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SAMPLING AND ANALYSIS PLAN FOR ZONE C SITE 31-BUILDING 760 UST 760 CNC
CHARLESTON SC
8/1/2000
CH2M HILL

**SAMPLING AND ANNALYSIS PLAN
FOR
ZONE C/ SITE 31- BUILDING 760
UST 760**

SITE IDENTIFICATION # 01118

**Charleston Naval Complex
Charleston, South Carolina**

**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND**

Contract Number N62467-99-C-0960

August 2000

**SAMPLING AND ANALYSIS PLAN
FOR
ZONE C/ SITE 31-BUILDING 760
UST 760**

SITE IDENTIFICATION # 01118

**Charleston Naval Complex
Charleston, South Carolina**

**Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
Charleston, South Carolina 29406**

**Submitted by:
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Contract Number: N62467-99-C-0960

August 2000

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ACRONYMS AND ABBREVIATIONS

bls	below land surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene Isomers
CAP	Corrective Action Plan
CNC	Charleston Naval Complex
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EPA	Environmental Protection Agency
ft	Foot
mg/kg	microgram per kilogram
mg/L	microgram per liter
OVA	Organic Vapor Analyzer
QA	Quality Assurance
QC	Quality Control
RBSL	Risk-Based Screening Level
RDA	Redevelopment Authority
SAP	Sampling and Analysis Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SSTL	Site-Specific Target Level
TTNUS	Tetra Tech NUS
UST	Underground Storage Tank

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by CH2M-JONES, LLC. The plan is designed for Zone C/ Site 31-Building 760; Underground Storage Tank (UST) 760 located at the Charleston Naval Complex (CNC), Charleston, South Carolina.

The South Carolina Department of Health and Environmental Control (SCDHEC) has designated this site as Identification Number: 01118. This SAP provides methods to further evaluate the applicability of intrinsic remediation and monitoring well abandonment as a corrective action for UST 760 in accordance with SCDHEC Corrective Action Guidance, June 1997.

1.1 General Site Description

The CNC is in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina as shown in Figure 1. This installation consists of two major areas: an undeveloped dredge materials area on the east bank of the Cooper River on Daniel Island in Berkley County, and a developed area on the west bank of the Cooper River. The developed portion of the base is on the peninsula bounded on the west by the Ashley River and on the east by the Cooper River. The site is located within the developed portion of the base as shown in Figure 1. (Tetra Tech, NUS [TTNUS], 1999).

The area surrounding CNC is "mature urban", having long been developed with commercial, industrial, and residential land use. Commercial areas are primarily west of CNC; industrial areas are primarily to the north of the base along Shipyard Creek. A site vicinity map, which exhibits adjacent properties and structures, vicinity roads, current utilities, and vicinity surface drainage, is included as Figure 2.

Building 760, also known as the Naval Hospital Building NH-D, was constructed in 1917 and served as housing for Naval families until base closure. UST 760 was located on the southwest side of Building 760 and provided heating oil to the building (Figure 3). The UST had a 1,000-gallon capacity and was constructed of steel. It is unknown when the UST was installed but the system was deactivated in March 1998 (TTNUS 1999).

1.2 Objective

This SAP presents the groundwater monitoring plan to assess the down gradient plume migration and intrinsic bioremediation/natural attenuation of petroleum hydrocarbons contamination in order to validate the assumptions and calculations used in the in the Rapid Assessment completed by TTNUS 1999. Details for the abandonment of monitoring wells at UST 760 are also included in this plan.

2.0 RECEPTOR SURVEY

A receptor survey of the site vicinity was conducted by TTNUS personnel to identify potential receptors for petroleum hydrocarbon contamination. Figures 2 and 3 depict the public utilities located within 250 feet (ft) of the former UST 760 study area. Specific information concerning the depth of utilities below land surface (bls) is currently unavailable, however, utilities at this site generally are between 2 to 6 feet bls. The following utility receptors were located:

- Sanitary sewer, water utility: Sanitary sewer line and water line extend east to west along Kenny Lane south of building 760. The sanitary sewer line and water line enter Building 760 on the south side of the Building. No hydraulically down gradient (with respect to groundwater) sanitary sewer lines or water lines were identified within 250 feet down gradient of UST 760.
- Electricity utility, gas utility: An electrical transformer station is located approximately 45 feet west of the site, which provides subsurface electrical feeds to the boiler house and Building 760. The electrical line leading from the transformer station to Building 760 is located approximately 20 feet north of UST 760. This is the nearest down gradient electrical line to the former UST location. The electrical feed to the boiler house is located approximately 5 feet south of UST 760. A primary electrical line extends east to west south of Kenny Lane. A gas line also originates from the west side of Building 760 and extends towards the south. This gas main is located approximately 5 feet east of UST 760.
- Storm drain utility: The nearest storm drain utility is located approximately 35 feet south of UST 760. No down gradient storm drain utilities were identified within 250 feet of UST 760.

According to the Tier I and Tier II report completed by TTNUS, a survey of groundwater users within a 7-mile radius of CNC was conducted by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. Results of the water use investigation revealed that no drinking water wells, which utilize the shallow aquifer, are located within a 4-mile radius of CNC. Irrigation wells are not identified within 1,000 feet of the site. Numerous monitoring wells are located within 1,000 feet of the site. The nearest surface water body to UST 760 is Noisette Creek located approximately 2,000 feet to the north. No basements are located on the CNC property.

There are no city, county or state-zoning ordinances, the property (CNC) is currently owned by the federal government. Information concerning zoning ordinances was obtained from the SOUTHDIV Remedial Project Manager located at 2155 Eagle Drive, North Charleston, South Carolina 29406 (TTNUS, 1999).

2.1 Fate and Transport Modeling

No groundwater concentrations exceeded the SCDHEC Risk Based Screening Levels (RBSLs); therefore, fate and transport modeling is not required for this site.

2.2 Site-Specific Target Levels

The only identified future potential receptor is the construction (utility) worker. Site soil concentrations were compared with RBSLs for ingestion or dermal contact with surficial soil. Surficial soil was not impacted at the site; however, for the construction worker pathway, exposure to subsurface soil is evaluated as surface soil because the worker is expected to have direct contact with the subsurface soil (TTNUS, 1999). The calculations for dermal contact and incidental ingestion can be found in the Tier II completed by TTNUS.

Compound of Concern	Maximum Concentration (mg/kg)	RBSL for Ingestion or Dermal Contact with Soil- Commercial (mg/kg)	Exceed the RBSL
Benzene	0.010	200	No
Naphthalene	13.4	41,000	No

2.3 Soil Leaching SSTL

SSTLs were calculated for benzene and Naphthalene concentrations leaching from subsurface soil to groundwater using the SCDHEC Soil Leachability Model and Selected Minimum RBSLs. The input parameters for the leachability model were determined using the figures in the SCDHEC Risk-based Corrective Action Guidelines (January 1998), soil quality and grain size data, and the Selected Minimum RBSLs calculated for the site. The soil leaching SSTLs calculated for benzene and Naphthalene are provided in the following table (TTNUS 1999).

Chemical of Concern	Concentration in CNC31-B03/31SLB03112 (mg/kg)	Soil Leaching SSTL (mg/kg)
Benzene	0.010	0.974
Naphthalene	13.4	182

The soil leaching SSTL for benzene is 0.974 mg/kg, which is above the maximum benzene concentration detected (0.010 mg/kg), indicating the soil benzene levels will not leach into the groundwater at concentrations above RBSL for a construction worker. The soil leaching SSTL calculated for naphthalene is 182 mg/kg, which is, well above the maximum naphthalene concentration detected (13.4 mg/kg) and indicates that naphthalene in subsurface soils will not leach into the groundwater above the RBSL for a construction worker (TTNUS, 1999). For information on the leachability models used, see Appendix A.

3.0 PROPOSED REMEDIATION TECHNOLOGY

Based on the results of the Tier I and Tier II modeling, an Intrinsic Remediation with a monitoring period of 18 months will be performed for the site. The monitoring program will consist of sampling initially all of the surrounding wells adjacent to the source point, and only sampling selected wells thereafter. The proposed monitoring program is described in detail in Sections 4.0 and 5.0 of this plan.

4.0 MONITORING WELL INSTALLATION AND ABANDONMENT

4.1 Monitoring Well Installation

Because five monitoring wells located in and around this site, no monitoring wells will be installed as part of this plan.

4.2 Monitoring Well Abandonment

A total of thirteen monitoring wells will be abandoned at Building 760 following the South Carolina Well Standards and Regulations R.61-71. The well abandonment will include grouting wells, removing stick-ups and removing all guard posts. Any well casing and screen removed will be decontaminated and disposed of as general refuse.

4.3 Surveying

Because no monitoring wells will be installed at this site, a new survey will not be conducted.

4.4 Equipment Decontamination

All drilling equipment, augers, well casing and screens, and soil and groundwater sampling equipment involved in field sampling activities will be decontaminated according to the Environmental Protection Agencies (EPA) "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).

5.0 PROPOSED GROUNDWATER MONITORING PROGRAM

5.1 Monitoring Frequency and Reporting

The groundwater monitoring program proposed at UST 760 will be performed in accordance with SCDHEC Corrective Action Guidance Document and consist of the following:

- **Frequency:** Initially all monitoring wells at this site will be sampled. Thereafter, groundwater samples will be collected from wells CNC31-MW01 as a source well, CNC31-MW02 as the up gradient well and CNC31-MW03 as the down gradient well.
- **Reporting:** Semi-annual groundwater monitoring reports will be submitted to SCDHEC.

Included in the semi-annual reports will be field and analytical information from the certified laboratory indicating well numbers, analytical methods used, date sampled, date analyzed, and method detection limits.

At the end of the 18-month period (or as nessasarry), a performance evaluation will be submitted to SCDHEC providing the effectiveness of the intrinsic biodegradation/natural attenuation occurring and any recommendations for the site.

- **Groundwater Sampling**

Prior to any groundwater sampling, each well will be measured for water levels and total depth and each well will be purged in accordance the EPA EISOPQAM.

5.2 Analytical Parameters

The following constituents will be analyzed for each groundwater sample:

- Benzene, Toluene, Ethylbenzene, total Xylene (BTEX) using method 8260.
- Naphthalene using method 8260.

The following parameters will be analyzed in order to evaluate the effectiveness of intrinsic remediation:

- Nitrate (NO^{-3})
- Sulfate (SO^{-4})
- Total dissolved iron
- Methane (CH_4)
- Alkalinity

5.3 Field Measurements

The following parameters will be sampled in the field:

- Temperature
- pH
- Dissolved Oxygen
- Depth to water table
- Depth of well
- Turbidity
- Specific Conductance

Field measurements will be recorded in the field book and in field forms provided in Appendix B.

5.4 Groundwater Level Measurements

Groundwater measurements will be taken from all monitoring wells at the site during each sampling event. All water level measurements will be taken on the same day as anticipated sampling.

Measurements will be taken with an electrical water level meter or interface probe if floating product is present using the highest part of the top of the casing as a reference point for determining depths to water and total depths. Water level measurements will be recorded to the nearest 0.01 foot in the field book.

5.5 Sample Handling

Sample Handling will be conducted with the following references:

EPA EISOPQAM (EPA May, 1996)

Charleston Naval Complex Sampling and Analysis Plan (June, 1998)

5.6 Sample Packing and Shipping

The following forms will be completed to complete the packing/shipping process:

- Sample labels
- Chain-of-custody labels
- Appropriate labels applied to shipping coolers
- Chain-of-custody forms
- Federal express air bills

5.7 Quality Control

Quality Control (QC) samples will be collected during sampling events. QC samples may include field blanks, field duplicates, and trip blanks. Definitions of each can be found below as described by the EISOPQAM:

- **Field Blank:** a sample collected using organic-free water, which has been run over/through sample collection equipment. These samples are used to determine if contaminants have been introduced by contact of the sample medium with sampling equipment. Equipment field blanks are often associated with collecting rinse blanks of equipment that has been field cleaned.
- **Field Duplicates:** Two or more samples collected from a common source. The purpose of a duplicate sample is to estimate the variability of a given characteristic or contamination associated with a population.
- **Trip Blank:** A sample, which is prepared prior to the sampling event in the actual container and is stored with the investigative samples throughout the sampling event. They are often packaged for shipment with the other samples and submitted for analysis. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in contaminant concentration). If samples are to be shipped, trip blanks are to be provided with each shipment but not for each cooler.

5.8 Field QA/QC

More information on field QC can be found in section 5.6.

5.9 Control Limits

Analysis	Control Parameter	Control Limit	Corrective Action
Air Monitoring	Check Calibration of OVA daily	Calibrate to manufactures specifications	Recalibrate. If unable to calibrate, replace.
pH of water	Continuing calibration check of pH 7.0 buffer	pH= 7.0	Recalibrate. If unable to calibrate, replace electrode.
Specific Conductance of water	Continuing calibration check of standard solution	> 1% of standard	Recalibrate.

5.10 Record keeping

In addition to records kept in logbooks, forms will be kept on log sheets for soil and groundwater. See Appendix B.

5.11 Site Management and Base Support

Throughout the investigation activities, work on the CNC will be coordinated through SOUTHDIV and SCDHEC.

The primary contacts for each are as follows:

1. SOUTHDIV point of contact
Gabe Magwood
Southern Division Engineering Command
2155 Eagle Drive
North Charleston, SC 29406
(843) 820-7307

2. SOUTHDIV point of contact
Tony Hunt
Southern Division Engineering Command
2155 Eagle Drive
North Charleston, SC 29406
(843) 820-7307

3. SCDHEC point of contact
Paul Bristol
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(843) 898-3559

REFERENCES

South Carolina Department of Health and Environmental Control.; 1997. Corrective Action Guidance.

Tetra Tech NUS, Inc.; 1999 Rapid Assessment for Site 31 (Building 760), Charleston, South Carolina.

United States Environmental Protection Agency; 1990. Code of Federal Regulations 136.

United States Environmental Protection Agency; 1988. EPA Users Guide to Contract Laboratory Program.

United States Environmental Protection Agency; 1996. EPA Environmental Investigations Standard Operating Procedures for Quality Assurance Manual.

APPENDIX A

IN-SITU SOIL RISK EVALUATION

SOUTH CAROLINA
Department of Health and Environmental Control (DHEC)

Site Data

SITE ID #		COUNTY	Charleston
FACILITY NAME	Site 31, Building 760		
STREET ADDRESS	Charleston Naval Complex, North Charleston, SC		

Soil Risk Evaluation Data

			<u>Figure</u>
TPH	<u>9600</u> mg/kg		
Soil % SAND (Estimated)	<u>60</u> %		
Soil % CLAY (Estimated)	<u>20</u> %		
Worst Case	Benzene	<u>0.01</u> mg/kg	Cs
Soil Analyses	Toluene	mg/kg	Cs
	Ethylbenzene	mg/kg	Cs
	Xylenes	mg/kg	Cs
	Naphthalene	<u>13.4</u> mg/kg	Cs
	MTBE	mg/kg	Cs
Natural Organic Carbon Content	<u>3570</u> mg/kg		foc
Average Annual Recharge	<u>25</u> cm		Hw
Distance from highest Soil Impact to water table	<u>30</u> cm		L
Bulk Density of Soil	<u>1.55</u> g/cc		Bd 1
Wetting Front Suction	<u>12</u> cm		Hf 2
Soil Hydraulic Conductivity	<u>5.60E-04</u> cm/sec		Kf 3
Porosity	<u>0.47</u> decimal %		Φ 4
Residual Water Content	<u>0.05</u> decimal %		Wr 5

List possible human exposure pathways from surface soil.
Soil leaching to groundwater - utility trench

Bold indicates site specific data

IN-SITU SOIL RISK EVALUATION

ALCULATIONS:

Equation Set I - Determine soil pore water concentration resulting from physical partitioning (Cw).

Step 1 - Calculate the total organic carbon content (foc) of the soil.

$$foc = (foc + TPH/1.724) * 1E-6 = \underline{0.0091} \text{ decimal \%}$$

Step 2 - Calculate the concentration of COC in soil pore water (Cw) directly in contact with the contaminate soil.

$$Cw = Cs * ((Wr * 1g/cc + Bd) / ((Bd * Koc * foc) + Wr + ((\theta - Wr) * H))) = \underline{0.0124} \text{ mg/l}$$

Equation Set II - Determine the velocity of the soil pore water (Vw)

Step 1 - Calculate the air filled porosity (f) in decimal percent.

$$f = \theta - Wr = \underline{0.42} \text{ decimal \%}$$

Step 2 - Determine the time for water to percolate through the vadose zone soil (from depth of worst case soil sample to the water table at site).

$$t = (f/Kf) * (L - ((Hw - Hf) * (\ln((Hw + L - Hf) / (Hw - Hf)))))) = \underline{6,023} \text{ seconds}$$

Step 3 - Determine the velocity of the water (Vw) in feet per year.

$$Vw = (L/30.48cm/ft) / (t/31,500,000sec/year) = \underline{5,148} \text{ ft/year}$$

Equation Set III - Determine the organic retardation effect (Vc) of the contaminant.

Step 1 - Calculate the soil/water distribution coefficient (Kd) (ml/g) for uncontaminated soil.

$$Kd = Koc * foc * 1E-6 = \underline{0.28917} \text{ ml/g}$$

Step 2 - Calculate the retardation effect of natural soil organic matter on COC migration.

$$Vc = Vw / (1 + ((Bd * Kd) / \theta)) = \underline{2,635} \text{ ft/year}$$

Equation Set IV - Determine biodegradation rates and provide final COC concentration (Cf) at depth of concern.

Step 1 - Calculate the time (Tc) in days required for the COC to reach groundwater.

$$Tc = 365 \text{ day/yr} * (L/30.48cm/ft) / Vc = \underline{0.14} \text{ days}$$

Step 2 - Calculate estimated concentration of COC in the soil pore water (Cp) necessary to protect groundwater.

$$Cp = 10^{(\log(Crsbl) + ((Tc/2.3) * (0.693/t^{1/2})))} = \underline{0.1509} \text{ mg/l}$$

COC concentration in soil pore water (Cp) is greater than concentration necessary to protect groundwater (Cw), therefore the SSTL must be calculated.

CALCULATIONS:

Equation Set I - Determine soil pore water concentration resulting from physical partitioning (Cw).

Step 1 - Calculate the total organic carbon content (fcs) of the soil.

$$fcs = (foc + TPH/1.724) * 1E-6 = \underline{0.0091} \text{ decimal \%}$$

Step 2 - Calculate the concentration of COC in soil pore water (Cw) directly in contact with the contaminate soil.

$$Cw = Cs * ((Wr * 1g/cc + Bd) / ((Bd * Koc * fcs) + Wr + ((\phi - Wr) * H))) = \underline{3.05} \text{ ng/l}$$

Equation Set II - Determine the velocity of the soil pore water (Vw)

Step 1 - Calculate the air filled porosity (f) in decimal percent.

$$f = \phi - Wr = \underline{0.42} \text{ decimal \%}$$

Step 2 - Determine the time for water to percolate through the vadose zone soil (from depth of worst case soil sample to the water table at site).

$$t = (f / Kf) * (L - (Hw - Hf)) * (\ln(Hw + ((L - Hf) / (Hw - Hf)))) = \underline{6,023} \text{ seconds}$$

Step 3 - Determine the velocity of the water (Vw) in feet per year.

$$Vw = (L / 30.48 \text{ cm/ft}) / (t / 31,500,000 \text{ sec/year}) = \underline{5148} \text{ ft/year}$$

Equation Set III - Determine the organic retardation effect (Vc) of the contaminant.

Step 1 - Calculate the soil/water distribution coefficient (Kd) (ml/g) for uncontaminated soil.

$$Kd = Koc * foc * 1E-6 = \underline{5.50851} \text{ ml/g}$$

Step 2 - Calculate the retardation effect of natural soil organic matter on COC migration.

$$Vc = Vw * (1 + ((Bd * Kd) / \phi)) = \underline{269} \text{ ft/year}$$

APPENDIX B

GROUNDWATER SAMPLE LOG SHEET

Page of

Project Site Name: <u>CNC31</u> Project No.: _____ <input type="checkbox"/> Domestic Well Data <input checked="" type="checkbox"/> Monitoring Well Data <input type="checkbox"/> Other Well Type: _____ <input type="checkbox"/> QA Sample Type: _____	Sample ID No.: <u>31GLM0101</u> Sample Location: <u>MW-1</u> Sampled By: <u>R.H.</u> C.O.C. No.: _____ Type of Sample: <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration
---	---

SAMPLING DATA:

Date: <u>7-27-99</u>	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other NA
Time: <u>1055</u>	Method: <u>Clear</u>							

PURGE DATA:

Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
<u>7-27-99</u>	Method: <u>Slow Purge</u>	Initial	<u>4.84</u>	<u>.082</u>	<u>24.0</u>	<u>Ø</u>	<u>2.40</u>	
Monitor Reading (ppm):	1	<u>5.02</u>	<u>.067</u>	<u>24.9</u>	<u>Ø</u>	<u>2.14</u>		
Well Casing Diameter & Material	2	<u>5.06</u>	<u>.068</u>	<u>26.9</u>	<u>Ø</u>	<u>1.73</u>		
Type: <u>P.V.C. 2'</u>	3	<u>5.09</u>	<u>.066</u>	<u>25.3</u>	<u>Ø</u>	<u>1.70</u>		
Total Well Depth (TD):	<u>18.83</u>							
Static Water Level (WL):	<u>13.03</u>							
One Casing Volume (gal/L):	<u>.98</u>							
Start Purge (hrs):	<u>0846</u>							
End Purge (hrs):	<u>1032</u>							
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
<u>BTEX, Naph, MTBE, EDB</u>	<u>HCl</u>	<u>3 x 40 ml. vials</u>	<u>7-27-99</u>
<u>Dissolved Methane</u>	<u>HCl</u>	<u>" " "</u>	<u>7-27-99</u>
<u>Anions (NO3, SO4)</u>	<u>—</u>	<u>1 x 500 ml Plastic</u>	<u>7-27-99</u>
<u>PAH</u>	<u>—</u>	<u>2 x 1 L amber</u>	<u>7-27-99</u>

OBSERVATIONS / NOTES:

Duped BTEX, Naph, MTBE, EDB & PAH

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

GROUNDWATER SAMPLE LOG SHEET

Page of

Project Site Name: <u>CNC 31</u> Project No.: _____ <input type="checkbox"/> Domestic Well Data <input checked="" type="checkbox"/> Monitoring Well Data <input type="checkbox"/> Other Well Type: _____ <input type="checkbox"/> QA Sample Type: _____	Sample ID No.: <u>31GLM0201</u> Sample Location: <u>MW-2</u> Sampled By: <u>RH/JA</u> C.O.C. No.: _____ Type of Sample: <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration
--	--

SAMPLING DATA:								
Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
<u>7-23-99</u>								
<u>1115</u>								
Method: _____								

PURGE DATA:								
Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
<u>7-23-99</u>	Initial	<u>4.85</u>	<u>248</u>	<u>23.8</u>	<u>Ø</u>	<u>1.61</u>		
Method: <u>Slow Purge</u>	1	<u>4.90</u>	<u>.077</u>	<u>24.4</u>	<u>Ø</u>	<u>1.11</u>		
Monitor Reading (ppm):	2	<u>4.94</u>	<u>.070</u>	<u>24.6</u>	<u>Ø</u>	<u>1.27</u>		
Well Casing Diameter & Material	3	<u>4.98</u>	<u>.070</u>	<u>24.5</u>	<u>Ø</u>	<u>1.50</u>		
Type: <u>PVC 2"</u>								
Total Well Depth (TD):	<u>18.96</u>							
Static Water Level (WL):	<u>12.78</u>							
One Casing Volume (gal/L):	<u>1.03</u>							
Start Purge (hrs):	<u>0840</u>							
End Purge (hrs):	<u>1007</u>							
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
<u>BTEX, Naph, MTBE, EDB</u>	<u>HCl</u>	<u>3x 40 ml vials</u>	<u>723-99</u>
<u>Dissolved Methane</u>	<u>HCl</u>	<u>" " "</u>	<u>"</u>
<u>PAH</u>	<u>-</u>	<u>2x 1k amber</u>	<u>"</u>
<u>Anions</u>	<u>-</u>	<u>1x 500 ml plastic</u>	<u>"</u>

OBSERVATIONS / NOTES:

Circle if Applicable: <input type="checkbox"/> MS/MSO Duplicate ID No.: _____	Signature(s): <u>R.H. JA</u>
--	---------------------------------

GROUNDWATER SAMPLE LOG SHEET

Page of

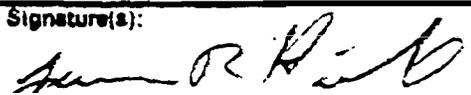
Project Site Name: <u>CNC31</u> Project No.: _____ <input type="checkbox"/> Domestic Well Data <input type="checkbox"/> Monitoring Well Data <input type="checkbox"/> Other Well Type: _____ <input type="checkbox"/> QA Sample Type: _____	Sample ID No.: <u>31GLM0401</u> Sample Location: <u>MW-4</u> Sampled By: <u>R.H</u> C.O.C. No.: _____ Type of Sample: <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration
--	--

SAMPLING DATA:									
Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other	
Time:	Visual	Standard	mS/cm	Degree C	NTU	mg/l	%	NA	
<u>7-28-77</u>									
<u>1115</u>									
Method:									

PURGE DATA:								
Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other
<u>7-28-77</u>								
Method: <u>Slow Purge</u>	Initial	<u>5.14</u>	<u>064</u>	<u>23.9</u>	<u>∅</u>	<u>3.30</u>		
Monitor Reading (ppm):	1	<u>5.01</u>	<u>062</u>	<u>24.1</u>	<u>∅</u>	<u>3.60</u>		
Well Casing Diameter & Material	2	<u>4.97</u>	<u>061</u>	<u>25.5</u>	<u>∅</u>	<u>3.16</u>		
Type: <u>P.V.C. 2"</u>	3	<u>4.96</u>	<u>063</u>	<u>24.7</u>	<u>∅</u>	<u>3.68</u>		
Total Well Depth (TD):	<u>19.28</u>							
Static Water Level (WL):	<u>12.47</u>							
One Casing Volume (gal/L):	<u>1.98</u>							
Start Purge (hrs):	<u>0847</u>							
End Purge (hrs):	<u>1031</u>							
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
<u>STEX, Naph, MTBE, EDB</u>	<u>HCl</u>	<u>3 x 40 ml Vials</u>	<u>7-28-99</u>
<u>PAH</u>	<u>-</u>	<u>2 x 1 L amber</u>	<u>12</u>

OBSERVATIONS / NOTES:
Dug well #31GLM0401 M
MS/MSD

Circle if Applicable: <input checked="" type="checkbox"/> MS/MSD Duplicate ID No.: <u>31GLM0401 M</u>	Signature(s): 
--	---

GROUNDWATER SAMPLE LOG SHEET

Page ___ of ___

Project Site Name:	<u>Zone C Site 31</u>	Sample ID No.:	<u>316LM0601</u>
Project No.:	<u>NO164 Bldg 760</u>	Sample Location:	<u>CVE31 MW6D</u>
<input type="checkbox"/> Domestic Well Data		Sampled By:	<u>JA</u>
<input type="checkbox"/> Monitoring Well Data		C.O.C. No.:	_____
<input type="checkbox"/> Other Well Type:	_____	Type of Sample:	
<input type="checkbox"/> QA Sample Type:	_____	<input type="checkbox"/> Low Concentration	
		<input type="checkbox"/> High Concentration	

SAMPLING DATA:									
Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other	
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA	
<u>8 19 99</u>									
<u>1740</u>									
Method:									

PURGE DATA:									
Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other	
Method:	Initial								
<u>8 19 99</u>									
Method:									
Monitor Reading (ppm):	1	<u>6.96</u>	<u>.256</u>	<u>22.5</u>	<u>1</u>	<u>1.55</u>			
Well Casing Diameter & Material	2	<u>6.97</u>	<u>.256</u>	<u>23.0</u>	<u>0</u>	<u>1.65</u>			
Type:	3	<u>6.86</u>	<u>.253</u>	<u>22.7</u>	<u>0</u>	<u>1.20</u>			
Total Well Depth (TD):	<u>35.35</u>								
Static Water Level (WL):	<u>13.75</u>								
One Casing Volume(gal/L):	<u>3.5</u>								
Start Purge (hrs):	<u>1615</u>								
End Purge (hrs):	<u>1740</u>								
Total Purge Time (min):									
Total Vol. Purged (gal/L):									

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
<u>BTEX/EDB</u>	<u>HCl</u>	<u>3 x 40ml</u>	
<u>PAH</u>	<u>-</u>	<u>2 x 1 ltr.</u>	

OBSERVATIONS / NOTES:

Resample event due to FEDEx mix-up.

Circle if Applicable:	Signature(s):
<input type="checkbox"/> MS/MSD <input type="checkbox"/> Duplicate ID No.	

GROUNDWATER SAMPLE LOG SHEET

Page of

Project Site Name:	<u>Zone: C Site 31</u>	Sample ID No.:	<u>31 GLM0601</u>
Project No.:	<u>ND164 Bldg 760</u>	Sample Location:	<u>CNC31 MW06D</u>
<input type="checkbox"/> Domestic Well Data		Sampled By:	<u>D. Anderson</u>
<input checked="" type="checkbox"/> Monitoring Well Data		C.O.C. No.:	<u> </u>
<input type="checkbox"/> Other Well Type:	<u> </u>	Type of Sample:	
<input type="checkbox"/> QA Sample Type:	<u> </u>	<input type="checkbox"/> Low Concentration	
		<input type="checkbox"/> High Concentration	

SAMPLING DATA:									
Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other	
Time:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA	
<u>8-12-99</u>									
<u>1640</u>									
Method: <u>Low Flow</u>									

PURGE DATA:									
Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	Salinity	Other	
Method:	Initial								
<u>8-12-99</u>									
<u>Low Flow</u>									
Monitor Reading (ppm):	1	<u>7.10</u>	<u>.275</u>	<u>220</u>	<u>14</u>	<u>2.84</u>	<u>-</u>	<u>-</u>	
Well Casing Diameter & Material	2	<u>6.63</u>	<u>.268</u>	<u>21.9</u>	<u>3</u>	<u>1.09</u>	<u>-</u>	<u>-</u>	
Type: <u>2" PVC</u>	3	<u>6.91</u>	<u>.264</u>	<u>21.9</u>	<u>1</u>	<u>1.09</u>	<u>-</u>	<u>-</u>	
Total Well Depth (TD): <u>36.64</u>									
Static Water Level (WL): <u>15.92</u>									
One Casing Volume (gal/L): <u>1517</u> ^{2.25} 332									
Start Purge (hrs): <u>1517</u>									
End Purge (hrs): <u>1639</u>									
Total Purge Time (min):									
Total Vol. Purged (gal/L): <u>10.0</u>									

SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
<u>BTEX / EDB</u>	<u>HCl</u>	<u>3 x 40ML</u>	
<u>PAC</u>	<u>-</u>	<u>2 x 1L</u>	

OBSERVATIONS / NOTES:

20.72' = H₂O Column
3-32 = 1 volume
Replaced Horiba battery & recalibrated @ readings #2

Circle if Applicable:	Signature(s):
<input type="checkbox"/> MS/MSD <input type="checkbox"/> Duplicate ID No..	



FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page of

Project Site Name: <u>CNC 31 Site 31</u>	Sample ID No.: <u>31GLM0101</u>
Project No.: <u>Zone C NO164</u>	Sample Location: <u>Site 31-MWI</u>
Sampled By: <u>JA/RH</u>	Duplicate: <input type="checkbox"/>
Field Analyst: _____	Blank: <input type="checkbox"/>
Field Form Checked as per QA/QC Checklist (initials): _____	

SAMPLING DATA:

Date: <u>7 23 99</u>	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Time: _____	(Visual)	(+/- mv)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(%)	(SU)
Method: _____								

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT CHEMetrics (Range: _____ mg/L) Analysis Time: 1420

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
<input type="checkbox"/>	1-5 mg/L	200 ml	0.200 N	0.01		x 0.01	= _____ mg/L
<input type="checkbox"/>	2-10 mg/L	100 ml	0.200 N	0.02		x 0.02	= _____ mg/L

CHEMetrics: 2 mg/L

Notes: _____

Alkalinity:

Equipment: HACH Digital Titrator AL-DT CHEMetrics (Range: _____ mg/L) Analysis Time: 1100

Filtered:

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
<input checked="" type="checkbox"/>	10-40 mg/L	100 ml	0.1600 N	0.1	& <u>47</u>	x 0.1	= <u>4.7</u> mg/L
<input type="checkbox"/>	40-160 mg/L	25 ml	0.1600 N	0.4	& _____	x 0.4	= _____ mg/L
<input type="checkbox"/>	100-400 mg/L	100 ml	1.600 N	1.0	& _____	x 1.0	= _____ mg/L
<input type="checkbox"/>	200-800 mg/L	50 ml	1.600 N	2.0	& _____	x 2.0	= _____ mg/L
<input type="checkbox"/>	500-2000 mg/L	20 ml	1.600 N	5.0	& _____	x 5.0	= _____ mg/L
<input type="checkbox"/>	1000-4000 mg/L	10 ml	1.600 N	10.0	& _____	x 10.0	= _____ mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:			

CHEMetrics: _____ mg/L

Notes: _____

Standard Additions: Titrant Molarity: _____ Digits Required: 1st.: _____ 2nd.: _____ 3rd.: _____

Carbon Dioxide:

Equipment: HACH Digital Titrator CA-DT CHEMetrics (Range: _____ mg/L) Analysis Time: 1118

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
<input checked="" type="checkbox"/>	10-50 mg/L	200 ml	0.3636 N	0.1	<u>365</u>	x 0.1	= <u>37</u> mg/L
<input type="checkbox"/>	20-100 mg/L	100 ml	0.3636 N	0.2		x 0.2	= _____ mg/L
<input type="checkbox"/>	100-400 mg/L	200 ml	3.636 N	1.0	<u>55</u>	x 1.0	= _____ mg/L
<input type="checkbox"/>	200-1000 mg/L	100 ml	3.636 N	2.0		x 2.0	= _____ mg/L

CHEMetrics: _____ mg/L



FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page of

Project Site Name: <u>CNC 31 Bldg 760</u>	Sample ID No.: <u>310^F 2 mphi01</u>
Project No.: <u>NO164 Zone C</u>	Sample Location: <u>MW1</u>
Sampled By: <u>7 23 99</u>	Duplicate: <input type="checkbox"/>
Field Analyst: <u>JA</u>	Blank: <input type="checkbox"/>
Field Form Checked as per QA/QC Checklist (initials): <input type="checkbox"/>	

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S²⁻):

Equipment: DR-700 DR-8 HS-C Color Chart HS-WR Color Wheel Analysis Time: 1138

Program/Module: 610nm 93 Other:

Concentration: 0.01 mg/L Filtered:

Notes: _____

Sulfate (SO₄²⁻):

Equipment: DR-700 DR-8 Other: Analysis Time:

Program/Module: 91

Concentration: mg/L Filtered:

Standard Solution: Results:

Standard Additions: Digits Required: 0.1ml: 0.2ml: 0.3ml:

Notes: _____

Nitrite (NO₂⁻-N):

Equipment: DR-700 DR-8 Other: Analysis Time: 1200

Program/Module: 60 Filtered:

Concentration: 0.024 mg/L Reagent Blank Correction:

Standard Solution: Results:

Notes: _____

Nitrate (NO₃⁻-N):

Equipment: DR-700 DR-8 Other: Analysis Time:

Program/Module: 55 Filtered:

Concentration: mg/L

Nitrite Interference Treatment:

Standard Solution: Results: Reagent Blank Correction:

Standard Additions: Digits Required: 0.1ml: 0.2ml: 0.3ml:

Notes: _____



FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page of

Project Site Name: <u>CNC31 Bldg 760</u>	Sample ID No.: <u>31GLM0101</u>
Project No.: <u>ND164 Zone C</u>	Sample Location: <u>MW1</u>
Sampled By: <u>T B GA</u>	Duplicate: <input type="checkbox"/>
Field Analyst: _____	Blank: <input type="checkbox"/>
Field Form Checked as per QA/QC Checklist (initials): 	

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn²⁺):

Equipment: DR-700 DR-840 HACH MN-5 Other: _____ Analysis Time: 1220

Program/Module: 525nm 41

Concentration: 0.3 mg/L Filtered:

Digestion:

Standard Solution: Results: _____ Reagent Blank Correction:

Standard Additions: Digits Required: 0.1ml: _____ 0.2ml: _____ 0.3ml: _____

Notes: _____

Ferrous Iron (Fe²⁺):

Equipment: DR-700 DR-840 IR-18C Color Wheel Other: _____ Analysis Time: 1210

Program/Module: 500nm 33

Concentration: 0.07 mg/L Filtered:

Notes: _____

Hydrogen Sulfide (H₂S):

Equipment: HS-C Other: _____ Analysis Time: _____

Concentration: _____ mg/L Exceeded 5.0 mg/L range on color chart:

Notes: _____

QA/QC Checklist:

All data fields have been completed as necessary:

Correct measurement units are cited in the SAMPLING DATA block:

Multiplication is correct for each *Multiplier* table:

Final calculated concentration is within the appropriate *Range Used* block:

Alkalinity *Relationship* is determined appropriately as per manufacturer instructions:

QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents:

Nitrite interference treatment used for Nitrate test if Nitrite was detected:

Title block is initialized by person who performed the QA/QC Checklist:



FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page of

Project Site Name: <u>CNC 31 Bldg 760</u>	Sample ID No.: <u>31GLM0201</u>
Project No.: <u>ND164 Zone C</u>	Sample Location: <u>Site 31 MW1</u>
Sampled By: <u>JA/RH</u>	Duplicate: <input type="checkbox"/>
Field Analyst: _____	Blank: <input type="checkbox"/>
Field Form Checked as per QA/QC Checklist (initials): _____	

SAMPLING DATA:

Date: <u>7 23 99</u>	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Time: _____	(Visual)	(+/- mV)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(‰)	(SU)
Method: _____								

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT CHEMetrics (Range: _____ mg/L) Analysis Time: 1022

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
<input type="checkbox"/>	1-5 mg/L	200 ml	0.200 N	0.01	_____	x 0.01	= _____ mg/L
<input type="checkbox"/>	2-10 mg/L	100 ml	0.200 N	0.02	_____	x 0.02	= _____ mg/L

CHEMetrics: 2 mg/L

Notes: _____

Alkalinity:

Equipment: HACH Digital Titrator AL-DT CHEMetrics (Range: _____ mg/L) Analysis Time: 1104

Filtered:

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
<input checked="" type="checkbox"/>	10-40 mg/L	100 ml	0.1600 N	0.1	_____ & <u>14</u>	x 0.1	= <u>510</u> mg/L
<input type="checkbox"/>	40-160 mg/L	25 ml	0.1600 N	0.4	_____ & _____	x 0.4	= _____ mg/L
<input type="checkbox"/>	100-400 mg/L	100 ml	1.600 N	1.0	_____ & _____	x 1.0	= _____ mg/L
<input type="checkbox"/>	200-800 mg/L	50 ml	1.600 N	2.0	_____ & _____	x 2.0	= _____ mg/L
<input type="checkbox"/>	500-2000 mg/L	20 ml	1.600 N	5.0	_____ & _____	x 5.0	= _____ mg/L
<input type="checkbox"/>	1000-4000 mg/L	10 ml	1.600 N	10.0	_____ & _____	x 10.0	= _____ mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:	_____	_____	_____

CHEMetrics: _____ mg/L

Notes: _____

Standard Additions: Titrant Molarity: _____ Digits Required: 1st.: _____ 2nd.: _____ 3rd.: _____

Carbon Dioxide:

Equipment: HACH Digital Titrator CA-DT CHEMetrics (Range: _____ mg/L) Analysis Time: 1120

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
<input checked="" type="checkbox"/>	10-50 mg/L	200 ml	0.3636 N	0.1	<u>450</u>	x 0.1	= <u>45</u> mg/L
<input type="checkbox"/>	20-100 mg/L	100 ml	0.3636 N	0.2	_____	x 0.2	= _____ mg/L
<input type="checkbox"/>	100-400 mg/L	200 ml	3.636 N	1.0	_____	x 1.0	= _____ mg/L
<input type="checkbox"/>	200-1000 mg/L	100 ml	3.636 N	2.0	_____	x 2.0	= _____ mg/L

CHEMetrics: _____ mg/L

Notes: _____



FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page of

Project Site Name: <u>CNC 31 Bldg 760</u>	Sample ID No.: <u>314m0201</u>
Project No.: <u>NO164</u> <u>Zone C</u>	Sample Location: <u>mw2</u>
Sampled By: <u>7 23 99</u>	Duplicate: <input type="checkbox"/>
Field Analyst: <u>JA</u>	Blank: <input type="checkbox"/>
Field Form Checked as per QA/QC Checklist (initials): 	

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S²⁻):

Equipment: DR-700 DR-8 HS-C Color Chart HS-WR Color Wheel Analysis Time: 1139

Program/Module: 610nm 93 Other:

Concentration: 0.01 mg/L Filtered:

Notes:

Sulfate (SO₄²⁻):

Equipment: DR-700 DR-8 Other: Analysis Time:

Program/Module: 91

Concentration: mg/L Filtered:

Standard Solution: Results:

Standard Additions: Digits Required: 0.1ml: 0.2ml: 0.3ml:

Notes:

Nitrite (NO₂⁻-N):

Equipment: DR-700 DR-8 Other: Analysis Time: 1241

Program/Module: 60

Concentration: 0.026 mg/L Filtered:

Reagent Blank Correction:

Standard Solution: Results:

Notes:

Nitrate (NO₃⁻-N):

Equipment: DR-700 DR-8 Other: Analysis Time:

Program/Module: 55

Concentration: mg/L Filtered:

Nitrite Interference Treatment:

Standard Solution: Results: Reagent Blank Correction:

Standard Additions: Digits Required: 0.1ml: 0.2ml: 0.3ml:

Notes:



FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page of

Project Site Name: <u>CNC 31 Bldg 760</u>	Sample ID No.: <u>316LM0201</u>
Project No.: <u>ND164 Zone C</u>	Sample Location: <u>MW2</u>
Sampled By: <u>7 23 99</u>	Duplicate: <input type="checkbox"/>
Field Analyst: _____	Blank: <input type="checkbox"/>
Field Form Checked as per QA/QC Checklist (initials): 	

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn²⁺):

Equipment: DR-700 DR-8 HACH MN-5 Other: _____ Analysis Time: 1221

Program/Module: 525nm 41

Concentration: 0.1 mg/L Filtered:

Standard Solution: Results: _____ Digestion:

Standard Additions: Digits Required: 0.1ml: _____ 0.2ml: _____ 0.3ml: _____ Reagent Blank Correction:

Notes: _____

Ferrous Iron (Fe²⁺):

Equipment: DR-700 DR-8 IR-18C Color Wheel Other: _____ Analysis Time: 1211

Program/Module: 500nm 33

Concentration: 0.05 mg/L Filtered:

Notes: _____

Hydrogen Sulfide (H₂S):

Equipment: HS-C Other: _____ Analysis Time: _____

Concentration: _____ mg/L Exceeded 5.0 mg/L range on color chart:

Notes: _____

QA/QC Checklist:

All data fields have been completed as necessary:

Correct measurement units are cited in the SAMPLING DATA block:

Multiplication is correct for each *Multiplier* table:

Final calculated concentration is within the appropriate *Range Used* block:

Alkalinity *Relationship* is determined appropriately as per manufacturer instructions:

QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents:

Nitrite Interference treatment used for Nitrate test if Nitrite was detected:

Title block is initialized by person who performed the QA/QC Checklist:



FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page of

Project Site Name: <u>CNC 31 Bldg 760</u>	Sample ID No.: <u>31GFM0301</u>
Project No.: <u>ND164 Zone C</u>	Sample Location: <u>MW3</u>
Sampled By: <u>7 23 99</u>	Duplicate: <input type="checkbox"/>
Field Analyst: <u>JA</u>	Blank: <input type="checkbox"/>
Field Form Checked as per QA/QC Checklist (initials): 	

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Surface (SO₄²⁻):

Equipment: DR-700	DR-8 <u> </u>	HS-C Color Chart	HS-WR Color Wheel	Analysis Time: <u>1140</u>
Program/Module: 610nm	93	Other: <u> </u>		
Concentration: <u>0.10</u> mg/L				Filtered: <input type="checkbox"/>
Notes: <u> </u>				

Sulfate (SO₄²⁻):

Equipment: DR-700	DR-8 <u> </u>	Other: <u> </u>	Analysis Time: <u> </u>
Program/Module: <u> </u>	91		
Concentration: <u> </u> mg/L	Filtered: <input type="checkbox"/>		
Standard Solution: <input type="checkbox"/>	Results: <u> </u>		
Standard Additions: <input type="checkbox"/>	Digits Required: 0.1ml: <u> </u> 0.2ml: <u> </u> 0.3ml: <u> </u>		
Notes: <u> </u>			

Nitrite (NO₂⁻-N):

Equipment: DR-700	DR-8 <u> </u>	Other: <u> </u>	Analysis Time: <u>1202</u>
Program/Module: <u> </u>	60		
Concentration: <u>0.020</u> mg/L	Filtered: <input type="checkbox"/>		
		Reagent Blank Correction: <input type="checkbox"/>	
		Standard Solution: <input type="checkbox"/>	Results: <input type="checkbox"/>
Notes: <u> </u>			

Nitrate (NO₃⁻-N):

Equipment: DR-700	DR-8 <u> </u>	Other: <u> </u>	Analysis Time: <u> </u>
Program/Module: <u> </u>	55		
Concentration: <u> </u> mg/L	Filtered: <input type="checkbox"/>		
		Nitrite Interference Treatment: <input type="checkbox"/>	
		Reagent Blank Correction: <input type="checkbox"/>	
Standard Solution: <input type="checkbox"/>	Results: <u> </u>		
Standard Additions: <input type="checkbox"/>	Digits Required: 0.1ml: <u> </u> 0.2ml: <u> </u> 0.3ml: <u> </u>		
Notes: <u> </u>			

APPENDIX C

APPENDIX D

Volatilization Factor: Groundwater to Ambient Air (VFwamb)

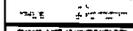
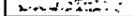
Chemical	Dair	Dwater	H	θ_{scap}	θ_{wcap}	θ_{as}	θ_{ws}	θ_T	Def-air	Def-water
	cm ² /s	cm ² /s	cm ³ /cm ³	cm ² /s	cm ² /s					
Benzene	0.093	1.10E-05	2.20E-01	0.038	0.342	0.33	0.15	0.48	1.36E-05	1.01E-02
Toluene	0.085	9.40E-06	2.60E-01	0.038	0.342	0.33	0.15	0.48	1.13E-05	9.20E-03
Ethylbenzene	0.076	8.50E-06	3.20E-01	0.038	0.342	0.33	0.15	0.48	9.39E-06	8.22E-03
Xylenes	0.072	8.50E-06	2.90E-01	0.038	0.342	0.33	0.15	0.48	9.40E-06	7.79E-03
Naphthalene	0.072	9.40E-06	4.90E-02	0.038	0.342	0.33	0.15	0.48	2.92E-05	7.79E-03

Chemical	hcap	hv	Def-ws	Uair	air	Lgw	W	VFwamb	TR (carc)	HI (nonc)
	cm	cm	cm ² /s	cm/sec	cm	cm	cm	mg/m ³ /mg/L		
Benzene	5	117	3.22E-04	225	200	122	1500	1.94E-05	1.00E-06	NA
Toluene	5	117	2.68E-04	225	200	122	1500	1.90E-05	NA	1
Ethylbenzene	5	117	2.23E-04	225	200	122	1500	1.95E-05	NA	1
Xylenes	5	117	2.23E-04	225	200	122	1500	1.77E-05	NA	1
Naphthalene	5	117	6.55E-04	225	200	122	1500	8.77E-06	NA	1

Chemical	BWadult	AT	SfI (carc)	RfD (nonc)	IR air	EF	ED	RBSLair	RBSLwater
	kg	yr	[mg/kg-day] ⁻¹	[mg/kg-day]	m ³ /day	day/yr	yr	mg/m ³	mg/L
Benzene	70	70	2.90E-02	NA	20	90	1	3.43E-02	1769.4
Toluene	70	1	NA	1.14E-01	20	90	1	1.62E+00	8.51E+04
Ethylbenzene	70	1	NA	2.86E-01	20	90	1	4.06E+00	2.08E+05
Xylenes	70	1	NA	NA*	20	90	1	NA*	NA*
Naphthalene	70	1	NA	3.71E-04	20	90	1	5.27E-03	6.00E+02

Reference: American Society for Testing and Materials (ASTM), 1997. *Standard Guide for Risk-Based Corrective Action Applied to Petroleum Release Sites*. Designation E 1739-95⁶¹

*No inhalation reference dose is available for xylenes; therefore, no RBSLs can be calculated.

-  = South Carolina value
-  = Site-specific value or based on site-specific value
-  = Calculated value
-  = ASTM default value
-  = Value from EPA Integrated Risk Information System
-  = Assumptions for construction worker scenario

Construction Worker Inhalation RBSLs

Chemical	Dair	Dwater	H	θ_{air}	θ_{water}	θ_{soil}	θ_{veg}	θ_{r}	Def-cap	Def-s
	cm ³ /s	cm ³ /s	cm ³ /cm ³	cm ³ /s	cm ³ /s					
Benzene	0.093	1.10E-05	2.20E-01	0.038	0.342	0.33	0.15	0.48	1.36E-05	1.01E-02
Toluene	0.085	9.40E-06	2.60E-01	0.038	0.342	0.33	0.15	0.48	1.13E-05	9.20E-03
Ethylbenzene	0.076	8.50E-06	3.20E-01	0.038	0.342	0.33	0.15	0.48	9.39E-06	8.22E-03
Xylenes	0.072	8.50E-06	2.90E-01	0.038	0.342	0.33	0.15	0.48	9.40E-06	7.79E-03
Naphthalene	0.072	9.40E-06	4.90E-02	0.038	0.342	0.33	0.15	0.48	2.92E-05	7.79E-03

Chemical	hcap	hv	Def-ws	Uair	δair	Lgw	W	VFWamb	TR (carc)	HI (nonc)
	cm	cm	cm ³ /s	cm/sec	cm	cm	cm	mg/m ³ /mg/L		
Benzene	5	117	3.22E-04	225	200	122	1500	1.94E-05	1.00E-06	NA
Toluene	5	117	2.68E-04	225	200	122	1500	1.90E-05	NA	1
Ethylbenzene	5	117	2.23E-04	225	200	122	1500	1.95E-05	NA	1
Xylenes	5	117	2.23E-04	225	200	122	1500	1.77E-05	NA	1
Naphthalene	5	117	6.55E-04	225	200	122	1500	8.77E-06	NA	1

Chemical	BWadukt	AT	SfI (carc)	RfD (nonc)	IR air	EF	L D	RBSLair	RBSLwater
	kg	yr	[mg/kg-day] ⁻¹	[mg/kg-day]	m ³ /day	day/yr	yr	mg/m ³	mg/L
Benzene	70	70	2.90E-02	NA	20	90	1	3.43E-02	1769.4
Toluene	70	1	NA	1.14E-01	20	90	1	1.62E+00	8.51E+04
Ethylbenzene	70	1	NA	2.86E-01	20	90	1	4.06E+00	2.08E+05
Xylenes	70	1	NA	NA*	20	90	1	NA*	NA*
Naphthalene	70	1	NA	3.71E-04	20	90	1	5.27E-03	6.00E+02

*No inhalation reference dose is available for xylenes, therefore, no RBSL can be calculated for xylene

Construction Worker Inhalation RBSLs

Chemical			Dair	Dwater	H	0_{accap}	0_{wcap}	0_{ss}	0_{ws}	0_r	Deff-cap	Deff-s
			cm ² /s	cm ² /s	cm ³ /cm ³	cm ² /s						
Benzene			0.093	1.10E-05	2.26E-01	0.038	0.342	0.33	0.15	0.48	1.35E-05	1.01E-02
Toluene			0.085	9.40E-06	3.01E-01	0.038	0.342	0.33	0.15	0.48	1.07E-05	9.20E-03
Ethylbenzene			0.076	8.50E-06	2.80E-01	0.038	0.342	0.33	0.15	0.48	9.85E-06	8.22E-03
Xylenes			0.072	8.50E-06	2.78E-01	0.038	0.342	0.33	0.15	0.48	9.55E-06	7.79E-03
Naphthalene			0.072	9.40E-06	2.00E-03	0.038	0.342	0.33	0.15	0.48	5.79E-04	7.83E-03
MTBE			0.102	1.05E-05	4.16E-02	0.038	0.342	0.33	0.15	0.48	3.90E-05	1.10E-02

Chemical			hcap	hv	Deff-ws	Uair	δair	Lgw	W	VFWamb	TR (carc)	HI (nonc)
			cm	cm	cm ² /s	cm/sec	cm	cm	cm	mg/m ³ /mg/L		
Benzene			5	117	3.18E-04	225	200	122	1500	1.97E-05	1.00E-06	NA
Toluene			5	117	2.54E-04	225	200	122	1500	2.09E-05	NA	1
Ethylbenzene			5	117	2.34E-04	225	200	122	1500	1.79E-05	NA	1
Xylenes			5	117	2.27E-04	225	200	122	1500	1.72E-05	NA	1
Naphthalene			5	117	5.17E-03	225	200	122	1500	2.83E-06	NA	1
MTBE			5	117	8.79E-04	225	200	122	1500	9.99E-06	NA	1

Chemical	TR (carc)	HI (nonc)	BWadult	AT	Sfi (carc)	RfD (nonc)	IR air	EF	ED	RBSLair	H	RBSLwater
			kg	yr	[mg/kg-day] ⁻¹	[mg/kg-day]	m ³ /day	day/yr	yr	mg/m ³	cm ³ /cm ³	mg/L
Benzene	1.00E-06	NA	70	70	2.90E-02	NA	20	90	1	3.43E-02	2.26E-01	0.15
Toluene	NA	1	70	1	NA	1.14E-01	20	90	1	1.62E+00	3.01E-01	5.38
Ethylbenzene	NA	1	70	1	NA	2.86E-01	20	90	1	4.06E+00	2.80E-01	14.50
Xylenes	NA	1	70	1	NA	NA*	20	90	1	NA*	2.78E-01	NA*
Naphthalene	NA	1	70	1	NA	3.71E-04	20	90	1	5.27E-03	2.00E-03	2.63
MTBE	NA	1	70	1	NA	8.60E-01	20	90	1	1.22E+01	4.16E-02	293.443

*No Inhalation reference dose is available for xylenes; therefore, no RBSL can be calculated for xylene.

Minimum Construction Worker RBSLs

	Dermal	Incidental Ingestion	Inhalation	Minimum
	RBSL	RBSL	RBSL	RBSL
	mg/L	mg/L	mg/L	mg/L
Benzene	0.85	68.52	0.15	0.15
Toluene	23.98	5677.78	5.38	5.38
Ethylbenzene	6.05	2838.89	14.50	6.05
Xylene	102.33	56777.78	NA*	102.33
Naphthalene	1.63	1135.56	2.63	1.63
MTBE	25.92	141.94	293.44	25.92

*No inhalation reference dose is available for xylenes; therefore, no inhalation RBSL can be calculated.

Prepared By: _____

Reviewed By: _____

Construction Worker Incidental Ingestion RBSLs

	BW	AT	IR	ED	EF	Target	CSF oral	Rfd oral	RBSL
	kg	day	L/day	yrs	days/yr	Risk or HQ			mg/L
Benzene	70	5550	0.01	1	90	1.00E-06	2.90E-02		6.85E+01
Toluene	70	365	0.01	1	90	1.0	NA	2.00E-01	5677.778
Ethylbenzene	70	365	0.01	1	90	1.0	NA	1.00E-01	2838.889
Xylene	70	365	0.01	1	90	1.0	NA	2.00E+00	56777.78
Naphthalene	70	365	0.01	1	90	1.0	NA	4.00E-02	1135.556
MTBE	70	365	0.01	1	90	1.0	NA	5.00E-03	141.9444

Prepared By: _____

Reviewed By: _____

TABLES

TABLE 1

**GROUNDWATER ELEVATIONS
SITE 31, BUILDING 760
ZONE C, CHARLESTON NAVAL BASE COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA**

Well No.	Total Depth of Well, (ft)	Top of Casing Elevation, ft (MSL)	Date Measured	Depth to Free Product (BTOC)	Depth to Water, ft (BTOC)	Groundwater Elevation, ft (MSL)
CNC31-MW01	19	23.06	7/23/99	ND	12.91	10.15
			7/27/99	ND	13.01	10.05
			10/13/99	ND	13.11	9.95
CNC31-MW02	19	22.99	7/23/99	ND	12.78	10.21
			7/27/99	ND	12.89	10.10
			10/13/99	ND	13.00	9.99
CNC31-MW03	19	22.94	7/23/99	ND	13.10	9.84
			7/28/99	ND	13.24	9.70
			10/13/99	ND	13.32	9.62
CNC31-MW04	19	22.86	7/23/99	ND	12.32	10.54
			7/28/99	ND	12.47	10.39
			10/13/99	ND	12.49	10.37
CNC31-MW05	19	22.38	7/23/99	ND	12.10	10.28
			7/28/99	ND	12.21	10.17
			10/13/99	ND	12.26	10.12
CNC31-MW6D	37	23.22	8/9/99	ND	13.75	9.47
			8/12/99	ND	15.92	7.30
			10/13/00	ND	14.12	9.10

Notes:

MSL - Mean Sea Level

BTOC - Below Top of Casing

ft - feet

ND - Not Detected

TABLE 2

GROUNDWATER FIELD MEASUREMENTS
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Purge method	Volume (gallons)	Temp. (° C)	pH	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)
CNC31-MW01	07/23/99	PP	2.9	25.3	5.15	0.066	0	0.91
	07/27/99	PP	2.9	26.3	5.09	0.066	0	1.70
CNC31-MW02	07/23/99	PP	3.1	24.5	4.98	0.070	0	1.50
	07/27/99	PP	3.0	25.9	4.83	0.070	0	2.25
CNC31-MW03	07/23/99	PP	3.1	22.6	4.94	0.062	0	2.52
	07/28/99	PP	2.9	23.1	5.21	0.065	0	1.10
CNC31-MW04	07/23/99	PP	3.4	25.6	4.90	0.061	0	1.64
	07/28/99	PP	3.4	24.7	4.96	0.063	0	2.08
CNC31-MW05	07/23/99	PP	3.3	25.1	5.24	0.060	0	2.75
	07/28/99	PP	3.2	26.2	5.17	0.065	0	2.75
CNC31-MW6D	08/09/99	PP	10.5	22.7	6.86	0.253	0	1.20
	08/12/99	PP	10.0	21.9	6.91	0.264	1	1.09

Notes:

(° C) - Degrees Celsius

PP - Peristaltic pump, low flow technique

uMHOS/cm - Micro HOS per centimeter

NTU - Nephelometric turbidity units

mg/L - milligrams per liter

TABLE 3

GROUNDWATER NATURAL ATTENUATION FIELD MEASUREMENTS
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Dissolved Oxygen (mg/L)	Alkalinity (mg/L)	Carbon Dioxide (mg/L)	Sulfide (mg/L)	Ferrous Iron (mg/L)	Nitrite (mg/L)	Manganese (mg/L)	Nitrogen/Nitrate (mg/L)*	Sulfate (mg/L)*	Methane (ug/L)*
CNC31-MW01	7/23/99	2.0	4.7	37	0.01	0.07	0.024	0.3	<0.05	14	<5.2
CNC31-MW02	7/23/99	2.0	<10	45	0.01	0.05	0.026	0.1	<0.05	18	<5.2
CNC31-MW03	7/23/99	1.0	58	47	0.10	0.75	0.020	0.2	<0.05	12	5.9

Notes:

mg/L - Milligrams per liter

ug/L - Micrograms per liter

E- Estimated Concentration

* Fixed base laboratory analysis

TABLE 4

**SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 31, BUILDING 760
ZONE C, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA**

Sample Location	Sample Depth (feet)	Total Organic Vapor Headspace Concentration
CNC31-B01	1-2	2
	2-3	2
	3-4	2
	7-8	2
	8-9	2
	13-14	15
CNC31-B02	3-4	4
	6-7	4
CNC31-B03	1-2	4
	2-3	4
	6-7	4
	9-10	4
	10-11	4
	11-12	4
	12-13	260
CNC31-B04	3-4	6
	6-7	4
	7-8	4
	11-12	ND
CNC31-B05	1-2	5
	2-3	5
	3-4	5
	4-5	5
	5-6	5
	6-7	5
	7-8	5
	8-9	5
	9-10	5
	10-11	5
	11-12	5
	12-13	5
CNC31-B06	1-2	5
	2-3	5
	3-4	5
	4-5	5
	5-6	5
	6-7	5
	7-8	5
	8-9	5
	9-10	5
	10-11	5
	11-12	5
	12-13	5

TABLE 4 (Continued)

SUMMARY OF OVA SOIL SCREENING RESULTS
 SITE 31, BUILDING 760
 ZONE C, FORMER CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Depth (feet)	Total Organic Vapor Headspace Concentration
CNC31-B07	4-5	5
	5-6	5
	6-7	5
	7-8	5
	8-9	5
	9-10	5
	10-11	5
	11-12	5
	12-13	5
CNC31-B08	1-2	ND
	2-3	ND
	3-4	ND
	4-5	ND
	6-7	ND
	7-8	ND
	8-9	ND
	9-10	ND
	11-12	ND
CNC31-B09	4-5	ND
	8-9	ND

Note:

OVA - organic vapor analyzer equipped with a flame ionization detector

TABLE 5

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR SOIL
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Mobile Laboratory Screening Data (PPB) ⁽¹⁾					
			Benzene (ug/kg)	Toluene (ug/kg)	Ethylbenzene (ug/kg)	Total Xylenes (ug/kg)	Naphthalene (ug/kg)	Diesel Range Organics (mg/kg)
CNC31B01	31SFB01-1112	11-12	<5.0	<5.0	<5.0	<5.0	<5.0	<19
CNC31-B02	31SFB02-1112	11-12	16	44	360	1670	4500	8300
CNC31-B03	31SFB03-1112	11-12	160	700	2400	14800	34000	>10000
CNC31-B04	31SFB04-1112	11-12	<5.0	<5.0	<5.0	<5.0	<5.0	21
CNC31-B05	31SFB05-1112	11-12	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC31-B06	31SFB06-1112	11-12	<5.0	<5.0	<5.0	<5.0	<5.0	<10
CNC31-B07	31SFB07-1011	10-11	<5.0	<5.0	≥5.0	<5.0	<5.0	<10

NOTES:

⁽¹⁾ Mobile laboratory screening data was analyzed using USEPA Method 8021/8015M. Compounds not detected are reported as less than the instrument detection limit.

ug/kg Micrograms per kilogram

mg/kg Milligrams per kilogram

TABLE 6

**SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR GROUNDWATER
SITE 31, BUILDING 760
ZONE C, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA**

Sample Location	Sample Identification	Laboratory Screening ⁽¹⁾					
		Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Total Xylenes (ug/L)	Naphthalene (ug/L)	Diesel Range Organics (mg/L)
CNC31-B01	31GFB01-16	<1.0	<1.0	<1.0	<1.0	94	3.4
CNC31-B02	31GFB02-16	4.2	14	98	<1.0	1700	100
CNC31-B03	31GFB03-16	<1.0	4.6	25	131	1600	180
CNC31-B04	31GFB04-16	2.2	2.4	19	54	8700	10
CNC31-B05	31GFB05-15	<1.0	<1.0	<1.0	39	<1.0	<0.1
CNC31-B06	31GFB06-15	<1.0	<1.0	<1.0	<1.0	<1.0	<0.1
CNC31-B07	31GFB07-15	<1.0	<1.0	<1.0	<1.0	<1.0	<0.1

NOTES:

⁽¹⁾ Laboratory screening data were analyzed using USEPA Method 8020/8015M. Compounds not detected are reported as less than the instrument detection limit.

ug/L Micrograms per liter
mg/L Milligrams per liter

TABLE 7

**SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 31, BUILDING 760
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA**

Soil Boring / Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL ⁽¹⁾		5	1622	1260	42471	73084	29097	231109	12998	87866	210
CNC31-B01 / 31SLB011112	28-May-99	< 6	< 6	< 6	< 6	< 400	< 400	< 400	< 400	< 400	< 6
CNC31-B02 / 31SLB021112	28-May-99	< 6	< 6	< 6	< 6	< 400	< 400	< 400	< 400	< 400	< 6
CNC31-B02 / 31SLB021112D ⁽²⁾	28-May-99	< 6	< 6	< 6	3 ⁽³⁾	< 400	< 400	< 400	< 400	< 400	3 ⁽³⁾
CNC31-B03 / 31SLB031112	28-May-99	10	150	930	6800	< 7900	< 7900	< 7900	< 7900	< 7900	13400
CNC31-B04 / 31SLB041112	28-May-99	< 5	< 5	< 5	< 5	< 7300	< 7300	< 7300	< 7300	< 7300	3 ⁽³⁾
CNC31-B05 / 31SLB050910	28-May-99	< 6	< 6	< 6	< 6	< 360	< 360	< 360	< 360	< 360	< 6
CNC31-B06 / 31SLB061112	28-May-99	< 6	< 6	< 6	< 6	< 400	< 400	< 400	< 400	< 400	ND
CNC31-B07 / 31SLB071011	28-May-99	< 6	< 6	< 6	< 6	< 360	< 360	< 360	< 360	< 360	5 ⁽³⁾
CNC31-TL ⁽³⁾ / 31TL00101	28-May-99	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA	< 5

All concentrations are in micrograms per kilograms (ug/kg).

NA - Not analyzed

⁽¹⁾ South Carolina Department of Health and Environmental Control Risk Based Screening Levels for sandy soils; depth to groundwater less than 5 feet

⁽²⁾ Duplicate sample

⁽³⁾ Trip blank

⁽⁴⁾ Indicates the presence of an analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 8

SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl- benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	MTBE (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	Dibenzo(a,h) anthracene (ug/L)
RBSL ⁽¹⁾		5	700	1000	10000	40	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾
CNC31-MW01 / 31GLM0101	27-Jul-99	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10
CNC31-MW01 / 31GLM0101D	27-Jul-99	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10
CNC31-MW02 / 31GLM0201	27-Jul-99	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10
CNC31-MW03 / 31GLM0301	28-Jul-99	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10
CNC31-MW04 / 31GLM0401	28-Jul-99	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10
CNC31-MW05 / 31GLM0501	28-Jul-99	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10
CNC31-MW6D / 31GLM0601	19-Aug-99	< 5	< 5	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10
CNC31TL ⁽⁴⁾ / 31TL01001	28-Jul-99	< 5	< 5	< 5	< 5	< 5	< 5	NA	NA	NA	NA	NA

All concentrations are in ug/L.

NA - Not analyzed

⁽¹⁾ South Carolina Department of Health and Environmental Control Risk Based Screening Levels for groundwater.

⁽²⁾ The risk based screening level for individual PAH CoC is 10 ug/L or 25 ug/L for total PAHs.

⁽³⁾ Duplicate sample

⁽⁴⁾ Trip blank

TABLE 9

**COMPARISON OF MAXIMUM CONCENTRATIONS TO RBSLs
SITE 31, BUILDING 760
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA**

Chemical of Concern	Maximum Concentration (Soil) (ug/kg)	RBSLs (Soil) (ug/kg) ^(a)	Maximum Concentration (GW) (ug/L)	RBSLs (GW) (ug/L) ^(b)
Benzene	10	5	<6	5
Toluene	150	1622	<5	1000
Ethylbenzene	930	1260	<5	700
Xylenes	6800	42471	<5	10000
MTBE	<650	NA	<5	40
Naphthalene	13400	210	<5	10
Benzo(a)anthracene	<7900	73084	<10	10
Benzo(a)pyrene	<7900	NA	<10	10
Benzo(b)fluoranthene	<7900	29097	<10	10
Benzo(k)fluoranthene	<7900	231109	<10	10
Benzo(g,h,i)perylene	<7300	NA	<10	10
Chrysene	<7900	12998	<10	10
Dibenzo(a,h)anthracene	<7900	87866	<10	10

Notes:

(a) - From Risk-Based Corrective Action for Petroleum Releases, Table B3, Depth to GW - <5 ft, SCDHEC RBCA Guidelines, 1998.

(b) - From Risk-Based Corrective Action for Petroleum Releases, Table B1, SCDHEC RBCA Guidelines, 1998.

GW - Groundwater

RBSLs - Risk Based Screening Levels

Bolded value indicates the concentration exceeded the RBSL.

NA = Not Available

TABLE 10

EXPOSURE PATHWAY ASSESSMENT – CURRENT LAND USE
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure Point or Reason for Non-Selection	Data Requirements (If pathway selected)
Air	Inhalation	No	Area of boiler house below grade is above water table and not expected to act as a basement. No explosion hazard.	
	Explosion Hazard	No		
Groundwater	Ingestion	No	No current groundwater pathways complete. Drinking water provided by city. -	
	Dermal contact	No		
	Inhalation	No		
Surface Water	Ingestion	No	No surface water bodies within 1,000 feet	
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No surficial soil impact.	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	No	No current complete pathways.	
	Dermal contact	No		
	Inhalation	No		

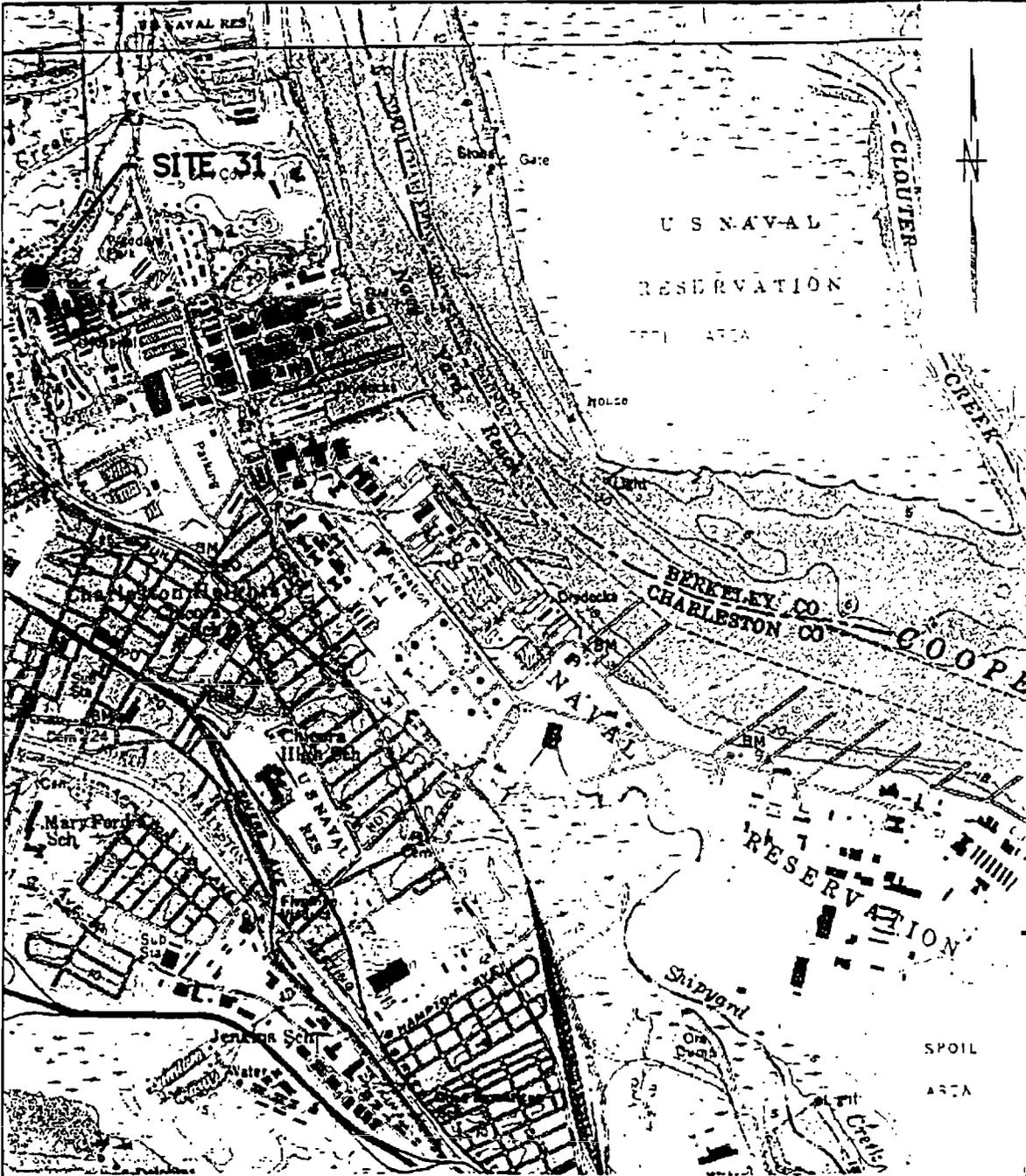
TABLE 11

EXPOSURE PATHWAY ASSESSMENT - FUTURE LAND USE
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure Point or Reason for Non-Selection	Data Requirements (if pathway selected)
Air	Inhalation	No	Area of boiler house below grade is above water table and not expected to act as a basement. No explosion hazard.	
	Explosion Hazard	No		
Groundwater	Ingestion	Yes	Groundwater exposure by potential construction worker (most likely in utility corridor). Both direct exposure and exposure by soil leaching to groundwater evaluated.	No additional data needed.
	Dermal contact	Yes		
	Inhalation	Yes		
Surface Water	Ingestion	No	No surface water bodies within 1,000 feet.	
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	Soil exposure by potential construction worker (most likely in utility corridor). Although there is no surficial soil impact, subsurface soil evaluated as surface soil for construction worker as direct contact likely in utility trench. Volatization of CoCs will occur before receptor enters the trench to work.	No additional data needed.
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	YES	Exposure evaluated as direct contact in utility trench (see above).	
	Dermal contact	YES		
	Inhalation	No		

FIGURES

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SOURCE: QUADRANGLE MAP SOUTH CAROLINA, REVISED 1979
 QUADRANGLE MAP NORTH CHARLESTON REVISED, 1979

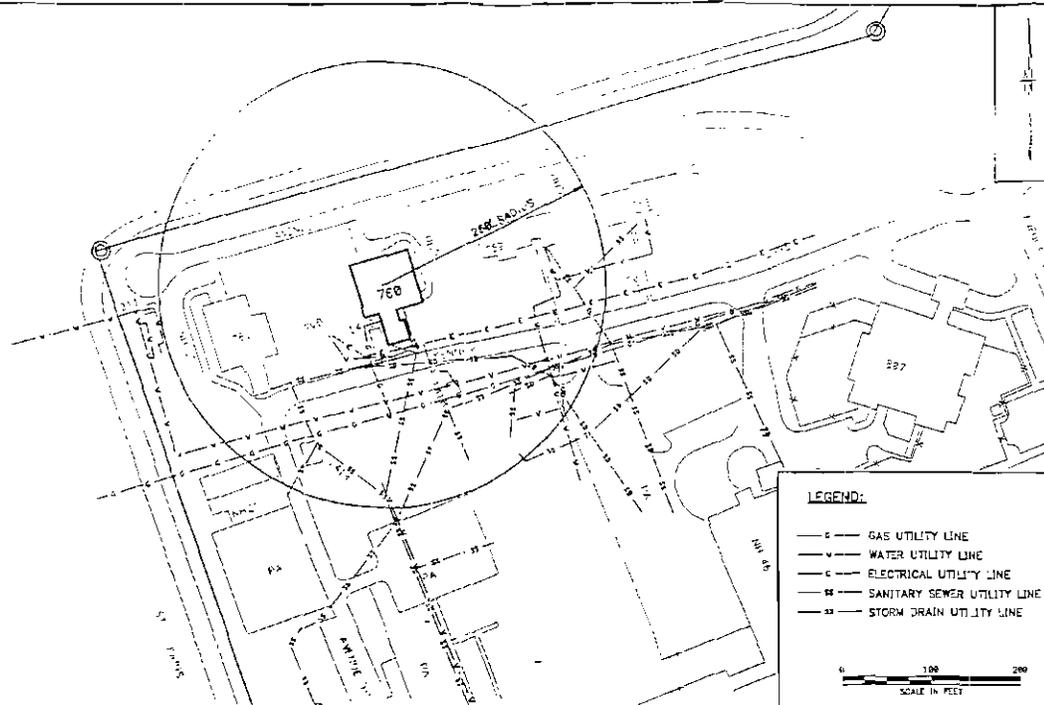


DRAWN BY HJP	DATE 8/20/99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	



SITE LOCATION MAP
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. N0164	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 1	REV. 0



NO.	DATE	REVISIONS	BY	CHKD	APPRD	REFERENCES

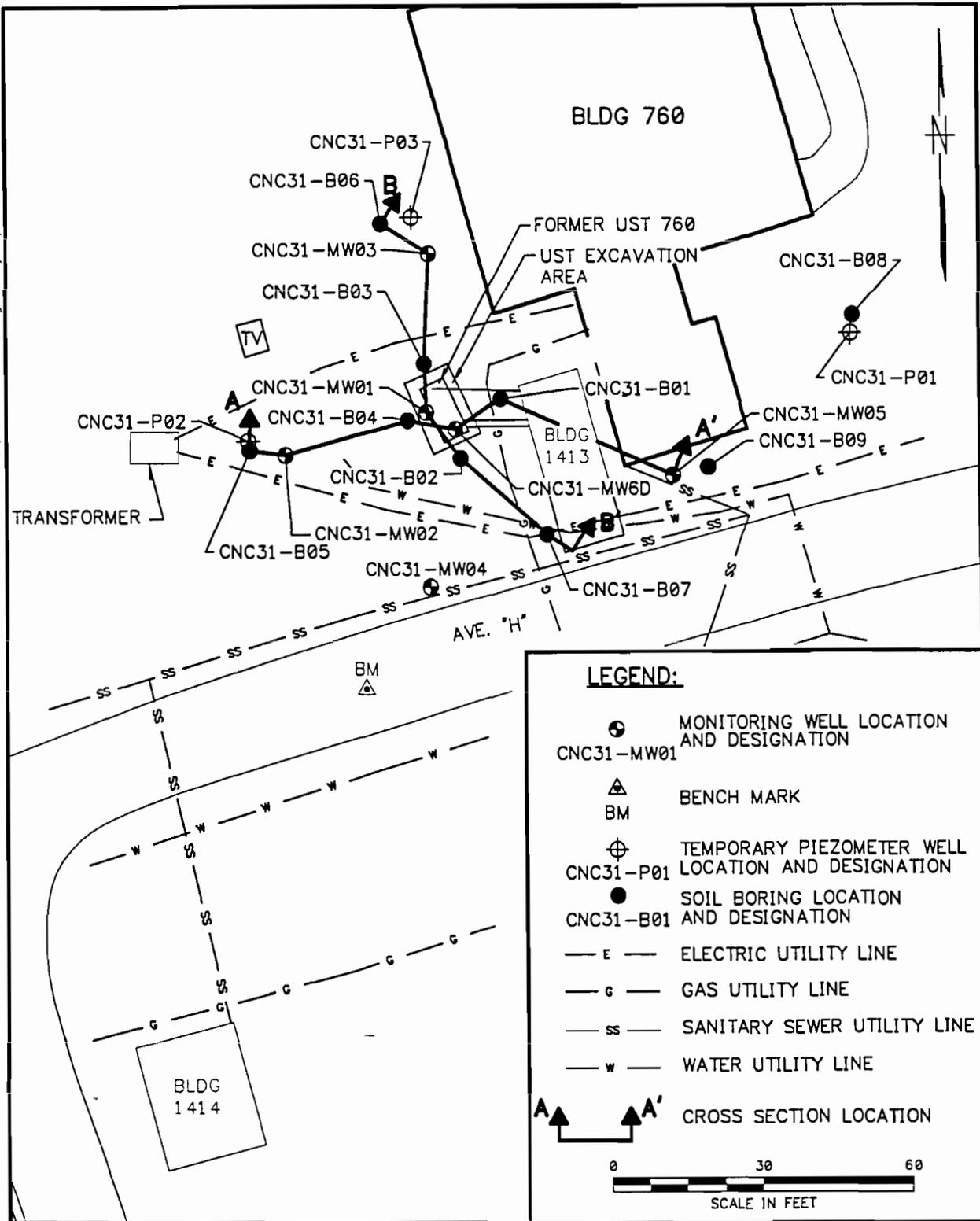
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 DATE: 8/18/99
 CHECKED BY: [blank]
 DATE: [blank]
 COST, SCH, CD, AREA: [blank]
 SCALE: AS NOTED



SITE VICINITY MAP
 SITE 31, BUILDING 768
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 0146
 APPROVED BY: [blank] DATE: [blank]
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 DRAWING NO. FIGURE 2
 REV. 0

ACAD:1640CM01.dwg 10/18/99 HJP

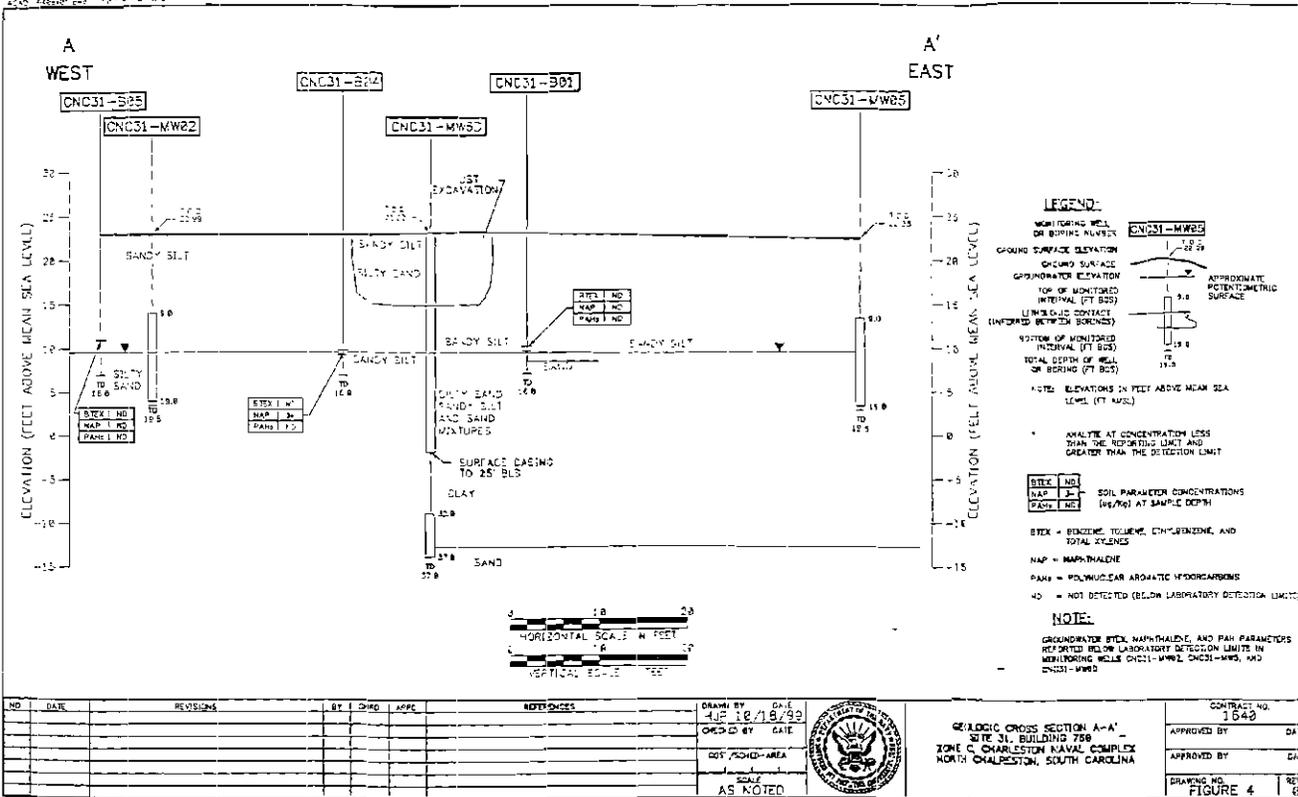


DRAWN BY HJP	DATE 10/18/99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	

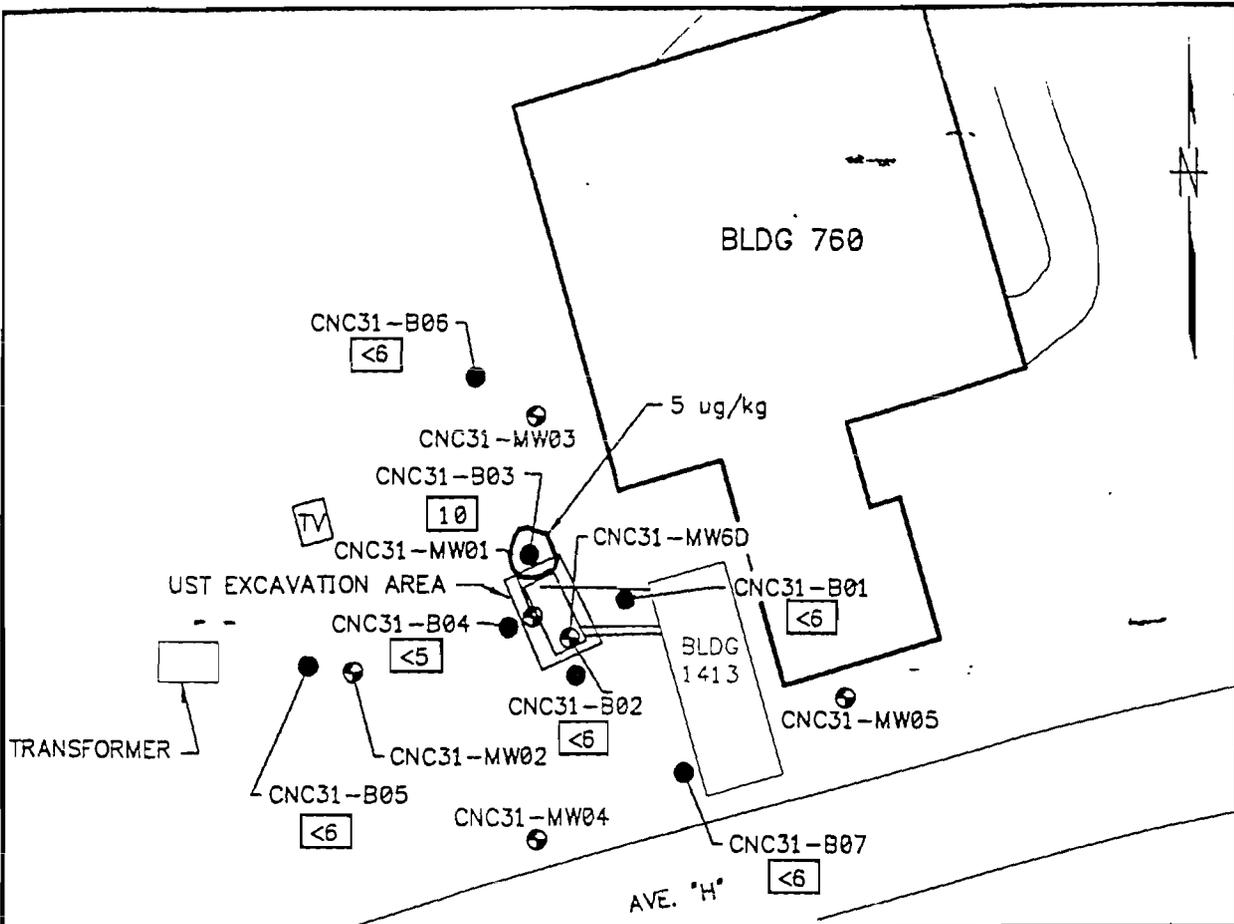


SITE MAP AND SAMPLING LOCATIONS
SITE 31, BUILDING 760
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 1640	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 3	REV. 0



ACAD:1540CM01.dwg 10/18/99 HJP



LEGEND:

- MONITORING WELL LOCATION AND DESIGNATION
CNC31-MW01
- SOIL BORING LOCATION AND DESIGNATION
CNC31-B07
- BENCH MARK
BM
- ANALYTE AT CONCENTRATION LESS THAN REPORTING LIMIT
<5
- BENZENE CONCENTRATION (ug/kg)
10
- BENZENE SOIL CONCENTRATION

0 30 60
SCALE IN FEET

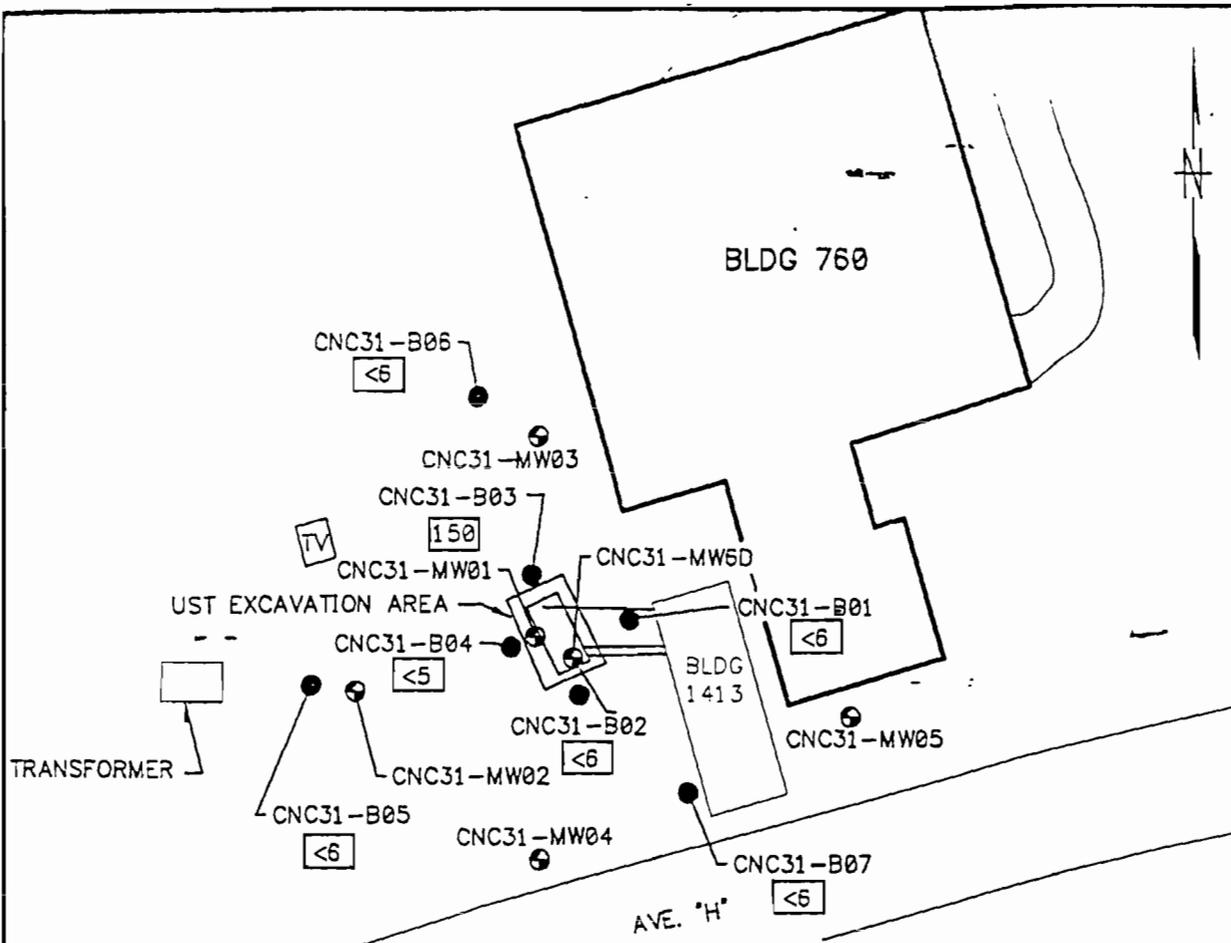
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CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	



SOIL BENZENE CONCENTRATION MAP
(MAY 1999)
SITE J1, BUILDING 760
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 1640	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 7	REV. 0

ACAD:1640GM02.dwg 10/18/99 HJP



LEGEND:

- MONITORING WELL LOCATION AND DESIGNATION
CNC31-MW01
- SOIL BORING LOCATION AND DESIGNATION
CNC31-B07
- ▲ BM BENCH MARK
- ◻ <6 ANALYTE AT CONCENTRATION LESS THAN REPORTING LIMIT
- ◻ 150 TOLUENE CONCENTRATION (ug/Kg)

0 30 60
SCALE IN FEET

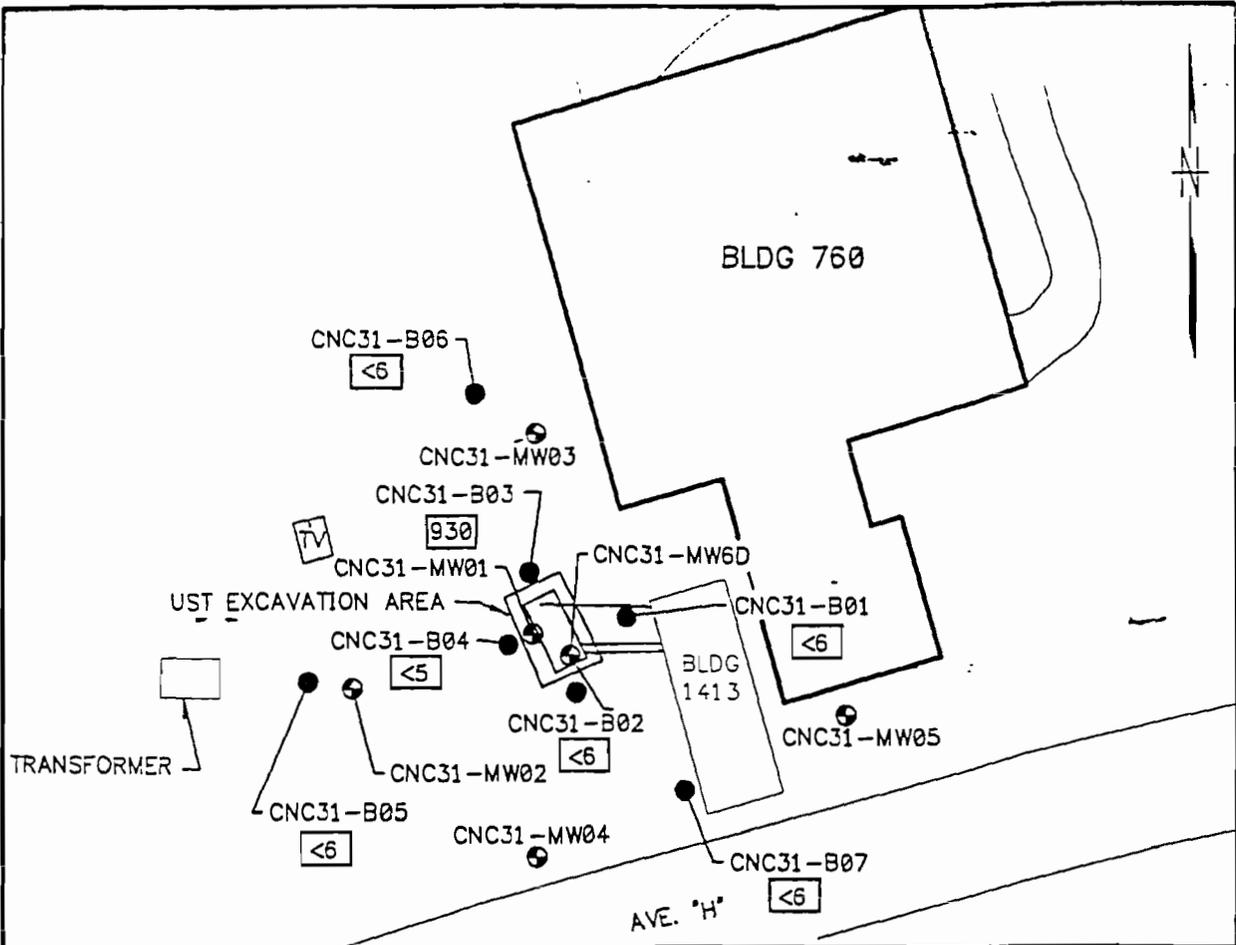
DRAWN BY HJP	DATE 10/18/99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	



SOIL TOLUENE CONCENTRATION MAP
(MAY 1999)
SITE 31, BUILDING 760
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 1640	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 8	REV. 0

ACAD:1640CM03.dwg 10/18/99 HJP



LEGEND:

- MONITORING WELL LOCATION AND DESIGNATION
CNC31-MW01
- SOIL BORING LOCATION AND DESIGNATION
CNC31-B07
- BENCH MARK
BM
- ANALYTE AT CONCENTRATION LESS THAN REPORTING LIMIT
<6
- ETHYLBENZENE CONCENTRATION (ug/Kg)
930

SCALE IN FEET

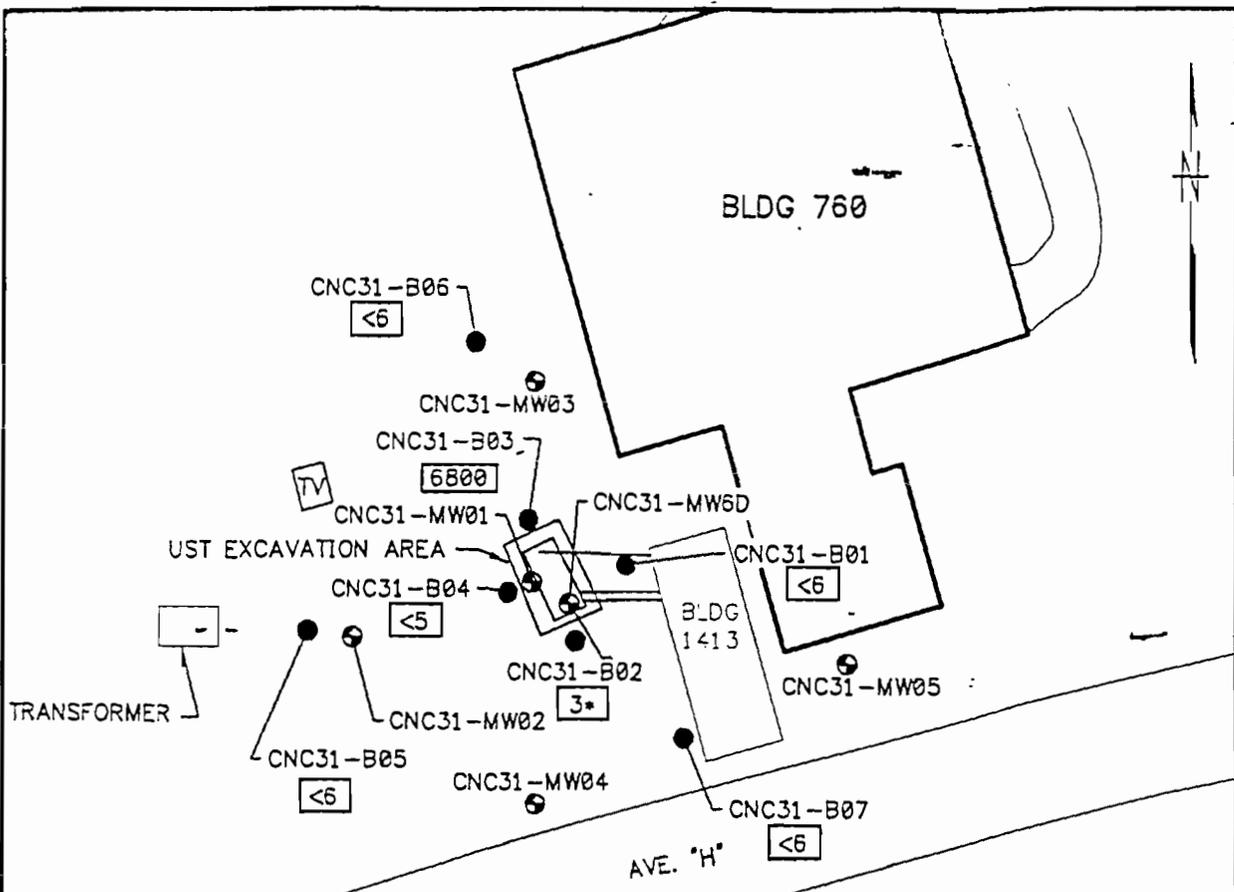
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CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	



SOIL ETHYLBENZENE CONCENTRATION MAP
 (MAY 1999)
 SITE 31, BUILDING 760
 ZONE C, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 1640	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 9	REV. 0

ACAD:1640CM04.dwg 10/18/99 HJP



LEGEND:

- MONITORING WELL LOCATION AND DESIGNATION
CNC31-MW01
- SOIL BORING LOCATION AND DESIGNATION
CNC31-B07
- BENCH MARK
BM
- ANALYTE AT CONCENTRATION LESS THAN REPORTING LIMIT
- TOTAL XYLENES CONCENTRATION (ug/Kg)
- ANALYTE AT CONCENTRATION LESS THAN THE REPORTING LIMIT AND GREATER THAN THE DETECTION LIMIT

0 30 50
SCALE IN FEET

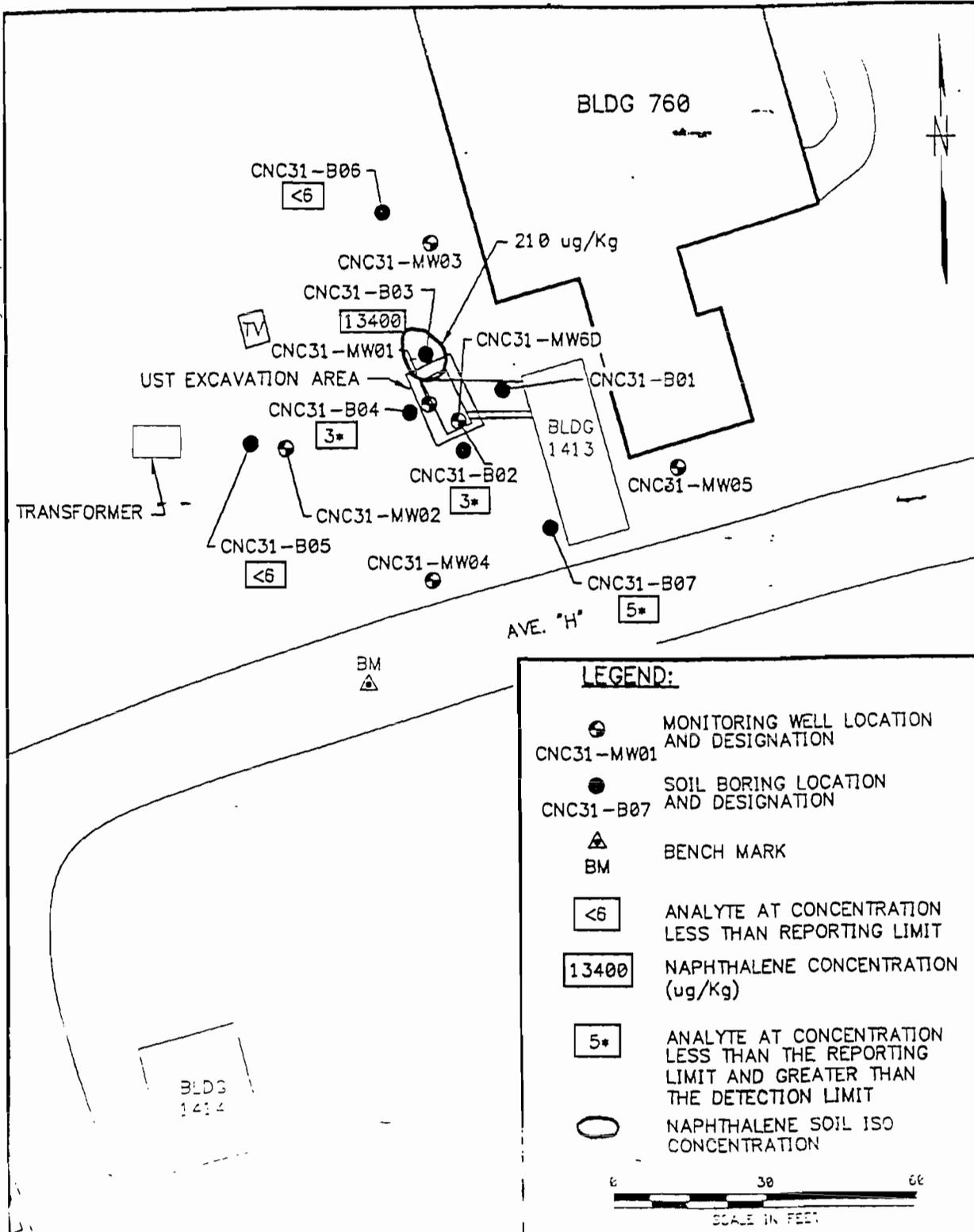
DRAWN BY HJP	DATE 10/18/99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE AS NOTED	



SOIL TOTAL XYLENES CONCENTRATION MAP
(MAY 1999)
SITE 31, BUILDING 760
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 1640	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 10	REV. 0

ACAD-1640CM05.dwg 10/18/99 HJP



LEGEND:

- MONITORING WELL LOCATION AND DESIGNATION
CNC31-MW01
- SOIL BORING LOCATION AND DESIGNATION
CNC31-B07
- BENCH MARK
BM
- ANALYTE AT CONCENTRATION LESS THAN REPORTING LIMIT
<6
- NAPHTHALENE CONCENTRATION (ug/Kg)
13400
- ANALYTE AT CONCENTRATION LESS THAN THE REPORTING LIMIT AND GREATER THAN THE DETECTION LIMIT
5*
- NAPHTHALENE SOIL ISO CONCENTRATION
O

0 30 60
SCALE IN FEET

DRAWN BY	DATE
HJP	10/18/99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE	
AS NOTED	



SOIL NAPHTHALENE CONCENTRATION MAP
(MAY 1999)
SITE #1, BUILDING 760
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO. 1640	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 11	REV. 0