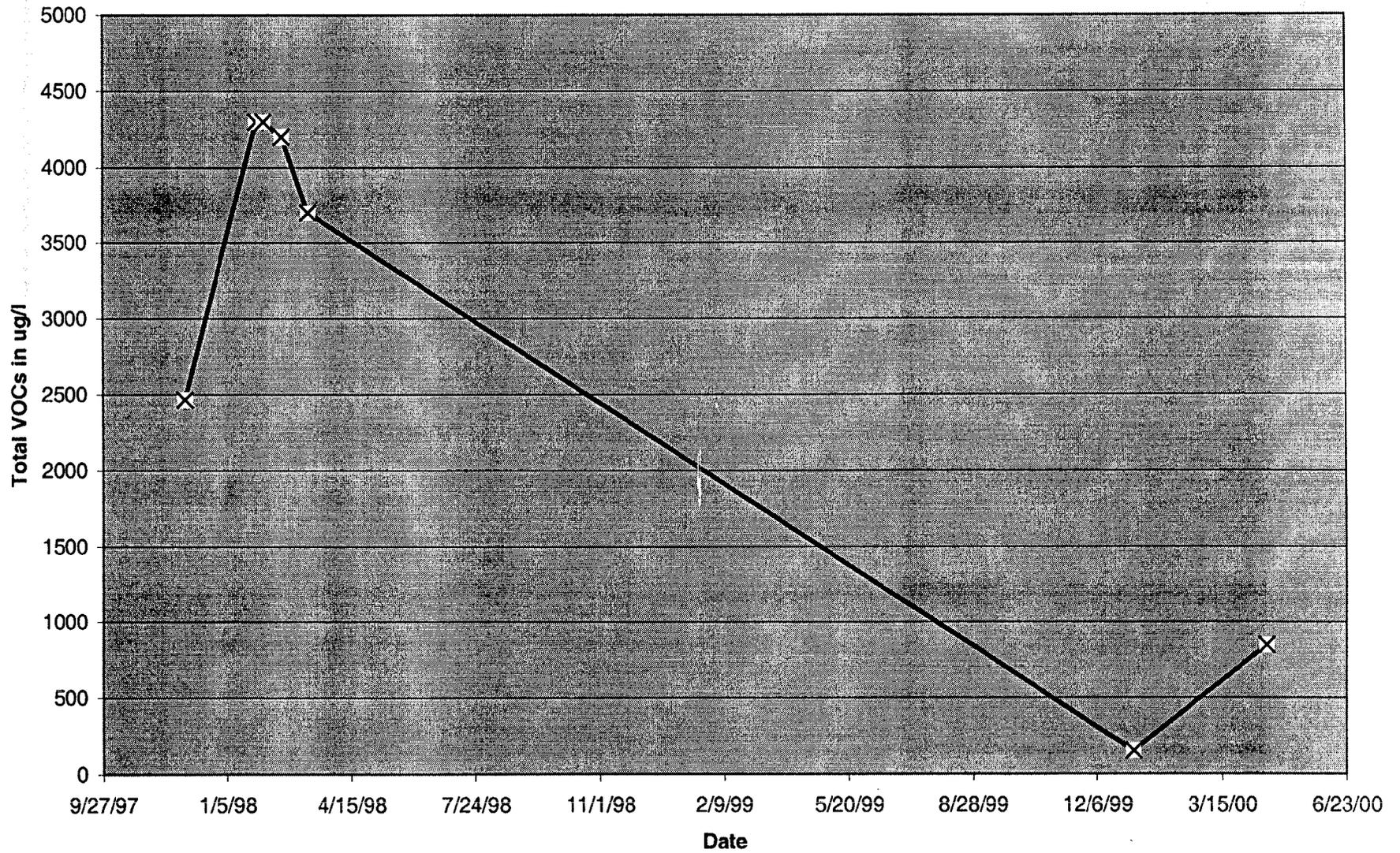
Total VOCs (ug/l) Well OLD-13-22B



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-22B**

	UNITS	Baseline	Week 1	Week 2	Week 4	Week 7	Week 18	Week 24	Week 30	Week 36	Week 52		
Sample ID		U4G02201	U4G02202	U4G02203	U4G02205	U4G02206	U4G02207	U4G02208	U4G02209	U4G02210	U4G02211		
Date Sampled		12/9/97	1/28/98	2/4/98	2/19/98	3/12/98	5/29/98	7/9/98	8/18/98	9/29/98	1/20/99	1/4/00	4/19/00
Source		offsite	offsite	offsite									
PCE	ug/l	<94	<2.5	<5	<2.5	<20	6.6	22.0	21	10	42	8.1	8.6
TCE	ug/l	690.0	11.0	21.0	24.0	360.0	56.0	22.0	54	26	36	226	263
C-1,2-DCE	ug/l	2000.0	55.0	90.0	94.0	1200.0	180.0	72.0	6.7	12	130	1470	1240
T-1,2-DCE	ug/l	<94	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	14.3	13.6
1,1-DCE	ug/l	<94	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	1	ND
VC	ug/l	<120	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	ND	ND
BENZENE	ug/l	<94	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	ND	ND
TOLUENE	ug/l	<94	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	ND	ND
ETHYLBENZ.	ug/l	<62	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	ND	ND
m/p XYLENE	ug/l	<62	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	ND	ND
O XYLENE	ug/l	<62	<2.5	<5	<2.5	<20	<5	< 2	< 2.5	<1	<5	ND	ND
total VOCs	ug/l	2690.0	66.0	111.0	118.0	1560.0	242.6	116.0	81.7	48.0	208.0	1719	1525.2

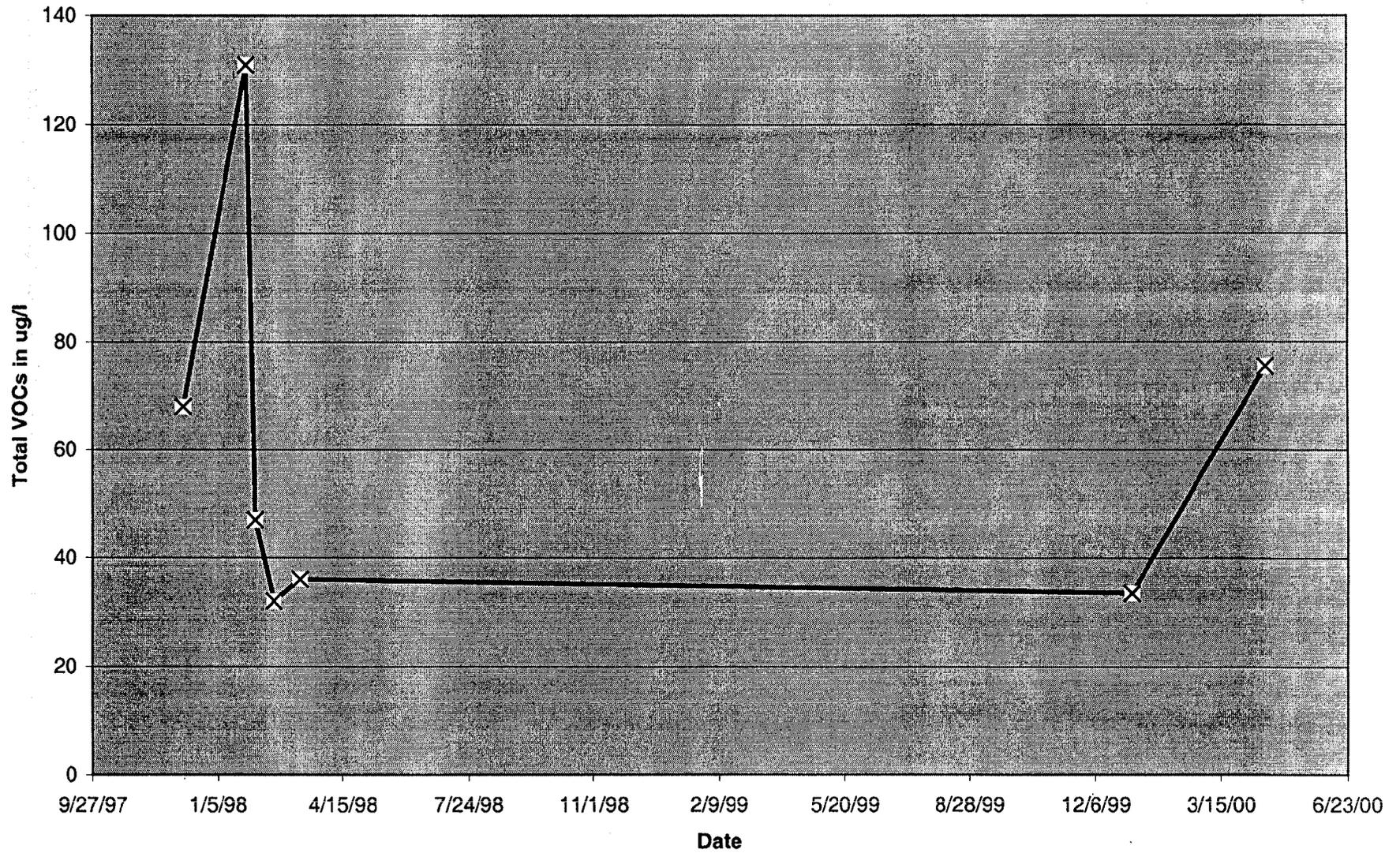
Total VOCs (ug/l) Well OLD-13-23B



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-23B**

	UNITS	Baseline	Week 1	Week 2	Week 4	Week 7					
Sample ID		U4G02301	U4G02302	U4G02303	U4G02304	U4G02305					
Date Sampled		12/3/97	1/29/98	2/4/98	2/19/98	3/12/98	1/4/00	4/20/00			
Source		offsite	offsite	offsite	offsite	offsite	offsite	offsite			
PCE	ug/l	23.0	<200	<50	<200	<50	9.0	ND			
TCE	ug/l	1900.0	3000.0	2400.0	2500.0	2000.0	25.4	142.0			
C-1,2-DCE	ug/l	520.0	1300.0	1900.0	1700.0	1700.0	119.0	698.0			
T-1,2-DCE	ug/l	24.0	<200	<50	<200	<50	ND	7.5			
1,1-DCE	ug/l	<5	<200	<50	<200	<50	ND	ND			
VC	ug/l	<5	<200	<50	<200	<50	ND	ND			
BENZENE	ug/l		<200	<50	<200	<50	ND	ND			
TOLUENE	ug/l		<200	<50	<200	<50	ND	ND			
ETHYLBENZ.	ug/l		<200	<50	<200	<50	ND	ND			
m/p XYLENE	ug/l		<200	<50	<200	<50	ND	ND			
O XYLENE	ug/l		<200	<50	<200	<50	ND	ND			
total VOCs	ug/l	2467.0	4300.0	4300.0	4200.0	3700.0	153.4	847.5			

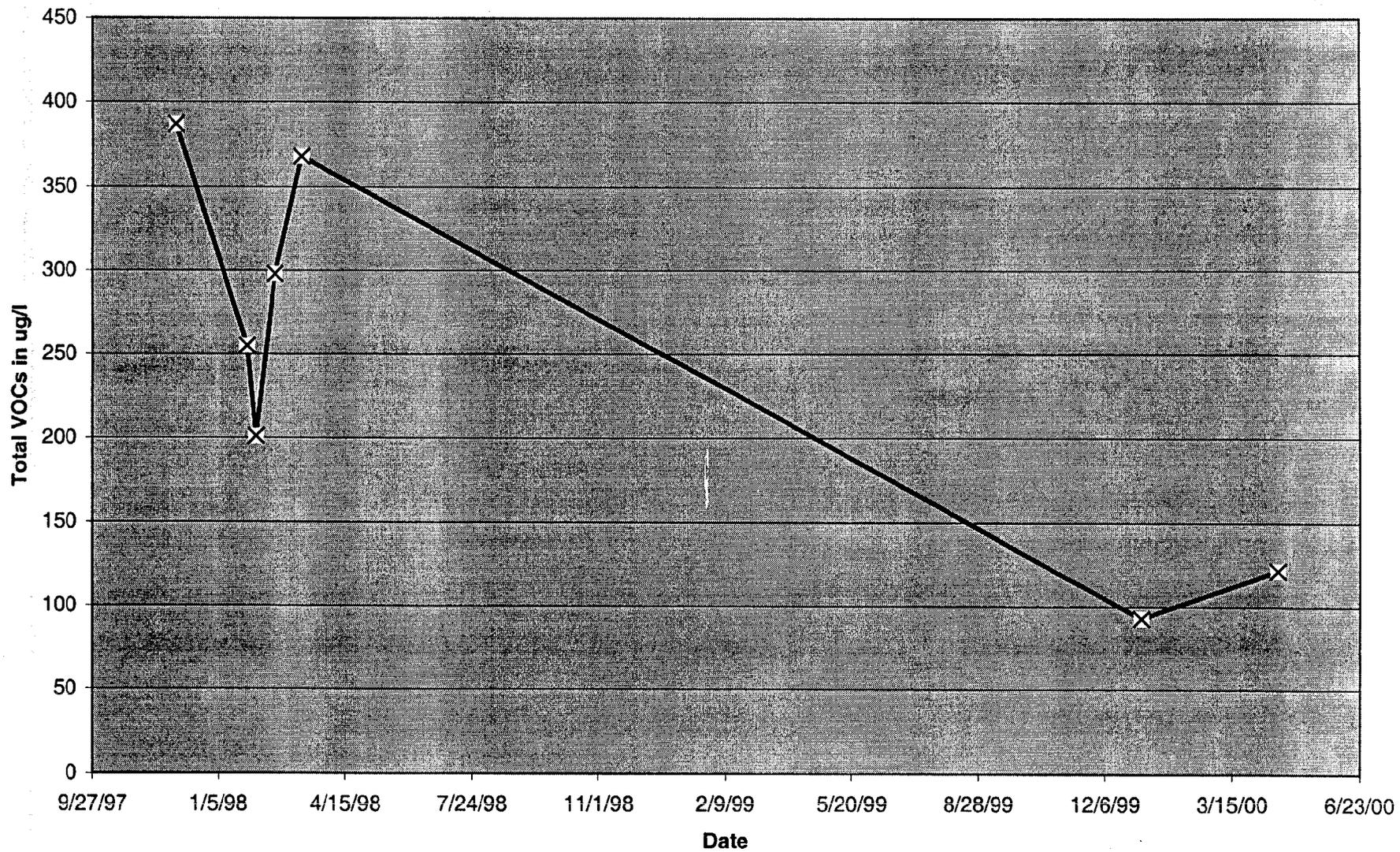
Total VOCs (ug/l) Well OLD-13-24A



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-24A**

	UNITS	Baseline	Week 1	Week 2	Week 4	Week 7					
Sample ID		U4G02401	U4G02402	U4G02403	U4G02404	U4G02405					
Date Sampled		12/9/97	1/28/98	2/4/98	2/19/98	3/12/98	1/4/00	4/20/00			
Source		offsite	offsite	offsite	offsite	offsite	offsite	offsite			
PCE	ug/l	<2	<10	<1	<1	<1	ND	ND			
TCE	ug/l	22.0	35.0	14.0	11.0	14.0	13.4	28.6			
C-1,2-DCE	ug/l	46.0	96.0	33.0	21.0	22.0	20.1	45.7			
T-1,2-DCE	ug/l	<1	<10	<1	<1	<1	ND	1.2			
1,1-DCE	ug/l	<2	<10	<1	<1	<1	ND	ND			
VC	ug/l	<2	<10	<1	<1	<1	ND	ND			
BENZENE	ug/l	<2	<10	<1	<1	<1	ND	ND			
TOLUENE	ug/l	<2	<10	<1	<1	<1	ND	ND			
ETHYLBENZ.	ug/l	<1	<10	<1	<1	<1	ND	ND			
m/p XYLENE	ug/l	<1	<10	<1	<1	<1	ND	ND			
O XYLENE	ug/l	<1	<10	<1	<1	<1	ND	ND			
total VOCs	ug/l	68.0	131.0	47.0	32.0	36.0	33.5	75.5			

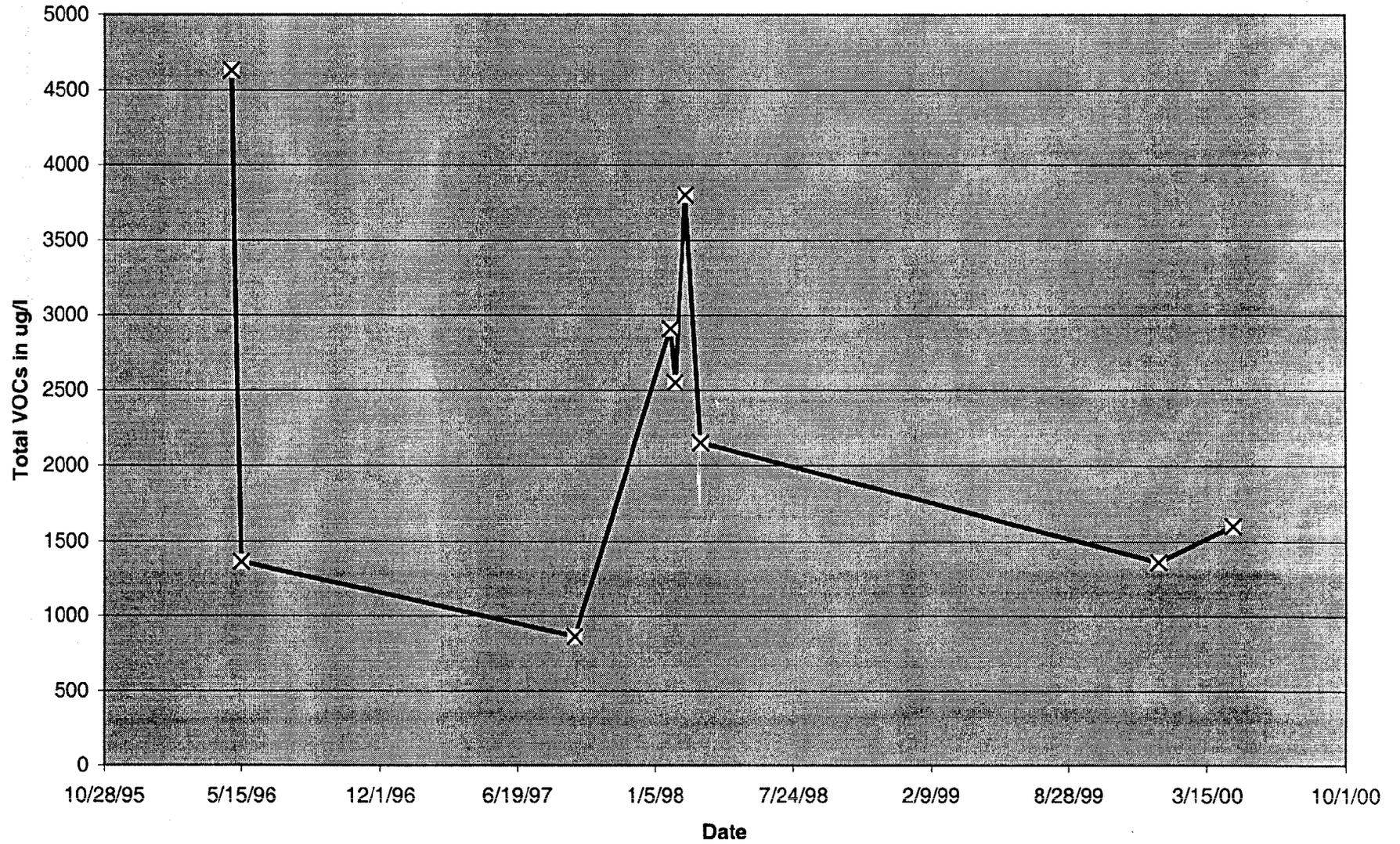
Total VOCs (ug/l) Well OLD-13-25B



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - OLD-13-25B**

	UNITS	Baseline	Week 1	Week 2	Week 4	Week 7					
Sample ID		U4G02501	U4G02502	U4G02503	U4G02504	U4G02505					
Date Sampled		12/3/97	1/28/98	2/4/98	2/19/98	3/12/98	1/4/00	4/20/00			
Source		offsite	offsite	offsite	offsite	offsite	offsite	offsite			
PCE	ug/l	280.0	240.0	180.0	270.0	320.0	69.4	57.5			
TCE	ug/l	71.0	15.0	21.0	28.0	32.0	17.3	35.4			
C-1,2-DCE	ug/l	36.0	<10	<10	<10	16.0	6.2	28.8			
T-1,2-DCE	ug/l	<5	<10	<10	<10	<5	ND	ND			
1,1-DCE	ug/l	<5	<10	<10	<10	<5	ND	ND			
VC	ug/l	<5	<10	<10	<10	<5	ND	ND			
BENZENE	ug/l		<10	<10	<10	<5	ND	ND			
TOLUENE	ug/l		<10	<10	<10	<5	ND	ND			
ETHYLBENZ.	ug/l		<10	<10	<10	<5	ND	ND			
m/p XYLENE	ug/l		<10	<10	<10	<5	ND	ND			
O XYLENE	ug/l		<10	<10	<10	<5	ND	ND			
total VOCs	ug/l	387.0	255.0	201.0	298.0	368.0	92.9	121.7			

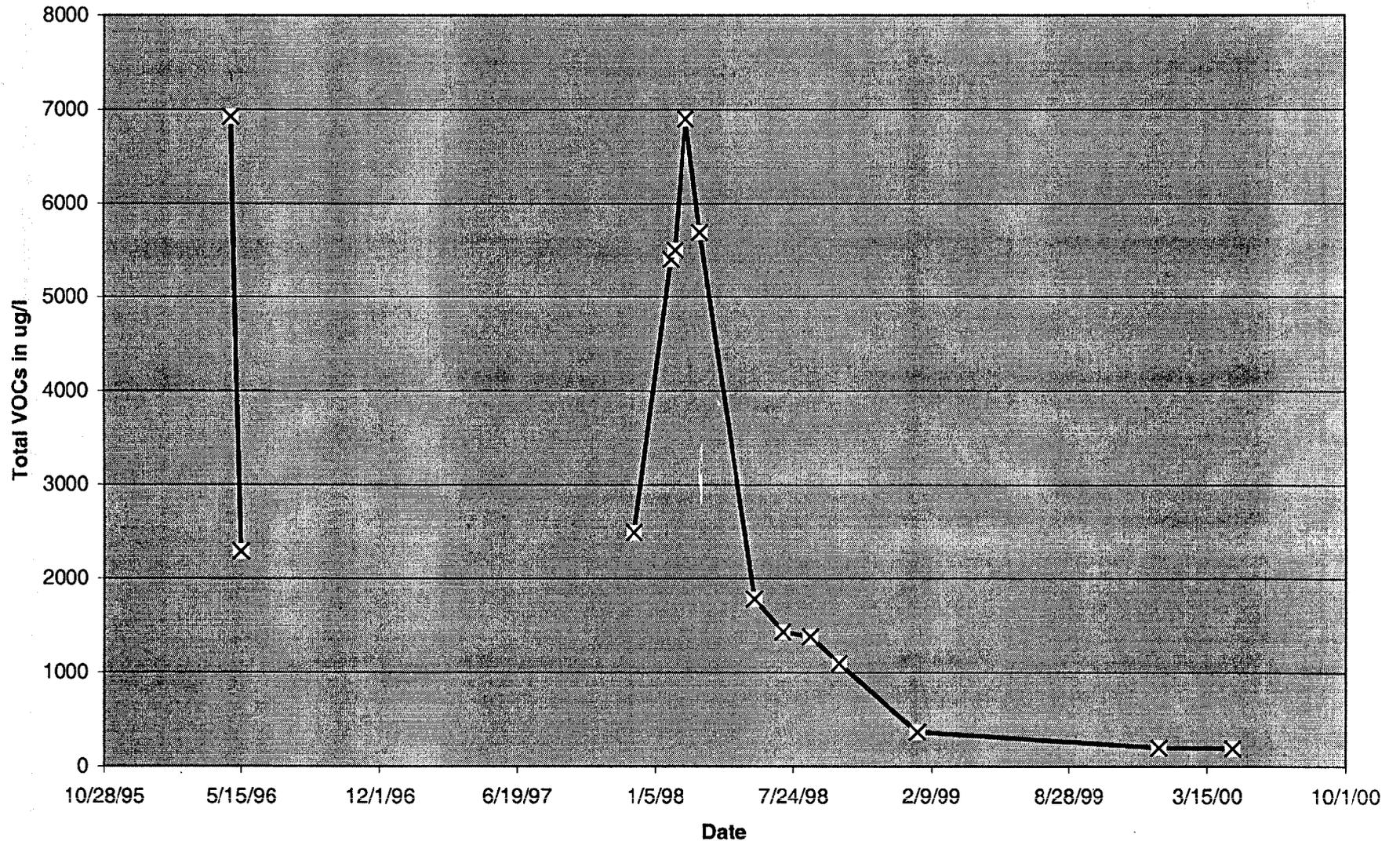
Total VOCs (ug/l) Well OLD-13-DP1



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - DP-1**

	UNITS			Baseline	Week 1	Week 2	Week 4	Week 7						
Sample ID		U4G00101F	U4G00102F	U4G00103	U4G00104	U4G00105	U4G00106	U4G00107						
Date Sampled		05/01/96	05/15/96	09/10/97	01/28/98	02/04/98	02/19/98	03/12/98	01/06/00	4/21/00				
Source		onsite	onsite	offsite	offsite	offsite	offsite	offsite	offsite	offsite	offsite			
PCE	ug/l	6.4	1.5	<.5	<50	<50	<200	<20	ND	ND				
TCE	ug/l	3000.0	450.0	69.6	310.0	150.0	<200	150.0	62.6	ND				
C-1,2-DCE	ug/l	1600.0	880.0	776.0	2600.0	2400.0	3800.0	2000.0	1240.0	1590.0				
T-1,2-DCE	ug/l	25.0	32.0	9.4	<50	<50	<200	<20	ND	12.2				
1,1-DCE	ug/l	N/D	N/D	0.7	<50	<50	<200	<20	ND	0.9				
VC	ug/l	N/D	1.0	7.8	<50	<50	<200	<20	62.3	1.2				
BENZENE	ug/l	N/D	N/D	<.5	<50	<50	<200	<20	ND	ND				
TOLUENE	ug/l	N/D	N/D	<.5	<50	<50	<200	<20	ND	ND				
ETHYLBENZ.	ug/l	N/D	N/D	<.5	<50	<50	<200	<20	ND	ND				
m/p XYLENE	ug/l	N/D	N/D	<.5	<50	<50	<200	<20	ND	ND				
O XYLENE	ug/l	N/D	N/D	<.5	<50	<50	<200	<20	ND	ND				
total VOCs	ug/l	4631.4	1364.5	863.5	2910.0	2550.0	3800.0	2150.0	1365.0	1604.3				

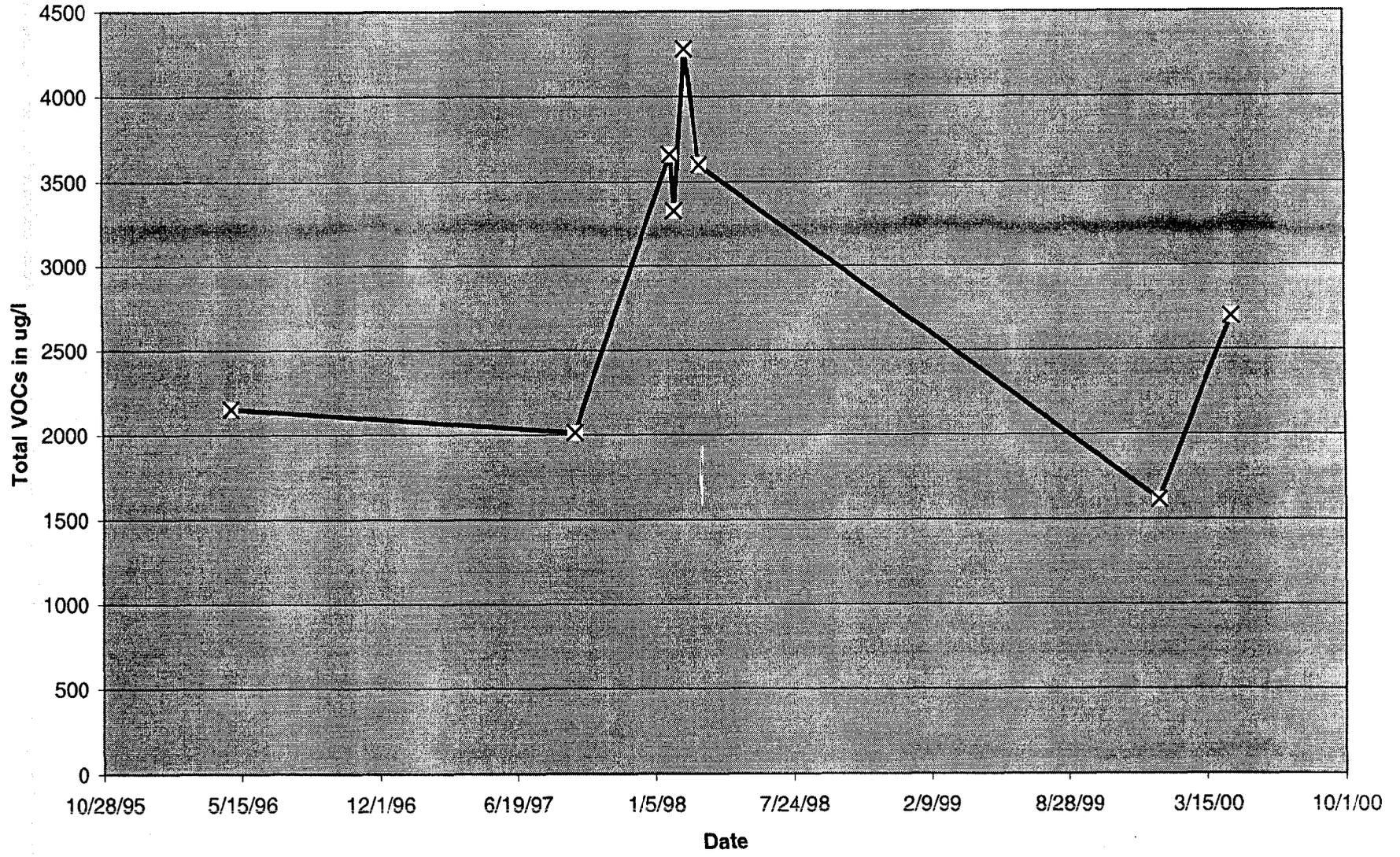
Total VOCs (ug/l) Well OLD-13-DP2



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - DP-2**

	UNITS					Baseline	Week 1	Week 2	Week 4	Week 7	Week 18	Week 24	Week 30	Week 36	Week 52		
Sample ID		U4G00201F	U4G00202F	U4G00203	U4G00204	U4G00205	U4G00206	U4G00207	U4G00208	U4G00209	U4G00210	U4G00211	U4G00212	U4G00213	U4G00214		
Date Sampled		5/1/96	5/15/96			12/5/97	1/29/98	2/4/98	2/19/98	3/12/98	5/29/98	7/9/98	8/18/98	9/29/98	1/20/99	1/6/00	4/21/00
Source		onsite	onsite			offsite	offsite	offsite									
PCE	ug/l	590.0	120.0			10.0	<100	<100	<200	<100	<100	< 50	< 50	<20	<10	4.3	13.5
TCE	ug/l	5800.0	1300.0			2400.0	1300.0	1300.0	1300.0	790.0	180.0	230.0	180.0	97.0	66	43.7	33.1
C-1,2-DCE	ug/l	530.0	840.0			<5	4100.0	4200.0	5600.0	4900.0	1600.0	1200.0	1200.0	1000.0	300	147	129
T-1,2-DCE	ug/l	5.0	25.0			75.0	<100	<100	<200	<100	<100	< 50	< 50	<20	<10	1.9	0.7
1,1-DCE	ug/l	N/D	1.1			<5	<100	<100	<200	<100	<100	< 50	< 50	<20	<10	ND	ND
VC	ug/l	N/D	0.4			<5	<100	<100	<200	<100	<100	< 50	< 50	<20	<10	1.6	15.9
BENZENE	ug/l	N/D	N/D				<100	<100	<200	<100	<100	< 50	< 50	<20	<10	ND	ND
TOLUENE	ug/l	N/D	N/D				<100	<100	<200	<100	<100	< 50	< 50	<20	<10	ND	ND
ETHYLBENZ.	ug/l	N/D	N/D				<100	<100	<200	<100	<100	< 50	< 50	<20	<10	ND	ND
m/p XYLENE	ug/l	N/D	N/D				<100	<100	<200	<100	<100	< 50	< 50	<20	<10	ND	ND
O XYLENE	ug/l	N/D	N/D				<100	<100	<200	<100	<100	< 50	< 50	<20	<10	ND	ND
total VOCs	ug/l	6925.0	2286.5			2485.0	5400.0	5500.0	6900.0	5690.0	1780.0	1430.0	1380.0	1097.0	366.0	198.5	192.2

Total VOCs (ug/l) Well OLD-13-DP3



**PERFORMANCE MONITORING AND SAMPLING PLAN - ANALYTICAL RESULTS  
GROUNDWATER RESULTS - DP-3**

	UNITS		Baseline	Week 1	Week 2	Week 4	Week 7						
Sample ID		U4G00301F	U4G00302	U4G00303	U4G00304	U4G00305	U4G00306						
Date Sampled		5/1/96	9/12/97	1/29/98	2/4/98	2/19/98	3/12/98	1/6/00	4/21/00				
Source		onsite	offsite	offsite	offsite	offsite	offsite	offsite	offsite	offsite			
PCE	ug/l	22.0	<.5	<50	<50	<200	<50	ND	ND				
TCE	ug/l	1400.0	110.0	360.0	330.0	680.0	700.0	98.0	24.8				
C-1,2-DCE	ug/l	710.0	1870.0	3300.0	3000.0	3700.0	2900.0	1500.0	2640.0				
T-1,2-DCE	ug/l	19.0	30.7	<50	<50	<200	<50	18.0	32.2				
1,1-DCE	ug/l	N/D	1.5	<50	<50	<200	<50	ND	1.8				
VC	ug/l	N/D	1.3	<50	<50	<200	<50	ND	ND				
BENZENE	ug/l	N/D	<.5	<50	<50	<200	<50	ND	ND				
TOLUENE	ug/l	N/D	<.5	<50	<50	<200	<50	ND	ND				
ETHYLBENZ.	ug/l	N/D	<.5	<50	<50	<200	<50	ND	ND				
m/p XYLENE	ug/l	N/D	<.5	<50	<50	<200	<50	ND	ND				
O XYLENE	ug/l	N/D	<.5	<50	<50	<200	<50	ND	ND				
total VOCs	ug/l	2151.0	2013.5	3660.0	3330.0	4280.0	3600.0	1616.0	2698.8				