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NSWC WHITE OAK
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Section: 03.06
Site 20903-5640 (White Oak)
Doc. #: 0022
00517

Groundwater Data Gap Report
for
Site 11 - Industrial Wastewater Disposal Area 100

Former
Naval Surface Warfare Center
White Oak
Silver Spring, Maryland

Engineering Field Activity Chesapeake
Naval Facilities Engineering Command

Contract Number N62472-90-D-1298

Contract Task Order 0298

December 2001

TETRA TECH NUS, INC.

Section: 03.06
Site 20903-5640 (White Oak)
Doc. #: W/0022

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PITT-12-1-035

December 17, 2001

Tetra Tech NUS Project Number 7687

Mr. Walter Legg
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Engineering Field Activity Chesapeake
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1314 Harwood Street, SE
Washington, District of Columbia 20374-5018

Reference: CLEAN Contract No. N62472-90-D-1298
Contract Task Order (CTO) 298

Subject: Former NSWC White Oak
Site 11 Groundwater Data Gap Report

Dear Mr. Legg:

Enclosed are 4 copies of the subject report (Rev. 0). Please review it at your convenience and provide me with any comments that you may have. Copies of this submittal have been sent to the individuals indicated below.

If you have any questions or would like to discuss this submittal, please call me at (412) 921-8291. Also, I am available to meet at your convenience with you and any other interested parties to discuss the study.

Very truly yours,

Ronald J. Kotun

Ronald J. Kotun, Ph.D.
Project Manager

RJK/sic

Attachment

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GROUNDWATER DATA GAP REPORT
FOR
SITE 11 - INDUSTRIAL WASTEWATER DISPOSAL AREA 100

FORMER
NAVAL SURFACE WARFARE CENTER
WHITE OAK
SILVER SPRING, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Chesapeake
Environmental Branch Code 18
Naval Facilities Engineering Command
Washington Navy Yard, Building 212
Washington, D.C. 20374-2121

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DECEMBER 2001

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1.0 INTRODUCTION

Through previous groundwater investigations at Site 11, contamination of both the overburden and bedrock aquifers was identified and partially characterized. The contaminants detected are primarily chlorinated organics, with TCE and 1,2-DCE most commonly detected and found at the highest concentrations. Through evaluation of groundwater sampling data, two groundwater plumes have been identified. The major plume is associated with former leaching wells LW04 and LW05, and a smaller, lower-concentration plume is associated with former leaching well LW02.

Based on evaluation of the data collected through March 2001, (presented in a June 1, 2001 letter report from Tetra Tech NUS to the Navy) and on subsequent technical discussions among Navy, USEPA, and MDE representatives, several key data gaps associated with bedrock groundwater at Site 11 were identified. These data gaps are summarized in Table 1-1, along with the proposed methods to resolve the data gaps. These proposed resolutions were agreed to in the June 14 technical meeting held at USEPA Region III, and included in the June 28, 2001 Site 11 Groundwater Data Gap Investigation Letter Work Plan.

During September and October 2001, a supplemental groundwater investigation was conducted at Site 11 to address these key data gaps remaining in regards to groundwater conditions at the site. The following sections describe the execution of the planned work and present the findings, interpretations, and conclusions.

TABLE 1-1

SUMMARY OF KEY DATA GAPS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Data Gap	Planned Resolution
The vertical extent of contamination in the bedrock aquifer is not defined	Additional deep monitoring wells will be drilled and sampled adjacent to wells 11GW118 (source area) and 11GW108 (downgradient migration pathway)
The extent of bedrock aquifer contamination southwest of well 11GW112 has not been defined	An additional bedrock monitoring well will be drilled and sampled in front of Building 1 at Site 11.
The biodegradation process is not yet completely characterized	Another round of natural attenuation sampling will be performed, adding analyses for biodegradation end products (methane, ethane, and ethene) and selected additional groundwater geochemistry parameters (chloride, alkalinity, TOC, major ions).
Background levels of select natural attenuation parameters are not defined	Background wells will be added to the next round of natural attenuation sampling
A bedrock well located along one migration pathway (11GW109) was not sampled in March 2001	Bedrock well 11GW109 will be included in the next round of sampling
There is limited trend data available with which to project degradation rates over time	An additional round of groundwater sampling will be performed that will include VOC analyses along with natural attenuation parameters

2.0 SITE INVESTIGATION ACTIVITIES

The following describes the field investigation activities performed to address the remaining key data gaps related to Site 11 groundwater.

2.1 WELL DRILLING AND INSTALLATION

Additional deep bedrock monitoring wells were installed at the site to investigate the vertical extent of contamination and evaluate the water-yielding characteristics of the deep bedrock. A total of three deep bedrock well borings were drilled to accommodate installation of four 2-inch PVC monitoring wells. In one bedrock boring (11GW119), two monitoring wells were installed. One monitoring well was installed in each of the other two bedrock borings (11GW120 and 11GW121).

Drilling operations began at 11GW119, which is located adjacent to previously installed monitoring wells 11GW22, 11GW110, and 11GW118 and near former leaching wells LW04 and LW05. This is the area of highest VOC levels in groundwater based on previous sampling. The target depth interval for this well was approximately 125 – 200 feet, as the deepest (and most contaminated) previously-installed well at that location (11GW118) is 105 feet deep. The 200 foot depth was selected as a preliminary cutoff depth based on the decreasing likelihood of encountering open fractures with increasing depth (generally, water well drillers in the area will not drill deeper than 200 feet in an attempt to find water, based on experience). This boring was drilled using air rotary methods. Competent bedrock was encountered 45 feet below ground surface (bgs) and an 8-inch permanent steel casing was set and grouted 10 feet into bedrock (55 feet bgs). An eight-inch diameter boring was then advanced to a total depth of 233 feet bgs.

Packer sampling was conducted in boring 11GW119 at depths where water-bearing zones were identified, in order to determine the depth interval within the bedrock where the highest contaminant levels were present. Although the borehole did not encounter any high-yielding fracture zones, the following minor water-yielding zones found below the threshold depth of 125 feet were identified as candidates for packer sampling:

- 150-160 feet bgs
- 180-190 feet bgs
- 200-233 feet bgs

After flushing the borehole to remove fine drill cuttings from the borehole walls, a dual packer/pump assembly was lowered into the borehole. At 153 feet bgs, fractures were encountered yielding

approximately 1 gallon per minute (gpm) or less. The interval from 150-160 feet bgs was isolated with two inflatable packers spaced 10 feet apart, to collect a sample from this water-bearing zone. Purging of this interval, using a submersible pump positioned between the packers, yielded varying amounts of water (from 2-5 gallons) before going dry. The isolated interval was allowed to recharge for 15-30 minutes before purging again. Total purge time for this interval was 4½ hours, followed by sampling for VOCs directly from the pump discharge line.

At 184 feet bgs, another minor water-bearing zone was identified during drilling operations. The interval from 180-190 feet bgs was isolated with packers, to obtain a sample from this water-bearing zone. Purging of this interval yielded approximately 0.75 gallons before going dry. The packer interval was allowed to recharge for 15 minutes then was purged, which was repeated over the course of 4 hours, followed by sampling for VOCs directly from the discharge line.

At approximately 210 feet bgs, a possible water-bearing zone was identified by the driller with an estimated yield of <0.25 gpm. The interval from 200-233 feet bgs was isolated with a single packer set at 200 feet (the bottom packer was not inflated in order to provide access to the total depth of the borehole). Purging of this interval yielded approximately 0.5 gallons before going dry. The packer interval was allowed to recharge at 15-minute intervals, then pumped, over the course of 4½ hours. A VOC sample was collected directly from the pump discharge line once purging was completed.

Based on the analytical results from the packer samples (which indicated declining VOC concentrations with depth, see Appendix A) and boring log information, two 2-inch diameter PVC monitoring wells were installed in the 11GW119 boring. Monitoring well 11GW119S was installed with its screened interval from 149 to 159 feet bgs and monitoring well 11GW119D was installed with its screened interval from 205 to 215 feet bgs. Well screens have .020-inch slot sizes and the annular space around each well screen was backfilled with appropriately graded sand. Bentonite chips/pellets were used to seal off the borehole intervals below, between, and above the screened intervals.

The target depth intervals for the new bedrock monitoring wells to be installed adjacent to 11GW108 (11GW120) and west of Building 1 (11GW121) were the depth interval where the highest levels of VOC contamination were found at the 11GW119 well boring location, as determined through the quick-turnaround sampling. Based on past groundwater sampling at the 11GW22/110/118 well cluster and the 11GW119S/D packer sampling results, the 85-130 foot depth interval was determined to be the most contaminated depth zone within the bedrock and was targeted for the remaining well installations. This interval is midway between the screened interval of 11GW118 (95-105 feet), the most contaminated bedrock well, and the adjacent water yielding zones sampled above (11GW110, 65-75 feet) and below (packer sample at 150 to 160 feet) well 11GW118.

The second bedrock boring drilled was 11GW120, located adjacent to previously installed monitoring wells 11GW66 and 11GW108 downgradient (northeast) of 11GW119. The 11GW120 well boring was drilled to the top of bedrock using mud rotary methods, then to the total depth of 138 feet bgs with air rotary methods. It was decided to use mud rotary for drilling through the overburden to more effectively contain the drill cuttings generated. Competent bedrock was encountered 21 feet bgs. A 6-inch permanent steel casing was set and grouted 10 feet into the bedrock (31 ft bgs). A six-inch diameter boring was then advanced from 31 feet to the total depth. Three fracture zones were encountered where water was observed. The first water-yielding zone was encountered 46 feet bgs and yielded an estimated flow of 3 gallons/minute. The second water-yielding zone was encountered 97 feet bgs and yielded approximately 0.5 gallons/minute. The last water-yielding zone encountered was 125 feet bgs and yielded approximately 1.0 gallon/minute. Monitoring well 11GW120 was installed with its screened interval from 123 to 133 feet bgs. Construction methods for this well were the same as were used for 11GW119S/D, except that the borehole annulus above the bentonite pellet seal was backfilled with cement-bentonite grout.

The final boring installed was 11GW121, located upgradient (southwest) of 11GW119 and 11GW112. This boring was drilled to a total depth of 123 feet bgs. As was the case with 11GW120, the boring was drilled to the top of bedrock using mud rotary methods. Competent bedrock was encountered 42 feet bgs. A 6-inch permanent steel casing was set and grouted 10 feet into bedrock (52 ft bgs) then the remainder of the boring was completed using air rotary drilling. Two water-bearing fracture zones were encountered during drilling. The first water-bearing zone was encountered 76 feet bgs and yielded an estimated 0.5 gallons/minute. The second water-bearing zone was encountered 106 feet bgs and yielded significantly more water, estimated at approximately 2.5 gallons/minute. Monitoring well 11GW121 was installed with its screened interval from 100 to 110 feet bgs. Construction methods for this well were the same as were used for 11GW120, except that the well was completed as a flush-mount to avoid damaging the well during the impending construction activities in this area. Upon completion of well installation activities, all of the new monitoring wells were developed, using the air lift method, until the discharge was visibly clear.

Boring logs and well construction diagrams for all of the newly installed wells are included in Appendix B. Table 2-1 provides monitoring well construction information for all of the wells at Site 11.

All new wells were surveyed by a Maryland-licensed surveyor to determine the positional coordinates and vertical elevations. The locations of the new wells are shown on Figure 1, along with the locations of the previously existing monitoring wells, historic leaching well locations, and general Site 11 features.

2.2 GROUNDWATER SAMPLING

Approximately two weeks after installation and development of the new wells, all 14 bedrock wells at Site 11 were sampled (11GW106, 11GW107, 11GW108, 11GW109, 11GW110, 11GW112, 11GW114, 11GW115, 11GW116, 11GW117, 11GW118, 11GW119, 11GW120, and 11GW121), using low-flow purging and sampling methods as per the Master Field Sampling Plan (FSP, Brown and Root Environmental, 1998) for the site. In addition, 6 saprolite monitoring wells located along the contaminant flow paths were sampled (11GW22, 11GW28, 11GW29, 11GW66, 11GW87, and 11GW105). Each sample was analyzed for low-concentration volatile organics. In addition, the well samples were analyzed for the following natural attenuation indicator parameters:

- Dissolved oxygen
- Carbon dioxide
- Nitrate/nitrite
- Ferrous iron
- Sulfate/sulfide
- Methane
- Ethane
- Ethene
- Oxidation-reduction potential
- pH
- Specific conductance
- Temperature
- Turbidity
- Chloride
- Alkalinity
- Total organic carbon

Major ion analyses (Ca, Mg, Na, K, Cl, SO4, CO3, and HCO3) were performed for selected wells located along the flow paths of contamination from the source areas. The wells sampled for major ions include bedrock wells 11GW106, 11GW107, 11GW108, 11GW109, 11GW110, 11GW118, 11GW119, 11GW120, and 11GW121; and overburden wells 11GW22, 11GW28, and 11GW66. Analytical methods that were used are presented in Table 2-2.

2.3 HYDROGEOLOGIC CHARACTERIZATION

One round of water level measurements was collected on October 1, 2001 from all of the monitoring wells at Site 11 to evaluate groundwater flow patterns in both the overburden and bedrock. Table 2-1 provides the water level data and the groundwater elevations calculated from these measurements.

Aquifer tests (slug tests) were performed on the new monitoring wells to provide additional data with which to project the mass flux of groundwater/contaminants within the bedrock and for the design of remedial measures for the bedrock aquifer (if necessary). The slug testing results are discussed in Section 3.1 and the test data/calculations are included in Appendix C.

2.4 WELL ABANDONMENT

Eleven monitoring wells, no longer considered to be necessary for groundwater characterization activities at Site 11, were abandoned using a tremie pipe to backfill the wells with cement/bentonite grout to ground surface. A backhoe was then employed to remove the surface casing, protective bollards, and concrete pad from each abandoned well. The following wells were abandoned during this field effort:

- 11GW25
- 11GW67
- 11GW68
- 11GW72
- 11GW73
- 11GW84
- 11GW88
- 11GW104
- PZ62
- PZ64
- PZ65

2.5 INVESTIGATION-DERIVED WASTE MANAGEMENT

All drill cuttings and well abandonment debris (i.e., concrete, protective surface casings, PVC well stick-ups) were disposed of in a 30-yard rolloff box. The water generated from packer sampling, borehole flushing, and well development was containerized in a 6,500 gallon Baker Tank.

TABLE 2-1

SUMMARY OF WATER LEVEL DATA AND MONITORING WELL CONSTRUCTION DETAILS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Monitoring Well	Top of Riser Elevation (ft above msl)	Ground Surface Elevation (ft above msl)	Monitored Geologic Unit	Screened Interval (ft bgs)	10/1/01	
					Depth to water (ft. tor)	GW Elev. (ft above msl)
11GW22	371.84	368.59	S&G/Saprolite	20-40	25.67	346.17
11GW23	373.04	370.16	Saprolite	20-45	29.09	343.95
11GW24	360.80	361.03	Saprolite	10-30	19.60	341.20
11GW26	355.97	353.59	Saprolite	10-30	15.31	340.66
11GW27	356.76	353.45	Saprolite	9-29	15.50	341.26
11GW28	349.75	346.75	Saprolite	20-40	17.16	332.59
11GW29	332.82	329.38	Saprolite	9-19	13.57	319.25
11GW66	348.78	346.15	Saprolite	9-24	11.61	337.17
11GW69	367.82	364.30	Saprolite	16-31	28.72	339.10
11GW70D	354.48	352.28	Saprolite	40-60	32.32	322.16
11GW71	352.49	349.63	Saprolite	10.25-25.25	13.06	339.43
11GW84	351.16	347.71	Saprolite	19-29	NA	NA
11GW85	365.58	362.39	Saprolite	25-40	30.35	335.23
11GW86	346.69	343.42	Saprolite	20-30	17.85	328.84
11GW87	343.32	341.46	Saprolite	36-56	15.36	327.96
11GW101	375.98	372.76	Saprolite	26-36	28.42	347.56
11GW102	368.86	366.48	Saprolite	18-28	26.35	342.51
11GW103	374.40	372.13	Saprolite	26-36	33.64	340.76
11GW105	365.61	363.72	Saprolite	34-44	26.16	339.45
11GW106	365.82	364.27	Bedrock	67.5-77.5	23.29	342.53
11GW107	348.44	346.34	Bedrock	42.5-52.5	18.00	330.44
11GW108	348.91	346.56	Bedrock	36.5-46.5	11.20	337.71
11GW109	339.05	339.34	Bedrock	45-55	13.76	325.29
11GW110	368.51	366.92	Bedrock	64.5-74.5	24.40	344.11
11GW111	371.33	369.69	Saprolite	28-38	26.15	345.18
11GW112	371.61	369.70	Bedrock	95-105	27.77	343.84
11GW114	349.64	347.40	Bedrock	39-49	11.52	338.12
11GW115	343.90	341.60	Bedrock	56-66	15.01	328.89
11GW116	329.25	327.60	Bedrock	58-68	11.82	317.43
11GW117	329.76	327.60	Bedrock	84-94	12.35	317.41
11GW118	368.51	366.90	Bedrock	95-105	25.64	342.87
11GW119S	368.21	366.85	Bedrock	149-159	25.61	342.60
11GW119D	368.46	366.85	Bedrock	205-215	NA	NA
11GW120	347.73	346.76	Bedrock	123-133	15.30	332.43
11GW121	371.93	372.23	Bedrock	100-110	27.69	344.24
11PZ63	378.10	375.34	Clay/Saprolite	10-30	18.99	359.11

NA - not available
S&G - sand and gravel
tor - top of riser
msl - mean sea level
bgs - below ground surface

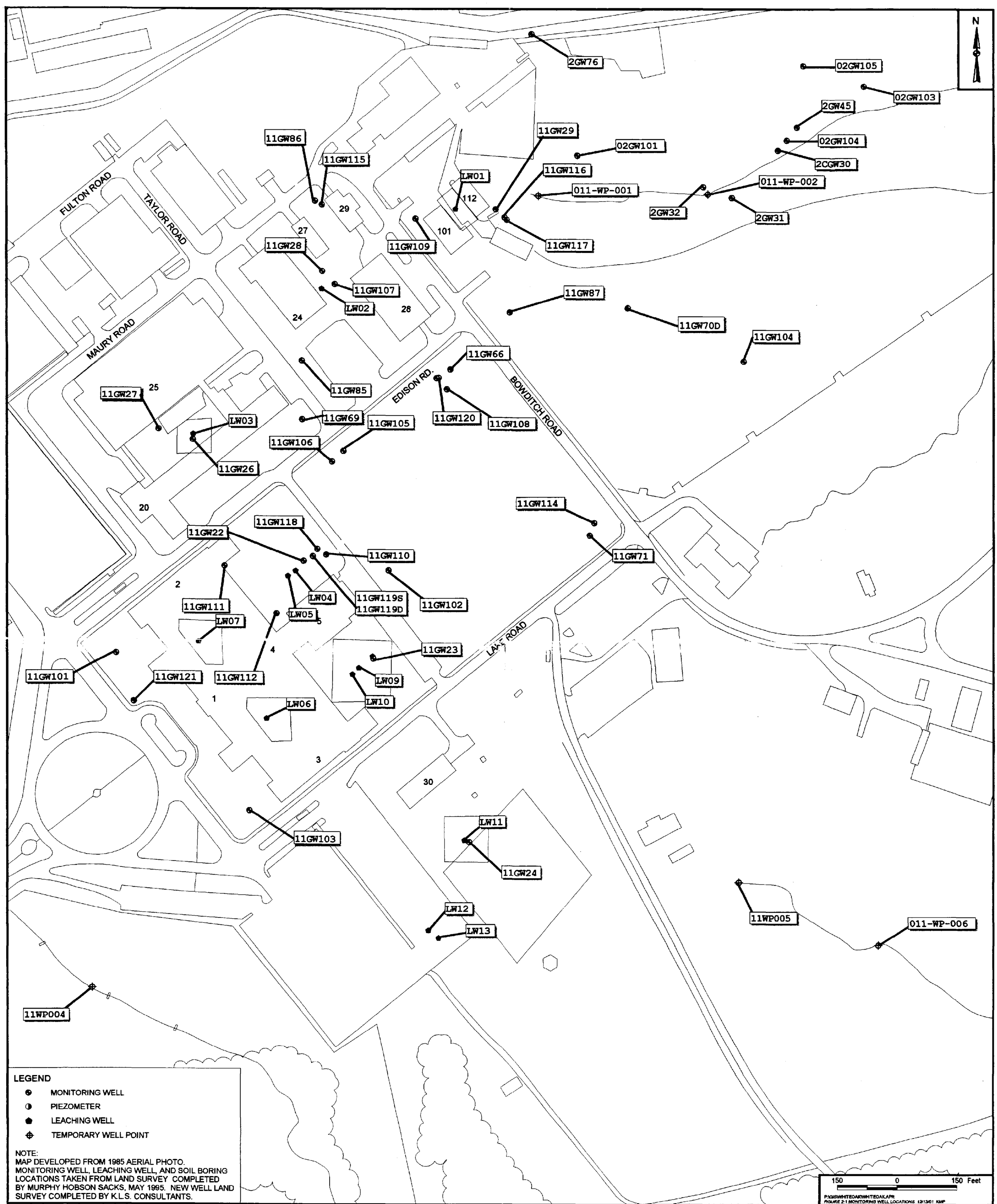
TABLE 2-2

ANALYTICAL METHODS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Fixed-Base Lab Analyses		
Parameter	**Method**	**Sample Volume/Preservation Requirements**
Low-concentration volatile organics	CLP OLC02.1	3 – 40 ml VOA vials, HCL to pH < 2, cool to 4°C
Total organic carbon	EPA Method 415.1	125 ml HDPE, H_2SO_4 to pH < 2, cool to 4°C
Methane, Ethane, Ethene	RSK SOPs 147 and 175	3 – 40 ml VOA vials, HCL to pH < 2, cool to 4°C
Ca, Mg, Na, K	SW-846 6010B	500 ml HDPE, HNO_3 to pH < 2
Cl, SO_4, NO_2, NO_3	EPA Method 300	250 ml HDPE, cool to 4°C
Alkalinity	SM2320	250 ml HDPE, cool to 4°C

Field Analyses				
Parameter	**Test Kit & Brand**	**Cat. No.**	**Range, mg/L, or as noted**	**Method**
Dissolved Oxygen (DO), High Range	Chemetrics test kit	K-7512	0-12	Rhodazine D
DO, Low Range	Same	K-7501	0-1	Indigo Carmine
Carbon Dioxide (dissolved)	Same	K-1910, 1920, 1925	10-2500	NaOH titrant w/ pH indicator
Nitrate, Low Range	HACH-DR-850	24298-00	0-0.50	8192-Cadmium Reduction
Nitrite, Low Range	HACH-DR-850	25120-25	0-0.35	8507-Diazotization (Accu Vac Ampuls)
Sulfate	HACH-DR-850	25090-25	0-70	8051-Sulfa Ver 4 (Accu Vac Ampuls)
Sulfide	HACH-DR-850	22445-00	0-0.70	8131 Methylene Blue
Hydrogen Sulfide	HS-C – HACH	25378-00	0-5	Color chart/ H_2S effervescence
Ferrous Iron	IR-18C – HACH	26672-00	0-10	Color disc/ 1, 10 Phenanthroline
DO	Horiba U-22 multi parameter meter	NA	0-19.99 mg/L	Diaphragm gavanic
ORP	Same	NA	±1999 mV	Platinum Electrode
PH	Same	NA	0-14 SU	Glass electrode
Specific Conductance	Same	NA	0-9.99 S/m	Electrode
Temperature	Same	NA	0-55° C	Thermistor
Turbidity	Same	NA	0-800 NTU	Penetration & scattering

Cat. No. = reagents or kit number



LEGEND

- MONITORING WELL
- PIEZOMETER
- LEACHING WELL
- TEMPORARY WELL POINT

NOTE:
MAP DEVELOPED FROM 1985 AERIAL PHOTO.
MONITORING WELL, LEACHING WELL, AND SOIL BORING LOCATIONS TAKEN FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY 1995. NEW WELL LAND SURVEY COMPLETED BY K.L.S. CONSULTANTS.

FIGURE 2-1

SHEET _ OF _

NAVFAC DRAWING NO. —

SPEC. —

CONST. CONT. NO.

DRAWING SIZE: D

CODE I.D. NO. 60091

DEPARTMENT OF THE NAVY — CHESAPEAKE DIVISION — NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.

STATION NAME — STATION LOCATION

MONITORING WELL LOCATIONS
SITE 11
FORMER NSWC-WHITE OAK, SILVER SPRING, MARYLAND

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSON DRIVE
PITTSBURGH, PA. 15220

DES. | DR. | CHK.
SUBMITTED BY: TITLE DATE
PROGRAM MANAGER DATE
APPROVED DATE
EFD FOR COMMAND NAVFAC

D9A	403
04	404
E.I.C	405
401	406
402	D4B

REVIEWED BY ROICC DATE

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

3.0 INVESTIGATION RESULTS

The following describes the results of the groundwater data gap investigation. An overall presentation of the data is provided, with follow-up discussion focused on the key data gaps that were targeted for study.

3.1 HYDROGEOLOGIC CONDITIONS

Groundwater is encountered at Site 11 in both the surficial unconsolidated sediments (consisting primarily of saprolite, with some alluvium) and in the underlying fractured metamorphic bedrock (Wissahickon Gneiss). The Site 11 RFI Report (Tetra Tech NUS, 2000) and the Site 11 RFI Addendum (Tetra Tech NUS, 2001) provide more detailed descriptions of geologic and hydrogeologic conditions across the study area. Additional hydrogeologic investigation work performed for this investigation includes the collection of a comprehensive round of water levels (see Table 2-1) to evaluate groundwater flow patterns, and slug testing of the new bedrock wells to add to the database regarding the hydraulic characteristics of the bedrock aquifer.

Based on the water levels and associated groundwater elevations presented in Table 2-1, groundwater flow across Site 11 in both the saprolite and bedrock is predominantly to the northeast towards a small tributary stream to Paint Branch. Figures 3-1, 3-2, and 3-3 show the groundwater flow patterns in the saprolite, shallow bedrock, and intermediate-depth bedrock (85-130 ft), respectively. Some groundwater mounding within the saprolite, associated with a local topographic high, is evident in Figure 3-1 in the main building area and to the northwest, consistent with past observations.

Vertical hydraulic gradients are predominantly downward, as shown on Table 3-1, although some upward gradients were also observed (between the saprolite and shallow bedrock). The hydraulic head data for the well clusters indicates that there is a general tendency for Site 11 groundwater to move downward, along with the predominantly lateral flow. Where hydraulic head differentials are largest, this probably indicates a restricted hydraulic connection rather than pronounced downward flow, as the bedrock groundwater flow system generally becomes less permeable with depth and there has been no high transmissivity zone found at depth that could act as a preferential conduit for groundwater migration across Site 11.

Slug tests were performed in three of the four new wells (11GW119S, 11GW120, and 11GW121) to determine bulk hydraulic conductivity (K) values for the portions of the bedrock aquifer screened by the wells. The Bouwer and Rice (1976) method was used to determine hydraulic conductivity values from the field data. Due to the extremely low recovery rates of the wells during the rising head slug tests, supplemental falling head tests were not performed in the wells. Well 11GW119D was also to be slug

tested, however due to the extremely low yield of this well (it had not yet recovered completely from well development activities that occurred two weeks prior to the slug testing activities) it could not be tested. Table 3-2 lists the slug testing results for the new wells, along with previous slug test results. In general, the water-yielding fracture zones in the new bedrock wells were extremely tight, with bulk hydraulic conductivities of the screened intervals in the 10^{-1}-10^{-3} ft/day (10^{-4}-10^{-6} cm/sec) range.

The overall average (geometric mean) bulk hydraulic conductivity for the bedrock aquifer is approximately 0.17 ft/day based on slug testing results. The actual overall bulk K for the bedrock is likely lower, as the well installations and subsequent slug testing were biased towards the most significant water-yielding fracture zones encountered. Conversely, the actual individual fracture Ks are much higher than the bulk K values calculated, as the data evaluation methods for slug tests assume that the aquifer has consistent water-transmitting capabilities throughout the entire screened interval, while in fractured bedrock the water is only produced by a single or few discrete fractures within the interval.

The slug test data were grouped to evaluate bulk hydraulic conductivity trends with depth. The geometric mean bulk K for the bedrock wells screened less than 85 feet in depth was 0.315 ft/day. For the wells screened in the 85 – 110 ft depth range, the mean bulk K was 0.687 ft/day. Excluding the result for 11GW117, which was anomalously high in comparison to all other wells (over an order of magnitude greater than any other), the mean bulk K for the 85 – 100 ft depth interval was 0.17 ft/day. For the wells screened below 110 feet (11GW119S and 11GW120), the mean bulk K value was 0.0092 ft/day. Assuming a K value for 11GW119D to be half the lowest measured K value for the bedrock wells since the yield of this well was too low to even test (1/2 of 0.003 ft/day, or .0015 ft/day), the mean bulk K for the deeper bedrock is reduced further, to about 0.005 ft/day. Comparison of the results for these well groupings indicates that the bulk K of the bedrock decreases markedly with increasing depth. The average deep bedrock well bulk hydraulic conductivity was well over an order of magnitude lower than the averages for the more shallow wells, confirming the expected general decrease in water transmitting capacity for the bedrock aquifer with increasing depth.

3.2 NATURE AND EXTENT OF CONTAMINATION

Figures 3-4 (VOCs) and 3-5 (other analytes) show the distributions of all positively detected analytes in groundwater across Site 11 for the October 2001 round of groundwater sampling, while Table 3-3 provides a summary of all positive detections. Appendix A contains the full database for all fixed-base laboratory analyses. The contaminants detected, the concentrations, and contaminant distributions are generally consistent with what has been observed at the site in the past. Two groundwater contaminant plumes are evident. The larger and higher concentration plume is centered around well cluster 11GW22/110/118/119S/119D and former leaching wells LW04 and LW05, and extends downgradient to the northeast, as evidenced by low levels of contamination at well cluster 11GW66/108/120. Further

downgradient, at well cluster 11GW29/116/117, contaminant concentrations are trace to nondetect, constraining the lateral extent of the plume. The primary contaminants associated with this plume are TCE and cis 1,2-DCE, with 1,2-DCA also present in significant concentrations. Some contamination was also found in well 11GW112, located slightly upgradient (southwest) from the former leaching wells. The contamination in this well may be a result of the well purging activities associated with groundwater sampling pulling nearby contamination slightly upgradient from the source area.

A smaller and lower concentration plume is centered around wells 11GW28 and 11GW107, and former leaching well LW02. The primary contaminants associated with this plume are PCE and TCE. Based on the absence of contamination in downgradient well 11GW109, this smaller plume is localized in extent.

Acetone was found at high concentrations in samples from all of the new monitoring wells and in samples from some of the nearby wells, especially the samples from wells 11GW119S, 11GW119D, and 11GW121 (Table 3-3). Significant levels of acetone were not found in previous groundwater sampling at Site 11, nor was it detected at significant concentrations during the packer sampling activities. Subsequent investigation of these high acetone detections revealed that a contaminated batch of coated bentonite pellets had recently been released on the market, and that the brand of pellets used for the new well installations was the same brand that had been identified as being contaminated with acetone. As a result, the elevated actone levels are considered to be assoicated with the bentonite pellets used in the new wells and acetone is not considered to be a site-related contaminant. Acetone readily degrades in the subsurface environment, thus the elevated concentrations present are not expected to persist over an extended time period.

3.3 DATA GAP DISCUSSIONS

The following subsections address the key data gaps targeted for this investigation.

3.3.1 Data Gap 1 – Definition of the Vertical Extent of Contamination

The vertical extent of groundwater contamination in the bedrock aquifer was addressed by the installation and sampling of deep bedrock monitoring wells 11GW119S and 11GW119D, along with the sampling of adjacent monitoring wells 11GW22, 11GW110, and 11GW118. As indicated by the contaminant concentrations presented in Table 3-3, overall contaminant levels (excluding acetone detections, see Section 3.2 discussion) are highest in well 11GW118, screened from 95 to 105 feet bgs. From this point, contaminant levels decline with increasing depth, as evidenced by the steadily declining contaminant levels in 111GW119S and 11GW119D. In well 11GW119D, screened from 205 – 215 feet, the VOC concentrations detected were all below the applicable federal Maximum Contaminant Levels (MCLs). Based on the extremely low yields of fractures encountered at depth, there also appears to be little

groundwater movement through deeper portions of the bedrock aquifer, as was expected. Based on the results of this data gap investigation, the vertical extent of contamination in Site 11 groundwater at levels exceeding MCLs is estimated to be approximately 200 feet, with the highest contaminant levels occurring at depths less than130 feet bgs.

3.3.2 Data Gap 2 – Defining the Extent of Contamination Southwest of Well 11GW112

Elevated levels of VOCs had previously been detected in well 11GW112, located southwest of former leaching wells LW04 and LW05. During this data gap investigation, well 11GW121 was installed and sampled to determine the extent of this contamination to the southwest. Aside from a trace level detection of chloroform (0.9 µg/L) and acetone, no VOCs were detected in this well (see Table 3-3 and Figure 3-4). Based on these results, the contamination at 11GW112 does not appear to extend any significant distance to the southwest. In addition, there is a slight gradient from 11GW121 towards 11GW112, indicating a general northeast flow direction for groundwater in this area (Figure 3-3). The contamination in 11GW112 appears to be related to former leaching wells LW04 and LW05, which are located approximately 100 feet downgradient of 11GW112. Purging of this well prior to sampling may be pulling low levels of contamination upgradient from the LW04/LW05 area, especially given the low storativity of the tightly-fractured bedrock aquifer.

3.3.3 Data Gap 3 – More Complete Characterization of the Biodegradation Process

A comprehensive round of natural attenuation sampling was performed to address this data gap, as described in Section 2. Results of the sampling are presented in Table 3-4. Data from selected wells located within or near the contaminant source areas were evaluated using an EPA-developed worksheet for screening for anaerobic biodegradation of chlorinated solvents. The results of this screening, presented in Appendix D, indicate that there is some level of biodegradation occurring in groundwater. Evidence of biodegradation is stronger in the bedrock wells than in the overburden wells, as indicated by the overall higher screening scores. In general, dissolved oxygen (DO) and oxidation-reduction potential (ORP) readings did not indicate reductive dechlorination. DO levels in most wells were in the aerobic range, while ORP levels ranged from –157 to 283, with no apparent correlation between ORP and contamination levels. Levels of Fe+2 above 1 mg/L, indicating that iron reduction is occurring, were found in about half of the wells. For carbon dioxide, an indicator of metabolic activity, 5 of the 7 highest concentrations were found in wells with relatively high VOC levels. Of the six most contaminated wells, only 11GW119S did not have an elevated CO2 level. Sulfate levels throughout groundwater at Site 11 were low (<20 mg/L), which is favorable for anaerobic biodegradation. Nitrate levels in the most impacted wells at Site 11 were generally low (<1 mg/L), which is favorable for anaerobic biodegradation. Alkalinity levels were highest in bedrock wells versus overburden wells, with 3 of the 5 highest alkalinities associated with the more highly contaminated bedrock wells. No significant correlation was observed

between chloride levels and contaminant presence, however given the relatively low contaminant levels present relative to typical background chloride levels, a notable increase in chloride due to dechlorination of chlorinated solvents was not expected. The highest methane levels were found in the most contaminated bedrock wells (11GW110/112/118). This suggests that methanogenesis is occurring in the aquifer, which is associated with reductive dechlorination.

Cis-1,2-dichloroethene (1,2-DCE), a common daughter product associated with the breakdown of PCE and TCE, was found in all wells where significant levels of TCE and/or PCE were detected. This compound is almost always present in groundwater as a breakdown product of PCE/TCE, thus it's consistent presence at Site 11 is a strong indicator that biodegradation is occurring. Vinyl chloride, ethene, and ethane, on the other hand, were not detected at significant levels in Site 11 groundwater. This may indicate that the dechlorination process is not advancing beyond the breakdown to 1,2-DCE or it could indicate that breakdown beyond 1,2-DCE occurs rapidly and completely.

Contaminant concentration trends and PCE/TCE/1,2-DCE/VC versus total VOCs ratios for the most impacted wells for which historic data is available were also evaluated to look for trends in concentrations over time. As shown on Table 3-5, contaminant concentrations in overburden wells 11GW22, 11GW28, 11GW66, and 11GW87 have remained relatively consistent over time, recognizing the typical variability in groundwater data that can be expected to occur from one sampling event to another. PCE/TCE/1,2-DCE/VC ratios for these wells suggest that a minor amount of degradation is occurring, as evidenced by slight increases in TCE and/or 1,2-DCE relative concentrations in some wells.

Data for bedrock wells (Table 3-5) show a similar overall pattern of contaminant level and ratio trends. Concentrations appear to be stable to slowly declining overall. At bedrock wells 11GW112 and 11GW118, however, the evidence that dechlorination is occurring is much stronger, based on the clear declines of TCE ratios and increases in 1,2-DCE ratios.

A groundwater geochemistry evaluation was performed using major cation and anion concentrations for selected wells located along contaminant flowpaths. Table 3-3 provides the results of the analyses, while Appendix D includes a table (Table D-1) with major ion percentages and a triliner plot showing the geochemical signatures of the wells. The dominant cations in groundwater are calcium and sodium, while the dominant anion is bicarbonate. Most of the wells have similar geochemical signatures, as evidenced by the grouping on the combined cation/anion portion of the trilinear plot. Two exceptions to this are wells 11GW22 and 11GW28, which are overburden wells that have higher sodium, sulfate, and/or chloride levels than the other wells. In general, there were no distinct geochemical signatures for the more impacted wells versus the wells with little or no contamination.

Overall, the sampling data indicate that the contaminant plumes in the overburden and bedrock at Site 11 are stable to slowly declining in terms of concentration. The extents of the contaminant plumes appear to be essentially the same as has been observed previously, suggesting that there is no significant migration of contaminants occurring. Physical natural attenuation processes such as dilution and dispersion, along with some biodegradation activity as indicated primarily by the presence of cis-1,2-DCE at concentrations typically 2-3 times higher than TCE levels, appear to be effectively limiting the migration of contamination from source areas.

3.3.4 Data Gap 4 – Determination of Background Natural Attenuation Parameters

Knowledge of background concentrations of selected parameters is needed to evaluate the roles of several of the natural attenuation indicator parameters (carbon dioxide, alkalinity, and chloride). These parameters typically are evaluated in terms of increases over background levels (generally, levels 2x or greater above background are interpreted as being indicative of biological activity).

Bedrock wells 11GW114 and 11GW115 and overburden wells 11GW71 and 11GW86, which are located along the lateral edges of Site 11 and are outside of the areas of groundwater impacts, were sampled for natural attenuation parameters to determine background levels. Sampling results indicate, however, that the levels of carbon dioxide, alkalinity, and chloride in the background wells are within the middle to upper-middle range of all of the wells that were sampled at Site 11. The fact that a number of other wells had concentrations of carbon dioxide, alkalinity, and chloride below those of the background wells made the determination of true representative background levels for these constituents questionable. As a result, carbon dioxide, alkalinity, and chloride concentration evaluations were focused on whether the concentrations in the most highly contaminated wells were within the upper, middle, or low range in comparison to all of the other wells sampled. Relatively high levels of these constituents were interpreted as indicative of some level of biological activity.

3.3.5 Data Gap 5 – Groundwater Quality Data for Bedrock Well 11GW109

Bedrock monitoring well 11GW109 is located directly downgradient from a small secondary plume associated with former leaching well LW02. Monitoring wells in the immediate vicinity of LW02 have elevated levels of chlorinated organics, primarily PCE and TCE, thus water quality data from 11GW109 is useful for defining the downgradient extent of bedrock groundwater contamination. During the March 2001 round of groundwater sampling at the site, 11GW109 was inadvertently omitted from the sampling program. The well was sampled during the October 2001 sampling event, with only a trace level (0.6 µg/L) of cis 1,2-DCE detected (see Table 3-3 and Figure 3-4). This data indicates that the bedrock groundwater contamination associated with LW02 is very localized and is not migrating from the immediate area of the former leaching well.

3.3.6 Data Gap 6 – Projection of Contaminant Concentration Trends over Time

Data from the round of groundwater sampling conducted in October 2001 was used along with historic sampling data to identify contaminant concentration trends over time in the site monitoring wells and to use in projecting future contaminant concentrations. The contaminant trend evaluation is focused on the data collected from 1997 to present, as the identified contaminant sources for the Site 11 groundwater contamination (leaching wells LW02, LW04, and LW05) were excavated and removed in 1996. The evaluation also focuses primarily on PCE and TCE in those wells where they are present at concentrations above MCLs. The daughter degradation product cis-1,2-DCE is also evaluated for wells where a clear decline in cis-1,2-DCE levels is apparent, however since it is produced by TCE degradation it has actually increased slightly in some wells. Projections of trends were made based on the assumption that first-order kinetics can be used to reasonably approximate the decline in concentration over time.

For the overburden monitoring wells, PCE/TCE levels over the 1997 through 2001 time period are generally consistent or slowly declining. Overburden wells 11GW22, 11GW28, and 11GW66 had detections of PCE and/or TCE at concentrations above MCLs during 2001 (Table 3-5). Based on the 1997 – 2001 data, the times required for contaminant levels to naturally decline to MCLs were projected for the overburden aquifer. First-order rate constants were calculated by using contaminant concentration changes from 1997 to 2001 (the March and October 2001 concentrations were averaged to generate an average concentration for 2001). The rate constants calculated were then used to project the time required to reach MCLs from the current time (2001). The times required for PCE and/or TCE concentrations to reach MCLs range from 0 to 66 years (Table 3-6), with the longest time projection for PCE at well 11GW28. The time required for cis-1,2-DCE to reach the MCL in well 11GW22 was projected to be about 3 years. First-order rate equations used as the basis to estimate the rates of contaminant concentration decline are also provided in Table 3-6.

For the bedrock monitoring wells that have been sampled more than once, there appears to be a slight overall downward trend from 1999 through 2001, based on limited data (Table 3-5). To allow for normal variability between sampling rounds, the bedrock well data was grouped and averaged. For the older bedrock wells, the June 1999 and October 2000 data were averaged together (the resulting composite concentrations are assumed to be reflective of February 2000 groundwater conditions) and the two rounds of 2001 data were averaged and assumed to be reflective of June 2001 groundwater conditions. For the bedrock wells installed in 2000, the 2000 concentrations were compared to the average 2001 concentrations. These average concentrations were then used to project contaminant concentration declines over time (Table 3-6), as was done with the overburden wells. Projected times required for

contaminant levels to naturally decline to MCLs range from approximately 3 to 17 years, however the projections are based on only 1-2 years of data and should be regarded with caution.

TABLE 3-1

HYDRAULIC HEAD MEASUREMENTS - MONITORING WELL CLUSTERS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING MARYLAND

Monitoring Well	Screened Interval (ft bgs)	Monitored Geologic Unit	Groundwater Elevation 10/1/01
11GW22	20-40	S&G/Saprolite	346.17
11GW110	64.5-74.5	Bedrock	344.11
11GW118	95-105	Bedrock	342.87
11GW119S	149-159	Bedrock	342.6
11GW66	9-24	Saprolite	337.17
11GW108	36.5-46.5	Bedrock	337.71
11GW120	123-133	Bedrock	332.43
11GW105	34-44	Saprolite	339.45
11GW106	67.5-77.5	Bedrock	342.53
11GW71	10.25-25.25	Saprolite	339.43
11GW114	39-49	Bedrock	338.12
11GW86	20-30	Saprolite	328.84
11GW115	56-66	Bedrock	328.89
11GW29	9-19	Saprolite	319.25
11GW116	58-68	Bedrock	317.43
11GW117	84-94	Bedrock	317.41

TABLE 3-2

SLUG TEST RESULTS SUMMARY
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Well Identification	Screened Interval (ft below ground)	Hydraulic Conductivity (K) Falling Head (ft/day)	Rising Head (ft/day)	Average (ft/day)
11GW106	67.5 – 77.5	0.279	0.233	0.256
11GW107	42.5 – 52.5	3.154	3.046	3.100
11GW108	36.5 – 46.5	0.384	0.336	0.360
11GW109	45 – 55	1.281	1.652	1.467
11GW110	64.5 – 74.5	0.141	0.094	0.118
11GW112	95 – 105	0.211	0.237	0.224
11GW114	39 – 49	0.003	NA	0.003
11GW115	56 – 66	0.447	0.253	0.350
11GW116	58 – 68	1.880	1.850	1.865
11GW117	84 – 94	49.90	41.30	45.60
11GW118	95 – 105	0.188	0.150	0.169
11GW119S	149 – 159	NA	0.0087	0.0087
11GW119D	205 – 215	NA	NA	NA
11GW120	123 – 133	NA	0.0098	0.0098
11GW121	100 – 110	NA	0.129	0.129
			Geometric Mean K (ft/day)	**0.17**

NA – Not applicable, no test performed

TABLE 3-3

SUMMARY OF POSITIVE DETECTIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

location	11GW22	11GW28	11GW29	11GW66	11GW87	11GW105	11GW106	11GW107
dup								
samp_date	10/02/01	10/04/01	10/03/01	10/05/01	10/08/01	10/04/01	10/04/01	10/04/01
Volatile Organics (ug/L)								
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	10 U	10 U	10 U	10 U	1 U	10 U	7	10 U
ACETONE	50 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
BENZENE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
CHLOROETHANE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
CHLOROFORM	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
CHLOROMETHANE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
CIS-1,2-DICHLOROETHENE	110	2.9	10 U	13	2.8	10 U	25	10 U
TETRACHLOROETHENE	10 U	61	10 U	10 U	1 U	10 U	10 U	8.6
TOLUENE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
TRANS-1,2-DICHLOROETHENE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
TRICHLOROETHENE	46	27	10 U	7.8	1.9	2.6	7.3	8.2
VINYL CHLORIDE	10 U	10 U	10 U	10 U	1 U	10 U	10 U	10 U
Volatile Gases (mg/L)								
ETHANE	0.004 U	0.004 U	0.004 U	0.004 U	0.004	0.004 U	0.004 U	0.004 U
METHANE	0.012	0.002 U	0.006	0.005	0.006	0.002 U	0.006	0.008
Inorganics (ug/L)								
CALCIUM	2700	8070		2160			17600	6970
MAGNESIUM	1530	6130		1810			4880	4950
POTASSIUM	2080	2070		2000			3560	2110
SODIUM	30200	11700		5510			6790	12200
Miscellaneous Parameters (mg/L)								
ALKALINITY	6.5	2.5	27	7.5	14	3.5	77	3
BIOCHEMICAL OXYGEN DEMAND								
CHEMICAL OXYGEN DEMAND								
CHLORIDE	31	4.1	6	2.1	3	3.5	1 U	1.6
FERROUS IRON								
HEXAVALENT CHROMIUM*								
NITRATE	5.5	1 U	1.7	1 U	1 U	1 U	6.9	1 U
OXIDATION REDUCTION POTENTIAL								
PH								
SULFATE	7	5.4	5.7	1 U	1.6	4.7	2.4	1 U
TOTAL ORGANIC CARBON	3.1	0.4	2.9	0.4 U	1.2	0.78	1.4	0.4 U

* Hexavalent chromium results listed as total/filtered

TABLE 3-3

SUMMARY OF POSITIVE DETECTIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

location dup samp_date	11GW108 10/04/01	11GW109 10/08/01	11GW110 10/02/01	11GW110 10/02/01	11GW112 10/05/01	11GW114 10/10/01	11GW115 10/09/01	11GW116 10/03/01
Volatile Organics (ug/L)								
1,1-DICHLOROETHANE	10 U	1 U	12	1 U	4.3	1 U	1 U	1 U
1,1-DICHLOROETHENE	10 U	1 U	4.6	1 U	1.5	1 U	1 U	1 U
1,2-DICHLOROETHANE	10 U	1 U	46	1 U	16	1 U	1 U	1 U
ACETONE	10 U	5 U	8.6	5 U	10 U	5 U	5 U	5 U
BENZENE	10 U	1 U	1 U	1 U	2.9	1 U	1 U	1 U
CARBON DISULFIDE	10 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U
CARBON TETRACHLORIDE	10 U	1 U	2.9	1 U	10 U	1 U	1 U	1 U
CHLOROETHANE	10 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U
CHLOROFORM	10 U	1 U	11	1.3	10 U	1 U	1 U	1 U
CHLOROMETHANE	10 U	1 U	1 U	1 U	10 U	1 U	1.1	1 U
CIS-1,2-DICHLOROETHENE	12	0.6	160	130	120	1 U	1 U	1 U
TETRACHLOROETHENE	10 U	1 U	3.2	1.4	10 U	1 U	1 U	1 U
TOLUENE	10 U	1 U	1 U	1 U	1.1	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	10 U	1 U	2.8	0.8	10 U	1 U	1 U	1 U
TRICHLOROETHENE	7.9	1 U	190	47	34	1 U	1 U	1 U
VINYL CHLORIDE	10 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U
Volatile Gases (mg/L)								
ETHANE	0.004 U	0.004 U	0.004 U		0.004 U	0.004 U	0.004 U	0.004 U
METHANE	0.005	0.01	31.5		17.1	8.4	6.9	0.7
Inorganics (ug/L)								
CALCIUM	2670	7790	4360					
MAGNESIUM	1250	4520	2460					
POTASSIUM	943	2860	2770					
SODIUM	5190	10400	6990					
Miscellaneous Parameters (mg/L)								
ALKALINITY	7.5	43	27		110	87	72	91
BIOCHEMICAL OXYGEN DEMAND								
CHEMICAL OXYGEN DEMAND								
CHLORIDE	1 U	6	4.9		3.6	3	5	9.1
FERROUS IRON								
HEXAVALENT CHROMIUM*								
NITRATE	1.2	1.2	0.5 U		1 U	1.2	3	0.5 U
OXIDATION REDUCTION POTENTIAL								
PH								
SULFATE	1 U	1.9	3		1 U	1.1	2.6	3
TOTAL ORGANIC CARBON	0.4 U	0.62	2.5		6.7	1.7	2	7.4

* Hexavalent chromium results listed as

TABLE 3-3

SUMMARY OF POSITIVE DETECTIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

location dup samp_date	11GW117 11GW1172000-D 10/03/01	11GW117 10/03/01	11GW117D 11GW1172000 10/03/01	11GW118 11GW1182000-D 10/02/01	11GW118 10/02/01	11GW118D 11GW1182000 10/02/01	11GW119D 10/02/01
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	1 U	1 U	1 U	17	17	17	1 U
1,1-DICHLOROETHENE	1 U	1 U	1 U	8.1	8.05	8	1 U
1,2-DICHLOROETHANE	1 U	1 U	1 U	77	76.5	76	2.5
ACETONE	5 U	5.3	8.1	550	385	220	35000
BENZENE	1 U	1 U	1 U	0.6	0.55	0.5	1 U
CARBON DISULFIDE	1 U	1 U	1 U	31	15.75	1 U	1 U
CARBON TETRACHLORIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	4.5	4.45	4.4	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U	1.3
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	1 U	1 U	1 U	340	345	350	7.2
TETRACHLOROETHENE	1 U	1 U	1 U	1.7	1.65	1.6	1 U
TOLUENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1.8	1.75	1.7	1 U
TRICHLOROETHENE	1 U	1 U	1 U	140	140	140	4
VINYL CHLORIDE	1 U	1 U	1 U	1	1	1	1 U
Volatile Gases (mg/L)							
ETHANE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
METHANE	0.014	0.0075	0.002 U	17.5	18.05	18.6	0.005
Inorganics (ug/L)							
CALCIUM				15800	15700	15600	35000
MAGNESIUM				7200	7075	6950	9280
POTASSIUM				5130	4685	4240	7040
SODIUM				14400	15800	17200	21400
Miscellaneous Parameters (mg/L)							
ALKALINITY	120	120	120	98	99	100	140
BIOCHEMICAL OXYGEN DEMAND							
CHEMICAL OXYGEN DEMAND							
CHLORIDE	2 U	2 U	2 U	7.8	7.6	7.4	4.3
FERROUS IRON							
HEXAVALENT CHROMIUM*							
NITRATE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
OXIDATION REDUCTION POTENTIAL							
PH							
SULFATE	5	5	5	2	1.5	1	21
TOTAL ORGANIC CARBON	1.1	2.05	3	12	12	12	44

* Hexavalent chromium results listed as

TABLE 3-3

SUMMARY OF POSITIVE DETECTIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

location dup samp_date	11GW119S 10/03/01	11GW120 10/05/01	11GW121 10/10/01	11GW27 10/09/01	11PZ63 10/09/01
Volatile Organics (ug/L)					
1,1-DICHLOROETHANE	3.9	1	1 U		
1,1-DICHLOROETHENE	0.8	10 U	1 U		
1,2-DICHLOROETHANE	16	2.9	1 U		
ACETONE	8400	34	1200		
BENZENE	1 U	10 U	1 U		
CARBON DISULFIDE	1 U	10 U	1 U		
CARBON TETRACHLORIDE	1 U	10 U	1 U		
CHLOROETHANE	1 U	10 U	1 U		
CHLOROFORM	1 U	2.1	0.9		
CHLOROMETHANE	1 U	10 U	1 U		
CIS-1,2-DICHLOROETHENE	47	15	1 U		
TETRACHLOROETHENE	1 U	10 U	1 U		
TOLUENE	1 U	10 U	1 U		
TRANS-1,2-DICHLOROETHENE	1 U	10 U	1 U		
TRICHLOROETHENE	21	16	1 U		
VINYL CHLORIDE	1 U	10 U	1 U		
Volatile Gases (mg/L)					
ETHANE	0.004 U	0.004 U	0.004 U		
METHANE	0.014	0.006	0.007		
Inorganics (ug/L)					
CALCIUM	26600	3010	21500		
MAGNESIUM	7360	1680	5550		
POTASSIUM	5230	3250	4440		
SODIUM	29500	6080	9890		
Miscellaneous Parameters (mg/L)					
ALKALINITY	140	22	64		
BIOCHEMICAL OXYGEN DEMAND				3.8	5.5
CHEMICAL OXYGEN DEMAND				5 U	5
CHLORIDE	3.7	2.6	3.6		
FERROUS IRON				0.1 U	16
HEXAVALENT CHROMIUM*				0.41/0.4	0.01 U/0.01 U
NITRATE	0.5 U	1 U	1 U		
OXIDATION REDUCTION POTENTIAL				0.4 MV	0.18 MV
PH				5.08 PHUNI	6.33 PHUNI
SULFATE	12	1 U	1 U		
TOTAL ORGANIC CARBON	87	0.66	2.9	0.63	3.2

* Hexavalent chromium results listed as

TABLE 3-4

SUMMARY OF NATURAL ATTENUATION DATA COLLECTED OCTOBER 2001
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Monitoring Well	Field Analyses													
	pH (SU)	SC (mS/cm)	Temp (°C)	Turbidity (NTU)	DO (meter) (mg/L)	DO (test kit) (mg/L)	ORP (mV)	Fe^{+2} (mg/L)	CO_2 (mg/L)	HS (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)
11GW22	4.99	0.172	19.3	9.8	5.04	4	283	0.01	45	0	9	0.02	0.004	>1.65
11GW28	4.93	0.204	17.8	9.24	5.29	5	277	0	70	0	1	0.02	0	>1.65
11GW29	5.63	0.348	20.6	0.5	3.27	6	67	3.8	13	0	7	0.04	0	0
11GW66	5.06	0.149	16.2	27.8	5.88	2	212	0.3	30	0	2	0.07	0.002	0.84
11GW87	6.05	0.698	15.4	198	3.7	1.5	-6	4	60	0	18	0.29	0	0
11GW105	5.11	0.178	20.1	14.3	6.74	6	247	0	30	0	0	0.02	0	>1.65
11GW106	7.14	0.205	20.5	4	7	1	-119	2	15	0	7	0	0	0
11GW107	4.95	0.194	17	1.8	4.11	2	269	0	50	0	1	0.01	0	>1.65
11GW108	5.5	0.067	19.6	1	7.7	2	196	0.2	22.5	0	0	0.01	0	>1.65
11GW109	6.43	0.155	18.1	7.6	2.9	0	-54	5	25	0	1	0.01	0	0
11GW110	5.76	0.087	18.9	1.2	4.01	1	168	0.1	50	0	0	0.07	0	0.34
11GW112	6.6	0.264	16.8	2.89	3.52	3	-80	4	40	0	0	0.04	0	0
11GW114	7.3	0.532	16.4	20.4	4.97	2.5	-157	1	17	0.1	1	0	0.006	1.59
11GW115	6.48	0.263	15.7	1	3.23	0.5	-58	4.1	35	0	0	0.02	0	0
11GW116	6.58	0.212	18.5	1.4	1.23	0.05	-117	3.2	18	0.3	0	0.1	0	0
11GW117	7.88	0.25	18.8	0.5	6.9	0.05	-155	0	<10	0.5	0	0.1	0	0
11GW118	6.65	0.231	17.7	1.5	2.31	0.05	-89	4.5	45	0.1	0	0.08	0	0
11GW119S	7.3	0.274	18.4	2	7.76	5	142	0	<10	0	11	0.01	0.002	0.03
11GW119D	7.56	0.329	16.2	89	7	6	154	0	14	0	13	0.14	0.007	0
11GW120	6.09	0.083	19.7	14	6.32	5	136	0	18	0	1	0.05	0.008	1.17
11GW121	7.16	0.232	17.3	9	4.6	3	-109	1.6	12	0	0	0.01	0	0

TABLE 3-4

SUMMARY OF NATURAL ATTENUATION DATA COLLECTED OCTOBER 2001
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Monitoring Well	Fixed-Base Lab Analyses								
	Alkalinity (mg/L)	TOC (mg/L)	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Methane (mg/L)	Ethane (mg/L)	Ethene (mg/L)
11GW22	6.5	3.1	31	<0.05	5.5	7	0.012	ND	ND
11GW28	2.5	0.4	4.1	<1.0	<1.0	5.4	ND	ND	ND
11GW29	27	2.9	6	<1.0	1.7	5.7	0.006	ND	ND
11GW66	7.5	<0.4	2.1	<1.0	<1.0	<1.0	0.005	ND	ND
11GW87	14	1.2	3	<1.0	<1.0	1.6	0.006	0.004	ND
11GW105	3.5	0.78	3.5	<1.0	<1.0	4.7	ND	ND	ND
11GW106	77	1.4	<1.0	<1.0	6.9	2.4	0.006	ND	ND
11GW107	3	<0.4	1.6	<1.0	<1.0	<1.0	0.008	ND	ND
11GW108	7.5	<0.4	<1.0	<1.0	1.2	<1.0	0.005	ND	ND
11GW109	43	0.62	6	<1.0	1.2	1.9	0.01	ND	ND
11GW110	27	2.5	4.9	<0.05	<0.5	3	31.5	ND	ND
11GW112	110	6.7	3.6	<1.0	<1.0	<1.0	17.1	ND	ND
11GW114	87	1.7	3	<1.0	1.2	1.1	8.4	ND	ND
11GW115	72	2	5	<1.0	3	2.6	6.9	ND	ND
11GW116	91	7.4	9.1	<0.05	<0.5	3	0.7	ND	ND
11GW117	120	1.1	<2.0	<0.05	<0.5	5	0.014	ND	ND
11GW118	98	12	7.8	<0.05	<0.5	2	17.5	ND	ND
11GW119S	140	87	3.7	<0.05	<0.5	12	0.014	ND	ND
11GW119D	140	44	4.3	<0.05	<0.5	21	0.005	ND	ND
11GW120	22	0.66	2.6	<1.0	<1.0	<1.0	0.006	ND	ND
11GW121	64	2.9	3.6	<1.0	<1.0	<1.0	0.007	ND	ND

TABLE 3-5

PCE/TCE/CIS-1,2-DCE/VINYL CHLORIDE TRENDS (ug/L)
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Well	Geologic Unit	Date	PCE	TCE	1,2-DCE	VC	Sum (PCE/ TCE/DCE/VC)	PCE/Sum	TCE/Sum	DCE/Sum
11GW22	OB	1985	12	166	0	0	178	0.07	0.93	0.00
		1989	10	110	1000	0	1120	0.01	0.10	0.89
		1991	9	150	0	0	159	0.06	0.94	0.00
		1997	3	61	215	0	279	0.01	0.22	0.77
		1999	3.4	75	153	0	231.4	0.01	0.32	0.66
		2000	2.6	61	110	0	173.6	0.01	0.35	0.63
		Mar-01	2.7	46	100	0	148.7	0.02	0.31	0.67
		Oct-01		46	110	0	156	0.00	0.29	0.71
11GW28	OB	1985	41	0	0	0	41	1.00	0.00	0.00
		1991	77	9	2	0	88	0.88	0.10	0.02
		1997	71	20	2	0	93	0.76	0.22	0.02
		1999	70	23	3.4	0	96.4	0.73	0.24	0.04
		2000	60	33	3.3	0	96.3	0.62	0.34	0.03
		Mar-01	61	22	3.9	0	86.9	0.70	0.25	0.04
		Oct-01	61	27	2.9	0	90.9	0.67	0.30	0.03
11GW66	OB	1989	0	6	8	0	14	0.00	0.43	0.57
		1991	0	5	2	0	7	0.00	0.71	0.29
		1997	0	8	6	0	14	0.00	0.57	0.43
		1999	0.56	9.6	14	0	24.16	0.02	0.40	0.58
		2000	0.8	14	22	0	36.8	0.02	0.38	0.60
		Mar-01	0	1.2	1.9	0	3.1	0.00	0.39	0.61
		Oct-01	0	7.8	13	0	20.8	0.00	0.38	0.63
11GW87	OB	1991	0	2	0	0	2	0.00	1.00	0.00
		1997	0	1	2	0	3	0.00	0.33	0.67
		1999	0	2.5	3	0	5.5	0.00	0.45	0.55
		2000	0	2.7	3	0	5.7	0.00	0.47	0.53
		Mar-01	0	2.2	2.7	0	4.9	0.00	0.45	0.55
		Oct-01	0	1.9	2.8	0	4.7	0.00	0.40	0.60

TABLE 3-5

PCE/TCE/CIS-1,2-DCE/VINYL CHLORIDE TRENDS (ug/L)
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

Well	Geologic Unit	Date	PCE	TCE	1,2-DCE	VC	Sum (PCE/ TCE/DCE/VC)	PCE/Sum	TCE/Sum	DCE/Sum
11GW106	BR	1999	0	7.3	19	0	26.3	0.00	0.28	0.72
		2000	0	8.4	24	0	32.4	0.00	0.26	0.74
		Mar-01	0	7.5	23	0	30.5	0.00	0.25	0.75
		Oct-01	0	7.3	25	0	32.3	0.00	0.23	0.77
11GW107	BR	1999	10	7.3	0.2	0	17.5	0.57	0.42	0.01
		2000	11	11	0	0	22	0.50	0.50	0.00
		Mar-01	11	9.3	0	0	20.3	0.54	0.46	0.00
		Oct-01	8.6	8.2	0	0	16.8	0.51	0.49	0.00
11GW108	BR	1999	1	17.2	23.2	0	41.4	0.02	0.42	0.56
		2000	1.1	20	23	0	44.1	0.02	0.45	0.52
		Mar-01	1	15	20	0	36	0.03	0.42	0.56
		Oct-01	0	7.9	12	0	19.9	0.00	0.40	0.60
11GW110	BR	1999	7.7	347	275	0	629.7	0.01	0.55	0.44
		2000	4.7	220	160	0	384.7	0.01	0.57	0.42
		Mar-01	5.6	220	160	0	385.6	0.01	0.57	0.41
		Oct-01	3.2	180	140	0	323.2	0.01	0.56	0.43
11GW112	BR	2000	0	56	88	0	144	0.00	0.39	0.61
		Mar-01	0.7	65	120	0.5	186.2	0.00	0.35	0.64
		Oct-01	0	34	120	0	154	0.00	0.22	0.78
11GW118	BR	2000	4	260	230	0.8	494.8	0.01	0.53	0.46
		Mar-01	2.1	140	340	0.9	483	0.00	0.29	0.70
		Oct-01	1.7	140	345	1	487.7	0.00	0.29	0.71

Notes: 1999 results are an average of 4 rounds of sampling
Site 11 leaching wells removed in late 1996
OB - Overburden well
BR - Bedrock well

H:WO-Site 11 NA trends

TABLE 3-6

CLEANUP RATE PROJECTIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

WELL	CONTAMINANT	C_0, ug/L	C_t, ug/L	t, years	k	C_x, ug/L	t_x, years
11GW22	TCE	61	46	4	0.07057	5	31.45
	1,2-DCE	215	110	4	0.16756	70	2.70
11GW28	PCE	71	61	4	0.03796	5	65.91
11GW66	TCE	8	4.5	4	0.14386	5	-0.73
11GW106	TCE	7.85	7.4	1.33	0.04439	5	8.83
11GW107	PCE	10.5	9.85	1.33	0.04805	5	14.11
	TCE	9.15	8.75	1.33	0.03361	5	16.65
11GW108	TCE	18.6	11.95	1.33	0.33269	5	2.62
11GW110	TCE	283.5	200	1.33	0.26235	5	14.06
	1,2-DCE	217.5	150	1.33	0.27940	70	2.73
11GW112	TCE	56	49.5	0.667	0.18500	5	12.39
11GW118	TCE	260	140	0.667	0.92819	5	3.59

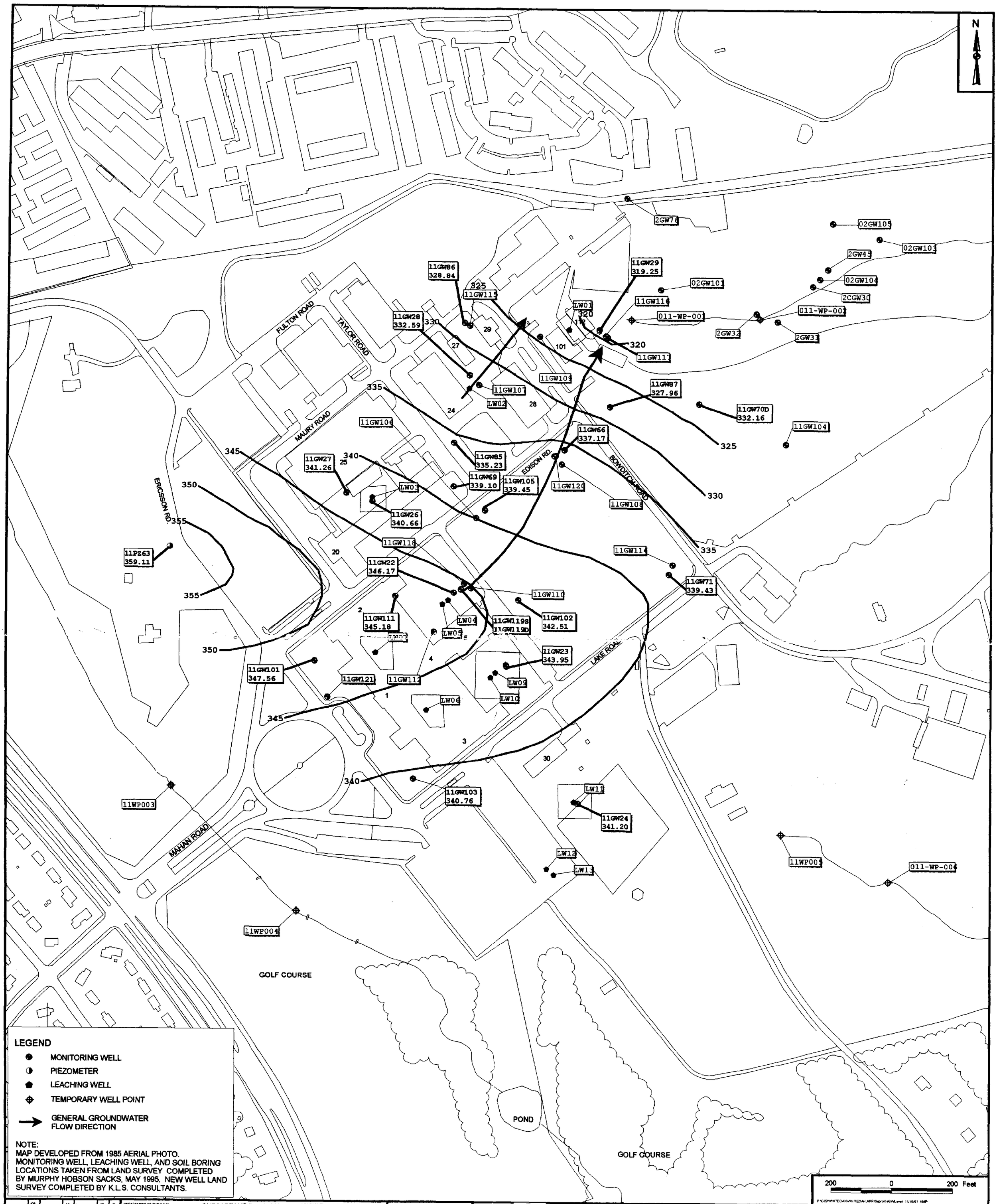
C_0 = Concentration at time 0 C_t = Concentration at time t C_x = Target concentration = MCL

t = Elapsed time t_x = Time required to reach target concentration, from current time

$C_t = C_0 \times e^{-kt}$ $C_x = C_0 \times e^{-ktx}$

k = 1st order coefficient = $-(\ln (C_t/C_0))/t$

H:WO Site 11 Cleanup Rate Proj



LEGEND

- MONITORING WELL
- PIEZOMETER
- LEACHING WELL
- TEMPORARY WELL POINT
- GENERAL GROUNDWATER FLOW DIRECTION

NOTE:
MAP DEVELOPED FROM 1985 AERIAL PHOTO.
MONITORING WELL, LEACHING WELL, AND SOIL BORING LOCATIONS TAKEN FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY 1995. NEW WELL LAND SURVEY COMPLETED BY K.L.S. CONSULTANTS.

FIGURE 3-1

SHEET _ OF _

NAVFAC DRAWING NO.

SPEC.

CONST. CONT. NO.

DRAWING SIZE: C

CODE I.D. NO. 80091

DEPARTMENT OF THE NAVY — CHESAPEAKE DIVISION — NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.

SITE 11
SAPROLITE GROUNDWATER FLOW PATTERN
OCTOBER 1, 2001
FORMER NSWC-WHITE OAK, SILVER SPRING, MARYLAND

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSON DRIVE
PITTSBURGH, PA 15220

DES. | DR. | CHK.
SUBMITTED BY: K. Peila — TITLE — DATE 10-30-01
PROGRAM MANAGER — DATE
APPROVED — DATE
EFD FOR COMMAND NAVFAC

DGA	403
04	404
E.I.C.	405
401	406
402	04B

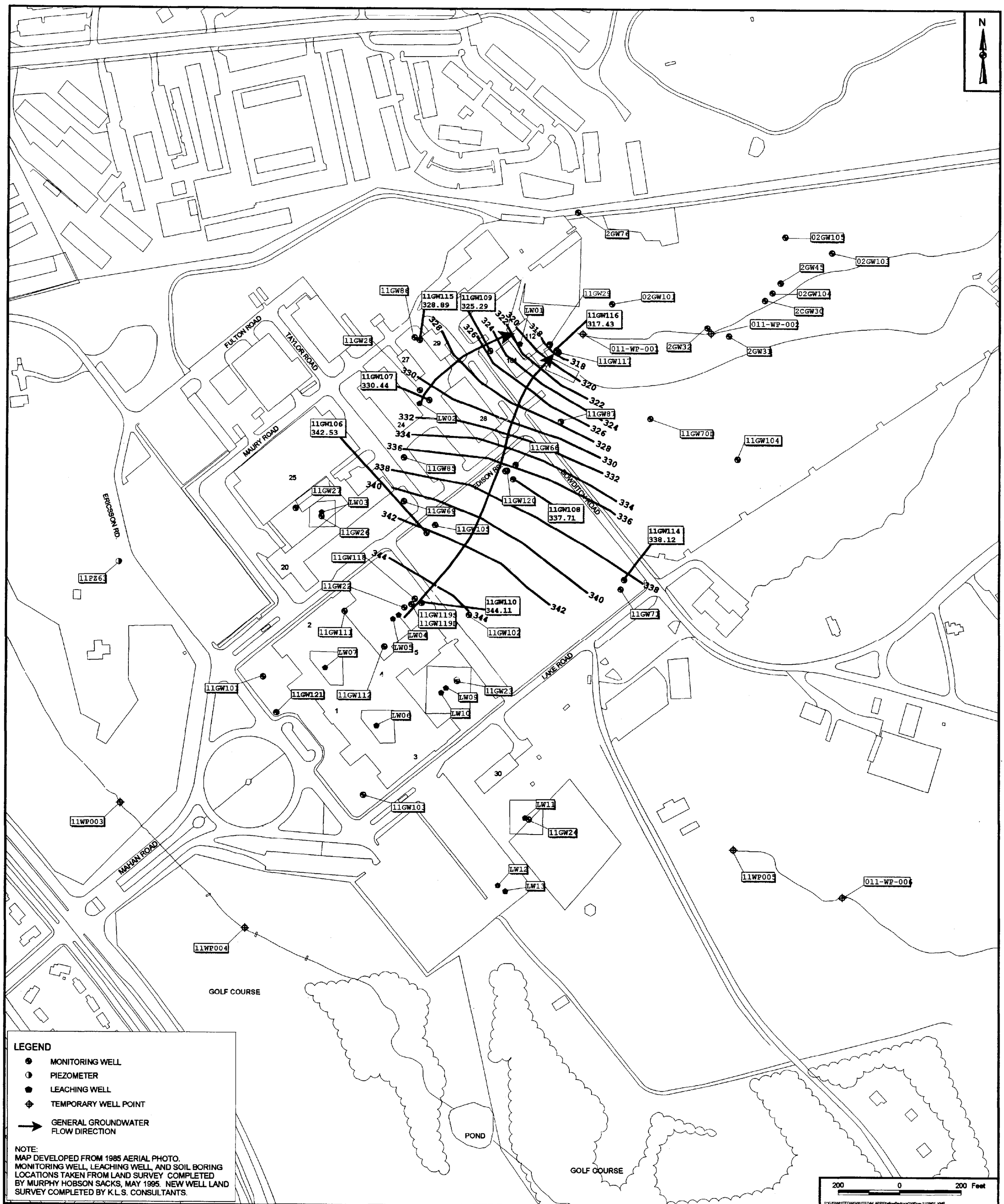
REVIEWED BY ROICC — DATE

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

P:\GIS\WHITEOAK\WHITEOAK_APR\Saprolite\GWL.mxd 11/19/01 KMP

OC517ABOX



LEGEND

- MONITORING WELL
- PIEZOMETER
- LEACHING WELL
- TEMPORARY WELL POINT
- GENERAL GROUNDWATER FLOW DIRECTION

NOTE:
MAP DEVELOPED FROM 1985 AERIAL PHOTO. MONITORING WELL, LEACHING WELL, AND SOIL BORING LOCATIONS TAKEN FROM LAND SURVEY COMPLETED BY MURPHY HOBSON SACKS, MAY 1995. NEW WELL LAND SURVEY COMPLETED BY K.L.S. CONSULTANTS.

200 0 200 Feet

P:\C120WHITEOAK\WHITEOAK APR\ShallowBedrockGWFlow 11/19/01 IGMP

FIGURE 3-2

SHEET _ OF _

NAVFAC DRAWING NO.

SPEC.

CONST. CONT. NO.

DRAWING SIZE: C

CODE I.D. NO. 60091

DEPARTMENT OF THE NAVY — CHESAPEAKE DIVISION — NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.

SITE 11
SHALLOW BEDROCK GROUNDWATER FLOW PATTERN
OCTOBER 1, 2001
FORMER NSWC-WHITE OAK, SILVER SPRING, MARYLAND

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSEN DRIVE
PITTSBURGH, PA. 15220

DES. | DR. | CHK.
SUBMITTED BY: K. Peila — TITLE — DATE 10-30-01
PROGRAM MANAGER — DATE
APPROVED — DATE
EFD FOR COMMAND NAVFAC

REVIEWED BY ROICC — DATE

D9A	403
D4	404
E.I.C.	405
401	406
402	D48

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

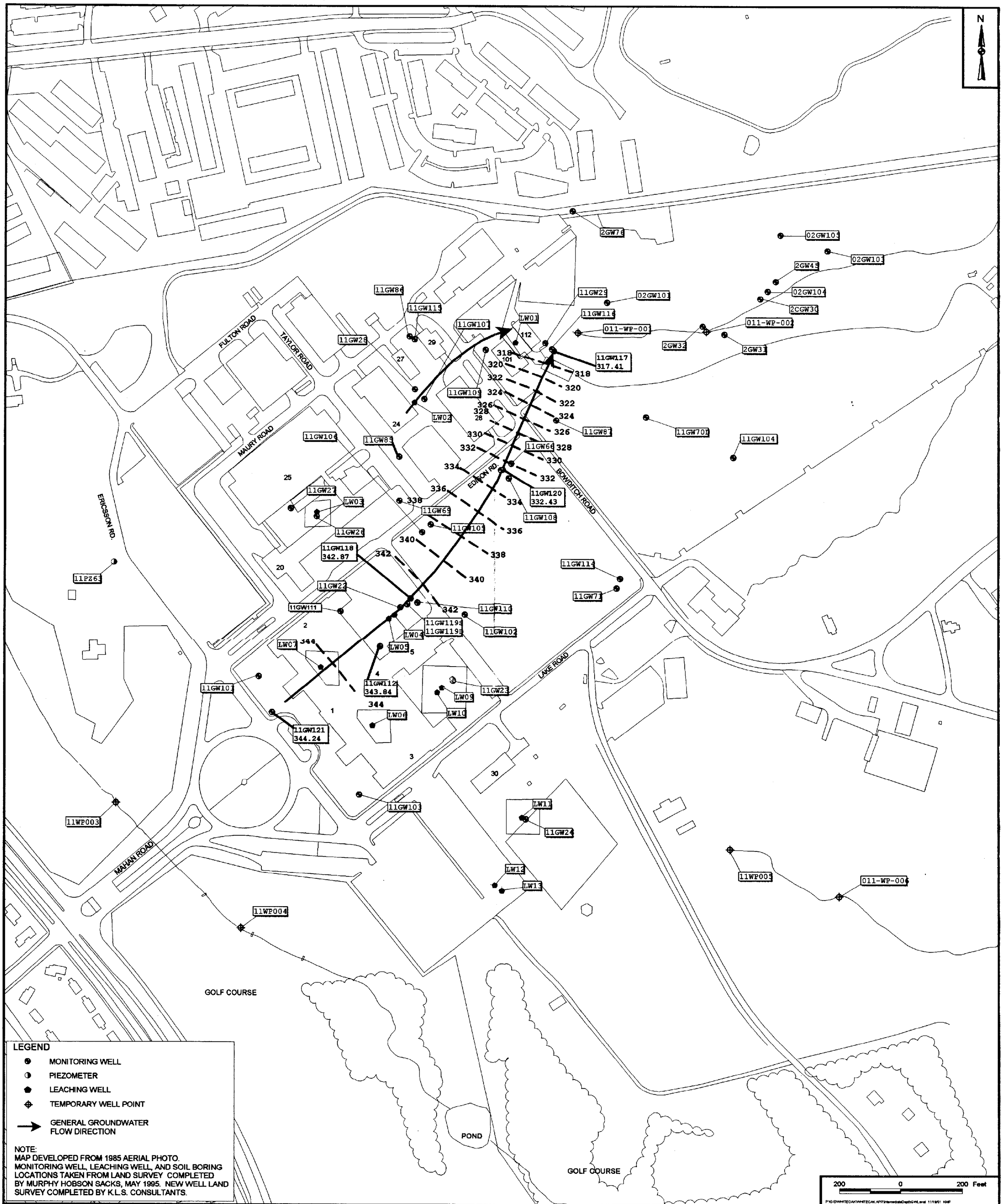


FIGURE 3-3

SHEET _ OF _

NAVFAC DRAWING NO.

SPEC.

CONST. CONT. NO.

DRAWING SIZE: C

CODE I.D. NO. 80091

DEPARTMENT OF THE NAVY — CHESAPEAKE DIVISION — NAVAL FACILITIES ENGINEERING COMMAND — WASHINGTON, D.C.

SITE 11
INTERMEDIATE - DEPTH (85-130 ft.)
BEDROCK GROUNDWATER LEVEL DATA
OCTOBER 1, 2001
FORMER NSWC-WHITE OAK, SILVER SPRING, MARYLAND

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSON DRIVE
PITTSBURGH, PA. 15220

DES. | DR. | CHK.

SUBMITTED BY: K. Peila — TITLE — DATE 10-30-01

PROGRAM MANAGER — DATE

APPROVED — DATE

EFD FOR COMMAND NAVFAC

REVIEWED BY ROICC — DATE

DBA	403
04	404
E.I.C.	405
401	406
402	048

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

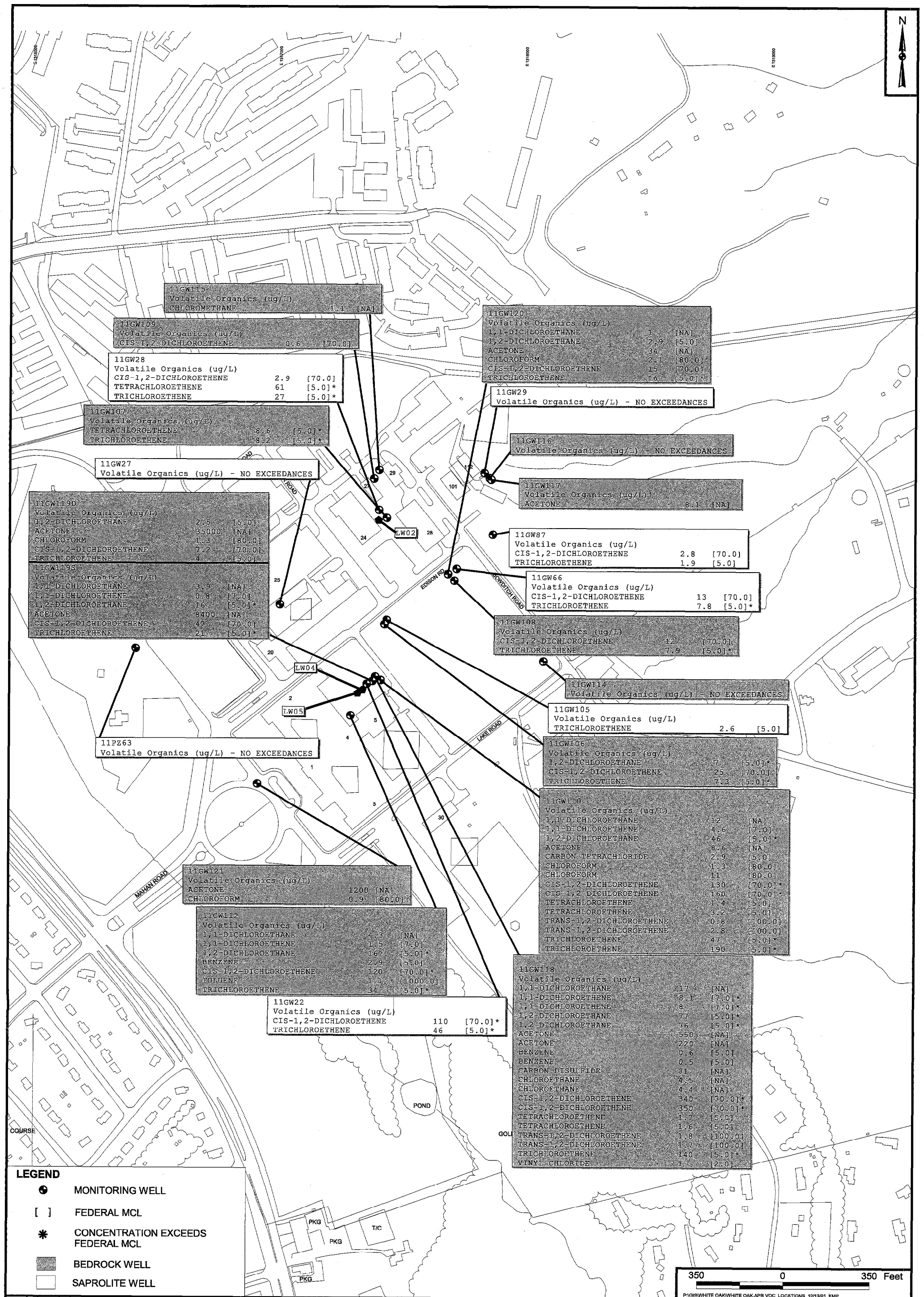


FIGURE 3-4

SHEET ___ OF ___

NAVFAC DRAWING NO.

SPEC.

CONST. CONT. NO.

DRAWING SIZE:

CODE I.D. NO. 80091

DEPARTMENT OF THE NAVY — CHESAPEAKE DIVISION — NAVAL FACILITIES ENGINEERING COMMAND — WASHINGTON, D.C.

VOLATILE ORGANICS IN GROUNDWATER - OCTOBER 2001
SITE 11 DATA GAP INVESTIGATION
FORMER NSWC WHITE OAK

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

DES. | DR. | CHK.
SUBMITTED BY: TITLE DATE
PROGRAM MANAGER DATE
APPROVED DATE
EFD FOR COMMAND NAVFAC

09A	403
04	404
E.I.C.	405
401	408
402	04B

REVIEWED BY ROICC DATE

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

00517AB3Z

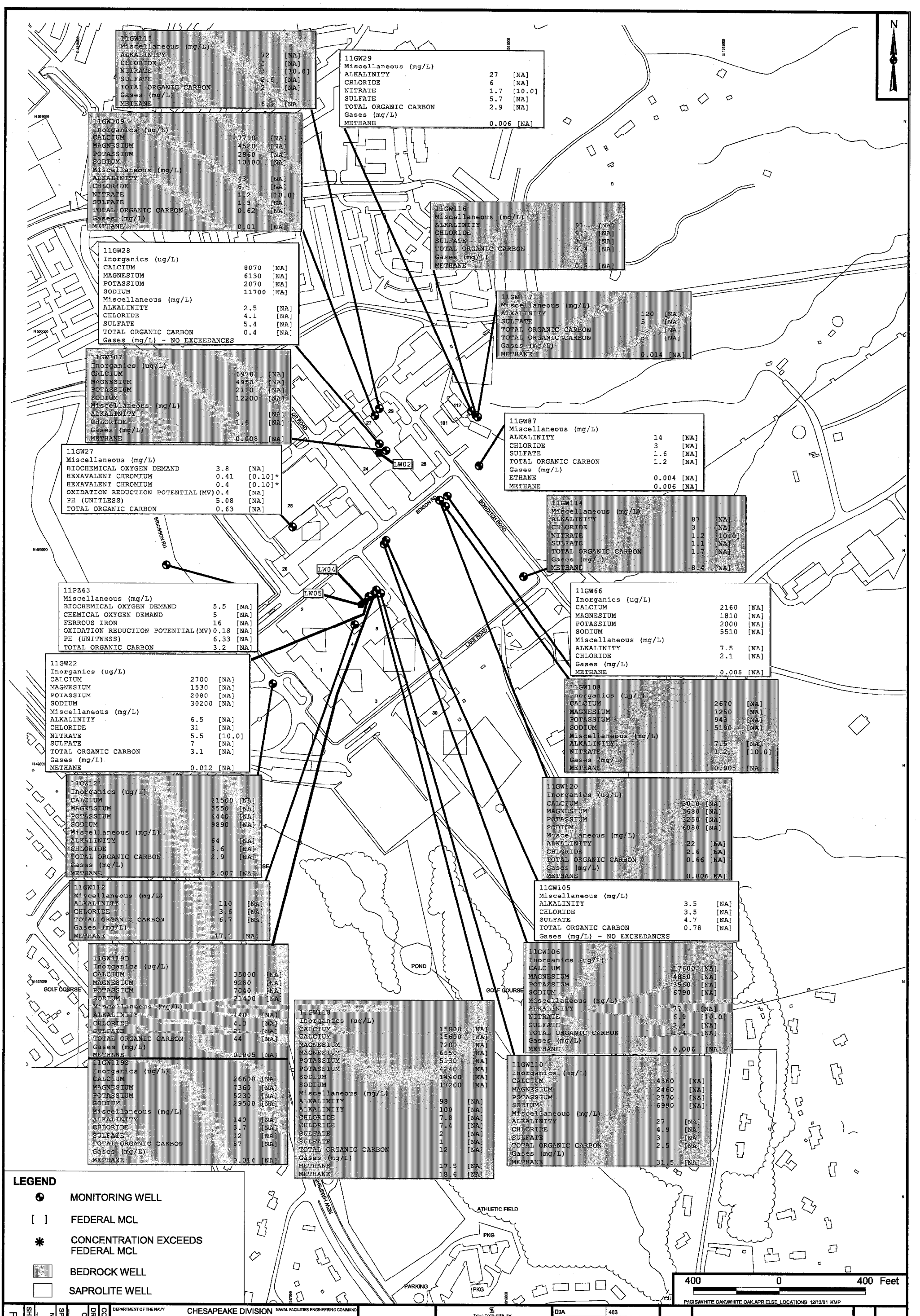


FIGURE 3-5

SHEET OF

SPEC.

NAVFAC DRAWING NO.

CONST. CONT. NO.

DRAWING SIZE: D

CODE I.D. NO. 80091

DEPARTMENT OF THE NAVY — CHESAPEAKE DIVISION — NAVAL FACILITIES ENGINEERING COMMAND — WASHINGTON, D.C.

OTHER ANALYTES IN GROUNDWATER - OCTOBER 2001
SITE 11 DATA GAP INVESTIGATION
FORMER NSWC WHITE OAK

SEAL AREA

Tetra Tech NUS, Inc.
FOSTER PLAZA VII
661 ANDERSEN DRIVE
PITTSBURGH, PA 15220

DES. DR. CHK.
SUBMITTED BY: TITLE DATE
PROGRAM MANAGER DATE
APPROVED DATE
EFD FOR COMMAND NAVFAC

9A	403
04	404
E.I.C.	405
401	406
402	4B

REVIEWED BY ROICC DATE

SYMBOL	DESCRIPTION	DATE	APPROVED

REVISIONS

4.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations were reached as a result of this data gap investigation of Site 11 groundwater:

4.1 CONCLUSIONS

- Volatile organics (TCE, PCE, cis-1,2-DCE, 1,2-DCA) are the primary concern in regards to groundwater contamination.

- Two discrete groundwater contaminant plumes have been identified. The plume with the highest contaminant levels and greatest areal extent is centered around well cluster 11GW/22110/118/119S/119D and former leaching wells LW03 and LW04; a much smaller, lower concentration plume is located in the vicinity of wells 11GW28/107 and former leaching well LW02. Contamination detected in well 11GW112 is part of the larger plume and is not due to a separate source.

- Overburden groundwater flows to the northeast across most of Site 11. There is some localized mounding of groundwater in the western portion of the site that corresponds to a local topographic high.

- The bedrock groundwater flow direction is to the northeast, towards the small tributary of Paint Branch that flows eastward from the eastern edge of Site 11. It is expected that the bedrock groundwater discharges to this tributary.

- The contaminant plumes decrease in concentration rapidly with increasing distance from the sources. It is expected that contaminant concentrations are reduced through natural processes to trace/nondetect levels prior to reaching the stream or any potential human receptors.

- The highest levels of groundwater contamination are in the portion of the bedrock aquifer less than 130 feet in depth. Packer sampling and subsequent deep well installations confirm that contaminant levels drop off with increasing depth below 130 feet.

- Bedrock is tightly fractured in general – the water transmitting capacity of the bedrock aquifer is relatively low, with a 4 order-of-magnitude range (<0.003 ft/day to 46 ft/day) in bulk hydraulic conductivities (geometric mean K 0.17 ft/day). Based on slug testing results, the water-transmitting capability of the bedrock aquifer decreases with depth.

- Natural attenuation sampling results and evaluations indicate that some biodegradation of contaminants (PCE/TCE to DCE) is occurring, especially in the bedrock aquifer. Natural processes (dispersion, dilution, biodegradation) appear to be effectively limiting the migration of contamination, and the discharge of groundwater to local surface water bodies also limits the potential migration distance of the contamination.

- Based on evaluations of contaminant trends over time, the contaminant plumes are stable to slowly declining in terms of concentration and areal extent. It is expected that contaminant concentrations will continue to decline over time, both in the source areas and downgradient, as a result of the discontinued use of the leaching wells and the removal of the located leaching wells.

- The projected rates of contaminant concentration decline due to natural attenuation processes vary. The projected groundwater cleanup rates for bedrock groundwater are faster than for overburden groundwater.

- Groundwater contaminant concentrations exceed Federal MCLs for drinking water, indicating an unacceptable risk to potential groundwater users. There are no current or anticipated future groundwater users in the area of the contaminant plume who may be adversely impacted by the bedrock groundwater contamination.

4.2 RECOMMENDATIONS

- Based on the data collected, the evaluations described in this report, and the conclusions presented above, it is recommended that Site 11 groundwater be evaluated through a Corrective Measures Study (CMS). The characterization of Site 11 groundwater performed to date is adequate to move forward with an evaluation of remedial options for the site.

- As part of the corrective measures study, it is recommended that the natural attenuation evaluation process be completed for Site 11 groundwater in accordance with existing EPA guidance, and the results of the evaluation presented in the CMS.

- Continued periodic monitoring of the bedrock aquifer (semiannual sampling of selected wells) is recommended to ensure that the contaminant distributions and trends do not adversely change over time.

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Tetra Tech NUS, June 1, 2001. Letter Report - March 2001 Groundwater Sampling Results - Site 11. Pittsburgh, Pennsylvania.

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APPENDIX A

ANALYTICAL DATA

Monitoring Well Sampling Results

n298_res -
full appendix results

order	001	002	003	004	005	006	007	008	009	010
location	11GW22	11GW105	11GW106	11GW107	11GW108	11GW109	11GW110	11GW110	11GW112	11GW114
dup										
samp_date	10/2/2001	10/4/2001	10/4/2001	10/4/2001	10/4/2001	10/8/2001	10/2/2001	10/2/2001	10/5/2001	10/10/2001
Volatile Organics (ug/L)										
1,1,1-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
1,1,2,2-TETRACHLOROETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
1,1,2-TRICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
1,1-DICHLOROETHANE	10 U	10 U	10 U	10 U	10 U	1 U	12	1 U	4.3	1 U
1,1-DICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	1 U	4.6	1 U	1.5	1 U
1,2,4-TRICHLOROBENZENE	10 U					1 U	1 U	1 U		1 U
1,2-DIBROMO-3-CHLOROPROPANE	10 U					1 U	1 U	1 U		1 U
1,2-DIBROMOETHANE	10 U					1 U	1 U	1 U		1 U
1,2-DICHLOROBENZENE	10 U					1 U	1 U	1 U		1 U
1,2-DICHLOROETHANE	10 U	10 U	7	10 U	10 U	1 U	46	1 U	16	1 U
1,2-DICHLOROPROPANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
1,3-DICHLOROBENZENE	10 U					1 U	1 U	1 U		1 U
1,4-DICHLOROBENZENE	10 U					1 U	1 U	1 U		1 U
2-BUTANONE	50 U	10 U	10 U	10 U	10 U	5 U	5 U	5 U	10 U	5 U
2-HEXANONE	50 U	10 U	10 U	10 U	10 U	5 U	5 U	5 U	10 U	5 U
4-METHYL-2-PENTANONE	50 U	10 U	10 U	10 U	10 U	5 U	5 U	5 U	10 U	5 U
ACETONE	50 U	10 U	10 U	10 U	10 U	5 U	8.6	5 U	10 U	5 U
BENZENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	2.9	1 U
BROMOCHLOROMETHANE	10 U					1 U	1 U	1 U		1 U
BROMODICHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
BROMOFORM	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
BROMOMETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
CARBON DISULFIDE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
CARBON TETRACHLORIDE	10 U	10 U	10 U	10 U	10 U	1 U	2.9	1 U	10 U	1 U
CHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
CHLORODIBROMOMETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
CHLOROETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
CHLOROFORM	10 U	10 U	10 U	10 U	10 U	1 U	11	1.3	10 U	1 U
CHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
CIS-1,2-DICHLOROETHENE	110	10 U	25	10 U	12	0.6	160	130	120	1 U
CIS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
ETHYLBENZENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
M+P-XYLENES	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
METHYLENE CHLORIDE	20 U	10 U	10 U	10 U	10 U	2 U	2 U	2 U	10 U	2 U
O-XYLENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
STYRENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
TETRACHLOROETHENE	10 U	10 U	10 U	8.6	10 U	1 U	3.2	1.4	10 U	1 U
TOLUENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	1.1	1 U
TRANS-1,2-DICHLOROETHENE	10 U	10 U	10 U	10 U	10 U	1 U	2.8	0.8	10 U	1 U
TRANS-1,3-DICHLOROPROPENE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
TRICHLOROETHENE	46	2.6	7.3	8.2	7.9	1 U	190	47	34	1 U
VINYL CHLORIDE	10 U	10 U	10 U	10 U	10 U	1 U	1 U	1 U	10 U	1 U
Volatile Gases (mg/L)										
ETHANE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U		0.004 U	0.004 U
ETHENE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U		0.004 U	0.004 U
METHANE	0.012	0.002 U	0.006	0.008	0.005	0.01	31.5		17.1	8.4

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order	001	002	003	004	005	006	007	008	009	010
location	11GW22	11GW105	11GW106	11GW107	11GW108	11GW109	11GW110	11GW110	11GW112	11GW114
dup										
samp_date	10/2/2001	10/4/2001	10/4/2001	10/4/2001	10/4/2001	10/8/2001	10/2/2001	10/2/2001	10/5/2001	10/10/2001
Inorganics (ug/L)										
CALCIUM	2700		17600	6970	2670	7790	4360			
MAGNESIUM	1530		4880	4950	1250	4520	2460			
POTASSIUM	2080		3560	2110	943	2860	2770			
SODIUM	30200		6790	12200	5190	10400	6990			
Miscellaneous Parameters (mg/L)										
ALKALINITY	6.5	3.5	77	3	7.5	43	27		110	87
BIOCHEMICAL OXYGEN DEMAND										
CHEMICAL OXYGEN DEMAND										
CHLORIDE	31	3.5	1 U	1.6	1 U	6	4.9		3.6	3
FERROUS IRON										
HEXAVALENT CHROMIUM										
NITRATE	5.5	1 U	6.9	1 U	1.2	1.2	0.5 U		1 U	1.2
NITRITE	0.05 U	1 U	1 U	1 U	1 U	1 U	0.05 U		1 U	1 U
OXIDATION REDUCTION POTENTIAL										
PH										
SULFATE	7	4.7	2.4	1 U	1 U	1.9	3		1 U	1.1
SULFIDE										
TOTAL ORGANIC CARBON	3.1	0.78	1.4	0.4 U	0.4 U	0.62	2.5		6.7	1.7

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order	011	012	013	014	015	016	017	018	019
location	11GW115	11GW116	11GW117	11GW117	11GW117	11GW118	11GW118	11GW118	11GW119D
dup			11GW1172000-D		11GW1172000	11GW1182000-D		11GW1182000	
samp_date	10/9/2001	10/3/2001	10/3/2001	10/3/2001	10/3/2001	10/2/2001	10/2/2001	10/2/2001	10/2/2001
Volatile Organics (ug/L)									
1,1,1-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-TETRACHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-TRICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	17	17	17	1 U
1,1-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	8.1	8.05	8	1 U
1,2,4-TRICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DIBROMO-3-CHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DIBROMOETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-DICHLOROETHANE	1 U	1 U	1 U	1 U	1 U	77	76.5	76	2.5
1,2-DICHLOROPROPANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,3-DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-DICHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-BUTANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-HEXANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-METHYL-2-PENTANONE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	5 U	5 U	5 U	5.3	8.1	550	385	220	35000
BENZENE	1 U	1 U	1 U	1 U	1 U	0.6	0.55	0.5	1 U
BROMOCHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMODICHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMOFORM	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	1 U	1 U	1 U	1 U	1 U	31	15.75	1 U	1 U
CARBON TETRACHLORIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLORODIBROMOMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	4.5	4.45	4.4	1 U
CHLOROFORM	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.3
CHLOROMETHANE	1.1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	340	345	350	7.2
CIS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
METHYLENE CHLORIDE	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
O-XYLENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
STYRENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TETRACHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1.7	1.65	1.6	1 U
TOLUENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRANS-1,2-DICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	1.8	1.75	1.7	1 U
TRANS-1,3-DICHLOROPROPENE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	1 U	1 U	1 U	1 U	1 U	140	140	140	4
VINYL CHLORIDE	1 U	1 U	1 U	1 U	1 U	1	1	1	1 U
Volatile Gases (mg/L)									
ETHANE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
ETHENE	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
METHANE	6.9	0.7	0.014	0.0075	0.002 U	17.5	18.05	18.6	0.005

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location	11GW115	11GW116	11GW117	11GW117	11GW117	11GW118	11GW118	11GW118	11GW119D
dup			11GW1172000-D		11GW1172000	11GW1182000-D		11GW1182000	
samp_date	10/9/2001	10/3/2001	10/3/2001	10/3/2001	10/3/2001	10/2/2001	10/2/2001	10/2/2001	10/2/2001
Inorganics (ug/L)									
CALCIUM						15800	15700	15600	35000
MAGNESIUM						7200	7075	6950	9280
POTASSIUM						5130	4685	4240	7040
SODIUM						14400	15800	17200	21400
Miscellaneous Parameters (mg/L)									
ALKALINITY	72	91	120	120	120	98	99	100	140
BIOCHEMICAL OXYGEN DEMAND									
CHEMICAL OXYGEN DEMAND									
CHLORIDE	5	9.1	2 U	2 U	2 U	7.8	7.6	7.4	4.3
FERROUS IRON									
HEXAVALENT CHROMIUM									
NITRATE	3	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
NITRITE	1 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
OXIDATION REDUCTION POTENTIAL									
PH									
SULFATE	2.6	3	5	5	5	2	1.5	1	21
SULFIDE									
TOTAL ORGANIC CARBON	2	7.4	1.1	2.05	3	12	12	12	44

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order	020	021	022	023	024	025	026	027	028	029	030
location	11GW119S	11GW120	11GW121	11GW27	11GW27	11GW28	11GW29	11GW66	11GW87	11PZ63	11PZ63
dup											
samp_date	10/3/2001	10/5/2001	10/10/2001	10/9/2001	10/9/2001	10/4/2001	10/3/2001	10/5/2001	10/8/2001	10/9/2001	10/9/2001
Volatile Organics (ug/L)											
1,1,1-TRICHLOROETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
1,1,2,2-TETRACHLOROETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
1,1,2-TRICHLOROETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
1,1-DICHLOROETHANE	3.9	1	1 U			10 U	10 U	10 U	1 U		
1,1-DICHLOROETHENE	0.8	10 U	1 U			10 U	10 U	10 U	1 U		
1,2,4-TRICHLOROBENZENE	1 U		1 U						1 U		
1,2-DIBROMO-3-CHLOROPROPANE	1 U		1 U						1 U		
1,2-DIBROMOETHANE	1 U		1 U						1 U		
1,2-DICHLOROBENZENE	1 U		1 U						1 U		
1,2-DICHLOROETHANE	16	2.9	1 U			10 U	10 U	10 U	1 U		
1,2-DICHLOROPROPANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
1,3-DICHLOROBENZENE	1 U		1 U						1 U		
1,4-DICHLOROBENZENE	1 U		1 U						1 U		
2-BUTANONE	5 U	10 U	5 U			10 U	10 U	10 U	5 U		
2-HEXANONE	5 U	10 U	5 U			10 U	10 U	10 U	5 U		
4-METHYL-2-PENTANONE	5 U	10 U	5 U			10 U	10 U	10 U	5 U		
ACETONE	8400	34	1200			10 U	10 U	10 U	5 U		
BENZENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
BROMOCHLOROMETHANE	1 U		1 U						1 U		
BROMODICHLOROMETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
BROMOFORM	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
BROMOMETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
CARBON DISULFIDE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
CARBON TETRACHLORIDE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
CHLOROBENZENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
CHLORODIBROMOMETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
CHLOROETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
CHLOROFORM	1 U	2.1	0.9			10 U	10 U	10 U	1 U		
CHLOROMETHANE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
CIS-1,2-DICHLOROETHENE	47	15	1 U			2.9	10 U	13	2.8		
CIS-1,3-DICHLOROPROPENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
ETHYLBENZENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
M+P-XYLENES	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
METHYLENE CHLORIDE	2 U	10 U	2 U			10 U	10 U	10 U	2 U		
O-XYLENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
STYRENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
TETRACHLOROETHENE	1 U	10 U	1 U			61	10 U	10 U	1 U		
TOLUENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
TRANS-1,2-DICHLOROETHENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
TRANS-1,3-DICHLOROPROPENE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
TRICHLOROETHENE	21	16	1 U			27	10 U	7.8	1.9		
VINYL CHLORIDE	1 U	10 U	1 U			10 U	10 U	10 U	1 U		
Volatile Gases (mg/L)											
ETHANE	0.004 U	0.004 U	0.004 U			0.004 U	0.004 U	0.004 U	0.004		
ETHENE	0.004 U	0.004 U	0.004 U			0.004 U	0.004 U	0.004 U	0.004 U		
METHANE	0.014	0.006	0.007			0.002 U	0.006	0.005	0.006		

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order	020	021	022	023	024	025	026	027	028	029	030
location	11GW119S	11GW120	11GW121	11GW27	11GW27	11GW28	11GW29	11GW66	11GW87	11PZ63	11PZ63
dup											
samp_date	10/3/2001	10/5/2001	10/10/2001	10/9/2001	10/9/2001	10/4/2001	10/3/2001	10/5/2001	10/8/2001	10/9/2001	10/9/2001
Inorganics (ug/L)											
CALCIUM	26600	3010	21500			8070		2160			
MAGNESIUM	7360	1680	5550			6130		1810			
POTASSIUM	5230	3250	4440			2070		2000			
SODIUM	29500	6080	9890			11700		5510			
Miscellaneous Parameters (mg/L)											
ALKALINITY	140	22	64			2.5	27	7.5	14		
BIOCHEMICAL OXYGEN DEMAND				3.8						5.5	
CHEMICAL OXYGEN DEMAND				5 U						5	
CHLORIDE	3.7	2.6	3.6			4.1	6	2.1	3		
FERROUS IRON				0.1 U						16	
HEXAVALENT CHROMIUM				0.41	0.4					0.01 U	0.01 U
NITRATE	0.5 U	1 U	1 U			1 U	1.7	1 U	1 U		
NITRITE	0.05 U	1 U	1 U			1 U	1 U	1 U	1 U		
OXIDATION REDUCTION POTENTIAL				0.4 MV						0.18 MV	
PH				5.08 PHUNI						6.33 PHUNI	
SULFATE	12	1 U	1 U			5.4	5.7	1 U	1.6		
SULFIDE				1 U						1 U	
TOTAL ORGANIC CARBON	87	0.66	2.9	0.63		0.4	2.9	0.4 U	1.2	3.2	

from n298_res.dbf
from d:\w 298_prelim
from n2 ls

11GW119 Packer Sampling Results

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119150160

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O04

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090309.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	0.5	J
75-09-2	Methylene chloride	2	U
67-64-1	Acetone	6	
75-15-0	Carbon disulfide	1	U
156-60-5	trans-1,2-Dichloroethene	5.3	
75-34-3	1,1-Dichloroethane	5.7	
156-59-2	cis-1,2-Dichloroethene	67	E
74-97-5	Bromochloromethane	1	U
67-66-3	Chloroform	1	U
78-93-3	2-Butanone	5	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon tetrachloride	1	U
71-43-2	Benzene	0.6	J
107-06-2	1,2-Dichloroethane	31	E
79-01-6	Trichloroethene	49	E
78-87-5	1,2-Dichloropropane	1	U
106-93-4	1,2-Dibromoethane	1	U
75-27-4	Bromodichloromethane	1	U
10061-01-5	cis-1,3-Dichloropropene	1	U
108-88-3	Toluene	1.1	
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	0.7	J
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
1330-20-7	m&p-xylenes	1	U
95-47-6	o-xylene	1	U
100-42-5	Styrene	1	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

11GW119150160

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O04

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090309.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
75-25-2	Bromoform	1	U
108-10-1	4-Methyl-2-pentanone	5	U
591-78-6	2-Hexanone	5	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U
541-73-1	1,3-Dichlorobenzene	1	U
106-46-7	1,4-Dichlorobenzene	1	U
95-50-1	1,2-Dichlorobenzene	1	U
96-12-8	1,2-Dibromo-3-chloropropane	1	U
120-82-1	1,2,4-Trichlorobenzene	1	U

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119150160DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O04DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090406.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100 Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
74-87-3	Chloromethane	5	UD
75-01-4	Vinyl chloride	5	UD
74-83-9	Bromomethane	5	UD
75-00-3	Chloroethane	5	UD
75-35-4	1,1-Dichloroethene	5	UD
75-09-2	Methylene chloride	5.5	JD
67-64-1	Acetone	25	UD
75-15-0	Carbon disulfide	5	UD
156-60-5	trans-1,2-Dichloroethene	5.7	D
75-34-3	1,1-Dichloroethane	7.3	D
156-59-2	cis-1,2-Dichloroethene	92	D
74-97-5	Bromochloromethane	5	UD
67-66-3	Chloroform	5	UD
78-93-3	2-Butanone	25	UD
71-55-6	1,1,1-Trichloroethane	5	UD
56-23-5	Carbon tetrachloride	5	UD
71-43-2	Benzene	5	UD
107-06-2	1,2-Dichloroethane	30	D
79-01-6	Trichloroethene	60	D
78-87-5	1,2-Dichloropropane	5	UD
106-93-4	1,2-Dibromoethane	5	UD
75-27-4	Bromodichloromethane	5	UD
10061-01-5	cis-1,3-Dichloropropene	5	UD
108-88-3	Toluene	5	UD
10061-02-6	trans-1,3-Dichloropropene	5	UD
79-00-5	1,1,2-Trichloroethane	5	UD
127-18-4	Tetrachloroethene	5	UD
124-48-1	Dibromochloromethane	5	UD
108-90-7	Chlorobenzene	5	UD
100-41-4	Ethylbenzene	5	UD
1330-20-7	m&p-xylenes	5	UD
95-47-6	o-xylene	5	UD
100-42-5	Styrene	5	UD

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119150160DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O04DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090406.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100 Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
75-25-2	Bromoform	5	UD
108-10-1	4-Methyl-2-pentanone	25	UD
591-78-6	2-Hexanone	25	UD
79-34-5	1,1,2,2-Tetrachloroethane	5	UD
541-73-1	1,3-Dichlorobenzene	5	UD
106-46-7	1,4-Dichlorobenzene	5	UD
95-50-1	1,2-Dichlorobenzene	5	UD
96-12-8	1,2-Dibromo-3-chloropropane	5	UD
120-82-1	1,2,4-Trichlorobenzene	5	UD

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119180190

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O03

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090308.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	J
75-09-2	Methylene chloride	2	U
67-64-1	Acetone	9.4	
75-15-0	Carbon disulfide	1	U
156-60-5	trans-1,2-Dichloroethene	0.6	J
75-34-3	1,1-Dichloroethane	5.7	
156-59-2	cis-1,2-Dichloroethene	72	E
74-97-5	Bromochloromethane	1	U
67-66-3	Chloroform	3.3	
78-93-3	2-Butanone	5	U
71-55-6	1,1,1-Trichloroethane	1	U
56-23-5	Carbon tetrachloride	1	U
71-43-2	Benzene	0.7	J
107-06-2	1,2-Dichloroethane	33	E
79-01-6	Trichloroethene	40	E
78-87-5	1,2-Dichloropropane	1	U
106-93-4	1,2-Dibromoethane	1	U
75-27-4	Bromodichloromethane	0.8	J
10061-01-5	cis-1,3-Dichloropropene	1	U
108-88-3	Toluene	0.9	J
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	0.6	J
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
1330-20-7	m&p-xylenes	1	U
95-47-6	o-xylene	1	U
100-42-5	Styrene	1	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119180190

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O03

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090308.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
75-25-2	Bromoform	1	U
108-10-1	4-Methyl-2-pentanone	5	U
591-78-6	2-Hexanone	5	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U
541-73-1	1,3-Dichlorobenzene	1	U
106-46-7	1,4-Dichlorobenzene	1	U
95-50-1	1,2-Dichlorobenzene	1	U
96-12-8	1,2-Dibromo-3-chloropropane	1	U
120-82-1	1,2,4-Trichlorobenzene	1	U

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VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO.

11GW119180190

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No. N5733 Site: NSWC W Location: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O03

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090308.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 1 Concentration Units: (ug/L or ug/Kg) ug/L

CAS Number	Compound Name	RT	Est. Conc.	Q
1. 354-23-4	Ethane, 1,2-dichloro-1,1,2-t	2.87	1.9	J
2.				
3.				
4.				
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VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119180190DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O03DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090405.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100 Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
74-87-3	Chloromethane	5	UD
75-01-4	Vinyl chloride	5	UD
74-83-9	Bromomethane	5	UD
75-00-3	Chloroethane	5	UD
75-35-4	1,1-Dichloroethene	5	UD
75-09-2	Methylene chloride	5.7	JD
67-64-1	Acetone	25	UD
75-15-0	Carbon disulfide	5	UD
156-60-5	trans-1,2-Dichloroethene	5	UD
75-34-3	1,1-Dichloroethane	6.8	D
156-59-2	cis-1,2-Dichloroethene	92	D
74-97-5	Bromochloromethane	5	UD
67-66-3	Chloroform	3.8	JD
78-93-3	2-Butanone	25	UD
71-55-6	1,1,1-Trichloroethane	5	UD
56-23-5	Carbon tetrachloride	5	UD
71-43-2	Benzene	5	UD
107-06-2	1,2-Dichloroethane	30	D
79-01-6	Trichloroethene	41	D
78-87-5	1,2-Dichloropropane	5	UD
106-93-4	1,2-Dibromoethane	5	UD
75-27-4	Bromodichloromethane	5	UD
10061-01-5	cis-1,3-Dichloropropene	5	UD
108-88-3	Toluene	5	UD
10061-02-6	trans-1,3-Dichloropropene	5	UD
79-00-5	1,1,2-Trichloroethane	5	UD
127-18-4	Tetrachloroethene	5	UD
124-48-1	Dibromochloromethane	5	UD
108-90-7	Chlorobenzene	5	UD
100-41-4	Ethylbenzene	5	UD
1330-20-7	m&p-xylenes	5	UD
95-47-6	o-xylene	5	UD
100-42-5	Styrene	5	UD

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119180190DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O03DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090405.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100 Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
75-25-2	Bromoform	5	UD
108-10-1	4-Methyl-2-pentanone	25	UD
591-78-6	2-Hexanone	25	UD
79-34-5	1,1,2,2-Tetrachloroethane	5	UD
541-73-1	1,3-Dichlorobenzene	5	UD
106-46-7	1,4-Dichlorobenzene	5	UD
95-50-1	1,2-Dichlorobenzene	5	UD
96-12-8	1,2-Dibromo-3-chloropropane	5	UD
120-82-1	1,2,4-Trichlorobenzene	5	UD

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO.

11GW119180190DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No. N5733 Site: NSWC W Location: LB16056 Group: 5971-VC

Matrix: (soil/water) WATER Lab Sample ID: O03DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090405.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100 Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 3 Concentration Units: (ug/L or ug/Kg) ug/L

CAS Number	Compound Name	RT	Est. Conc.	Q
1.	Unknown	1.78	2.7	J
2.	Column Bleed	27.70	2.6	J
3. 91-20-3	Naphthalene	30.72	4.2	J
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VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119200233

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O02

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090307.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
74-87-3	Chloromethane	1	U
75-01-4	Vinyl chloride	1	U
74-83-9	Bromomethane	1	U
75-00-3	Chloroethane	1	U
75-35-4	1,1-Dichloroethene	1	U
75-09-2	Methylene chloride	2	U
67-64-1	Acetone	5	U
75-15-0	Carbon disulfide	1	U
156-60-5	trans-1,2-Dichloroethene	1.4	
75-34-3	1,1-Dichloroethane	3.4	
156-59-2	cis-1,2-Dichloroethene	45	E
74-97-5	Bromochloromethane	1	U
67-66-3	Chloroform	6.5	
78-93-3	2-Butanone	5	U
71-55-6	1,1,1-Trichloroethane	0.6	J
56-23-5	Carbon tetrachloride	1	U
71-43-2	Benzene	1	U
107-06-2	1,2-Dichloroethane	24	
79-01-6	Trichloroethene	19	
78-87-5	1,2-Dichloropropane	1	U
106-93-4	1,2-Dibromoethane	1	U
75-27-4	Bromodichloromethane	1.5	
10061-01-5	cis-1,3-Dichloropropene	1	U
108-88-3	Toluene	1	U
10061-02-6	trans-1,3-Dichloropropene	1	U
79-00-5	1,1,2-Trichloroethane	1	U
127-18-4	Tetrachloroethene	1	U
124-48-1	Dibromochloromethane	1	U
108-90-7	Chlorobenzene	1	U
100-41-4	Ethylbenzene	1	U
1330-20-7	m&p-xylenes	1	U
95-47-6	o-xylene	1	U
100-42-5	Styrene	1	U

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

11GW119200233

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O02

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090307.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Concentration Units: (ug/L or ug/Kg) ug/L

CAS No.	Compound		Q
75-25-2	Bromoform	1	U
108-10-1	4-Methyl-2-pentanone	5	U
591-78-6	2-Hexanone	5	U
79-34-5	1,1,2,2-Tetrachloroethane	1	U
541-73-1	1,3-Dichlorobenzene	1	U
106-46-7	1,4-Dichlorobenzene	1	U
95-50-1	1,2-Dichlorobenzene	1	U
96-12-8	1,2-Dibromo-3-chloropropane	1	U
120-82-1	1,2,4-Trichlorobenzene	1	U

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO.

11GW119200233

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No. N5733 Site: NSWC W- Location: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O02

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090307.D

Level: (low/med) Date Received: 08/3101

% Moisture: not dec. 100 Date Analyzed: 9/3/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 1 Concentration Units: (ug/L or ug/Kg) ug/L

CAS Number	Compound Name	RT	Est. Conc.	Q
1. 91-20-3	Naphthalene	30.68	3.26	J
2.				
3.				
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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.

11GW119200233DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O02DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090404.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100. Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
74-87-3	Chloromethane	5	UD
75-01-4	Vinyl chloride	5	UD
74-83-9	Bromomethane	5	UD
75-00-3	Chloroethane	5	UD
75-35-4	1,1-Dichloroethene	5	UD
75-09-2	Methylene chloride	5.6	JD
67-64-1	Acetone	25	UD
75-15-0	Carbon disulfide	5	UD
156-60-5	trans-1,2-Dichloroethene	5	UD
75-34-3	1,1-Dichloroethane	4.7	JD
156-59-2	cis-1,2-Dichloroethene	62	D
74-97-5	Bromochloromethane	5	UD
67-66-3	Chloroform	8.9	D
78-93-3	2-Butanone	25	UD
71-55-6	1,1,1-Trichloroethane	5	UD
56-23-5	Carbon tetrachloride	5	UD
71-43-2	Benzene	5	UD
107-06-2	1,2-Dichloroethane	22	D
79-01-6	Trichloroethene	21	D
78-87-5	1,2-Dichloropropane	5	UD
106-93-4	1,2-Dibromoethane	5	UD
75-27-4	Bromodichloromethane	5	UD
10061-01-5	cis-1,3-Dichloropropene	5	UD
108-88-3	Toluene	5	UD
10061-02-6	trans-1,3-Dichloropropene	5	UD
79-00-5	1,1,2-Trichloroethane	5	UD
127-18-4	Tetrachloroethene	5	UD
124-48-1	Dibromochloromethane	5	UD
108-90-7	Chlorobenzene	5	UD
100-41-4	Ethylbenzene	5	UD
1330-20-7	m&p-xylenes	5	UD
95-47-6	o-xylene	5	UD
100-42-5	Styrene	5	UD

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

SAMPLE NO.
11GW119200233DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No.: N5733 Site: NSWC WHILocation: LB16056 Group: 5971-VOA

Matrix: (soil/water) WATER Lab Sample ID: O02DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090404.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100 Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

CAS No.	Compound	Concentration Units: (ug/L or ug/Kg) ug/L	Q
75-25-2	Bromoform	5	UD
108-10-1	4-Methyl-2-pentanone	25	UD
591-78-6	2-Hexanone	25	UD
79-34-5	1,1,2,2-Tetrachloroethane	5	UD
541-73-1	1,3-Dichlorobenzene	5	UD
106-46-7	1,4-Dichlorobenzene	5	UD
95-50-1	1,2-Dichlorobenzene	5	UD
96-12-8	1,2-Dibromo-3-chloropropane	5	UD
120-82-1	1,2,4-Trichlorobenzene	5	UD

1E

VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

SAMPLE NO.

11GW119200233DL

Lab Name: CHEMTECH Contract: TETRA TECH NUS, INC.

Project No. N5733 Site: NSWC W Location: LB16056 Group: 5971-V(

Matrix: (soil/water) WATER Lab Sample ID: O02DL

Sample wt/vol: 25.0 (g/mL) ML Lab File ID: VF090404.D

Level: (low/med) Date Received: 8/31/01

% Moisture: not dec. 100 Date Analyzed: 9/4/01

GC Column: RTX624 ID: 0.53 (mm) Dilution Factor: 5.0

Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number TICs found: 3 Concentration Units: (ug/L or ug/Kg) ug/L

CAS Number	Compound Name	RT	Est. Conc.	Q
1.	Unknown	1.78	2.6	J
2.	Column Bleed	27.72	3.4	J
3. 91-20-3	Naphthalene	30.77	2.9	J
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

APPENDIX B

BORING LOGS
WELL CONSTRUCTION DIAGRAMS

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 116W119
DATE: 8/23-24/01
GEOLOGIST: Scott Neil
DRILLER: Cary Ellison

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
				SAND					↑				
									↑				
							↑		DRY				
									↓				
	10						OR/RED MICACEOUS		MOIST				
							SAND						
							RED/BRN/YELLOW		MOIST				
	20			SAPROLITE			MICACEOUS SAND						
									WATER @ 28'				
	30						RED/BRN/YELLOW		WET				
							MICACEOUS SAND						
							TR GRAVEL						
	40						BRN/YELLOW MICACEOUS		WET				
							SAND - WEATHERED						
							BEDROCK @ 41'						
							TOP OF BEDROCK @ 45'		STOP FOR THE DAY @ 1636 (8/23/01)				
				BEDROCK			RESUME DRILLING ON →		8/24/01 @ 0843				
	50						INTO BEDROCK						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes _____ No _____ Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 11GW119
DATE: 8/24-27/01
GEOLOGIST: Scott Neil
DRILLER: CARY ELLISON

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	50								SET CASING (8")				
									@ 55' ON 8/24/01				
1327									RESUME DRILLING				
									ON 8/27/01 FROM				
	60						LIGHT GRAY-DUSTY		55'				
							LT. BRN @ 65' - DUSTY						
							BACK TO LT. GRAY		DUSTY				
	70												
							BROWNISH THEN TURN						
	80						GRAY (LIGHT)		DUSTY				
	90						MED GRAY		DUSTY-MOIST				
							MED GRAY - WATER						
	100						AT 100-105' (1GPM)		DAMP				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ____ No ____ Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 11GW119
DATE: 8/27/01
GEOLOGIST: Scott Neil
DRILLER: CARY ELLISON

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	100												
							WATER FROM 100-105'						
							1 GPM ?						
	110						MED GRAY		DAMP/MOIST				
	120						MED-DARK GRAY		MOIST / DUSTY				
							POSSIBLE FRACS @ 127'						
							BASED ON DRILLING						
	130								MOIST				
							DAMP @ 137'						
	140						MED-DARK GRAY		MOIST				
							POSSIBLE FRACS @ 143'						
							BASED ON DRILLING						
	150						DARK GRAY		WET				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes _____ No _____ Well I.D. #: _____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 116W119
DATE: 8/27-28/01
GEOLOGIST: Scott Neil
DRILLER: Bob Atkinson

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	150												
164'							POSSIBLE FRACTURES @		END DRILLING				
							153' BASED ON DRILLING		FOR 8/27/01 @ 155'				
	160						DARK GRAY WET		RESUME DRILLING				
							CUTTINGS (POSSIBLY		ON 8/28/01 @ 155'				
							DUE TO ABOVE ZONES).						
	170						DARK GRAY DAMP						
							CUTTINGS						
							DUSTY						
	180												
							POSSIBLE WATER @ 184'						
							0.5 - 1 GPM ?		≈ 2 GPM FROM TOP				
									TO BOTTOM OF HOLE				
	190						DARK GRAY CUTTINGS		DAMP FROM UPPER				
									ZONES ?				
	200						DARK GRAY CUTTINGS						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ____ No ____ Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 11GW119
DATE: 8/28/01
GEOLOGIST: Scott Neil
DRILLER: BOB ATKINSON

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	200												
									NO INCREASE IN				
									GPM FROM B.H.				
	210						DARK GRAY CUTTINGS		DAMP - FROM				
									UPPER ZONES ?				
	220						DARK GRAY CUTTINGS		NO INCREASE IN				
									FLOW.				
									SOFT FROM 220-				
									225'.				
									↓				
	230						DARK GRAY - SOFT DRILLING - NO WATER						
							↓						
	233												
				T.D.									

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No ____ Well I.D. #: ____

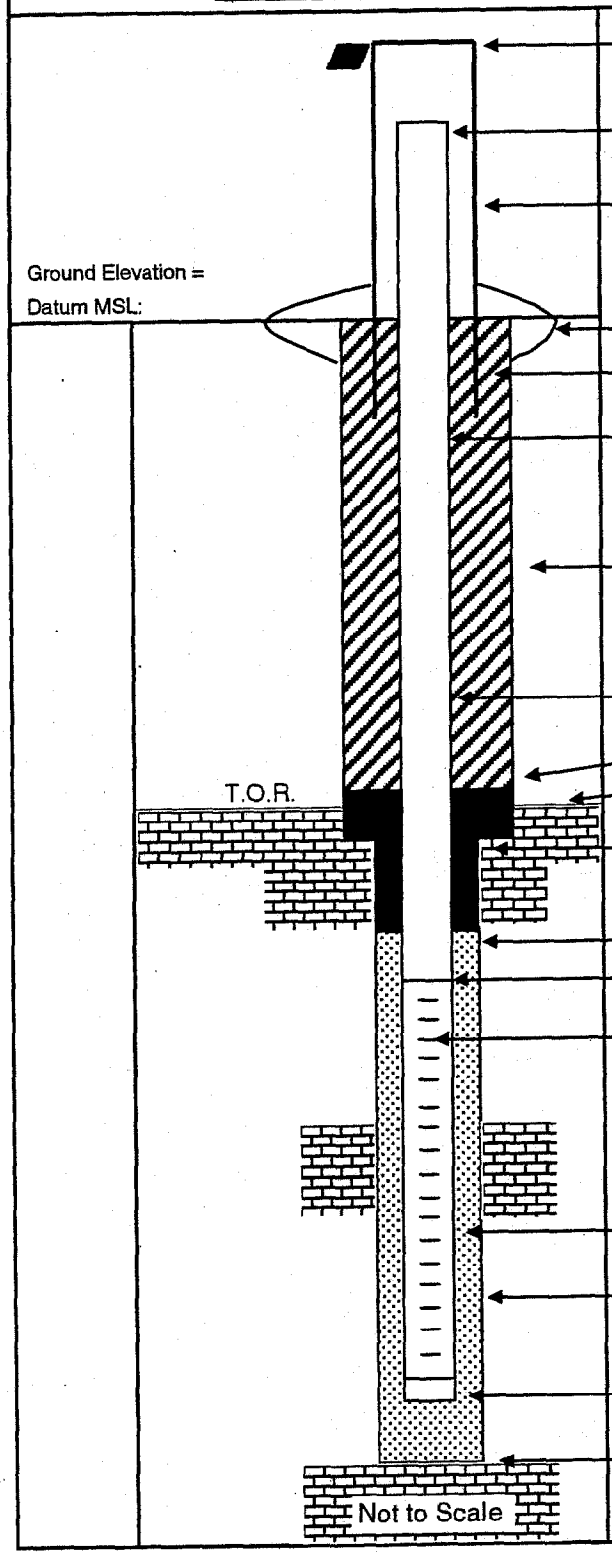
Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 11GW119S

PERMIT No:

PROJECT:	NSWC White Oak	DRILLING Co.:	CT&E	BORING No.:	11GW119
PROJECT No.:	7687	DRILLER:	Carey Ellison	DATE COMPLETED:	9/12/01
SITE:	Site 11	DRILLING METHOD:	Air Rotary	NORTHING:	
GEOLOGIST:	Scott Neil	DEV. METHOD:	Air Lift	EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing: 8-inch

Type of Surface Casing: Steel

Type of Surface Seal: Cement

I.D. of Permanent Casing: 8-inch

I.D. of Riser: 2-inch

Type of Riser: Sch 40 PVC

Borehole Diameter: 11-inch

Type of Backfill: Bardold Hole Plug to 15'

Elevation / Depth Top of Seal: 1143.5

Elevation / Depth Top of Bedrock: 145'

Type of Seal: Bentonite Pellets

Elevation / Depth of Top of Fine Sand: NA

Elevation / Depth of Top of Filter Pack: 145.5

Elevation / Depth of Top of Screen: 149'

Type of Screen: ~~0.020 x 10~~ Sch 40 PVC

Slot Size x Length: 0.020 x 10'

I.D. of Screen: 2-inch

Type of Filter Pack: 10-20 Silica Sand

Diameter of Hole in Bedrock:
Core / Ream: 8-inch

Elevation / Depth of Bottom of Screen: 159'

Elevation / Total Depth of Borehole: 163.5

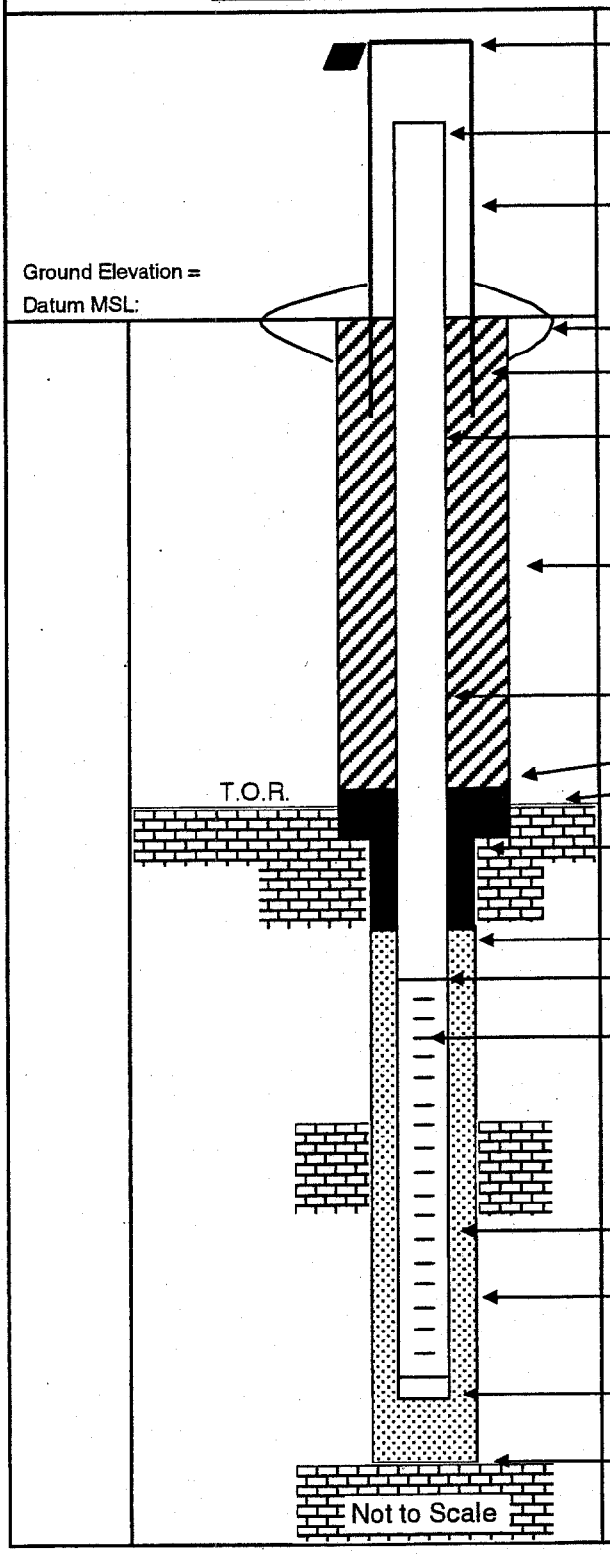
Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 11GW119D

PERMIT No:

PROJECT:	NSWC White Oak	DRILLING Co.:	CT&E	BORING No.:	11GW119
PROJECT No.:	7687	DRILLER:	CARY ELLISON	DATE COMPLETED:	9/11/01
SITE:	Site 11	DRILLING METHOD:	AIR ROTARY	NORTHING:	
GEOLOGIST:	Scott Neil	DEV. METHOD:	AIR LIFT	EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal:

I.D. of Permanent Casing: 8-INCH

I.D. of Riser: 2-INCH

Type of Riser: SCH 40 PVC

Borehole Diameter: 11-INCH (8-INCH PERM. CASING)

Type of Backfill:

Elevation / Depth Top of Seal: 1163.5'

Elevation / Depth Top of Bedrock: 1 45'

Type of Seal: BENTONITE PELLETS

Elevation / Depth of Top of Fine Sand: 1 NA

Elevation / Depth of Top of Filter Pack: 1 200'

Elevation / Depth of Top of Screen: 1 205'

Type of Screen: SCH 40 PVC

Slot Size x Length: 0.020 X 10'

I.D. of Screen: 2-INCH

Type of Filter Pack: 10-20 SILICA SAND

Diameter of Hole in Bedrock:
Core / Ream: 8-INCH

Elevation / Depth of Bottom of Screen: 1215'

Elevation / Total Depth of Borehole:* 1232'

* BENTONITE PELLETS TO 221'

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: Mobile Drill B-80

BORING No.: 11GW120
DATE: 8/31-9/4/01
GEOLOGIST: Scott Neil
DRILLER: Bob Atkinson / Carey Ellison

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0						OR/BRN CLAY - TR		SAPROLITE				
							SAND (MICACEOUS)						
	10												
							SAME AS ABOVE W/						
							SOME MICACEOUS SAND						
							SAPROLITE/ GRAY		WEATHERED BEDROCK				
	20						MICA CUTTINGS		@ ≈ 18-19'.				
							INTO BEDROCK @		EXPERIENCE LOSS				
							21'. GRAY CUTTINGS		OF MUD @ 20' ≈				
							W/ MICA FLAKES.		40 GALLONS.				
	30						DARK GRAY CUTTINGS		STEEL CASING TO				
							W/ MICA FLAKES.		31'.				
							RED/BRN @ 35' -		DRY.				
							DUSTY - MICACEOUS						
	40						GRAY DUSTY		DRY.				
							MICACEOUS						
							GRAY - MICACEOUS		DAMP				
							POSSIBLE FRACS		WET ≈ 3 GPM				
	50						GRAY CUTTINGS - WET						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: MUD ROTARY DRILLING USING AN 11 7/8 BIT TO 38' bgs. 6-INCH STEEL CASING ~~FROM~~ TO 38'; ON 8/31/01.

Converted to Well: Yes ✓ No _____ Well I.D. #: 11GW120

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 11GW120
DATE: 9/4/01
GEOLOGIST: Scott Neil
DRILLER: CARY ELLISON

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	50												
	60						GRAY CUTTINGS w/		WET FROM ABOVE?				
							MICA FLAKES						
	70						SAME AS ABOVE		WET				
							REDDISH CUTTINGS w/		WET				
	80						MICA @ 78'						
	90						SAME AS ABOVE		WET				
							DARK GRAY CUTTINGS		SLIGHT INCREASE				
							w/ MICA @ 98'		IN FLOW @ ≈ 97'				
	100								≈ 0.5 GPM				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ✓ No _____ Well I.D. #: 11GW120

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: Mobile Drill B-80

BORING No.: 11GW120
DATE: 9/4-5/01
GEOLOGIST: Scott Neil
DRILLER: Cary Ellison

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	100												
	110						BLK CUTTINGS W/		WET				
							MICA FLAKES						
	120						BLK CUTTINGS W/		WET				
							MICA FLAKES						
							POSSIBLE FRACS @ 125'-						
							CUTTINGS ARE REDDISH						
	130												
							BLK and REDDISH		WATER TURNED FROM				
							CUTTINGS W/ MICA		GRAY TO BRN @				
									131'.				
	140						TD = 138'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: STOP DRILLING ON 9/4/01 @ 107'. RESUME @ 107' ON 9/5/01. WELL SCREEN SET @ 123-133'. SAND FROM 133-120'.

Converted to Well: Yes ✓ No _____ Well I.D. #: 11GW120

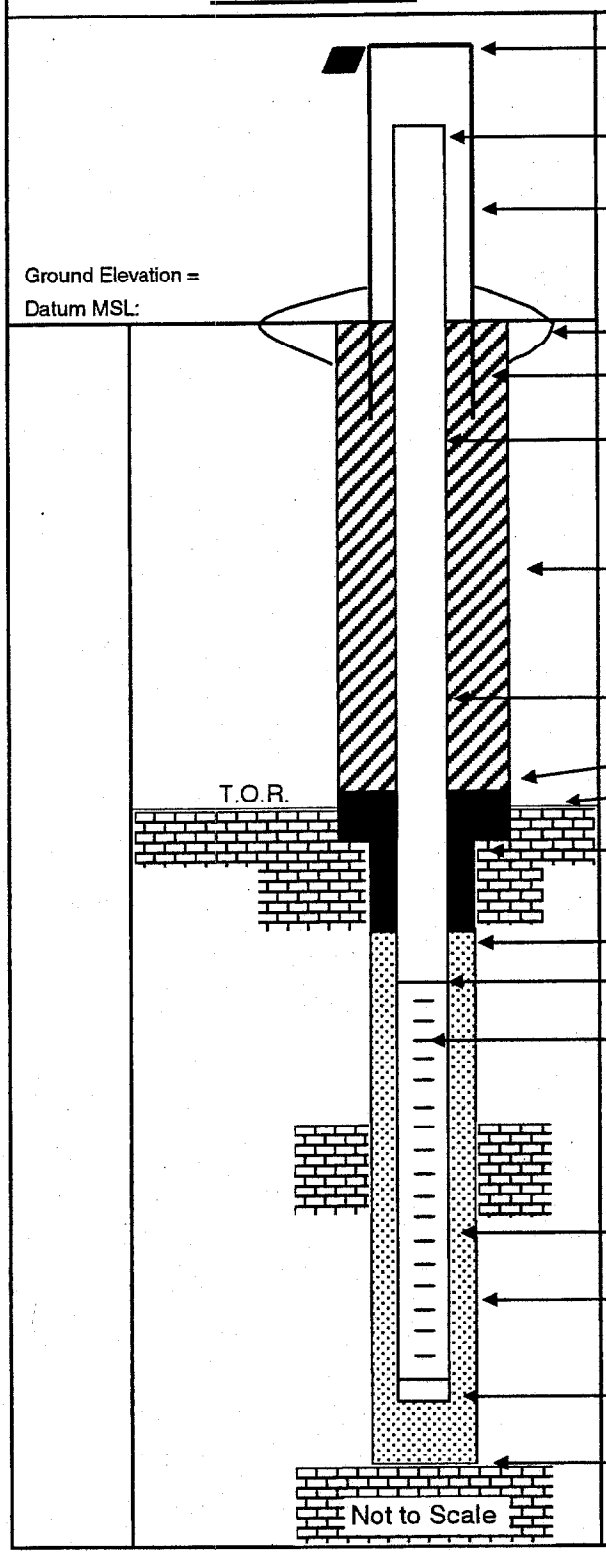
Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 11GW120

PERMIT No:

PROJECT:	NSWC White Oak	DRILLING Co.:	CT&E	BORING No.:	11GW120
PROJECT No.:	7687	DRILLER:	Cary Ellison	DATE COMPLETED:	9/5/01
SITE:	Site 11	DRILLING METHOD:	Air Rotary	NORTHING:	
GEOLOGIST:	Scott Neil	DEV. METHOD:	AIR LIFT	EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing: 6"

Type of Surface Casing: STEEL

Type of Surface Seal: CEMENT

I.D. of Permanent Casing: 6"

I.D. of Riser: 2"

Type of Riser: SCH. 40 PVC

Borehole Diameter: 11"

Type of Backfill: CEMENT / BENTONITE

Elevation / Depth Top of Seal: 1 117'

Elevation / Depth Top of Bedrock: 1 21'

Type of Seal: BENTONITE PELLETS

Elevation / Depth of Top of Fine Sand: 1 NA

Elevation / Depth of Top of Filter Pack: 1 120'

Elevation / Depth of Top of Screen: 1 123'

Type of Screen: SCH. 40 PVC

Slot Size x Length: 0.020 x 10'

I.D. of Screen: 2"

Type of Filter Pack: 10-20 SILICA SAND

Diameter of Hole in Bedrock:
Core / Ream: 6"

Elevation / Depth of Bottom of Screen: 1 133'

Elevation / Total Depth of Borehole: 1 138'

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: Mobile Drill B-50

BORING No.: 11GW121
DATE: 9/6-12/01
GEOLOGIST: Scott Neil
DRILLER: Cory Ellison

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	0												
	10					GRAY/ BRN	SILT / SAND (MICACEOUS)						
							COARSE SILTY SAND (QTZ						
	20						and MICACEOUS)						
							OR/YEL CLAY W/ SAND						
	30												
							WEATH BEDROCK @ 32'						
							BEDROCK @ 34' - BLK/						
							REDDISH CUTTINGS W/						
	40						QTZ & MICA		52'				
							BLK CUTTINGS W/ QTZ		SET CASING @ 42' bgs.				
							& MICA						
							FRACS BASED ON DRILLING @ 46'						
	50						GRAY W/ MICA		DUSTY				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: LOG CUTTINGS ONLY. DRILL RIG BREAKS DOWN ON 9/6/01 @ 42'. WILL SET CASING @ 42 bgs ON 9/7/01. RESUME DRILLING ON 9/12/01.

Converted to Well: Yes ____ No ____ Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 11GW121
DATE: 9/12/01
GEOLOGIST: Scott Neil
DRILLER: CARY ELLISON

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	50												
	60						LT. GRAY MICACEOUS		DUSTY				
	70						SAME AS ABOVE		DUSTY				
							FRACS @ 76'		MOIST @ 76'				
									≈ 0.5 GPM				
	80						LT-MED GRAY						
							FRACS @ 80'		MOIST				
	90						MED GRAY MICACEOUS		DUSTY				
	100						SAME AS ABOVE		DUSTY				

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks:

Converted to Well: Yes ✓ No ____ Well I.D. #: 11GW121

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: Former NSWC White Oak
PROJECT NUMBER: 7687
DRILLING COMPANY: CT&E
DRILLING RIG: MOBILE DRILL B-80

BORING No.: 1GW121
DATE: 9/12/01
GEOLOGIST: Scott Neil
DRILLER: GARY ELLISON

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	100												
							WATER @ 106'		≈ 2-2.5 GPM				
	110						MED-DRK GRAY		DAMP				
	120						DRK GRAY		DAMP				
	123												
							TD = 123'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): [ ]

Remarks:

Converted to Well: Yes ✓ No ____ Well I.D. #: 1GW121

FLUSH MOUNT

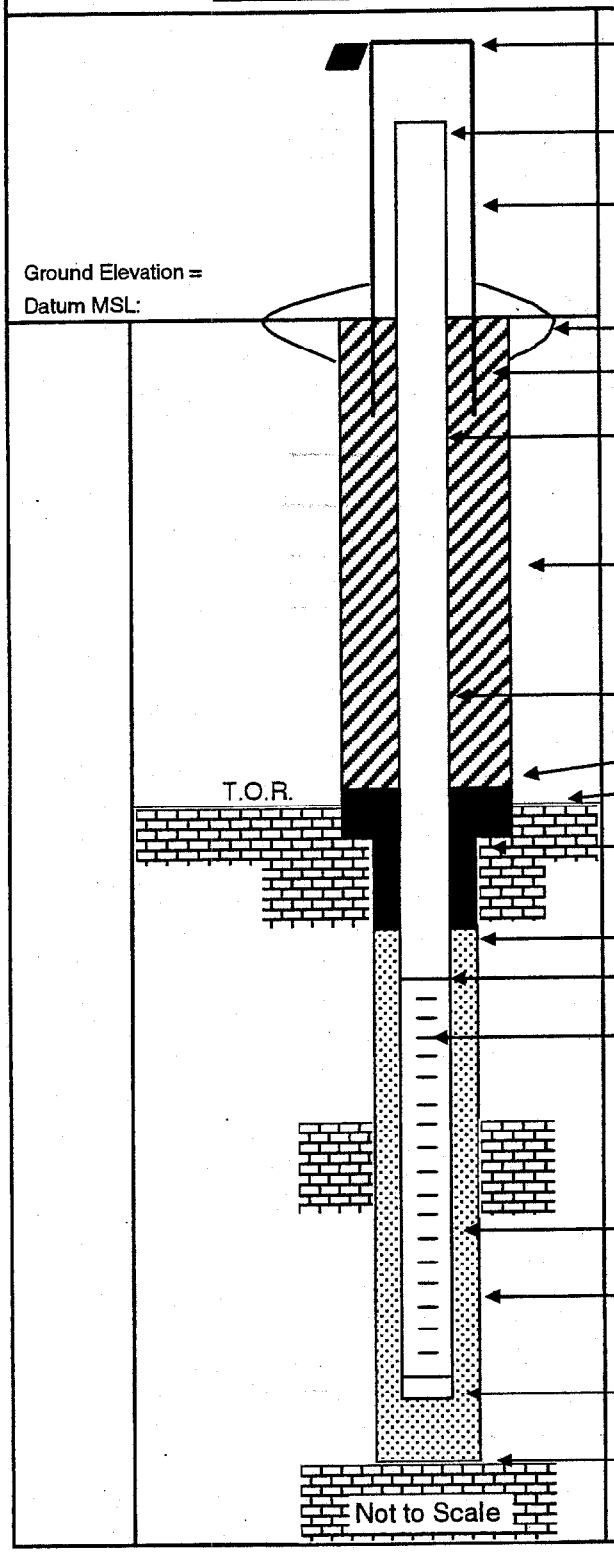
Tetra Tech NUS, Inc.

BEDROCK MONITORING WELL SHEET

WELL No.: 11GW121

PERMIT No:

PROJECT:	NSWC White Oak	DRILLING Co.:	CT&E	BORING No.:	11GW121
PROJECT No.:	7687	DRILLER:	CARY ELLISON	DATE COMPLETED:	9/13/01
SITE:	Site 11	DRILLING METHOD:	MUD/AIR ROTARY	NORTHING:	
GEOLOGIST:	Scott Neil	DEV. METHOD:		EASTING:	



Elevation of Top of Casing:

Stick Up of Casing Above Ground Surface:

Elevation of Top of Riser:

I.D. of Surface Casing:

Type of Surface Casing:

Type of Surface Seal: CEMENT

I.D. of Permanent Casing: 6-INCH

I.D. of Riser: 2-INCH

Type of Riser: SCH 40 PVC

Borehole Diameter: 11-INCH

Type of Backfill: CEMENT/BENTONITE GROUT

Elevation / Depth Top of Seal: / 94'

Elevation / Depth Top of Bedrock: / 42'

Type of Seal: BENTONITE PELLETS

Elevation / Depth of Top of Fine Sand: / NA

Elevation / Depth of Top of Filter Pack: / 97'

Elevation / Depth of Top of Screen: / 100'

Type of Screen: SCH 40 PVC

Slot Size x Length: 0.020 x 10'

I.D. of Screen: 2-INCH

Type of Filter Pack: 10-20 SILICA SAND

Diameter of Hole in Bedrock:
Core / Ream: 6-INCH

Elevation / Depth of Bottom of Screen: / 110'

Elevation / Total Depth of Borehole: / 123' *

* Bentonite pellets to 112'.

APPENDIX C

SLUG TEST CALCULATIONS

SLUG TEST CALCULATIONS AT
NSWC WHITE OAK
SILVER SPRINGS, MARYLAND
ALL K VALUES (OUTPUT) IN CENTIMETERS PER SECOND,
LENGTH VARIABLES IN FEET
TIME VARIABLES IN SECONDS

BOUWER AND RICE METHOD

WELL 11GW-119S

LIST OF VARIABLES

rw =	0.33
rc =	0.083
H =	133.6
L =	10
D =	135
yo =	3.6
yt =	2.65
t =	3600
A =	2.5
B =	0.5
C =	

CALCULATION OF ln(Re/rw)

ln(Re/rw) = 3.4533871

CALCULATION OF K

K = 3.07E-06

0.0087 ft/day

WELL 11GW-120

LIST OF VARIABLES

rw =	0.33
rc =	0.083
H =	119
L =	10
D =	120
yo =	3.6
yt =	3
t =	1800
A =	3
B =	0.5
C =	

CALCULATION OF ln(Re/rw)

ln(Re/rw) = 3.2881717

CALCULATION OF K

K = 3.47E-06

0.0098 ft/day

— Geo Mean .022 ft/day

WELL 11GW-121

LIST OF VARIABLES

rw =	0.25
rc =	0.083
H =	82.41
L =	10
D =	85
yo =	3.45
yt =	0.76
t =	1200
A =	3
B =	0.4
C =	

CALCULATION OF ln(Re/rw)

ln(Re/rw) = 3.4710161

CALCULATION OF K

K = 4.56E-05

0.129 ft/day

TETRA TECH NUS, INC. **CALCULATION WORKSHEET** PAGE ____ OF ____

CLIENT: Navy	JOB NUMBER:
SUBJECT: White Oak Slug Test - Hand Verification	
BASED ON: Bouwer & Rice WGW1195	DRAWING NUMBER:
BY: DP Cercone / CHECKED BY: JPO	APPROVED BY: / DATE:

$$\frac{R_e}{r_w} = \left[\frac{1.1}{\ln(L/r_w)} + \frac{A + B\ln[(D-H)/r_w]}{L/r_w}\right]^{-1}$$

$$= \left[\frac{1.1}{\ln(133.6/0.33)} + \frac{2.5 + 0.5\ln[(135-133.6/0.33)]}{10/0.33}\right]^{-1}$$

$$= \left[\quad + \frac{2.28}{30}\right]^{-1}$$

$$= 3.45$$

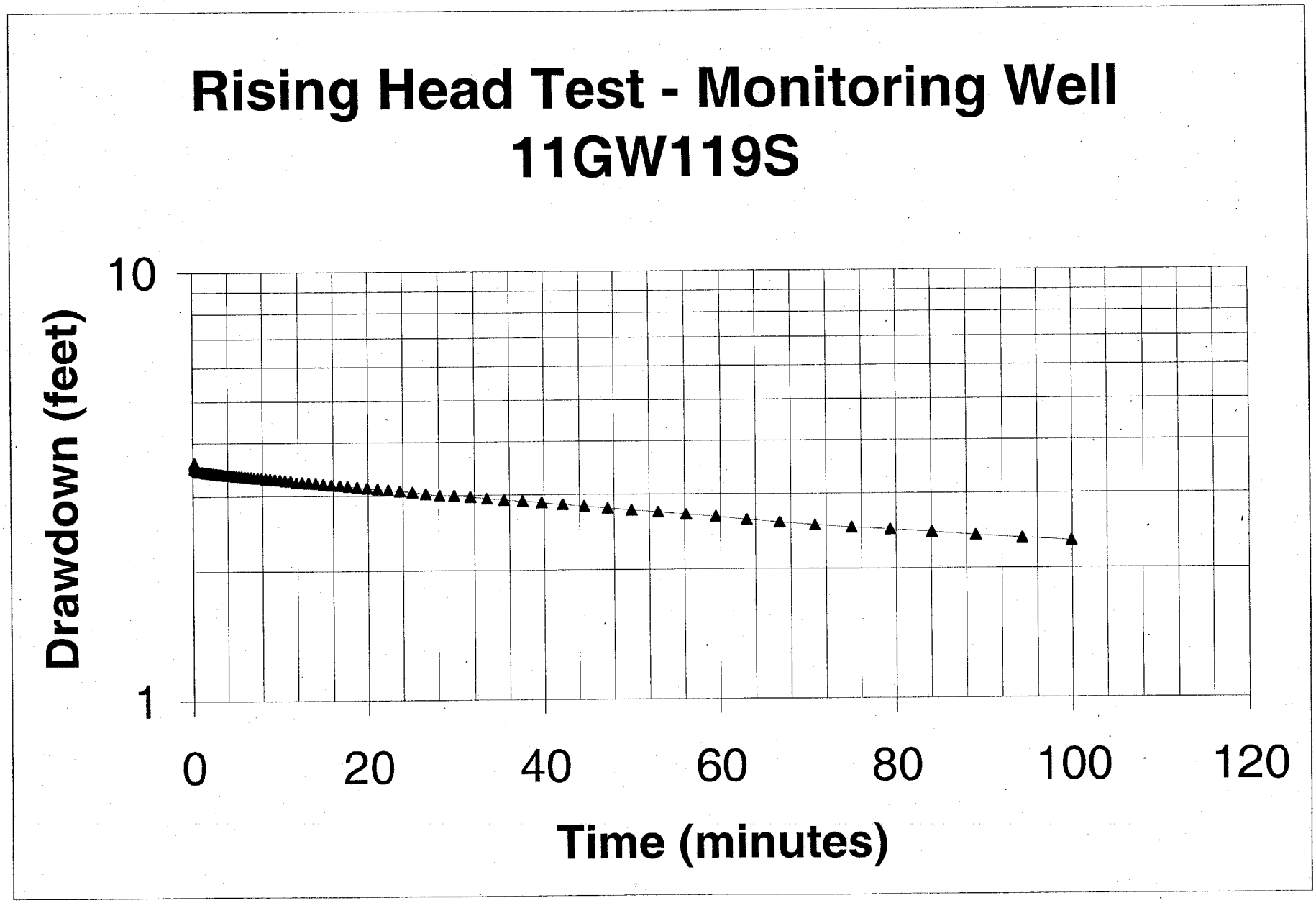
$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

$$\frac{(0.08)^2 \times 3.45}{2 \times 10} = \frac{(0.083)^2\ 3.45}{2 \cdot 10} \underbrace{\frac{1}{3600} \ln \frac{3.6}{2.65}}$$

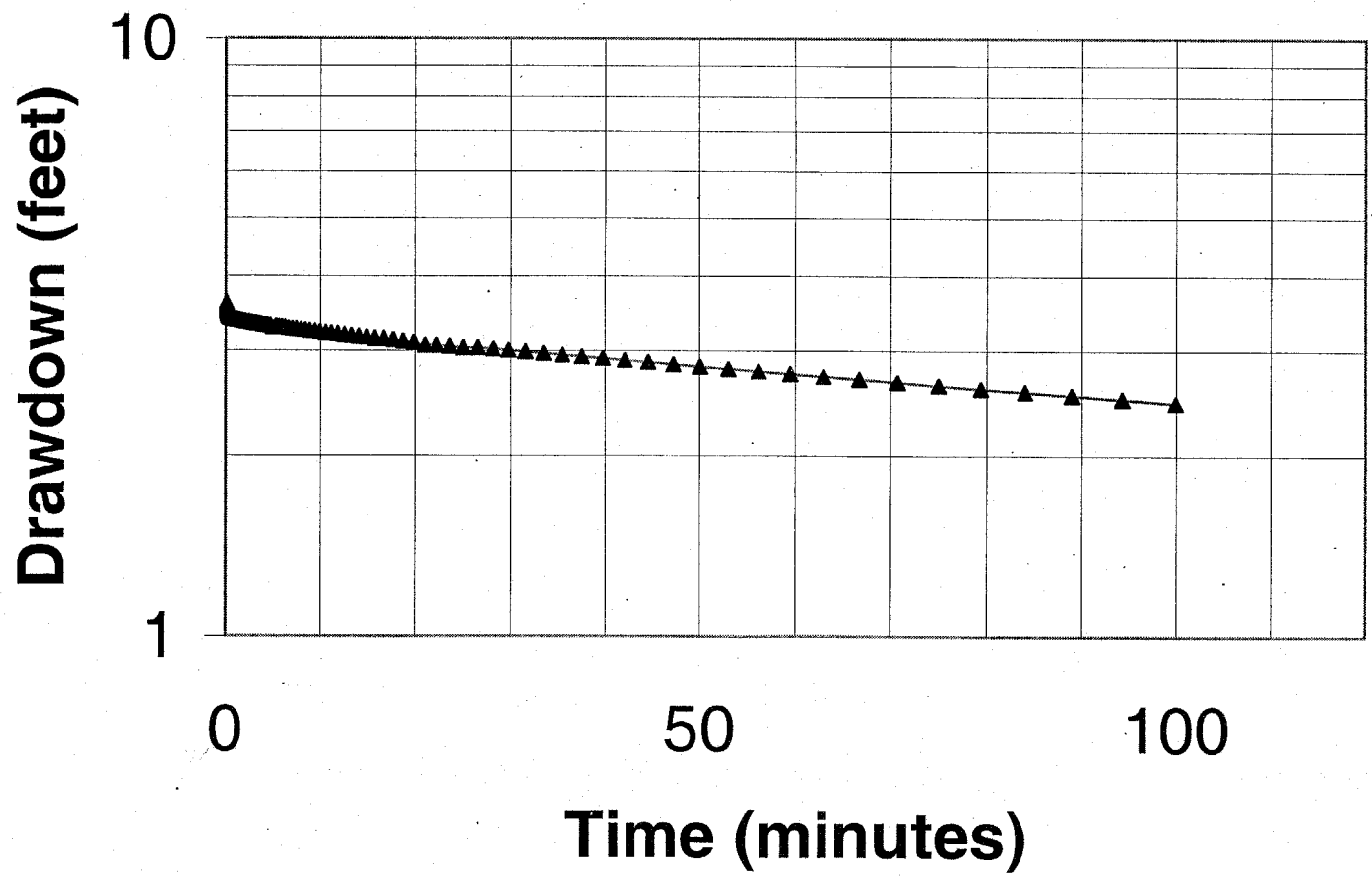
$$= 1.10 \times 10^{-3}$$

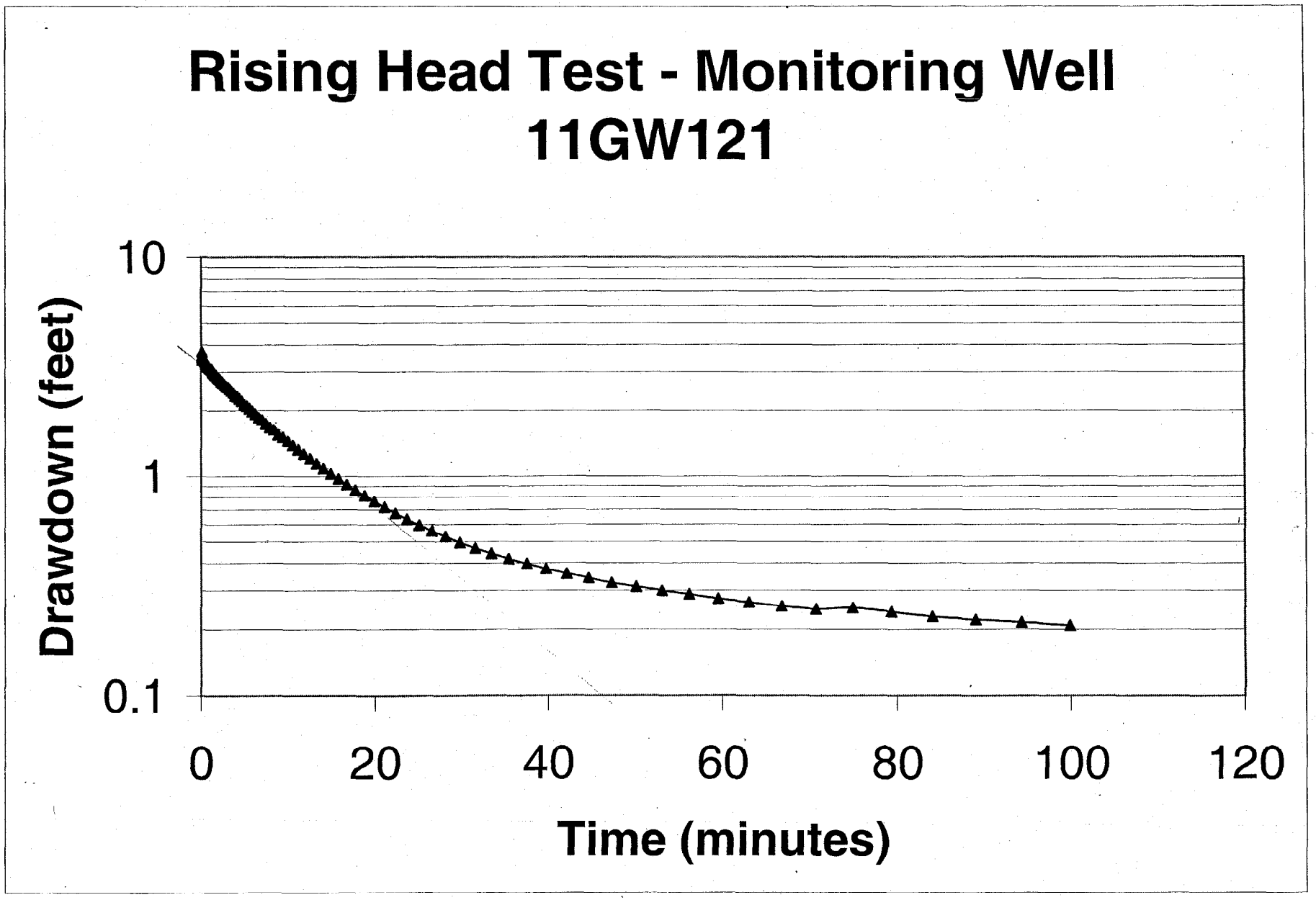
$$= 1.18 \times 10^{-3} * 8.5 \times 10^{-5} \text{ ft/sec}$$

$$= 1.01 \times 10^{-7} \times 30.28 = 3.08 \times 10^{-6} \text{ cm/sec}$$


Rising Head Test - Monitoring Well
11GW119S
Drawdown (feet)
10
1
0
20
40
60
80
100
120
Time (minutes)

Rising Head Test - Monitoring Well 11GW120




Rising Head Test - Monitoring Well
11GW121
Drawdown (feet)
10
1
0.1
0
20
40
60
80
100
120
Time (minutes)

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

PROJECT NAME: White Oak - Site 11 WELL/BORING NO.: 11GW119S

PROJECT NO.: 7687 GEOLOGIST: Dave Cercone

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10' TEST NO.:

STATIC WATER LEVEL (Depth/Elevation): 25.39 DATE: 10-2-01

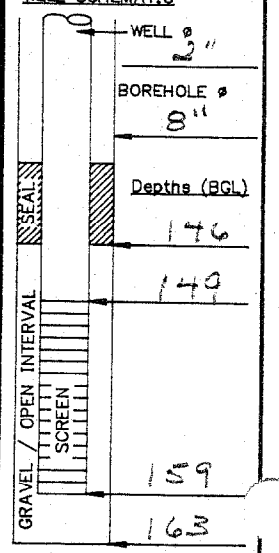
TEST TYPE (Rising/Falling/Constant Head): Rising Head CHECKED:

METHOD OF INDUCING WATER LEVEL CHANGE: Bailers PAGE ..... OF .....

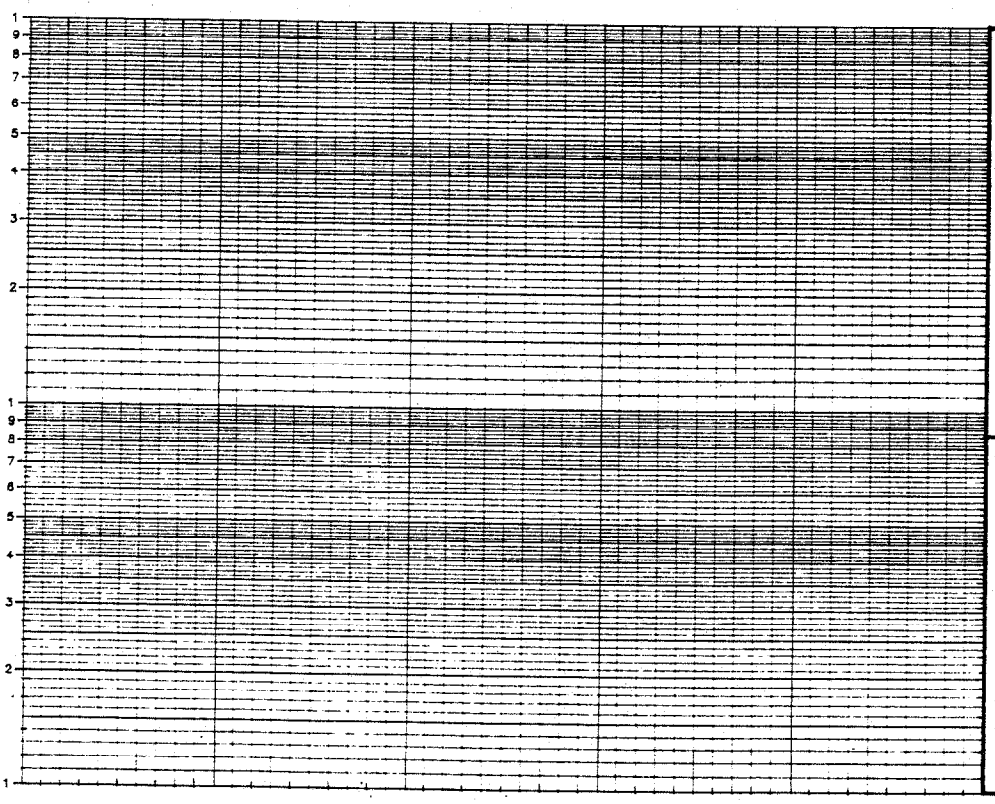
REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): Transducer at "0"

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0	25.39	—	371	26.12	0.73
11	27.88	2.49			
26	27.67	2.28			
53	27.38	1.99			
63	27.27	1.88			
81	27.10	1.71			
95	27.05	1.66			
102	26.98	1.59			
[illegible]	26.91	1.52			
16	26.66	1.27			
192	26.55	1.16			
281	26.35	0.96			

WELL SCHEMATIC



▽ Indicate SWL Depth on Drawing



REMARKS:

CALCS, SKETCH MAPS, ETC.:

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

PROJECT NAME: White Oak - Site 11 WELL/BORING NO.: 11GW120

PROJECT NO.: 7687 GEOLOGIST: D P Cercone

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10 TEST NO.:

STATIC WATER LEVEL (Depth/Elevation): 14.02 DATE: 10-2-01

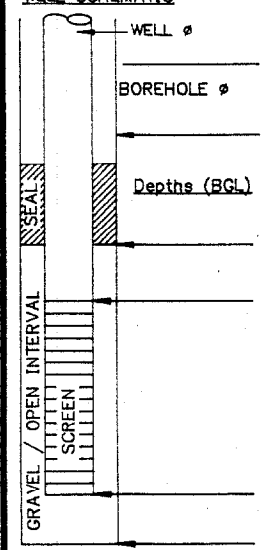
TEST TYPE (Rising/Falling/Constant Head): Rising CHECKED:

METHOD OF INDUCING WATER LEVEL CHANGE: BAILERS PAGE ..... OF .....

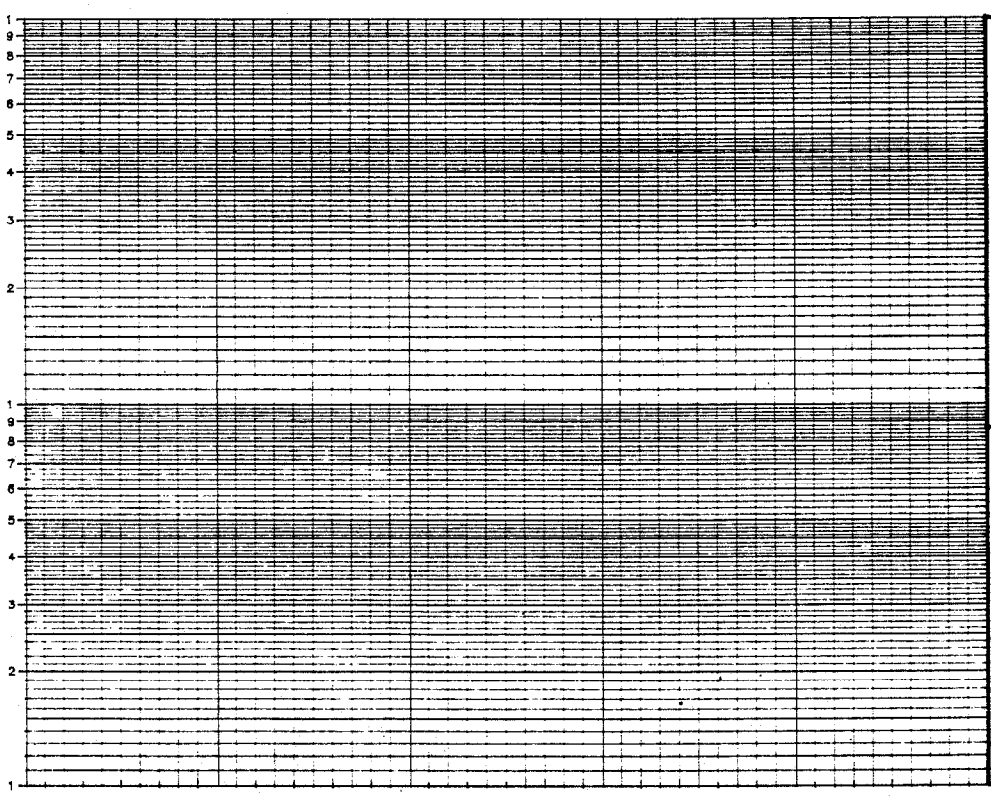
REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): Transducer "0"

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0	14.02	—	158	15.98	1.96
6	17.12	3.1	942	14.90	0.88
7	[illegible]	3.07			
10	17.04	3.02			
12	17.06	2.98			
15	[illegible]	2.95			
17	[illegible]	2.93			
20	[illegible]	2.9			
[illegible]	16.85	2.83			
34	[illegible]	2.78			
74	[illegible]	2.44			
[illegible]	16.30	2.48			

WELL SCHEMATIC



▽ Indicate SWL Depth on Drawing



REMARKS:

CALCS, SKETCH MAPS, ETC.:

HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

PROJECT NAME: White Oak - Site 11 WELL/BORING NO.: 11 GW121

PROJECT NO.: 6786 GEOLOGIST: Cercone

WELL DIAMETER: 2" SCREEN LENGTH/DEPTH: 10' TEST NO.:

STATIC WATER LEVEL (Depth/Elevation): 27.59 DATE: 10/3/01

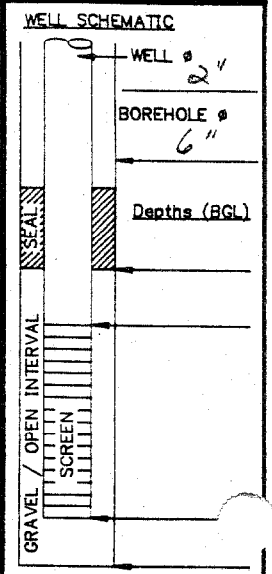
TEST TYPE (Rising/Falling/Constant Head): Rising CHECKED:

METHOD OF INDUCING WATER LEVEL CHANGE: BAILERS PAGE OF

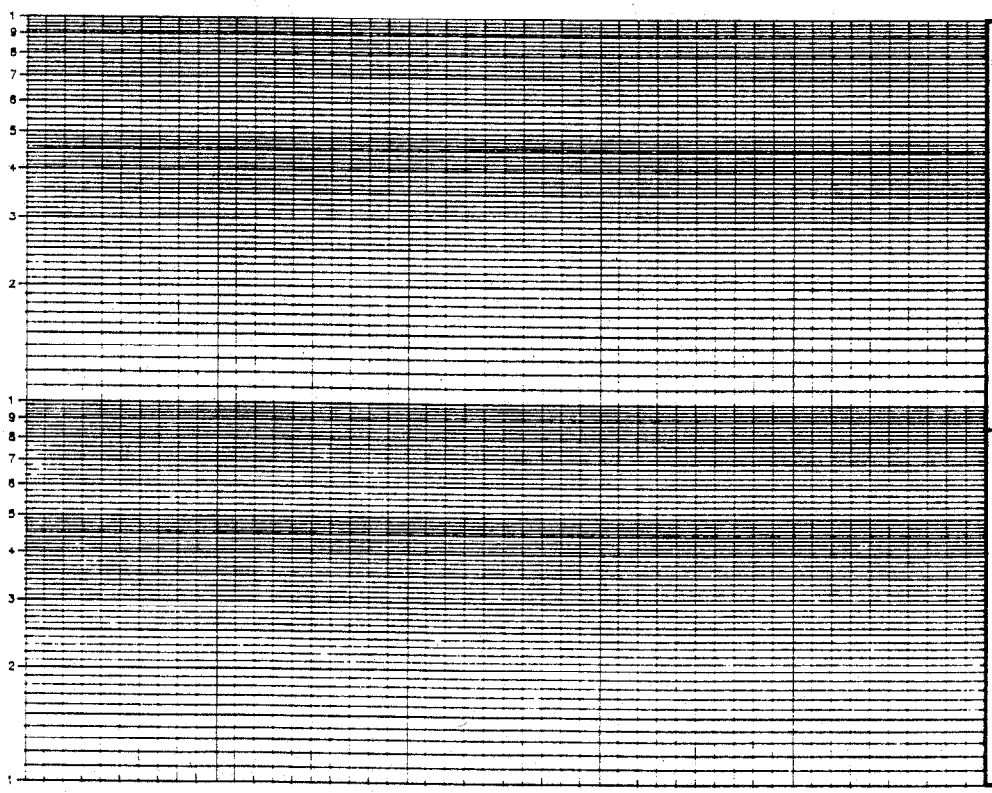
REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): Transducer "0"

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)
0845	27.59	—	8	29.15	
0 min	30.70		336	27.71	
	30.59				
	30.51				
1	30.45				
	30.38				
	30.31				
	30.26				
2	30.19				
3	29.95				
4	29.71				
6	29.38				

WELL SCHEMATIC



Indicate SWL Depth on Drawing



REMARKS:

CALCS, SKETCH MAPS, ETC.:

APPENDIX D

NATURAL ATTENUATION EVALUATIONS

EPA Natural Attenuation Screening Worksheets

EPA Worksheet for Screening for Anaerobic Biodegradation of Chlorinated Solvents

Location:	NSWC-White Oak	**By:**	JPO
Site:	11	**Date:**	11/12/2001
Well No:	11GW22	**Chkd:**	
Date Sampled:	10/1/2001	**Date:**	

Analytical Parameter	NA Indicator Level	Point Value	Conc. In Most Contaminated Zone	Units	Points Awarded
Dissolved Oxygen	<0.5, >0.5 mg/L	3, -3	4	mg/L	-3
Nitrate	<1 mg/L	2	>1.65	mg/L	0
Iron II	>1 mg/L	3	0.01	mg/L	0
Sulfate	<20 mg/L	2	9	mg/L	2
Sulfide	>1 mg/L	3	0.02	mg/L	0
Methane	<0.5, >0.5 mg/L	0, 3	0.012	mg/L	0
ORP	<50, <-100 mV	1, 2	283	mV	0
pH	<5 , >9	-2	4.99	SU	-1
TOC	>20 mg/L	2	3.1	mg/L	0
Temperature	>20 deg. C	1	19.3	C	0
Carbon Dioxide	>2x Bkgrnd	1	45	mg/L	1
Alkalinity	>2x Bkgrnd	1	6.5	mg/L	0
Chloride	>2x Bkgrnd	2	31	mg/L	2
Tetrachloroethene	Parent	0	1U	ug/L	0
Trichloroethene	If daughter	2	46	ug/L	2
cis-1,2-Dichloroethene	If daughter	2	110	ug/L	2
Vinyl Chloride	If daughter	2	1U	ug/L	0
Ethene/Ethane	>10, >100	2, 3	ND	ug/L	0
1,1,1-Trichloroethane	Parent	0	1U	ug/L	0
1,2-Dichloroethane	If daughter	2	1U	ug/L	0
Chloroethane	If daughter	2	1 U	ug/L	0
Carbon Tetrachloride	Parent	0	1 U	ug/L	0
Chloroform	Parent/daughter	0/2	1 U	ug/L	0
Methylene Chloride	Parent/daughter	0/2	2 U	ug/L	0
BTEX	>100	2	1 U	ug/L	0
Volatile Fatty Acids	>100	2	NA	ug/L	0
Hydrogen	>1 nM	3	NA	nM	0
Hydrogen	<1 nM	0	NA	nM	0
				Score	5

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation
6 to 14	Limited evidence for anaerobic biodegradation
15 to 20	Adequate evidence for anaerobic biodegradation
>20	Strong evidence for anaerobic biodegradation

EPA Worksheet for Screening for Anaerobic Biodegradation of Chlorinated Solvents

Location:	NSWC-White Oak	**By:**	JPO
Site:	11	**Date:**	11/12/2001
Well No:	11GW28	**Chkd:**	
Date Sampled:	10/1/2001	**Date:**	

Analytical Parameter	NA Indicator Level	Point Value	Conc. In Most Contaminated Zone	Units	Points Awarded
Dissolved Oxygen	<0.5, >0.5 mg/L	3, -3	5	mg/L	-3
Nitrate	<1 mg/L	2	>1.65	mg/L	0
Iron II	>1 mg/L	3	0	mg/L	0
Sulfate	<20 mg/L	2	1	mg/L	2
Sulfide	>1 mg/L	3	0.02	mg/L	0
Methane	<0.5, >0.5 mg/L	0, 3	NA	mg/L	0
ORP	<50, <-100 mV	1, 2	277	mV	0
pH	<5 , >9	-2	4.93	SU	-1
TOC	>20 mg/L	2	0.4	mg/L	0
Temperature	>20 deg. C	1	17.8	C	0
Carbon Dioxide	>2x Bkgrnd	1	70	mg/L	1
Alkalinity	>2x Bkgrnd	1	2.5	mg/L	0
Chloride	>2x Bkgrnd	2	4.1	mg/L	0
Tetrachloroethene	Parent	0	61	ug/L	0
Trichloroethene	If daughter	2	27	ug/L	2
cis-1,2-Dichloroethene	If daughter	2	2.9	ug/L	2
Vinyl Chloride	If daughter	2	10U	ug/L	0
Ethene/Ethane	>10, >100	2, 3	ND	ug/L	0
1,1,1-Trichloroethane	Parent	0	10U	ug/L	0
1,2-Dichloroethane	If daughter	2	10U	ug/L	0
Chloroethane	If daughter	2	10U	ug/L	0
Carbon Tetrachloride	Parent	0	10U	ug/L	0
Chloroform	Parent/daughter	0/2	10U	ug/L	0
Methylene Chloride	Parent/daughter	0/2	10U	ug/L	0
BTEX	>100	2	10U	ug/L	0
Volatile Fatty Acids	>100	2	NA	ug/L	0
Hydrogen	>1 nM	3	NA	nM	0
Hydrogen	<1 nM	0	NA	nM	0
				Score	3

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation
6 to 14	Limited evidence for anaerobic biodegradation
15 to 20	Adequate evidence for anaerobic biodegradation
>20	Strong evidence for anaerobic biodegradation

EPA Worksheet for Screening for Anaerobic Biodegradation of Chlorinated Solvents

Location:	NSWC-White Oak	**By:**	JPO
Site:	11	**Date:**	11/12/2001
Well No:	11GW110	**Chkd:**	
Date Sampled:	10/1/2001	**Date:**	

Analytical Parameter	NA Indicator Level	Point Value	Conc. In Most Contaminated Zone	Units	Points Awarded
Dissolved Oxygen	<0.5, >0.5 mg/L	3, -3	1	mg/L	-3
Nitrate	<1 mg/L	2	0.34	mg/L	2
Iron II	>1 mg/L	3	0.1	mg/L	0
Sulfate	<20 mg/L	2	0	mg/L	2
Sulfide	>1 mg/L	3	0.07	mg/L	0
Methane	<0.5, >0.5 mg/L	0, 3	31.5	mg/L	3
ORP	<50, <-100 mV	1, 2	168	mV	0
pH	<5 , >9	-2	5.76	SU	0
TOC	>20 mg/L	2	2.5	mg/L	0
Temperature	>20 deg. C	1	18.9	C	0
Carbon Dioxide	>2x Bkgrnd	1	50	mg/L	1
Alkalinity	>2x Bkgrnd	1	27	mg/L	0
Chloride	>2x Bkgrnd	2	4.9	mg/L	0
Tetrachloroethene	Parent	0	3.2	ug/L	0
Trichloroethene	If daughter	2	180	ug/L	2
cis-1,2-Dichloroethene	If daughter	2	140	ug/L	2
Vinyl Chloride	If daughter	2	1U	ug/L	0
Ethene/Ethane	>10, >100	2, 3	ND	ug/L	0
1,1,1-Trichloroethane	Parent	0	1U	ug/L	0
1,2-Dichloroethane	If daughter	2	29	ug/L	2
Chloroethane	If daughter	2	1U	ug/L	0
Carbon Tetrachloride	Parent	0	2.9	ug/L	0
Chloroform	Parent/daughter	0/2	11	ug/L	2
Methylene Chloride	Parent/daughter	0/2	2U	ug/L	0
BTEX	>100	2	1U	ug/L	0
Volatile Fatty Acids	>100	2	NA	ug/L	0
Hydrogen	>1 nM	3	NA	nM	0
Hydrogen	<1 nM	0	NA	nM	0
				Score	13

Score	**Interpretation**
0 to 5	Inadequate evidence for anaerobic biodegradation
6 to 14	Limited evidence for anaerobic biodegradation
15 to 20	Adequate evidence for anaerobic biodegradation
>20	Strong evidence for anaerobic biodegradation

EPA Worksheet for Screening for Anaerobic Biodegradation of Chlorinated Solvents

Location:	NSWC-White Oak	**By:**	JPO
Site:	11	**Date:**	11/12/2001
Well No:	11GW112	**Chkd:**	
Date Sampled:	10/1/2001	**Date:**	

Analytical Parameter	NA Indicator Level	Point Value	Conc. In Most Contaminated Zone	Units	Points Awarded
Dissolved Oxygen	<0.5, >0.5 mg/L	3, -3	3	mg/L	-3
Nitrate	<1 mg/L	2	0	mg/L	2
Iron II	>1 mg/L	3	4	mg/L	3
Sulfate	<20 mg/L	2	0	mg/L	2
Sulfide	>1 mg/L	3	0.04	mg/L	0
Methane	<0.5, >0.5 mg/L	0, 3	17.1	mg/L	3
ORP	<50, <-100 mV	1, 2	-80	mV	1
pH	<5 , >9	-2	6.6	SU	0
TOC	>20 mg/L	2	6.7	mg/L	0
Temperature	>20 deg. C	1	16.8	C	0
Carbon Dioxide	>2x Bkgrnd	1	40	mg/L	1
Alkalinity	>2x Bkgrnd	1	110	mg/L	1
Chloride	>2x Bkgrnd	2	3.6	mg/L	0
Tetrachloroethene	Parent	0	10 U	ug/L	0
Trichloroethene	If daughter	2	34	ug/L	2
cis-1,2-Dichloroethene	If daughter	2	120	ug/L	2
Vinyl Chloride	If daughter	2	10 U	ug/L	0
Ethene/Ethane	>10, >100	2, 3	ND	ug/L	0
1,1,1-Trichloroethane	Parent	0	10 U	ug/L	0
1,2-Dichloroethane	If daughter	2	16	ug/L	2
Chloroethane	If daughter	2	10 U	ug/L	0
Carbon Tetrachloride	Parent	0	10 U	ug/L	0
Chloroform	Parent/daughter	0/2	10 U	ug/L	0
Methylene Chloride	Parent/daughter	0/2	10 U	ug/L	0
BTEX	>100	2	4	ug/L	0
Volatile Fatty Acids	>100	2	NA	ug/L	0
Hydrogen	>1 nM	3	NA	nM	0
Hydrogen	<1 nM	0	NA	nM	0
				Score	16

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation
6 to 14	Limited evidence for anaerobic biodegradation
15 to 20	Adequate evidence for anaerobic biodegradation
>20	Strong evidence for anaerobic biodegradation

EPA Worksheet for Screening for Anaerobic Biodegradation of Chlorinated Solvents

Location:	NSWC-White Oak	**By:**	JPO
Site:	11	**Date:**	11/12/2001
Well No:	11GW118	**Chkd:**	
Date Sampled:	10/1/2001	**Date:**	

Analytical Parameter	NA Indicator Level	Point Value	Conc. In Most Contaminated Zone	Units	Points Awarded
Dissolved Oxygen	<0.5, >0.5 mg/L	3, -3	0.05	mg/L	3
Nitrate	<1 mg/L	2	0	mg/L	2
Iron II	>1 mg/L	3	4.5	mg/L	3
Sulfate	<20 mg/L	2	0	mg/L	2
Sulfide	>1 mg/L	3	0.08	mg/L	0
Methane	<0.5, >0.5 mg/L	0, 3	17.5	mg/L	3
ORP	<50, <-100 mV	1, 2	-89	mV	1
pH	<5 , >9	-2	6.65	SU	0
TOC	>20 mg/L	2	12	mg/L	0
Temperature	>20 deg. C	1	17.7	C	0
Carbon Dioxide	>2x Bkgrnd	1	45	mg/L	1
Alkalinity	>2x Bkgrnd	1	98	mg/L	1
Chloride	>2x Bkgrnd	2	7.8	mg/L	2
Tetrachloroethene	Parent	0	1.7	ug/L	0
Trichloroethene	If daughter	2	140	ug/L	2
cis-1,2-Dichloroethene	If daughter	2	310	ug/L	2
Vinyl Chloride	If daughter	2	1	ug/L	2
Ethene/Ethane	>10, >100	2, 3	ND	ug/L	0
1,1,1-Trichloroethane	Parent	0	1U	ug/L	0
1,2-Dichloroethane	If daughter	2	53	ug/L	2
Chloroethane	If daughter	2	4.5	ug/L	2
Carbon Tetrachloride	Parent	0	50U	ug/L	0
Chloroform	Parent/daughter	0/2	1U	ug/L	0
Methylene Chloride	Parent/daughter	0/2	2U	ug/L	0
BTEX	>100	2	0.6	ug/L	0
Volatile Fatty Acids	>100	2	NA	ug/L	0
Hydrogen	>1 nM	3	NA	nM	0
Hydrogen	<1 nM	0	NA	nM	0
				Score	28

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation
6 to 14	Limited evidence for anaerobic biodegradation
15 to 20	Adequate evidence for anaerobic biodegradation
>20	Strong evidence for anaerobic biodegradation

EPA Worksheet for Screening for Anaerobic Biodegradation of Chlorinated Solvents

Location: NSWC-White Oak
Site: 11
Well No: 11GW119S
Date Sampled: 10/1/01

By: JPO
Date: 11/12/2001
Chkd:
Date:

Analytical Parameter	NA Indicator Level	Point Value	Conc. In Most Contaminated Zone	Units	Points Awarded
Dissolved Oxygen	<0.5, >0.5 mg/L	3, -3	5	mg/L	-3
Nitrate	<1 mg/L	2	0.03	mg/L	2
Iron II	>1 mg/L	3	0	mg/L	0
Sulfate	<20 mg/L	2	11	mg/L	2
Sulfide	>1 mg/L	3	0.01	mg/L	0
Methane	<0.5, >0.5 mg/L	0, 3	0.014	mg/L	0
ORP	<50, <-100 mV	1, 2	142	mV	0
pH	<5 , >9	-2	7.3	SU	0
TOC	>20 mg/L	2	87	mg/L	2
Temperature	>20 deg. C	1	18.4	C	0
Carbon Dioxide	>2x Bkgrnd	1	<10	mg/L	0
Alkalinity	>2x Bkgrnd	1	140	mg/L	1
Chloride	>2x Bkgrnd	2	3.7	mg/L	0
Tetrachloroethene	Parent	0	1U	ug/L	0
Trichloroethene	If daughter	2	21	ug/L	2
cis-1,2-Dichloroethene	If daughter	2	47	ug/L	2
Vinyl Chloride	If daughter	2	1U	ug/L	0
Ethene/Ethane	>10, >100	2, 3	ND	ug/L	0
1,1,1-Trichloroethane	Parent	0	1U	ug/L	0
1,2-Dichloroethane	If daughter	2	16	ug/L	2
Chloroethane	If daughter	2	1U	ug/L	0
Carbon Tetrachloride	Parent	0	1U	ug/L	0
Chloroform	Parent/daughter	0/2	1U	ug/L	0
Methylene Chloride	Parent/daughter	0/2	2U	ug/L	0
BTEX	>100	2	1U	ug/L	0
Volatile Fatty Acids	>100	2	NA	ug/L	0
Hydrogen	>1 nM	3	NA	nM	0
Hydrogen	<1 nM	0	NA	nM	0
				Score	**10**

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation
6 to 14	Limited evidence for anaerobic biodegradation
15 to 20	Adequate evidence for anaerobic biodegradation
>20	Strong evidence for anaerobic biodegradation

EPA Worksheet for Screening for Anaerobic Biodegradation of Chlorinated Solvents

Location:	NSWC-White Oak	**By:**	JPO
Site:	11	**Date:**	11/12/2001
Well No:	11GW119D	**Chkd:**	
Date Sampled:	10/1/2001	**Date:**	

Analytical Parameter	NA Indicator Level	Point Value	Conc. In Most Contaminated Zone	Units	Points Awarded
Dissolved Oxygen	<0.5, >0.5 mg/L	3, -3	6	mg/L	-3
Nitrate	<1 mg/L	2	0	mg/L	2
Iron II	>1 mg/L	3	0	mg/L	0
Sulfate	<20 mg/L	2	13	mg/L	2
Sulfide	>1 mg/L	3	0.14	mg/L	0
Methane	<0.5, >0.5 mg/L	0, 3	0.005	mg/L	0
ORP	<50, <-100 mV	1, 2	154	mV	0
pH	<5 , >9	-2	7.56	SU	0
TOC	>20 mg/L	2	44	mg/L	2
Temperature	>20 deg. C	1	16.2	C	0
Carbon Dioxide	>2x Bkgrnd	1	14	mg/L	0
Alkalinity	>2x Bkgrnd	1	140	mg/L	1
Chloride	>2x Bkgrnd	2	4.3	mg/L	0
Tetrachloroethene	Parent	0	1U	ug/L	0
Trichloroethene	If daughter	2	4	ug/L	2
cis-1,2-Dichloroethene	If daughter	2	7.2	ug/L	2
Vinyl Chloride	If daughter	2	1U	ug/L	0
Ethene/Ethane	>10, >100	2, 3	ND	ug/L	0
1,1,1-Trichloroethane	Parent	0	1U	ug/L	0
1,2-Dichloroethane	If daughter	2	2.5	ug/L	2
Chloroethane	If daughter	2	1U	ug/L	0
Carbon Tetrachloride	Parent	0	1U	ug/L	0
Chloroform	Parent/daughter	0/2	1.3	ug/L	2
Methylene Chloride	Parent/daughter	0/2	2U	ug/L	0
BTEX	>100	2	1U	ug/L	0
Volatile Fatty Acids	>100	2	NA	ug/L	0
Hydrogen	>1 nM	3	NA	nM	0
Hydrogen	<1 nM	0	NA	nM	0
				Score	12

Score	Interpretation
0 to 5	Inadequate evidence for anaerobic biodegradation
6 to 14	Limited evidence for anaerobic biodegradation
15 to 20	Adequate evidence for anaerobic biodegradation
>20	Strong evidence for anaerobic biodegradation

Major Cation/Anion Evaluations, Trilinear Plot

TABLE D-1

GROUNDWATER GEOCHEMISTRY - MAJOR CATIONS/ANIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

	Cations				Anions		
Constituent	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Bicarbonate
11GW22							
Concentration	2.7	1.53	30.2	2.08	31	7	6.5
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.13473	0.1258578	1.3137	0.0531856	0.87451	0.14574	0.106535
% of Total	8.28	7.73	80.72	3.27	77.61	12.93	9.45
11GW28							
Concentration	8.07	6.13	11.7	2.07	4.1	5.4	2.5
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.402693	0.5042538	0.50895	0.0529299	0.115661	0.112428	0.040975
% of Total	27.42	34.33	34.65	3.60	42.99	41.78	15.23
11GW66							
Concentration	2.16	1.81	5.51	2	2.1	0	7.5
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.107784	0.1488906	0.239685	0.05114	0.059241	0	0.122925
% of Total	19.69	27.19	43.78	9.34	32.52	0.00	67.48
11GW106							
Concentration	17.6	4.88	6.79	3.56	0	2.4	77
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.87824	0.4014288	0.295365	0.0910292	0	0.049968	1.26203
% of Total	52.71	24.09	17.73	5.46	0.00	3.81	96.19
11GW107							
Concentration	6.97	4.95	12.2	2.11	1.6	0	3
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.347803	0.407187	0.5307	0.0539527	0.045136	0	0.04917
% of Total	25.96	30.40	39.62	4.03	47.86	0.00	52.14

TABLE D-1

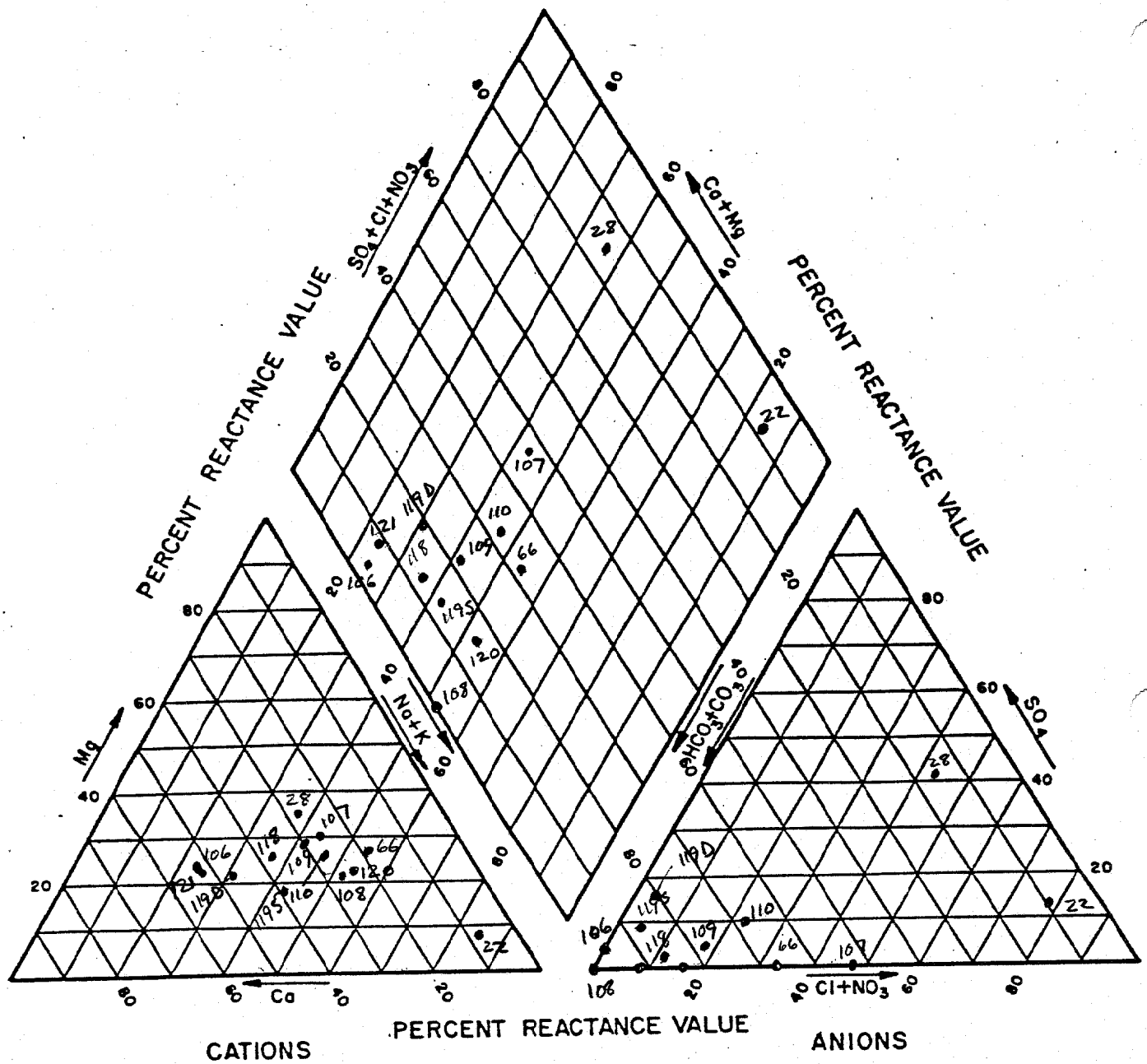
GROUNDWATER GEOCHEMISTRY - MAJOR CATIONS/ANIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

	Cations				Anions		
Constituent	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Bicarbonate
11GW108							
Concentration	2.67	1.25	5.19	0.943	0	0	7.5
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.133233	0.102825	0.225765	0.02411251	0	0	0.122925
% of Total	27.42	21.16	46.46	4.96	0.00	0.00	100.00
11GW109							
Concentration	7.79	4.52	10.4	2.86	6	1.9	43
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.388721	0.3718152	0.4524	0.0731302	0.16926	0.039558	0.70477
% of Total	30.23	28.91	35.18	5.69	18.53	4.33	77.14
11GW110							
Concentration	4.36	2.46	6.99	2.77	4.9	3	27
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.217564	0.2023596	0.304065	0.0708289	0.138229	0.06246	0.44253
% of Total	27.37	25.46	38.26	8.91	21.49	9.71	68.80
11GW118							
Concentration	15.7	7.08	15.8	4.69	7.6	1.5	99
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.78343	0.5824008	0.6873	0.1199233	0.214396	0.03123	1.62261
% of Total	36.05	26.80	31.63	5.52	11.48	1.67	86.85
11GW119S							
Concentration	26.6	7.36	29.5	5.23	3.7	12	140
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	1.32734	0.6054336	1.28325	0.1337311	0.104377	0.24984	2.2946
% of Total	39.62	18.07	38.31	3.99	3.94	9.43	86.63

TABLE D-1

GROUNDWATER GEOCHEMISTRY - MAJOR CATIONS/ANIONS
SITE 11 GROUNDWATER INVESTIGATION
FORMER NSWC WHITE OAK, SILVER SPRING, MARYLAND

	Cations				Anions		
Constituent	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Bicarbonate
11GW119D							
Concentration	35	9.28	21.4	7.04	4.3	21	140
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	1.7465	0.7633728	0.9309	0.1800128	0.121303	0.43722	2.2946
% of Total	48.24	21.08	25.71	4.97	4.25	15.32	80.42
11GW120							
Concentration	3.01	1.68	6.08	3.25	2.6	0	22
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	0.150199	0.1381968	0.26448	0.0831025	0.073346	0	0.36058
% of Total	23.62	21.73	41.59	13.07	16.90	0.00	83.10
11GW121							
Concentration	21.5	5.55	9.89	4.44	3.6	0	64
Conversion Multiplier	0.0499	0.08226	0.0435	0.02557	0.02821	0.02082	0.01639
Milliequivalents/Liter	1.07285	0.456543	0.430215	0.1135308	0.101556	0	1.04896
% of Total	51.75	22.02	20.75	5.48	8.83	0.00	91.17



Site 11 Groundwater
Trilinear Plot
Major Cations & Anions

NUMBER

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