N00639.AR.001865
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# FINAL ENVIRONMENTAL ASSESSMENT REPORT FOR BUILDING N-126 MILLINGTON SUPPACT TN

11/17/1993

ENSAFE ALLEN AND HOSHALL

# COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY
# NAVAL AIR STATION MEMPHIS
# MILLINGTON, TENNESSEE

## FINAL ENVIRONMENTAL ASSESSMENT REPORT
## BUILDING N-126
## FACILITY I.D. #0-791709

**Prepared for:**

**DEPARTMENT OF THE NAVY**
**SOUTHERN DIVISION**
**NAVAL FACILITIES ENGINEERING COMMAND**
**NORTH CHARLESTON, SOUTH CAROLINA**

**SOUTHDIV CONTRACT NUMBER:**
**N62467-89-D-0318**

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**November 17, 1993**

**Release of this document requires the prior notification of the Commanding Officer of Naval Air Station Memphis, Millington, Tennessee.**

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## ACRONYMS AND SYMBOLS

| TITLE | DEFINITION |
|---|---|
| ACGIH | American Council of Governmental and Industrial Hygienists |
| ADI | Average Daily Intake |
| ARAR | Applicable or Relevant and Appropriate Requirements |
| ASTM | American Society of Testing and Materials |
| BTEX | Benzene, Toluene, Ethylbenzene, and Total Xylenes |
| BW | Body Weight |
| CAG | Carcinogenic Assessment Group |
| CAP | Corrective Action Plan |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CFR | Code of Federal Regulations |
| CGI | Combustible Gas Indicator (Explosimeter) |
| CLEAN | Comprehensive Long-Term Environmental Action Navy |
| CLP | USEPA Contract Laboratory Program |
| CPC | Chemical-Protective Clothing |
| CPR | Cardiopulmonary Resuscitation |
| CSEP | Confined Space Entry Permit |
| CV | Coefficient of Variation |
| DOD | U.S. Department of Defense |
| DOT | U.S. Department of Transportation |
| DP | Duplicate (sample) |
| DQO | Data Quality Objective |
| DRO | Diesel Range Organics |
| E/A&H | EnSafe/Allen & Hoshall |
| EAR | Environmental Assessment Report |
| EFD | Engineering Field Division |
| EIC | Engineer-in-Charge |
| EP | Extraction Procedure/Exposure Period |
| EPA | United States Environmental Protection Agency |
| FB | Field Blank |
| FID | Flame Ionization Detector |
| GC | Gas Chromatography |
| GRO | Gasoline Range Organics |
| GW | Groundwater (sample) |
| HASP | Health and Safety Plan |
| HSWA | Hazardous and Solid Waste Amendments of 1984 |
| IDLH | Immediately Dangerous to Life and Health |
| IR | Average Soil Ingestion Rate |
| LEL | Lower Exposive Limit |
| LQAC | Laboratory Quality Assurance Coordinator |
| mg/kg | Milligrams/Kilogram |

| | |
|---|---|
| mg/L | Milligrams/Liter |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| MSA | Mine Safety Administration |
| MSDS | Material Safety Data Sheet |
| MSL | Mean Sea Level |
| MW | Monitoring Well |
| NAS | Naval Air Station |
| NAVFACENGCOM | Naval Facilities Engineering Command |
| NCP | National Oil and Hazardous Substances Contingency Plan |
| NCR | NEESA Contract Representative |
| NEESA | Naval Energy and Environmental Support Activity |
| NFA | No Further Action |
| NIOSH | National Institute of Occupational Safety and Health |
| OSHA | Occupational Safety and Health Administration |
| OVA | Organic Vapor Analyzer |
| PEL | Permissible Exposure Limit |
| PID | Photoionization Detector |
| ppb | Parts per Billion |
| PPE | Personal Protective Equipment |
| ppm | Parts per Million |
| PVC | Poly Vinyl Chloride |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan (QAP) |
| QA/QC | Quality Assurance/Quality Control |
| QC | Quality Control |
| R | Acceptable Incremental Lifetime Cancer Risk |
| RB | Rinsate Blank |
| RCRA | Resource Conservation and Recovery Act |
| SB | Soil Boring |
| SCBA | Self Contained Breathing Apparatus |
| SG | Soil Gas |
| SOP | Standard Operating Procedure |
| SOP/QAM | Standard Operating Procedures and Quality Assurance Manual (USEPA Region IV Environmental Compliance Branch) |
| SOUTHDIV | Southern Division, Naval Facilities Engineering Command |
| SOW | Statement of Work |
| SVOC | Semivolatile Organic Compounds |
| TB | Trip Blank |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TDEC | Tennessee Department of Environment and Conservation |
| TDS | Total Dissolved Solids |
| TLV | Threshold Limit Value |
| TPH | Total Petroleum Hydrocarbons |

| | |
|---|---|
| UEL | Upper Explosive Limit |
| ug/L | Micrograms/liter |
| VOA | Volatile Organic Analysis |
| VOC | Volatile Organic Compounds |
| WBGT | Wet Globe Bulb Temperature Index |

## EXECUTIVE SUMMARY

The Department of the Navy's Engineering Field Division, Southern Division Naval Facilities Engineering Command (SOUTHDIV) is providing engineering support and contract services to the Naval Air Station (NAS) Memphis, Millington, Tennessee in support of their compliance with the Tennessee Department of Environment and Conservation (TDEC) Underground Storage Tank (UST) Division regulations.

This Environmental Assessment Report (EAR) presents the findings of the assessment of petroleum hydrocarbon contamination associated with the underground storage tanks located near Building N-126, NAS Memphis.

The following conclusions and recommendations are based on information gathered during the assessment.

**Conclusions:**

- A petroleum release has occurred at this site. This release reportedly originated from three tanks that have since been removed (Tanks 7, 303, and 1241).

- The aquifer can be classified as "non-drinking water" based on a water use survey in the vicinity of the site and water samples collected near the site which did not meet several primary and secondary drinking water standards.

- Permeabilities of soil samples collected in native soil outside the tank pit exhibited average hydraulic conductivities ranging between $2.4 \times 10^{-6}$ and $4.5 \times 10^{-7}$ cm/s, which are typical permeabilities of clay. TDEC has established that cleanup levels for soil in a "non-drinking water aquifer" within this permeability range are 500 ppm (parts per million) for BTX (benzene, toluene and xylenes) and 1,000 ppm for TPH (total petroleum hydrocarbons). Groundwater cleanup levels for the "non-drinking water" classification are 0.070 ppm for benzene and 1.0 ppm for TPH.

- BTX and TPH concentrations in soil did not exceed the TDEC cleanup levels for a non-drinking water aquifer in any of the analyzed soil samples.

- TPH and benzene concentrations in groundwater exceeded the TDEC cleanup levels for a non-drinking water aquifer in two monitoring wells (N-MW-5 and N-MW-6). Monitoring well N-MW-5 is located adjacent to the tank pit and N-MW-6 is located approximately 100 feet north of the tank pit. Petroleum hydrocarbons were not detected in the other four wells.

- The groundwater beneath the site appears to flow toward the tank pit (adjacent to N-MW-5) and has a calculated hydraulic gradient ranging from 0.024 to 0.143 ft/ft.

- Depth to the static water table ranges from 8 to 14 feet below grade.

- Free product was not detected in any monitoring wells.

**Recommendations:**

- EnSafe/Allen and Hoshall (E/A&H) recommends the development of a Corrective Action Plan to determine the best course of action to remediate groundwater contamination at the site.

# 1.0 INTRODUCTION

On March 3, 1993, EnSafe/Allen & Hoshall was retained by the Department of the Navy to conduct an Environmental Assessment at the Building N-126 UST site (Facility I.D. #0-791709) located at the Naval Air Station in Millington, Tennessee. The purpose of this investigation was to measure the presence or absence of petroleum hydrocarbons in the subsurface at the site. The source of the release was reportedly three leaking tanks, Tank Nos. 7, 303, and 1241. The quantity of the suspected release is not known. This investigation has been completed in accordance with the Tennessee Department of Environment and Conservation Guidelines of January 1992.

## 1.1 Objectives and Scope

The objectives of the Environmental Assessment were in accordance with the Tennessee Department of Environment and Conservation's (TDEC) UST Division.

**Objectives:**

- Determine whether soil and/or groundwater were contaminated.
- Determine the horizontal and vertical extent of contamination, if any.
- Determine the extent and thickness of free phase product, if any.
- Describe the geology and hydrogeology beneath the site and the relationship with the contamination.
- Laboratory analysis of select soil and water samples for various parameters to aid in the design of remedial alternatives, if necessary. These are included as Appendix H.

The scope of work in this investigation included the following:

- A soil screening survey over the site using a KVA soil sampler and a portable infrared spectrophotometer to determine optimum monitoring well/soil boring locations.

- Installation of ten soil borings and six monitoring wells into the surficial aquifer to determine site-specific geologic and hydrogeologic characteristics.

- Determine the groundwater classification (drinking or non-drinking) through a water use survey in the vicinity of the site, water quality analyses, and a yield test (if necessary).

- Laboratory analysis of select soil and water samples for benzene, toluene, and xylenes (BTX) and for Total Petroleum Hydrocarbons (TPH) in the form of both Gasoline Range Organics (GRO) and Diesel Range Organics (DRO).

- Laboratory analysis of select soil and water samples for various parameters to aid in the design of remedial alternatives, if necessary.

- Identification of potential contamination pathways and receptors.

## 1.2 Background Information/Previous Work

In April 1992, National Salvage and Services Corporation was contracted to remove and provide proper closure documentation for USTs 7, 303, and 1241. After excavation and removal of the tanks, soil samples taken from the bottom of the pit at each corner of each tank indicated elevated levels of DRO-TPH. Table 1-1 lists the sample locations and analytical results.

**Table 1-1**
**Previous Analytical Results**
**Building N-126 USTs**
**(ppm)**

| Sample Location | TPH, Diesel Range Organics (Hi Boil Hydrocarbons) | TPH, Gasoline Range Organics (Lo Boil Hydrocarbons) | BTEX (Total) |
|---|---|---|---|
| UST #7 NW Corner | 169 | < 5.0 | < 1.0 |
| UST #7 NE Corner | 298 | < 5.0 | < 1.0 |
| UST #7 SW Corner | 318 | < 5.0 | < 1.0 |
| UST #7 SE Corner | 380 | < 5.0 | < 1.0 |
| UST #303 NW Corner | 1441 | < 5.0 | < 1.0 |
| UST #303 NE Corner | 620 | < 5.0 | < 1.0 |
| UST #303 SW Corner | 615 | < 5.0 | < 1.0 |
| UST #303 SE Corner | 2820 | < 5.0 | < 1.0 |
| UST #1241 NW Corner | 100 | < 5.0 | < 1.0 |
| UST #1241 NE Corner | 3435 | < 5.0 | < 1.0 |
| UST #1241 SW Corner | 135 | < 5.0 | < 1.0 |
| UST #1241 SE Corner | 88 | < 5.0 | < 1.0 |

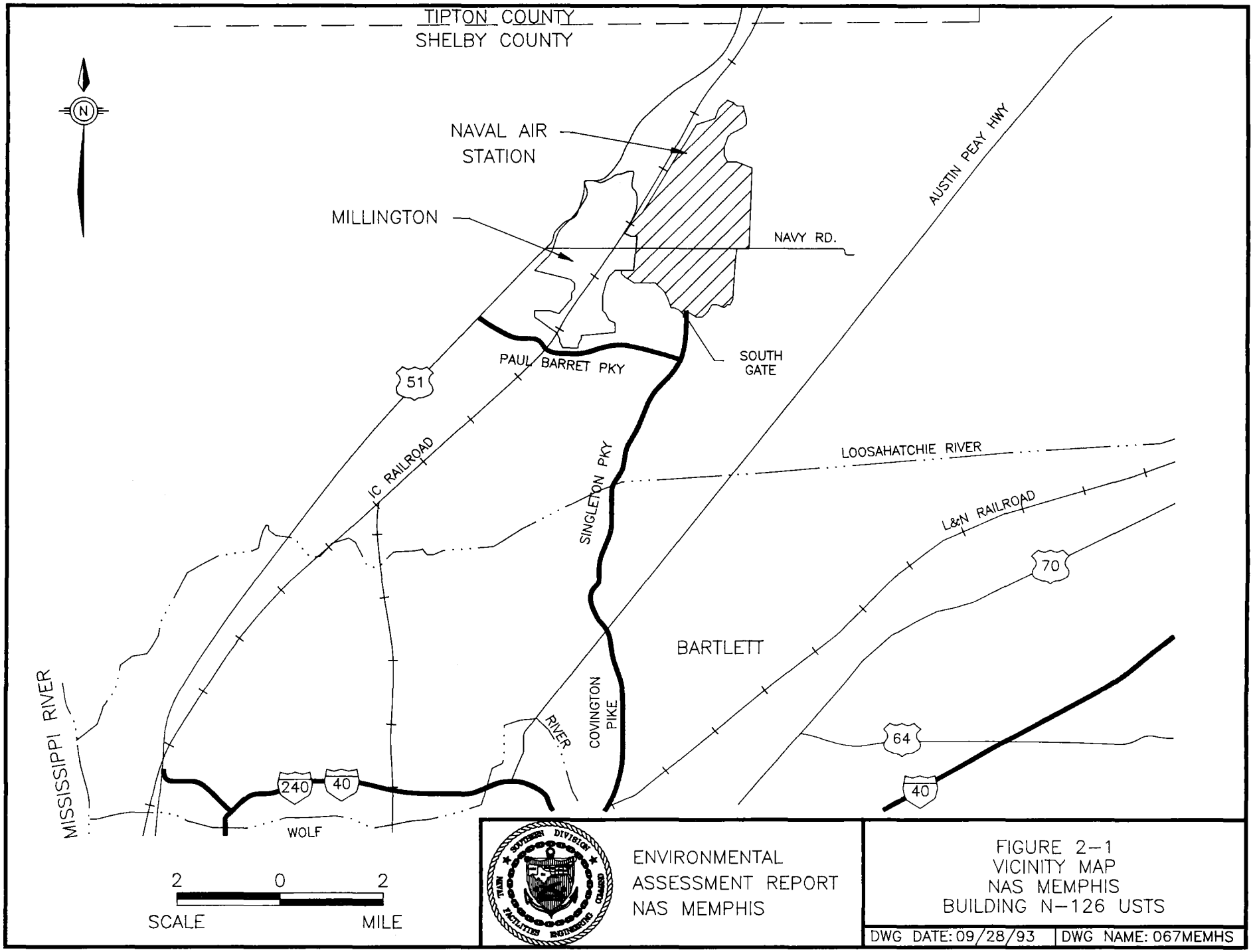
## 2.0 SITE DESCRIPTION

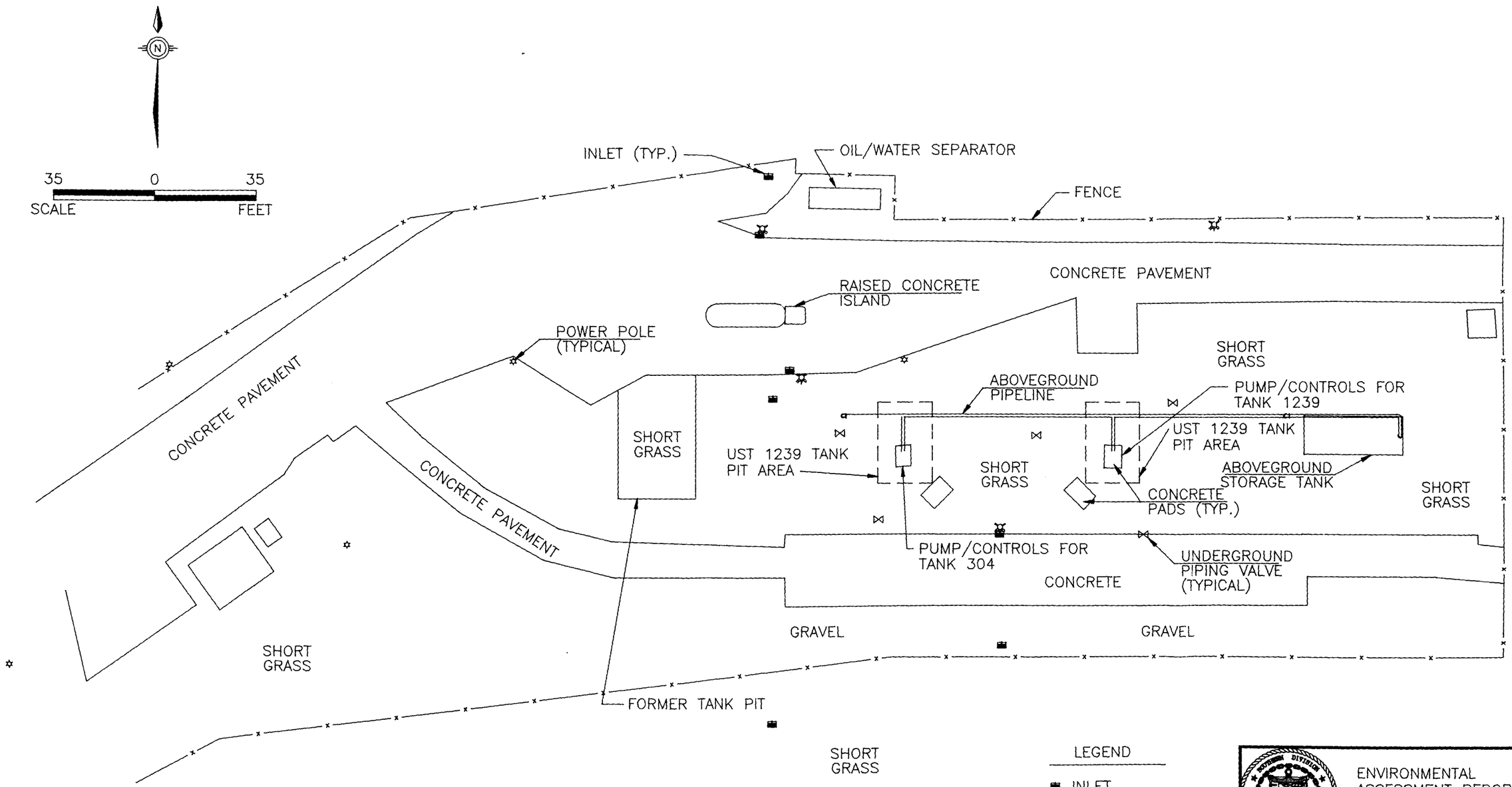
The site, located south of Building N-126 and adjacent to the N-94 fuel farm, is currently in use as a fuel dispensing facility. The subject site location is provided in Figures 2-1 and 2-2. There are two concrete 100,000-gallon underground tanks (USTs 304 and 1239) containing No. 2 fuel oil located immediately east of the former location of the three USTs that were removed (UST systems 7, 303, and 1241). UST 304 was taken out of service because of past problems with groundwater accumulating in the tank. The tank no longer contains No. 2 fuel oil and is believed to contain groundwater which has infiltrated from the surrounding soils. According to NAS Memphis personnel, fuel has not been observed in the tank's release detection wells. UST 1239 currently contains No. 2 fuel oil.

UST 7 was a 560-gallon steel tank of unknown usage; however, the tank is presumed to have contained AVGAS. USTs 303 and 1241 were 25,000-gallon steel AVGAS storage tanks. The three tanks were located close to each other in a grassy area with some concrete/asphalt coverage.

### 2.1 Discussion of Site Topography

The site is located in a grassy area bordered on three sides by concrete and asphalt drives. The area immediately north of the former tank pit is a concrete containment area (for an oil/water separator) bordered on the north by a concrete parking lot and apron. The two fuel oil storage tanks discussed in Section 2.0 are located immediately east of the area. Approximately 2 feet of relief exists across the site with the higher elevations being to the north toward Building N-126. Consequently, surface water drains to the south into a series of storm drains (Figure 2-3).


TIPTON COUNTY
SHELBY COUNTY
N
NAVAL AIR STATION
MILLINGTON
NAVY RD.
AUSTIN PEAY HWY
SOUTH GATE
PAUL BARRET PKY
51
IC RAILROAD
SINGLETON PKY
LOOSAHATCHIE RIVER
L&N RAILROAD
70
BARTLETT
COVINGTON PIKE
RIVER
64
40
240
40
MISSISSIPPI RIVER
WOLF
2 0 2
SCALE MILE
ENVIRONMENTAL ASSESSMENT REPORT NAS MEMPHIS
FIGURE 2-1
VICINITY MAP
NAS MEMPHIS
BUILDING N-126 USTS
DWG DATE: 09/28/93
DWG NAME: 067MEMHS

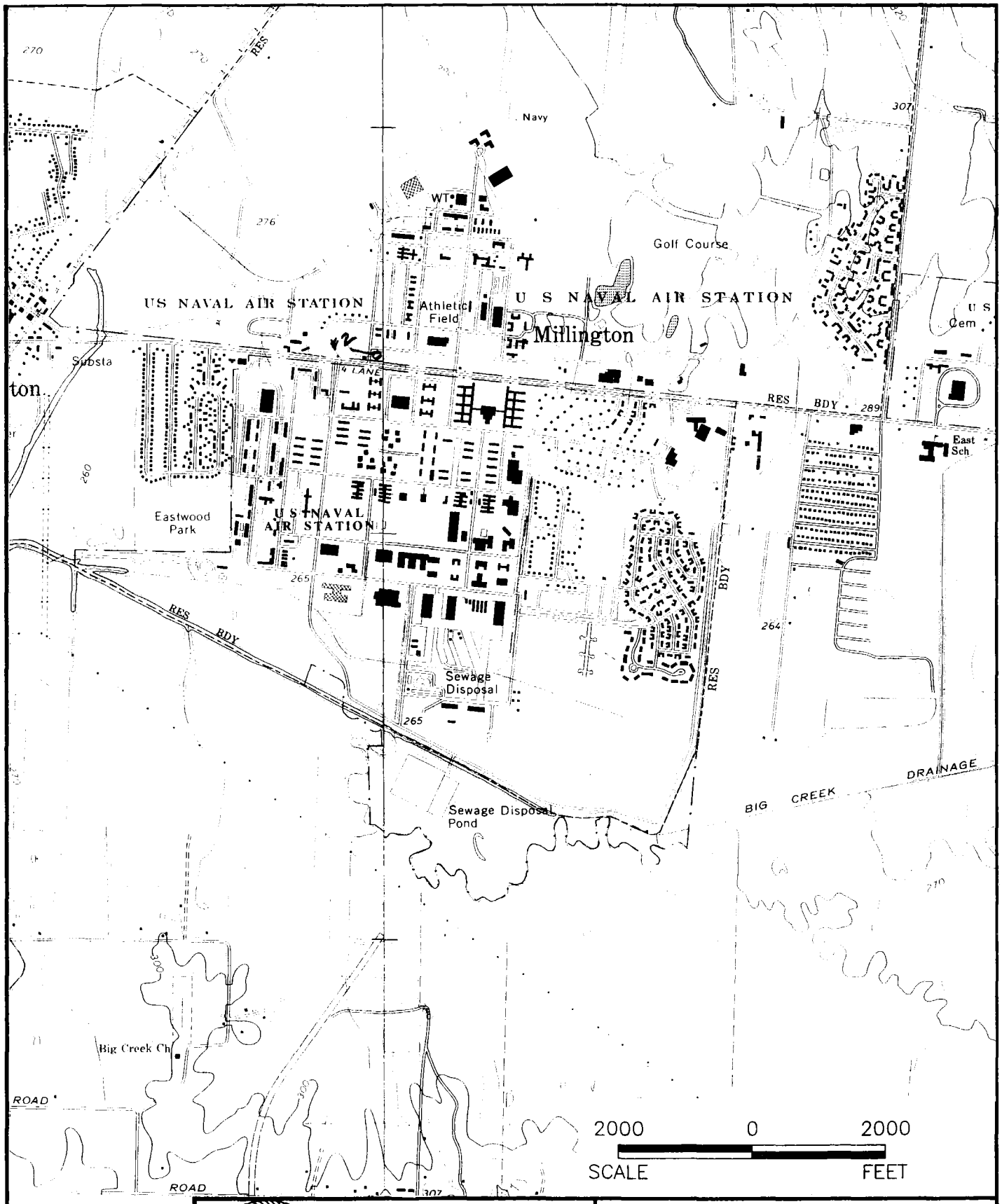



NOTE: LOCATIONS OF USTs 304 & 1239
TANK PIT AREA HAS HAS BEEN APPROXIMATED

ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN

FIGURE 2-2
SITE MAP
BUILDING N-126 USTs

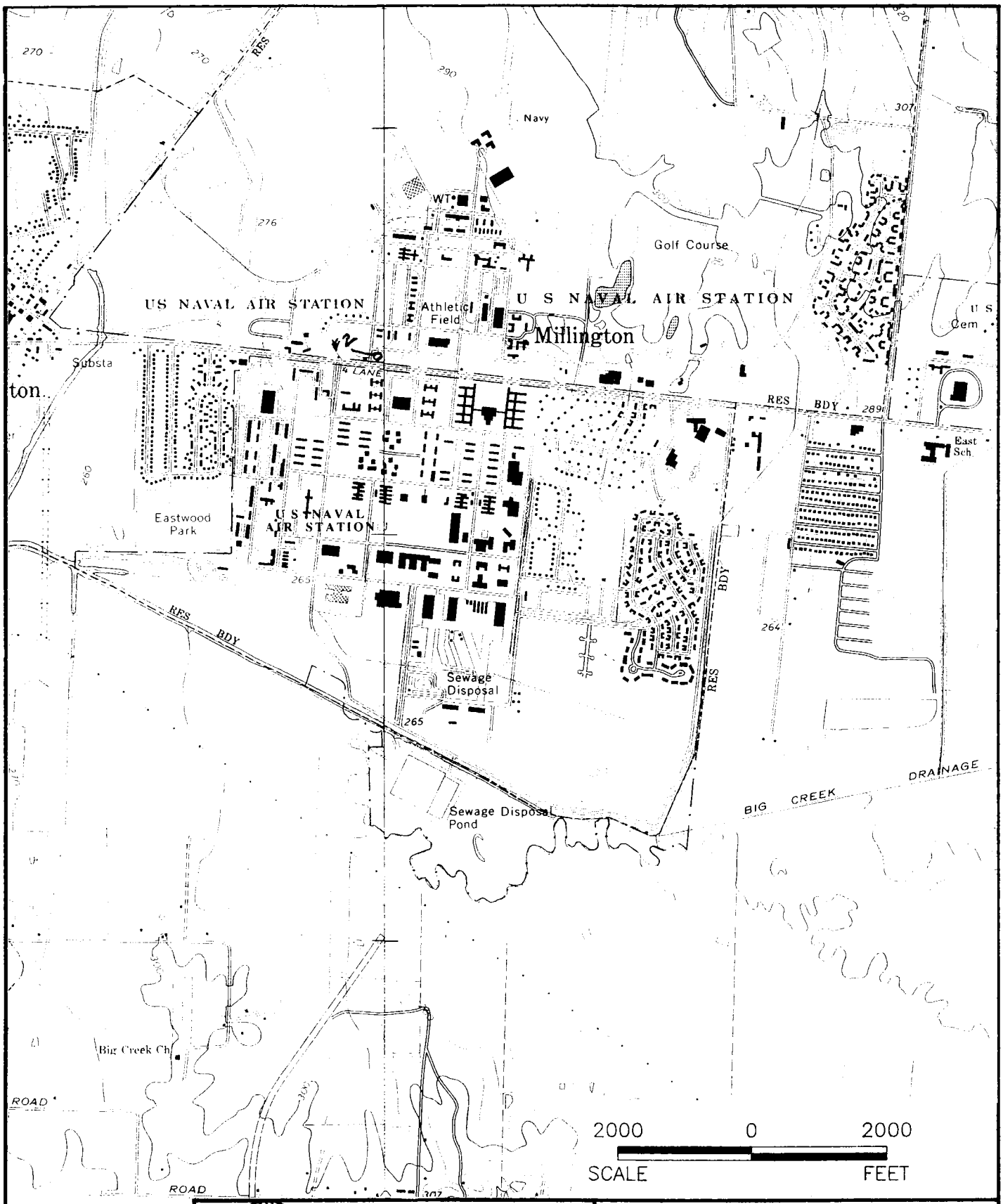
DWG DATE:11/10/93 | DWG NAME:067N-126




ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS

FIGURE 2-3
TOPOGRAPHIC MAP
NAS MEMPHIS

DWG DATE: 07/28/93 | DWG NAME: BOARD




ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS

FIGURE 2-3
TOPOGRAPHIC MAP
NAS MEMPHIS

DWG DATE: 07/28/93 | DWG NAME: BOARD

# 3.0 SOIL INVESTIGATION

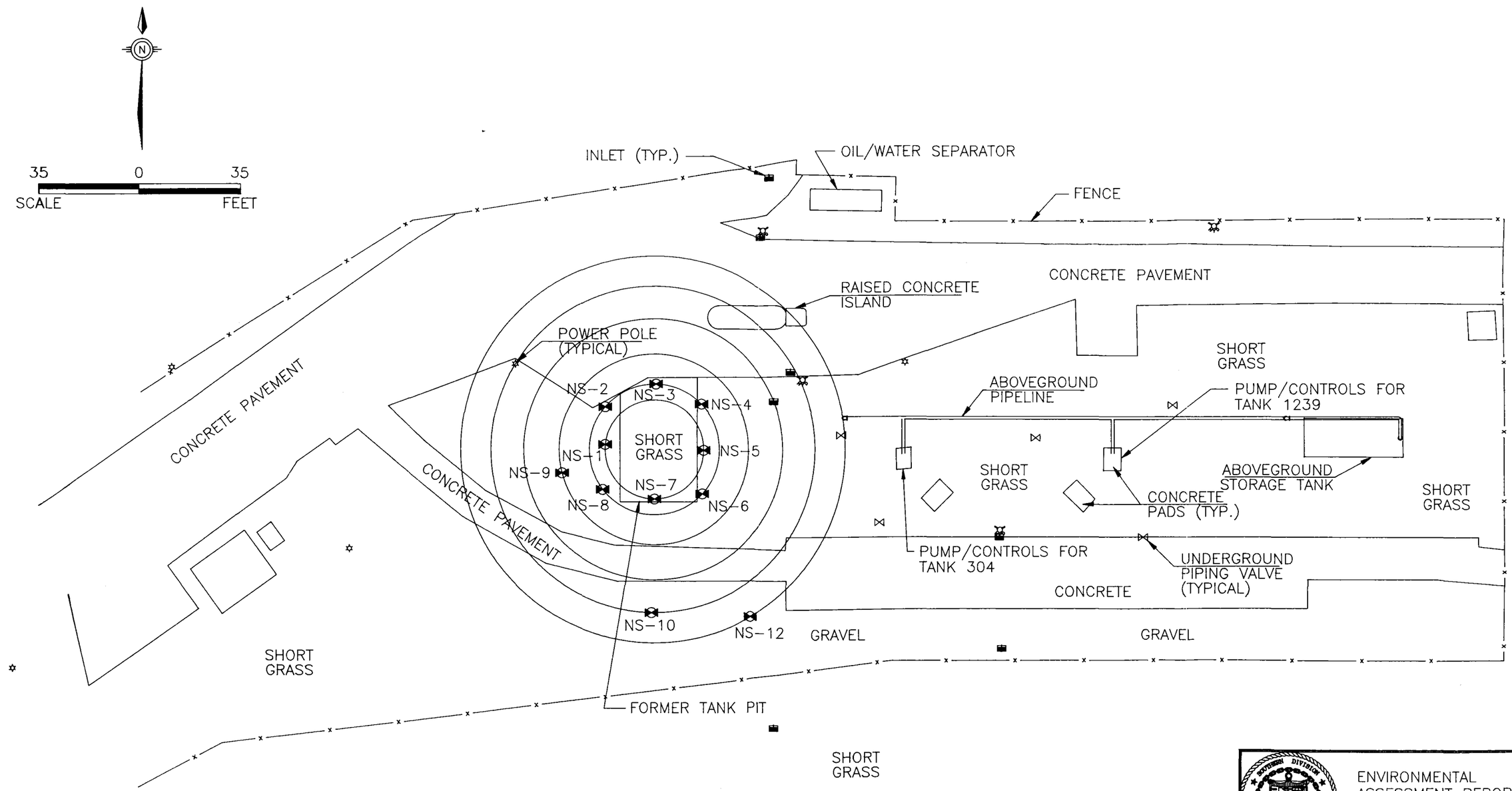
## 3.1 Soil Screening Survey

E/A & H personnel were onsite May 10, 1993 to conduct a soil screening survey. The screening was conducted utilizing a K-V Analytical (KVA) Rotary Hefty System. The KVA system is a hand-held, electric rotary hammer used to advance a stainless steel soil probe to the desired depth. Samples were collected from discrete intervals in a Teflon sleeve located in the end of the soil sampler. Soil samples were analyzed onsite by E/A & H personnel utilizing a General Analytical Corporation (GAC) portable infrared spectrophotometer (TPH Plus Analyzer) to screen the soil samples for TPH.

A sample grid was established in the area of the former tank pit in a radial pattern. Figure 3-1 shows the sampling grid pattern and the proposed sample locations. The soil probe was to be advanced to the depth of the bottom of the tank pit (approximately 16 ft. below land surface). Due to the stiff clays encountered during the soil screening activities, only a portion of the originally scheduled samples were collected. Samples that were collected indicated contamination migrating in a southwest direction. The results of the five samples that were collected and analyzed during the screening event are provided as Table 3-1.

## 3.2 Regional and Site Specific Geology

The site is located within the central Mississippi Embayment geologic province consisting of a 200-mile wide trough or syncline that plunges southward along an axis which approximates the Mississippi River. The Embayment is filled with several thousand feet of sediment dating from the Quaternary to Cretaceous Periods (0 to 140 million years ago). The geology and hydrogeology consist of a thick sequence of unconsolidated Quaternary and Tertiary sediments. This sequence comprises the Wilcox Group, Claiborne Group and Terrace Deposits and the surficial Loess deposits (in ascending order). Two major aquifer systems are included in this sequence, the Fort Pillow Formation (Wilcox Group) and the Memphis Sand Formation (Lower




LEGEND

NS – SAMPLE LOCATION

SOURCE: ALLEN AND HOSHALL

ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN

FIGURE 3-1
RADIAL SAMPLING GRID
BUILDING N-126 USTs

DWG DATE:09/28/93 | DWG NAME:67N126RS

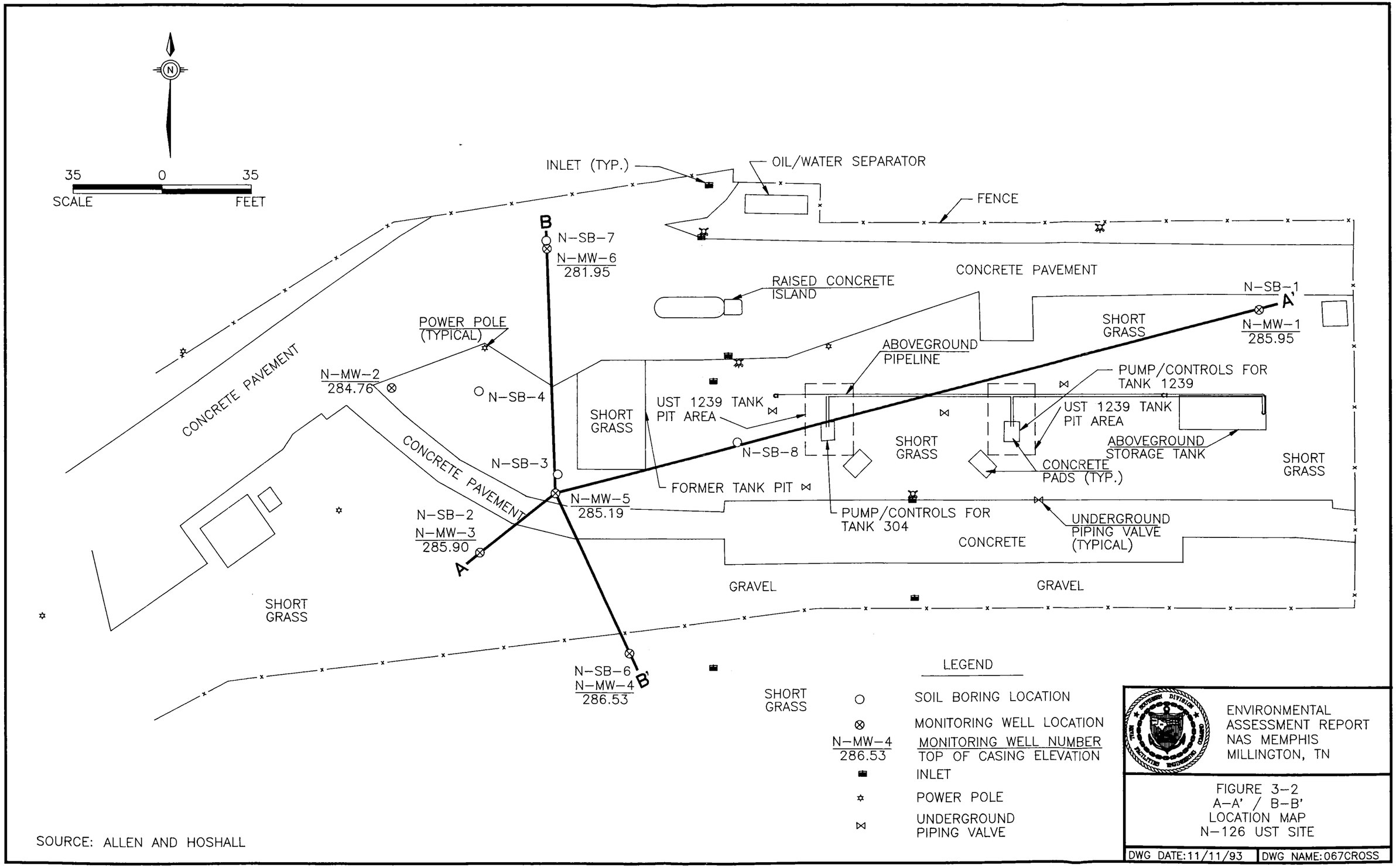

N
35 0 35
SCALE FEET
INLET (TYP.)
OIL/WATER SEPARATOR
FENCE
B
N-SB-7
N-MW-6
281.95
CONCRETE PAVEMENT
RAISED CONCRETE ISLAND
N-SB-1
A'
N-MW-1
285.95
SHORT GRASS
POWER POLE (TYPICAL)
ABOVEGROUND PIPELINE
PUMP/CONTROLS FOR TANK 1239
N-MW-2
284.76
N-SB-4
CONCRETE PAVEMENT
UST 1239 TANK PIT AREA
UST 1239 TANK PIT AREA
SHORT GRASS
SHORT GRASS
ABOVEGROUND STORAGE TANK
N-SB-8
CONCRETE PADS (TYP.)
SHORT GRASS
N-SB-3
CONCRETE PAVEMENT
FORMER TANK PIT
N-MW-5
285.19
N-SB-2
N-MW-3
285.90
A
PUMP/CONTROLS FOR TANK 304
UNDERGROUND PIPING VALVE (TYPICAL)
CONCRETE
GRAVEL
GRAVEL
SHORT GRASS
N-SB-6
N-MW-4
286.53
B'
SHORT GRASS
LEGEND
SOIL BORING LOCATION
MONITORING WELL LOCATION
N-MW-4 MONITORING WELL NUMBER
286.53 TOP OF CASING ELEVATION
INLET
POWER POLE
UNDERGROUND PIPING VALVE
ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN
FIGURE 3-2
A-A' / B-B'
LOCATION MAP
N-126 UST SITE
DWG DATE:11/11/93
DWG NAME:067CROSS
SOURCE: ALLEN AND HOSHALL

**Table 3-1**
**Soil Screening Survey**
**Building N-126 USTs**

| Date | Sample # | Time | Aromatic (ppm) | Aliphatic (ppm) |
|---|---|---|---|---|
| 5/10/93 | NS-1 | 10:10 | 0 | 16 |
| 5/10/93 | NS-1D | 10:30 | 0 | 123.3 |
| 5/11/93 | NS-10 | 11:25 | 0 | 11.7 |
| 5/11/93 | NS-11 | 13:50 | 0 | 3.5 |
| 5/11/93 | NS-12 | 13:50 | 0 | 13.7 |

Claiborne Group.) These aquifers provide approximately 95 percent of the municipal and industrial water supplies for the Memphis and Shelby County areas. These aquifers are overlain by the Jackson-Upper Claiborne confining unit (Jackson Clay, Cockfield, and Cook Mountain Formations). This significant confining unit retards the downward migration of shallow groundwater to the subordinate aquifers. Due to the confining nature of the Jackson-Upper Claiborne, and the limited (shallow) extent of the fuel release at the facility, impact to the lower aquifer systems is not a concern at this site.

The Terrace deposits and the surficial loess deposits are stratigraphically above the Jackson Clay. The Terrace deposits consist of Pleistocene and Pliocene age sand, gravel, some clay with thin layers of a ferrugineous sandstone and conglomerates at the base. This unit ranges in thickness from 0 to 100 feet and has limited uses as a groundwater source for agricultural applications.

The surficial loess deposits are windblown sediments comprised of silt, silty clay, clay and minor amounts of sand. Loess is typically 0 to 65 feet in the Memphis area. Water-bearing zones are present in this unit; however, yield is low and water quality is poor.

Shelby tube samples collected adjacent to boring B-5 at depth intervals of 11 to 13 and 16 to 18 feet indicate average permeabilities of $2.4 \times 10^{-6}$ and $4.5 \times 10^{-7}$ cm/sec. Shelby tube samples were analyzed in accordance with Method 9100 of Test Methods for Evaluation of Solid Waste, Third Edition (SW-846) and in general accordance with ASTM D-5084-90. The samples were collected from the zone suspected of having the highest permeability (8 feet to 10 feet) and from the soil-water interface (13 feet to 15 feet). Results of the permeability analysis are presented in Appendix B.

On the basis of the "non-drinking water" classification of the aquifer and the low permeabilities of the site soils, the soil cleanup levels should be 500 and 1000 ppm for BTX and TPH, respectively (as specified under UST Regulations 1200-1-15 Appendix III).

### 3.3 Soil Borings

Nine soil borings were drilled to define the extent of soil contamination and to characterize the geology/surficial sediments beneath the site.

Soil borings were drilled in conjunction with monitoring well installations. Soil samples were collected continuously using a 5-foot long, 2-inch inner diameter (ID) split barrel sampler through the hollow-stem augers to the terminating depth of the boring. Soil retrieved from the sampler was analyzed using a HNu Model GP101 Photoionization Detector (PID) to determine the interval exhibiting the highest concentration of Volatile Organic Compounds (VOCs). The interval exhibiting the highest PID reading was sampled and the soil placed immediately into one (1) 60 milliliter pre-cleaned glass volatile organic analysis (VOA) container and one (1) 125 milliliter pre-cleaned glass container for laboratory analysis.

Two to three soil samples were collected for laboratory analysis in soil borings with elevated PID readings. The soil sample exhibiting the most elevated PID reading, the deepest sample

with a PID reading and/or the soil sample above the soil water interface or the bottom of the boring (whichever was first encountered) were retained for laboratory analysis. In boreholes with no measurable PID readings, soil samples were retained from the boring's terminal depth or at the soil water interface, whichever was first encountered. Results of the organic vapor analysis are shown in Table 3-2. Soil samples were sent by overnight express for analysis. Soil samples were analyzed for BTEX and GRO-TPH using the Modified 8015/TN GRO.8020 and DRO-TPH using the Modified 8015/TN DRO Method.

To prevent possible cross-contamination between boreholes, split-spoon samplers were completely disassembled and decontaminated between each sample collection. The decontamination procedure consisted of steam cleaning to remove any gross contamination, a wash in a laboratory-grade detergent and a tap water rinse. The samplers were then further decontaminated using a triple rinse consisting of deionized water. New disposable latex gloves were worn by field personnel at all times during sampling and decontamination procedures.

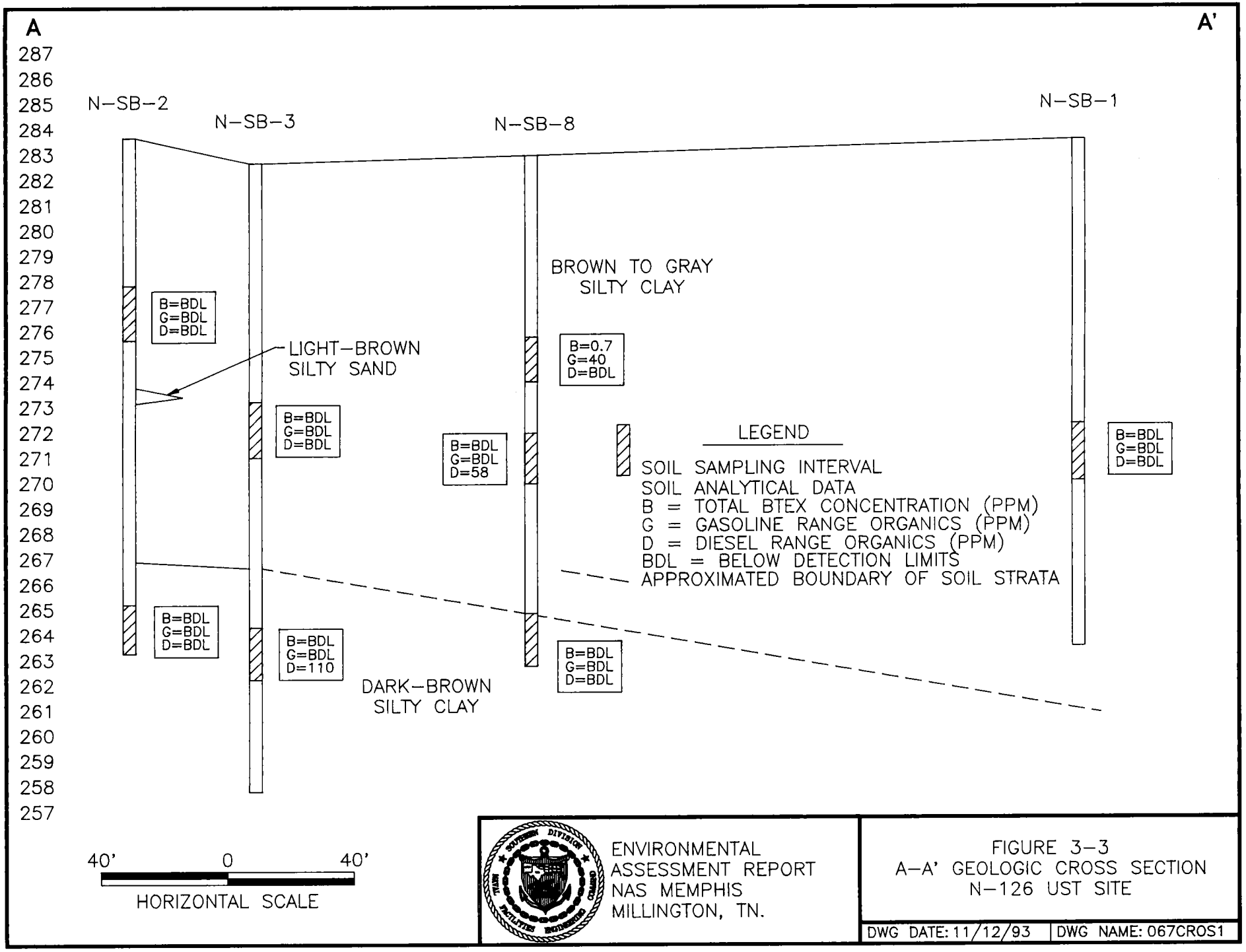
Soil borings N-SB-1, N-SB-2, N-SB-5, N-SB-7, N-SB-8, and N-SB-9 were drilled to a depth of 20 feet; N-SB-3 and N-SB-6 were drilled to a depth of 25 feet; and N-SB-4 was drilled to a depth of 18 feet. Placement of the initial borings was based on the information obtained from the soil screening survey. Soil types encountered during boring activities consisted primarily of silty clays from the surface to the terminating depth. Aside from slight color changes, there was very little stratification. The maximum depth penetrated was 25 feet below grade in borings N-SB-3 and N-SB-6, both of which terminated in a brown, soft silty clay. Lithologic cross sections generated from boring log data can be found in Figures 3-2, 3-3 and 3-4. Boring logs are included in Appendix A.

**Table 3-2**
**Headspace Readings**
**Building N-126 USTs (ppm)**

| Interval (ft. bls) | N-SB-1 | N-SB-2 | N-SB-3 | N-SB-4 | N-SB-5 | N-SB-6 | N-SB-7 | N-SB-8 | N-SB-9 |
|---|---|---|---|---|---|---|---|---|---|
| 0 - 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | N/S |
| 1 - 2 | 0 | 0 | 0 | 0 | N/R | 0 | 0 | 0 | N/S |
| 2 - 3 | N/R | 0 | 0 | 0 | N/R | 0 | 0 | 0 | N/S |
| 3 - 4 | N/R | 0 | 0 | N/R | N/R | 0 | 0 | 0 | N/S |
| 4 - 5 | N/R | 0 | 0 | N/R | N/R | 0 | 0 | 0 | N/S |
| 5 - 6 | 0 | 0 | 0 | 3.5 | 0 | 0 | 0 | 0 | N/S |
| 6 - 7 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | N/S |
| 7 - 8 | 0 | 0 | 3 | 4 | 0 | 0 | 0 | 200 | N/S |
| 8 - 9 | 0 | 0 | 6 | 4.5 | 0 | 0 | 0 | 500 | N/S |
| 9 - 10 | 0.5 | 0 | 3 | N/R | 0 | 0 | 0 | 600 | N/S |
| 10 - 11 | 1.2 | 0 | 3 | N/R | 0 | 0 | 0 | 500 | N/S |
| 11 - 12 | 0 | N/R | 0 | N/R | 0 | 0 | 0 | 50 | N/S |
| 12 - 13 | 0 | N/R | 0 | N/R | 0 | 0 | 0 | 0 | N/S |
| 13 - 14 | 0 | N/R | 0 | 0 | 0 | 0 | N/R | 0 | N/S |
| 14 - 15 | 0 | 0 | 0 | 0 | 0 | 0 | N/R | 0 | N/S |
| 15 - 16 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | N/S |
| 16 - 17 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | N/S |
| 17 - 18 | 0 | 0 | 20 | 20 | 0 | 0 | 0 | 8 | N/S |
| 18 - 19 | 0 | 0 | 35 | 30 | 0 | 0 | 0 | 0 | N/S |
| 19 - 20 | 0 | 0 | 18 | — | 0 | 0 | 0 | 0 | N/S |
| 20 - 21 | — | — | 15 | — | — | 0 | — | — | — |
| 21 - 22 | — | — | 0 | — | — | 0 | — | — | — |
| 22 - 23 | — | — | 0 | — | — | 0 | — | — | — |
| 23 - 24 | — | — | 0 | — | — | 0 | — | — | — |
| 24 - 25 | — | — | 0 | — | — | 0 | — | — | — |

**Notes:**

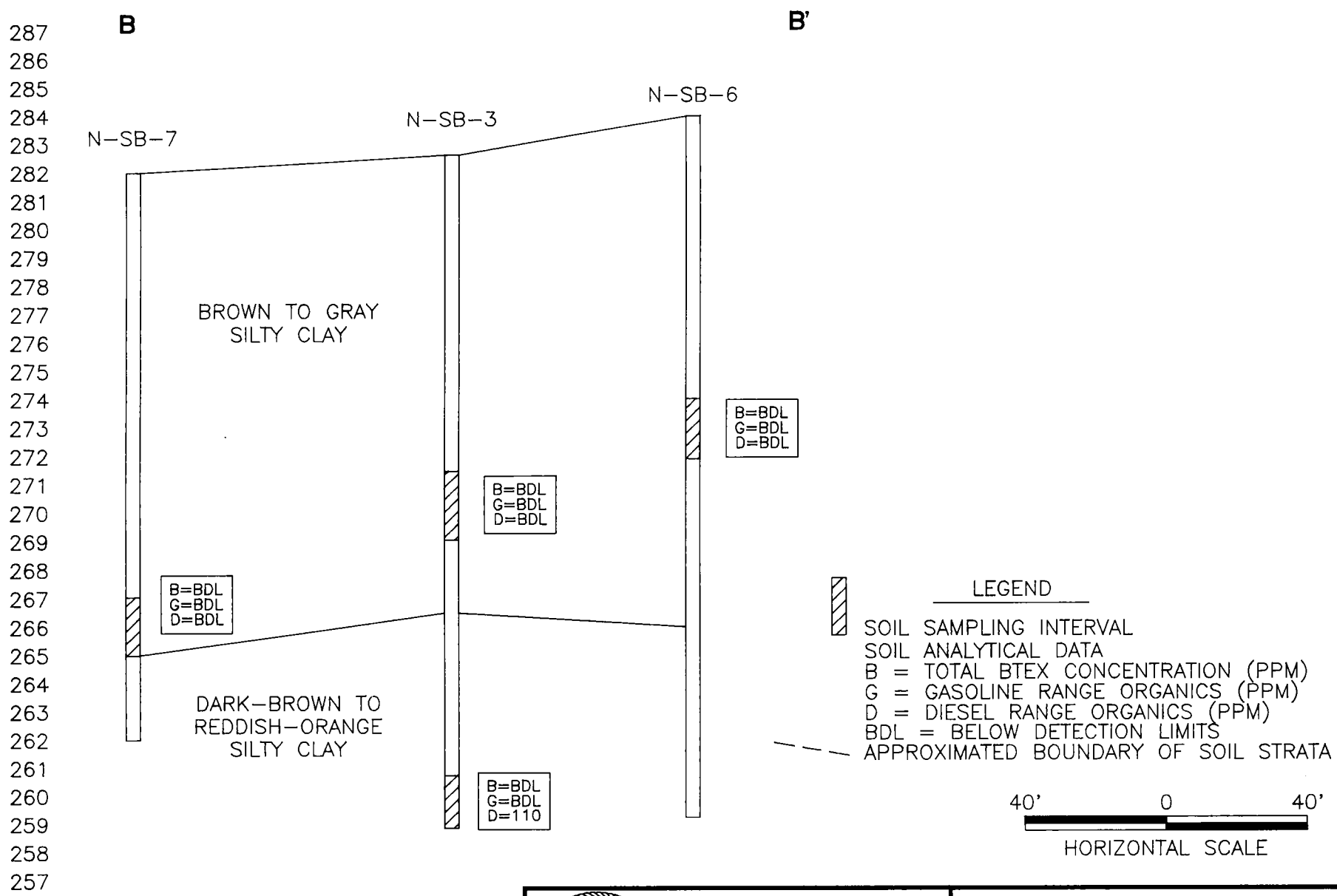
**N/R - Insufficient Recovery**
**N/S - Interval Not Sampled**




ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN.

FIGURE 3-3
A-A' GEOLOGIC CROSS SECTION
N-126 UST SITE

DWG DATE: 11/12/93 | DWG NAME: 067CROS1




ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN.

FIGURE 3-4
B-B' GEOLOGIC CROSS SECTION
N-126 UST SITE

DWG DATE: 11/11/93 | DWG NAME: 067CROS2

## 3.4 Soil Analytical Results

Discrete soil samples were collected from each boring and submitted to International Technologies Analytical Services in Knoxville, Tennessee for BTEX/GRO and DRO analyses. Laboratory results indicate measurable DRO concentrations in borings N-SB-3, N-SB-4, and N-SB-8 at concentrations of 110 mg/kg, 87 mg/kg, and 58 mg/kg respectively. Contaminants were detected from 7 to 21 feet below surface. BTEX and GRO concentrations of 2.0 mg/kg and 76 mg/kg were detected at the 7 to 9 foot interval in N-SB-8, respectively. The remaining soil samples were below the method detection limits. Figure 3-5 depicts soil boring locations. Soil analytical results are summarized in Table 3-3. Laboratory reports are included in Appendix B.

Headspace analyses performed on soil samples indicated organic vapor concentrations above background levels in borings SB-1, SB-3, SB-4 and SB-8. The highest measured organic vapor concentration in SB-3, the boring closest to the tank pit, was 35 ppm at the 18 to 19-foot interval. Green staining and a petroleum odor was noted in soil samples collected from this depth. Laboratory results from this same depth interval did not detect BTEX constituents in the analyzed soil sample. Boring SB-8 had the highest measurable organic vapor concentration of 600 mg/kg at the depth interval of 8 to 9 feet. As mentioned previously, this soil sample exhibited the most elevated BTEX and TPH concentrations. However, the analytical results were well below the 1,000 and 500 ppm TPH and BTEX soil cleanup levels.

In addition to the above analyses, samples were analyzed for several parameters to aid in the development of a Corrective Action Plan. These parameters and their results are presented in Appendix H.

**Table 3-3**
**Soil Analytical Results**
**Building N-126 USTs (mg/kg)**

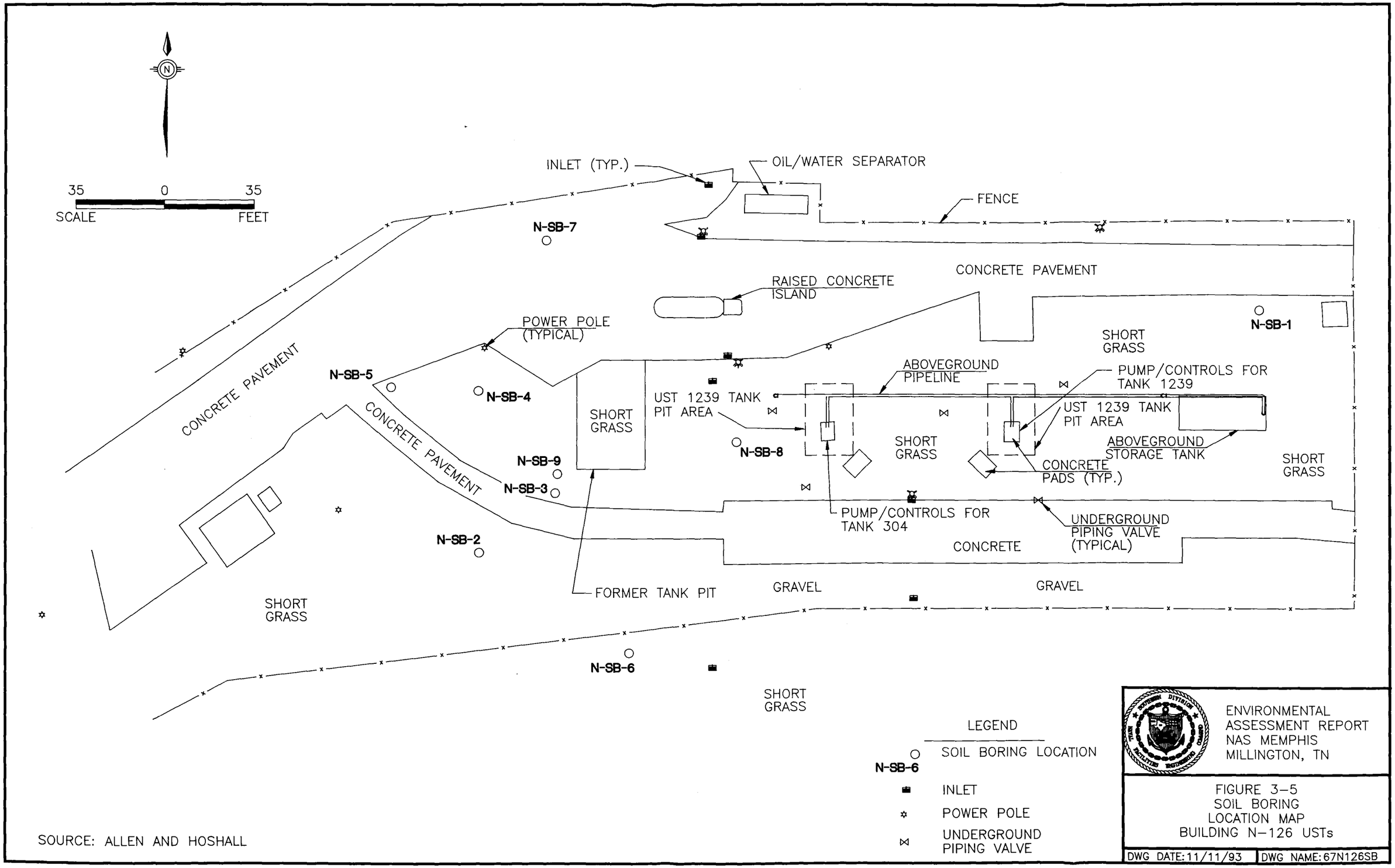
| Sample Number | Depth (feet) | BTEX | Gasoline Range Organics (GRO) | Diesel Range Organics (DRO) |
|---|---|---|---|---|
| N-SB-1-13 | 11 - 13 | BDL | BDL | BDL |
| N-SB-2-8 | 7 - 8 | BDL | BDL | BDL |
| N-SB-2-20 | 18 - 20 | BDL | BDL | BDL |
| N-SB-3-13 | 11 - 13 | BDL | BDL | BDL |
| N-SB-3-13DUP | 11 - 13 | BDL | BDL | BDL |
| N-SB-3-21 | 19 - 21 | BDL | BDL | 110 |
| N-SB-4-8 | 6 - 8 | BDL | BDL | BDL |
| N-SB-4-18 | 16 - 18 | BDL | BDL | 87 |
| N-SB-5-9 | 7 - 9 | BDL | BDL | BDL |
| N-SB-5-20 | 18 - 20 | BDL | BDL | BDL |
| N-SB-6-12 | 10 - 12 | BDL | BDL | BDL |
| N-SB-7-17 | 15 - 17 | BDL | BDL | BDL |
| N-SB-8-9 | 7 - 9 | 0.7 | 40 | BDL |
| N-SB-8-9DUP | 7 - 9 | 2.0 | 76 | 29 |
| N-SB-8-13 | 11 - 13 | BDL | BDL | 58 |
| N-SB-8-20 | 18 - 20 | BDL | BDL | BDL |

**Notes:**

**BDL = Below Detection Limit**
**mg/kg = milligrams per kilogram (ppm)**

**Detection Limits:**

**GRO = 10 mg/kg**
**BTEX = 0.1 mg/kg**
**DRO = 10 mg/kg**


N
35 0 35
SCALE FEET
INLET (TYP.)
OIL/WATER SEPARATOR
FENCE
N-SB-7
CONCRETE PAVEMENT
RAISED CONCRETE ISLAND
POWER POLE (TYPICAL)
N-SB-1
SHORT GRASS
ABOVEGROUND PIPELINE
PUMP/CONTROLS FOR TANK 1239
N-SB-5
N-SB-4
CONCRETE PAVEMENT
UST 1239 TANK PIT AREA
SHORT GRASS
UST 1239 TANK PIT AREA
N-SB-8
SHORT GRASS
ABOVEGROUND STORAGE TANK
CONCRETE PADS (TYP.)
SHORT GRASS
N-SB-9
CONCRETE PAVEMENT
N-SB-3
PUMP/CONTROLS FOR TANK 304
UNDERGROUND PIPING VALVE (TYPICAL)
N-SB-2
CONCRETE
FORMER TANK PIT
GRAVEL
GRAVEL
SHORT GRASS
N-SB-6
SHORT GRASS
LEGEND
SOIL BORING LOCATION
N-SB-6
INLET
POWER POLE
UNDERGROUND PIPING VALVE
SOURCE: ALLEN AND HOSHALL
ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN
FIGURE 3-5
SOIL BORING
LOCATION MAP
BUILDING N-126 USTs
DWG DATE: 11/11/93
DWG NAME: 67N126SB

## 4.0 GROUNDWATER INVESTIGATION

A groundwater investigation was completed to assess the extent of groundwater contamination beneath the site and to allow characterization of the surficial aquifer. The locations of the monitoring wells installed are shown in Figure 4-1.

### 4.1 Hydrogeology

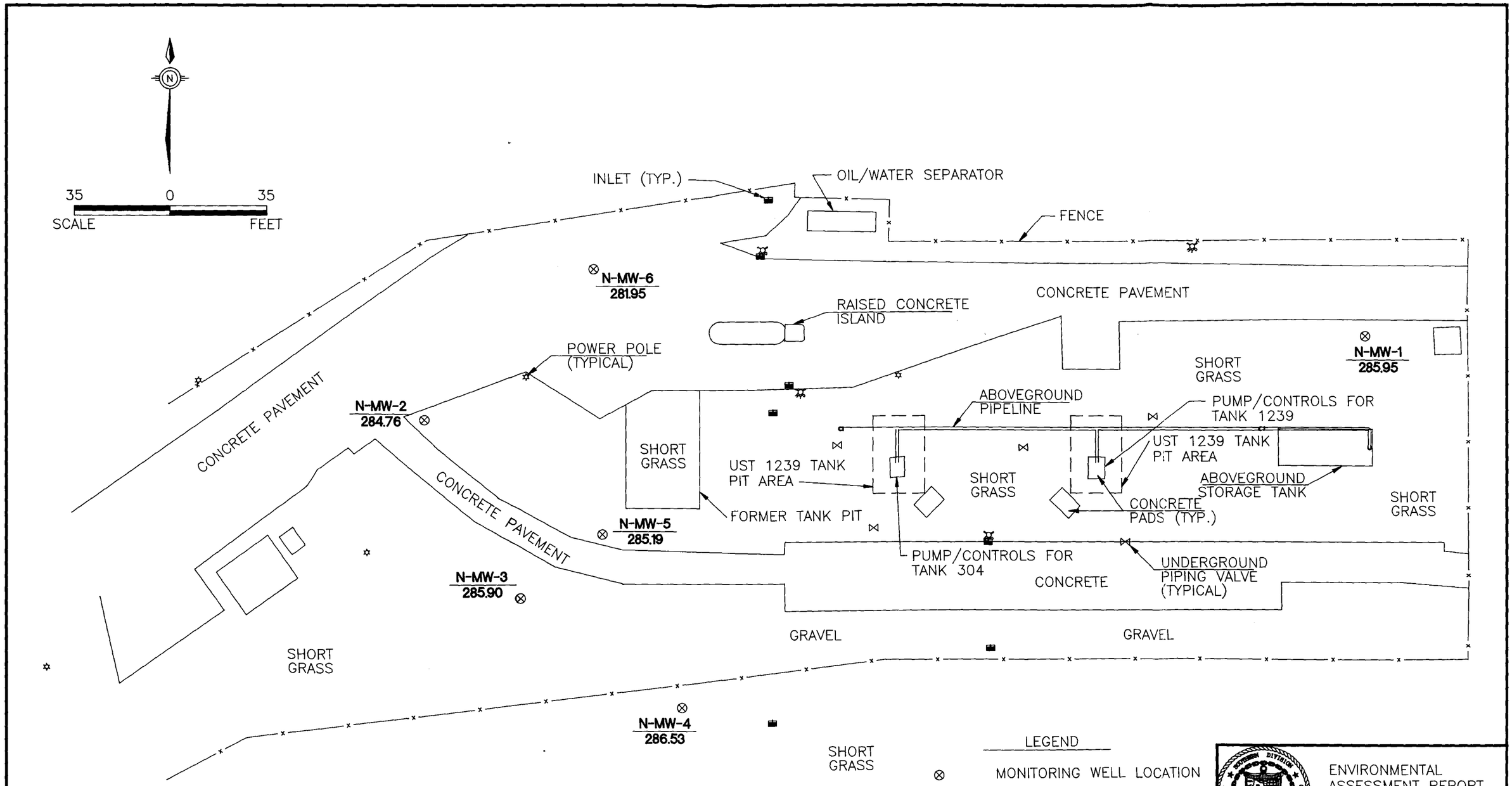
**Groundwater Flow Direction**

Initial monitoring well placement was based on the assumption that surficial groundwater would be influenced by topography and would flow to the southwest. Static water level measurements at each well were collected on May 28, 1993 and June 3, 1993. Using these water level measurements, piezometric surface diagrams (Figures 4-2 and 4-3) were constructed to show groundwater flow direction. As the flow arrows indicate, groundwater flow was directed to the northwest on each day the measurements were collected. However, because N-MW-5 was contaminated and there were no wells located north of N-MW-5, another well location was selected. N-MW-6 was placed due north of N-MW-5 to investigate the potential for contaminant migration in that direction.

The piezometric map of Figure 4-4 shows the water level data collected on July 20, 1993, which includes the new well information. This diagram indicates that local groundwater flow is directed toward the tank pit located near N-MW-5. The depression in the piezometric surface may be the result of increased infiltration into the tank pit or the result of reduced rainfall during the month of July which might have lowered the groundwater level.

**Groundwater Gradient**

The highest and lowest horizontal hydraulic gradients were calculated using the piezometric surface diagrams. The lowest gradient was calculated from Figure 4-2 (5/28/93) using the following relationship:

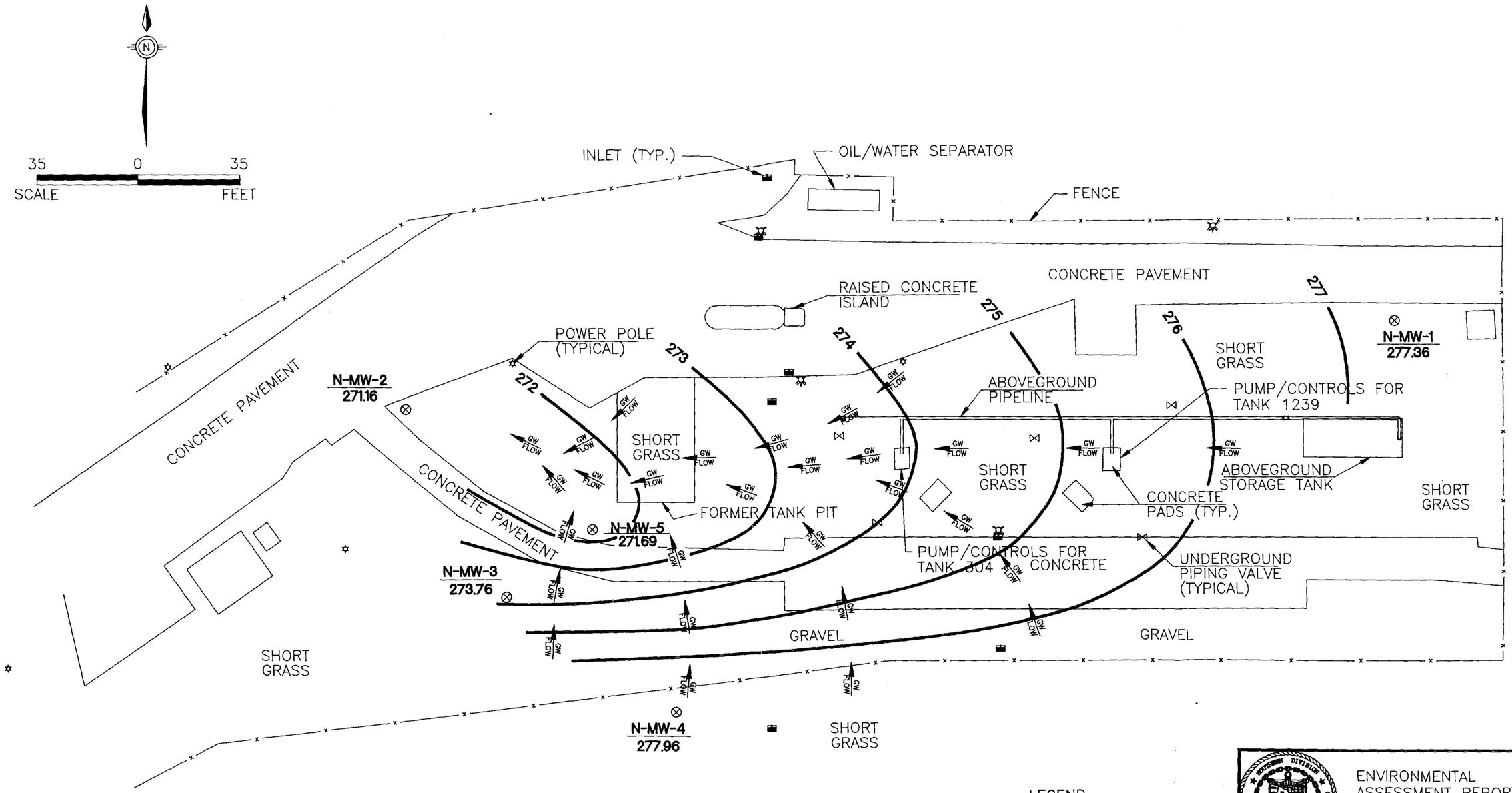



SOURCE: ALLEN AND HOSHALL

ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN

FIGURE 4-1
MONITORING WELL LOCATION MAP
BUILDING N-126 USTs

DWG DATE: 11/11/93 | DWG NAME: 67N126MW




LEGEND

⊗ – MONITORING WELL LOCATION

N-MW-4 / 276.23 – MONITORING WELL NUMBER / WATER ELEVATION

GW FLOW – GROUNDWATER FLOW

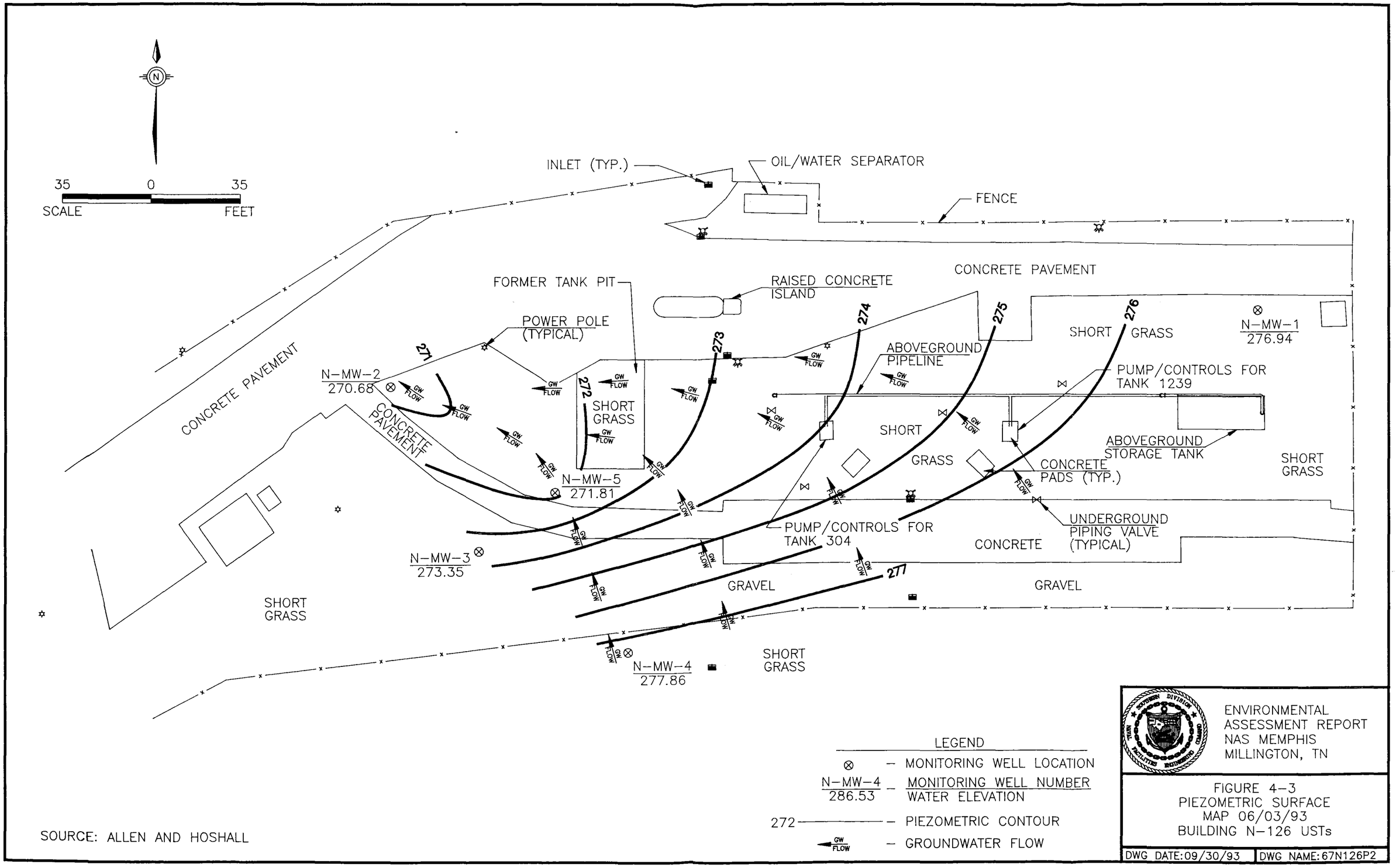
274 ——— – PIEZOMETRIC CONTOUR

SOURCE: ALLEN AND HOSHALL

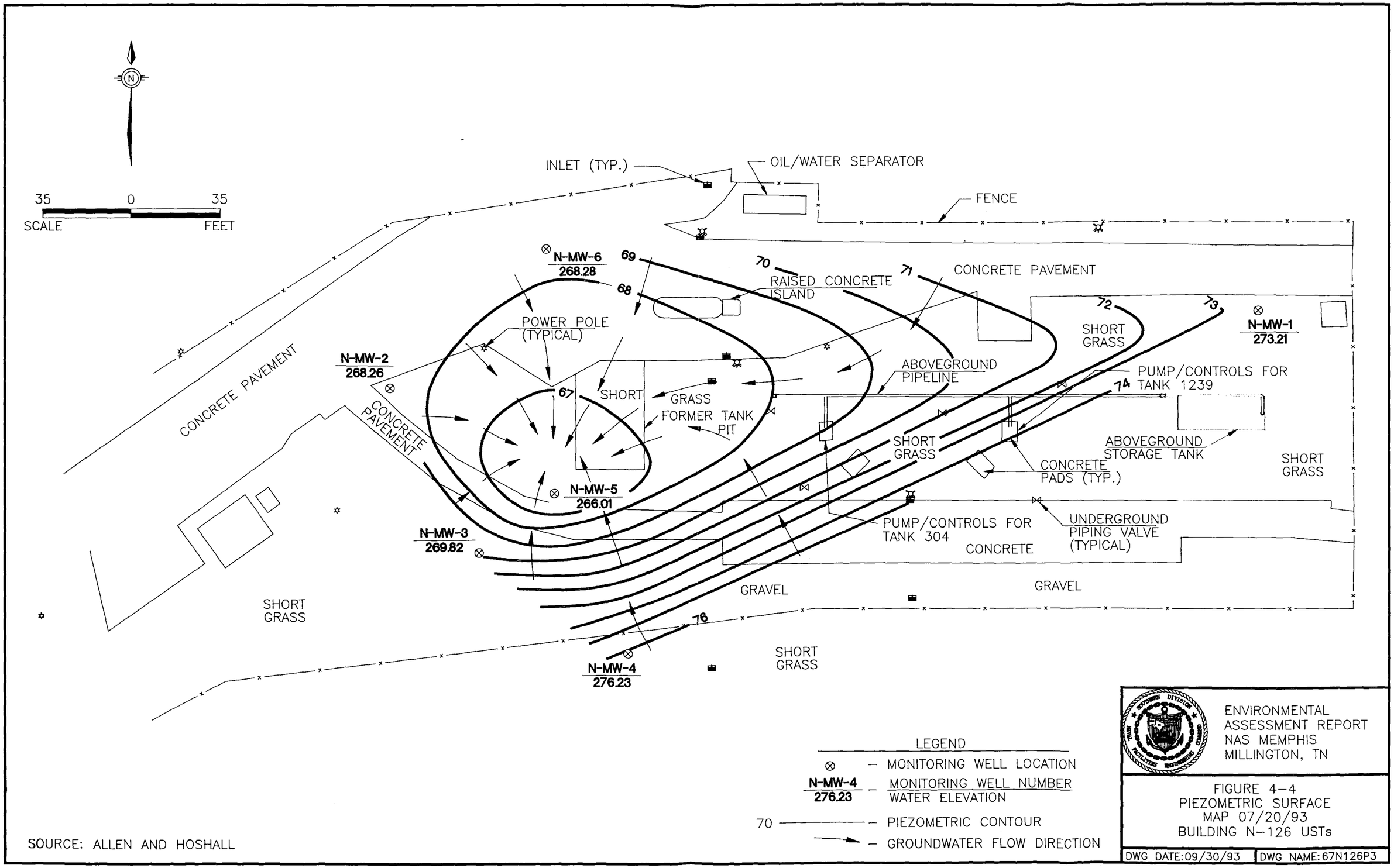
ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN

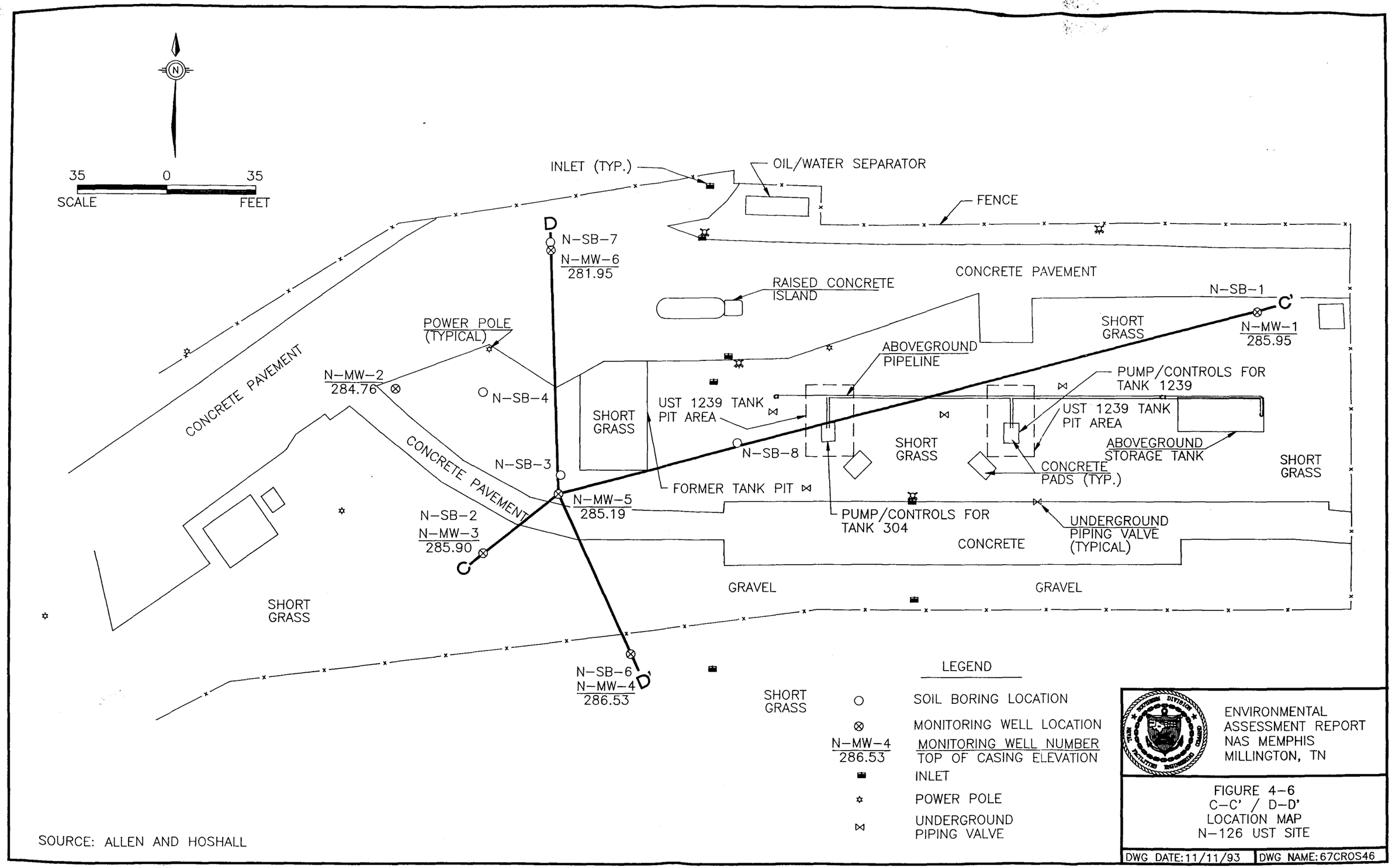
FIGURE 4-2
PIEZOMETRIC SURFACE
MAP 05/28/93
BUILDING N-126 USTs

DWG DATE:09/28/93 | DWG NAME:67N126P1




SOURCE: ALLEN AND HOSHALL


N
35 0 35
SCALE FEET
INLET (TYP.)
OIL/WATER SEPARATOR
FENCE
N-MW-6
268.28
69
68
70
71
RAISED CONCRETE ISLAND
CONCRETE PAVEMENT
72
73
N-MW-1
273.21
SHORT GRASS
POWER POLE (TYPICAL)
N-MW-2
268.26
CONCRETE PAVEMENT
ABOVEGROUND PIPELINE
PUMP/CONTROLS FOR TANK 1239
74
67
SHORT GRASS
FORMER TANK PIT
CONCRETE PAVEMENT
SHORT GRASS
ABOVEGROUND STORAGE TANK
SHORT GRASS
CONCRETE PADS (TYP.)
N-MW-5
266.01
N-MW-3
269.82
PUMP/CONTROLS FOR TANK 304
UNDERGROUND PIPING VALVE (TYPICAL)
CONCRETE
GRAVEL
GRAVEL
SHORT GRASS
76
SHORT GRASS
N-MW-4
276.23
LEGEND
⊗ – MONITORING WELL LOCATION
N-MW-4 / 276.23 – MONITORING WELL NUMBER / WATER ELEVATION
70 – PIEZOMETRIC CONTOUR
– GROUNDWATER FLOW DIRECTION
ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN
FIGURE 4-4
PIEZOMETRIC SURFACE
MAP 07/20/93
BUILDING N-126 USTs
DWG DATE:09/30/93
DWG NAME:67N126P3
SOURCE: ALLEN AND HOSHALL


N
35 0 35
SCALE FEET
INLET (TYP.)
OIL/WATER SEPARATOR
FENCE
D
N-SB-7
N-MW-6
281.95
CONCRETE PAVEMENT
RAISED CONCRETE ISLAND
N-SB-1
C'
N-MW-1
285.95
SHORT GRASS
POWER POLE (TYPICAL)
ABOVEGROUND PIPELINE
PUMP/CONTROLS FOR TANK 1239
CONCRETE PAVEMENT
N-MW-2
284.76
N-SB-4
UST 1239 TANK PIT AREA
SHORT GRASS
UST 1239 TANK PIT AREA
N-SB-8
SHORT GRASS
ABOVEGROUND STORAGE TANK
CONCRETE PADS (TYP.)
SHORT GRASS
CONCRETE PAVEMENT
N-SB-3
FORMER TANK PIT
N-MW-5
285.19
N-SB-2
N-MW-3
285.90
C
PUMP/CONTROLS FOR TANK 304
UNDERGROUND PIPING VALVE (TYPICAL)
CONCRETE
GRAVEL
GRAVEL
SHORT GRASS
N-SB-6
N-MW-4
286.53
D'
SHORT GRASS
LEGEND
SOIL BORING LOCATION
MONITORING WELL LOCATION
N-MW-4
286.53
MONITORING WELL NUMBER
TOP OF CASING ELEVATION
INLET
POWER POLE
UNDERGROUND PIPING VALVE
SOURCE: ALLEN AND HOSHALL
ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN
FIGURE 4-6
C-C' / D-D'
LOCATION MAP
N-126 UST SITE
DWG DATE: 11/11/93
DWG NAME: 67CROS46

Lowest gradient = 2.28 ft. head change/96 ft. distance = 0.024 ft./ft.

The highest gradient was calculated from Figure 4-4 (7/20/93) with the following relationship:

Highest gradient = 10 ft. head change/70 ft. distance = 0.143 ft./ft.

The following relationship was used in determining the horizontal hydraulic gradient:

Where:

$i = \Delta h/L$

$i$ = hydraulic gradient (ft./ft.)

$\Delta h$ = change in peizometric surface elevation (ft.)

$L$ = distance over which peizometric surface elevation changes (ft.)

**Groundwater Flow Velocity**

The lowest and highest estimated groundwater flow velocities were calculated using the following formula:

$$V = Ki/n_e$$

Where:

$V$ = groundwater velocity

$K$ = horizontal hydraulic conductivity

$i$ = horizontal hydraulic gradient

$n_e$ = effective porosity

For the velocity calculations, an average hydraulic conductivity of 0.234 feet/day was used. This value was obtained by averaging the hydraulic conductivity results from the slug tests presented below. To estimate the potential range of groundwater velocity, separate calculations were made with both the highest and lowest gradients previously derived. The effective porosity was obtained from the Tri-State Testing Services, Inc laboratory reports located in Appendix C.

An average of the four reported porosity values for boring N-126-SB9 was used in the velocity calculations.

Lowest estimated groundwater velocity = (0.234 ft./day)(0.0237)/(0.394) = 0.014 ft./day
Highest estimated groundwater velocity = (0.234 ft./day)(0.146)/(0.394) = 0.087 ft./day

**Slug Tests Results**

Rising and falling head slug tests were conducted during the field investigation to enhance estimates of aquifer characteristics. Before a slug test was started, the static water level in the well was measured using an electronic water level indicator. A "slug" was then "instantaneously" introduced into the well, at which time, the water level and the time "$T_0$" were recorded. Periodically, water level/elapsed time measurements were recorded as the head fell back to the original level. Similarly, each rising head slug test was preformed by removing the "slug" and recording water level/elapsed time measurements as the head rose back to normal. The time required for a slug test to be completed is a function of the water level rate of change and the hydraulic conductivity of the aquifer.

An In-Situ pressure transducer and a 2-channel Hermit 1000C data logger were used to measure and record water levels in the wells. To facilitate graphing of the data, the Hermit was programmed to record water level measurements on a logarithmic time scale. The slug used during the tests was a 5-foot long, 1.5-inch diameter stainless steel cylinder with a steel ring welded on one end. A teflon coated cable tethered to the cylinder served to suspend the slug in the well just above or below the water level. At the beginning of each test, the data logger was activated the instant the slug was either lowered into or removed from the water.

Data from the slug tests were compiled using the computer program AQTESOLV (Aquifer Test Solver) by the Geraghty and Miller Modeling Group (1989). AQTESOLV has several widely

published and accepted analytical solutions for many different kinds of aquifer tests. Rising and falling head slug test data were plotted using the unconfined aquifer solution. For this solution, time (elapsed) versus displacement (change in water level) is plotted on semi-logarithmic graph paper. Hydraulic conductivity (K) was computed by the program using an equation developed by Bouwer and Rice (1976) for unconfined aquifers. The AQTESOLV graphs are presented in Appendix D.

The hydraulic conductivities calculated from the rising and falling head slug tests are presented in Table 4-1. Injecting the slug produces falling head data and rising heads result from withdrawal of the slug. For MW-1 only one test is reported because an equipment malfunction produced anomalous results. The average hydraulic conductivity presented in Table 4-1 was calculated using both the falling and rising head data from all of the wells.

**Table 4-1**
**Slug Test Results**

| Well | K - Falling Head (feet/minute) | K - Rising Head (feet/minute) | K - Falling Head (feet/day) | K - Rising Head (feet/day) |
|---|---|---|---|---|
| N-126 MW-1 | 4.8907E-05 | N/A | 7.0426E-02 | N/A |
| N-126 MW-2 | 5.0160E-04 | 3.0440E-04 | 7.2230E-01 | 4.3834E-01 |
| N-126 MW-3 | 4.7204E-05 | 5.2103E-05 | 6.7974E-02 | 7.5028E-02 |
| N-126 MW-4 | 5.9370E-05 | 1.5050E-04 | 8.5493E-02 | 2.1672E-01 |
| N-126 MW-5 | 1.4480E-04 | 1.5490E-04 | 2.0851E-01 | 2.2306E-01 |
| Average K (ft./day) = 2.3421E-01 | | | | |

**Note: N/A - No data available due to equipment malfunction and anomalous results.**

## 4.2 Monitoring Well Placement

Well placement was dictated by the results of the soil screening survey cited above. Monitoring well MW-1 was placed near the eastern portion of the site upgradient to the former location of

the former tank pit and the present tanks. Monitoring wells MW-2, MW-3, and MW-4 were placed in the assumed downgradient direction of the plume, west, southwest, and south of the tank pit.

Monitoring well MW-5 was placed immediately adjacent to the tank pit. Monitoring well MW-6 was set in the new assumed downgradient location of the tank pit.

## 4.3 Monitoring Well Construction

Monitoring wells were installed with a CME 45 rotary drill rig using 4.25-inch inner diameter (8.25-inch outer diameter) hollow-stem augers. Monitoring wells MW-1 and MW-5 were installed on May 13, 1993. Monitoring wells MW-2 and MW-4 were installed on May 14, 1993. Monitoring well MW-3 was installed on May 17, 1993. Monitoring well MW-6 was installed on July 15, 1993. All auger, drilling rod, and sampling equipment were steam cleaned before augering activities began. Clean augers were used for each constructed monitoring well to prevent possible cross-contamination. Monitoring wells were constructed of 2" diameter Schedule 40 PVC riser and 10 to 15 feet of 2" diameter Schedule 40 PVC 0.010" slotted well screen.

The annular space surrounding each monitoring well was filled with a 20/40 silica sand pack from the bottom of the borehole to 2 feet above the screened interval. Sand was poured from the surface through the annular space of the open borehole after extracting the augers. A 2-foot bentonite seal was placed over the sand pack and the remaining annular space was filled to near land surface with a 97/3 percent mixture of Portland Type I cement and bentonite grout. A water-tight locking expansion cap was placed on each well casing and a 2.5-foot steel protective cover was installed. A 4-foot by 4-foot concrete pad with 2-foot steel protective posts positioned at each corner was installed around each well to help preserve the physical integrity of the wells. Monitoring well completion data are provided in Table 4-2 and calculated and actual well

construction materials used are provided in Table 4-3. Monitoring well construction details are provided in Appendix E.

**Table 4-2**
**Well Completion Data Building N-126 USTs**

| Monitoring Well Identification | Installation Date | Total Depth (ft btoc)[a] | Well Diameter (inches) | Screened Interval (ft bls) | Measuring Point Elevation[b] |
|---|---|---|---|---|---|
| N-MW-1 | 13 MAY 93 | 22.51 | 2 | 5.0 - 20.0 | 285.95 |
| N-MW-2 | 14 MAY 93 | 22.55 | 2 | 5.0 - 20.0 | 284.76 |
| N-MW-3 | 17 MAY 93 | 22.57 | 2 | 5.0 - 20.0 | 285.90 |
| N-MW-4 | 14 MAY 93 | 27.30 | 2 | 5.0 - 25.0 | 286.53 |
| N-MW-5 | 13 MAY 93 | 27.55 | 2 | 5.0 - 25.0 | 285.19 |
| N-MW-6 | 15 JULY 93 | 20.15 | 2 | 5.0 - 20.0 | 281.95 |

**Notes:**

[a] - below top of casing
[b] - feet mean sea level

**Table 4-3**
**Well Construction Materials**
**Building N-126 USTs**

| Monitoring Well Identification | Calculated Material Volumes Used | | | | Actual Material Volumes Used | | | |
|---|---|---|---|---|---|---|---|---|
| | Sand[a] 100 lb. bag | Bentonite[b] 5 gal. bucket | Grout[c] 94 lb. bag | Cement[d] 80 lb. bag | Sand 100 lb. bag | Bentonite 5 gal. bucket | Grout 96 lb. bag | Cement 80 lb. bag |
| N-MW-1 | 3.75 | ½ | 1 | 8 | 3.75 | ½ | 1 | 8 |
| N-MW-2 | 3.75 | ½ | 1 | 8 | 3.75 | ½ | 1 | 8 |
| N-MW-3 | 3.75 | ½ | 1 | 8 | 3.75 | ½ | 1 | 8 |
| N-MW-4 | 3.75 | ½ | 1 | 8 | 3.75 | ½ | 1 | 8 |
| N-MW-5 | 3.75 | ½ | 1 | 8 | 3.75 | ½ | 1 | 8 |
| N-MW-6 | 4.0 | ½ | 1 | 8 | 4.0 | ½ | 1 | 8 |

**Notes:**

[a] Sand = 20/40 sieve size
[b] Bentonite = ¼-inch pellets
[c] Grout = Portland Type I/Bentonite (93/7%) mixture
[d] Cement = Sakrete used in pad construction

## 4.4 Monitoring Well Development

Development of the monitoring wells was carried out by the drilling subcontractor using decontaminated 3-foot PVC bailers. Between six and eight well volumes were removed from each well and development continued until turbidity was reduced and visual clarity was achieved. Despite development, all monitoring wells remained relatively high in suspended solids due to the high clay content of the surrounding sediments. Well development and purge water was containerized in DOT approved 55-gallon drums, labeled, numbered, and left onsite. No free product was discovered in groundwater from any of the monitoring wells during monitoring well development and later sampling activities.

## 4.5 Monitoring Well Sampling

Groundwater samples were collected from monitoring wells MW-1 through MW-5 on May 27, 1993. Monitoring well MW-6 was sampled on July 20, 1993. Groundwater samples from MW-1 through MW-6 were collected with disposable 3-foot Teflon single-check valve bailers.

Static water level measurements were measured in each well and a minimum of three casing volumes were purged from each well before groundwater sampling. Purging was performed to remove stagnant water from the well casing and to assure groundwater samples were representative of the surrounding aquifer. Select water quality measurements were collected during purging including pH, temperature and conductivity. Data collected during the purging process are included in Table 4-4. Measured water quality parameters were stable before sampling.

Groundwater samples were transferred directly from the bailer into laboratory-prepared containers containing hydrochloric acid preservative, immediately packed on ice and delivered overnight to International Technologies Analytical Laboratory in Knoxville, Tennessee. Samples were analyzed using Modified EPA Method 8015/TN GRO.8020 for volatile organic aromatic

**Table 4-4**
**Well Purging Data**
**Building N-126 USTs**

| Well # | Total Depth (ft. btoc) | Depth to Water (ft. btoc) | Well Volume (gallons) | Purge Volume (gallons) | pH | Conductivity (mhos) | Temperature (°C) |
|---|---|---|---|---|---|---|---|
| MW-1 | 22.51 | 8.70 | 2.25 | 6.90 | 7.6 | 0.58 | 25 |
| | | | | | 7.3 | 0.58 | 24 |
| | | | | | 7.3 | 0.58 | 23 |
| MW-2 | 22.55 | 13.42 | 1.49 | 4.70 | 6.2 | 0.18 | 26 |
| | | | | | 6.1 | 0.18 | 26 |
| | | | | | 6.2 | 0.18 | 26 |
| MW-3 | 22.57 | 11.94 | 1.73 | 5.20 | 6.3 | 0.14 | 28 |
| | | | | | 6.3 | 0.14 | 28 |
| | | | | | 6.3 | 0.14 | 28 |
| MW-4 | 27.30 | 8.48 | 3.07 | 9.20 | 5.7 | 0.106 | 25.2 |
| | | | | | 5.7 | 0.10 | 26 |
| | | | | | 5.7 | 0.10 | 25 |
| MW-5 | 27.55 | 12.73 | 2.42 | 7.30 | | 0.58 | 23 |
| | | | | | 6.8 | 0.56 | 25 |
| | | | | | | 0.55 | 25 |
| MW-6 | 20.15 | 13.67 | 1.06 | 3.20 | 6.7 | 0.50 | 32 |
| | | | | | 6.5 | 0.49 | 31 |
| | | | | | 6.6 | 0.50 | 30 |

compounds (BTEX) and Gasoline Range Organics (GRO) and Modified EPA Method 8015/TN DRO for Diesel Range Organics (DRO). Field and equipment blanks were collected in the field and a trip blank accompanied the sample kit as standard QA/QC.

## 4.6 Groundwater Analytical Results

Free product was not observed in groundwater in any site monitoring wells. TPH values above the TDEC's cleanup level of 1.0 ppm were detected in N-MW-5 (17.2 ppm) and N-MW-6 (2.0 ppm). These wells are located next to and north of the tank pit, respectively. Xylene was detected in N-MW-5 at 0.002 ppm. However, the State of Tennessee has not established cleanup levels for xylene in its Underground Storage Tank regulations. In addition, this value is considerably lower than the 0.07 ppm cleanup value for benzene. Analytical data indicates the extent of impacted groundwater is limited primarily to the vicinity of the tank pit. A summary of the analytical results is included in Table 4-5. Laboratory reports for groundwater analyses are provided in Appendix F.

**Table 4-5**
**Groundwater Analytical Results**
**Building N-126 USTs**

| Sample I.D. | Date Sampled | Benzene (mg/l) | Toluene (mg/l) | Ethyl Benzene (mg/l) | Xylenes (Total) (mg/l) | GRO (mg/l) | DRO (mg/l) |
|---|---|---|---|---|---|---|---|
| N-MW-1 | 5/27/93 | 0.001U | 0.001U | 0.001U | 0.001U | 0.1U | 0.1U |
| N-MW-2 | 5/27/93 | 0.001U | 0.001U | 0.001U | 0.001U | 0.1U | 0.1U |
| N-MW-2DUP | 5/27/93 | 0.001U | 0.001U | 0.001U | 0.001U | 0.1U | 0.1U |
| N-MW-3 | 5/27/93 | 0.001U | 0.001U | 0.001U | 0.001U | 0.1U | 0.1U |
| N-MW-4 | 5/27/93 | 0.001U | 0.001U | 0.001U | 0.001U | 0.1U | 0.1U |
| N-MW-5 | 5/27/93 | 0.001U | 0.001U | 0.001U | 0.002* | 0.170 | 17.0 |
| N-MW-6 | 7/20/93 | 0.001U | 0.001U | 0.001U | 0.001U | 0.1U | 2.0 |
| N-MW-6DUP | 7/20/93 | 0.001U | 0.001U | 0.001U | 0.001U | 0.1U | 1.5 |

**Note:**

* - Analyte confirmed on secondary column
U - Analyte not detected

## 4.7 Water Level Data

To determine the direction of groundwater flow beneath the site, a water level measuring point on each monitoring well was established and referenced to a known benchmark elevation at NAS Memphis. Wells were then surveyed by a registered surveyor. Depth to groundwater was measured on May 28, 1993 and June 3, 1993 to the nearest 1/100th foot. Water level measurements were converted to water table elevations (Table 4-6) and are provided in Figures 4-2 and 4-3. Upon completion of N-MW-6, a third set of water level measurements was obtained on July 20, 1993. The piezometric surface map from this data is included as Figure 4-4.

## 4.8 Groundwater Classification

A water use survey was conducted in the vicinity of the facility to determine whether any domestic or agricultural wells are accessing the surficial aquifer. A water well survey completed by the Memphis and Shelby County Health Department (included in Appendix G) found the closest shallow well to be located approximately one mile west of the site.

Table 4-6
Water Table Elevations Building N-126 USTs

| | | Date of Measurement | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | May 28, 1993 | | June 3, 1993 | | July 20, 1993 | | |
| Moniting Well | Top of Casing Elevation (MSL) | Depth to Water (ft broc)[a] | Water Level Elevations (ft)[b] | Depth to Water (ft broc) | Water Level Elevations (ft) | Depth to water (ft broc) | Water Level Elevations (ft) | Total Depth of Well (ft) |
| N-MW-1 | 285.95 | 8.59 | 277.36 | 9.01 | 276.94 | 12.74 | 273.21 | 20.0 |
| N-MW-2 | 284.76 | 13.60 | 271.16 | 14.08 | 270.68 | 16.50 | 268.26 | 20.0 |
| N-MW-3 | 285.90 | 12.14 | 273.76 | 12.55 | 273.35 | 16.08 | 269.82 | 20.0 |
| N-MW-4 | 286.53 | 8.57 | 277.96 | 8.67 | 277.86 | 10.30 | 276.23 | 25.0 |
| N-MW-5 | 285.19 | 13.50 | 271.69 | 13.38 | 271.81 | 19.18 | 266.01 | 25.0 |
| N-MW-6 | 281.95 | – | – | – | – | 13.67 | 268.28 | 20.0 |

Note: [a] - ft. btoc = feet below top of casing, [b] - ft. mean sea level

A groundwater sample was collected from monitoring well MW-5 on May 27, 1993 and analyzed for Primary and Secondary Drinking Water Standards in accordance with the TDEC's Technical Guidance Document 002. Analytical results (included in Table 4-7) indicate iron, manganese and turbidity in excess of the respective suggested levels for drinking water. Because the shallow aquifer is not being utilized as a water source (drinking or otherwise) near the site, and the elevated iron, manganese and turbidity content fails to meet the drinking water standards, the aquifer can be characterized as a "non-drinking water" aquifer. Based upon this, the TDEC cleanup levels for non-drinking water are .07 ppm benzene and 1.0 ppm TPH.

**Table 4-7**
**N-MW-5 - Drinking Water Quality**

| Parameters | Result (mg/l) | Standard (mg/l) |
|---|---|---|
| Iron | 11.7 | 0.3 |
| Manganese | 8.7 | 0.05 |
| Turbidity | 230 NTU | 1 NTU |

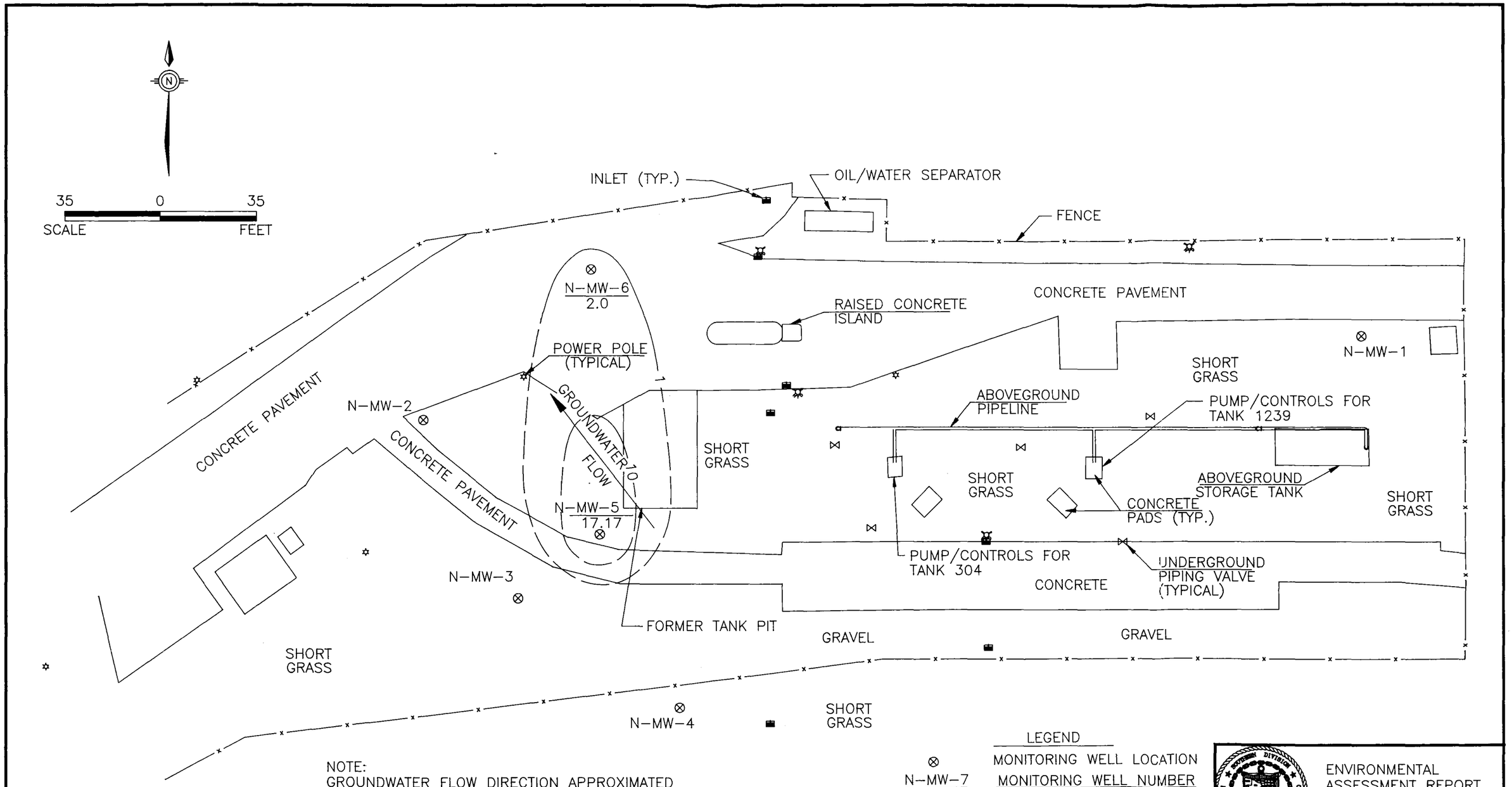
**Note:**

Turbidity is a primary drinking water standard and expressed in Nephelometric Turbidity Units (NTU). Iron and manganese are secondary drinking water standards.

## 4.9 Groundwater Contaminant Plume

The groundwater aerial contaminant plume map for TPH (Figure 4-5) indicates the approximate extent of TPH above the applicable cleanup level of 1.0 ppm. Groundwater contamination exceeding the TDEC cleanup levels appears for TPH only and is limited to the immediate vicinity of the tank pit and at least 100 feet north of it. Benzene and TPH were not detected in any other monitoring wells.

Two profile contaminant plume maps for TPH have been developed and are presented as Figures 4-6, 4-7 and 4-8. TPH profile plumes indicate the approximate extent of TPH above the applicable cleanup level of 1.0 ppm.



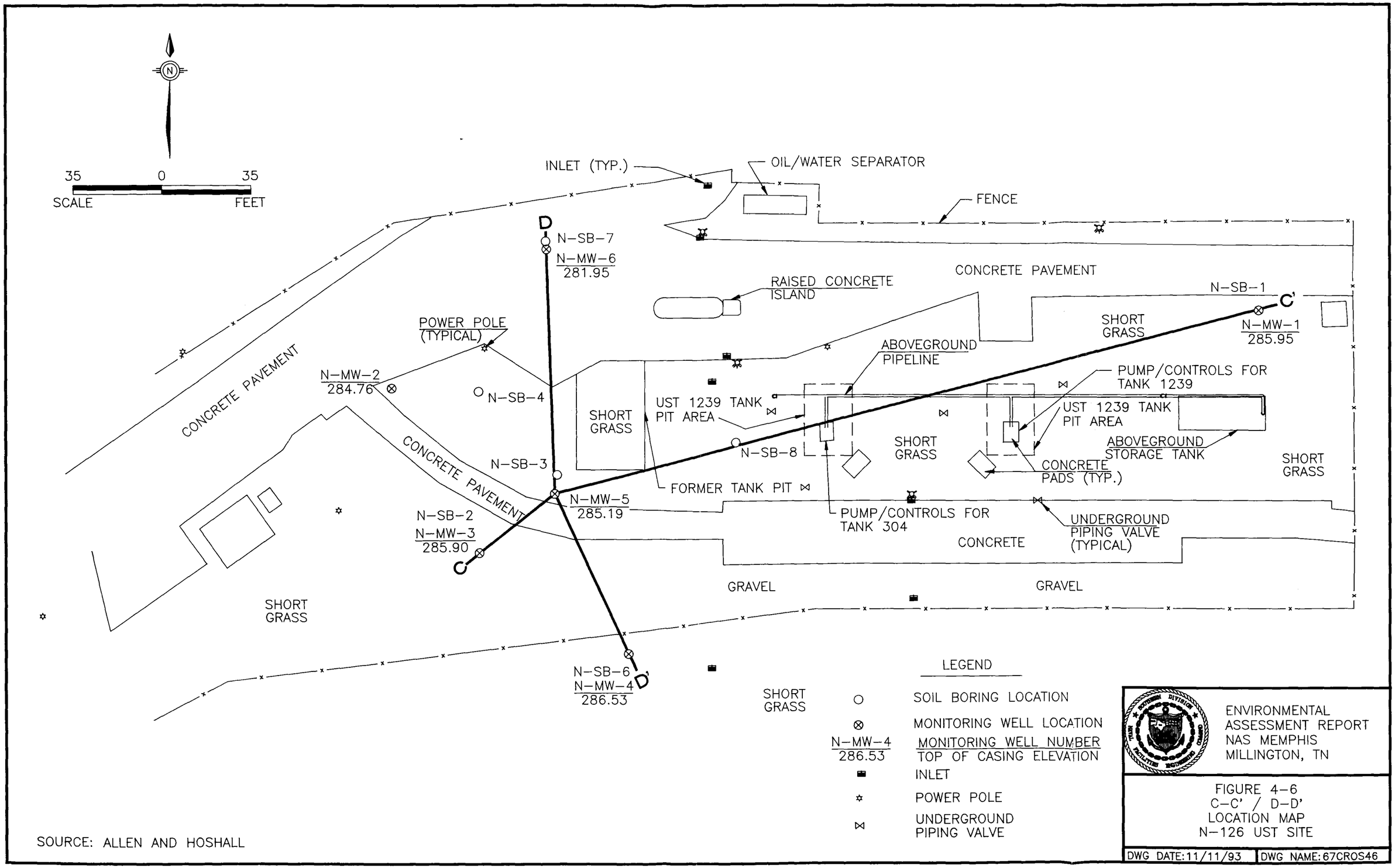

NOTE:
GROUNDWATER FLOW DIRECTION APPROXIMATED
ON GROUNDWATER CONTOUR DATA 6/3/93 & 7/20/93.

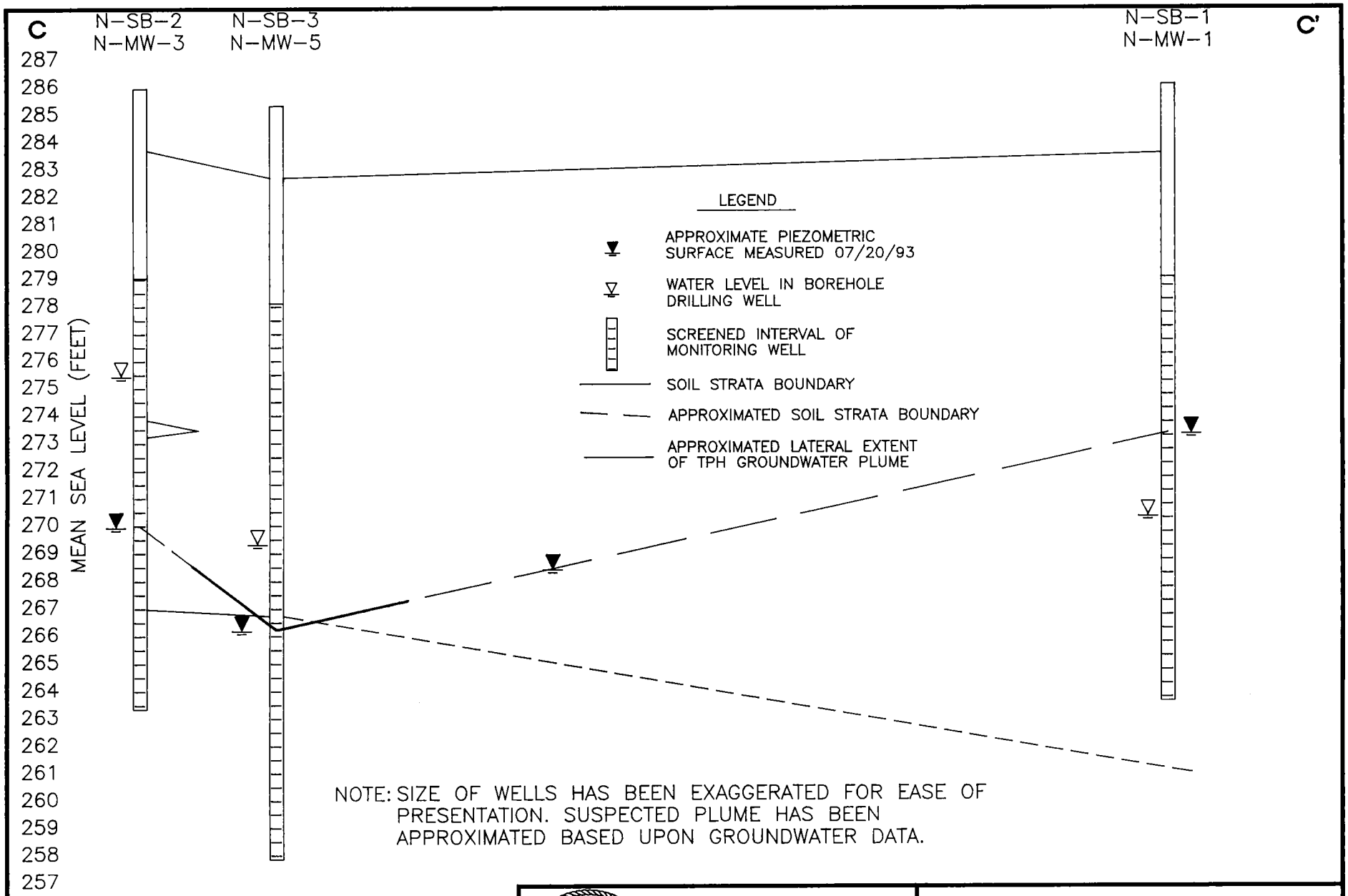
SOURCE: ALLEN AND HOSHALL

ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN

FIGURE 4-5
TPH PLUME
MAP (PPM)
BUILDING N-126 USTs

DWG DATE: 11/11/93 | DWG NAME: 67N126P4


N
35 0 35
SCALE FEET
INLET (TYP.)
OIL/WATER SEPARATOR
FENCE
D
N-SB-7
N-MW-6
281.95
CONCRETE PAVEMENT
RAISED CONCRETE ISLAND
N-SB-1
C'
N-MW-1
285.95
SHORT GRASS
POWER POLE (TYPICAL)
ABOVEGROUND PIPELINE
PUMP/CONTROLS FOR TANK 1239
N-MW-2
284.76
N-SB-4
CONCRETE PAVEMENT
UST 1239 TANK PIT AREA
UST 1239 TANK PIT AREA
SHORT GRASS
SHORT GRASS
ABOVEGROUND STORAGE TANK
N-SB-8
CONCRETE PADS (TYP.)
SHORT GRASS
N-SB-3
CONCRETE PAVEMENT
FORMER TANK PIT
N-MW-5
285.19
N-SB-2
N-MW-3
285.90
C
PUMP/CONTROLS FOR TANK 304
UNDERGROUND PIPING VALVE (TYPICAL)
CONCRETE
GRAVEL
GRAVEL
SHORT GRASS
N-SB-6
N-MW-4
286.53
D'
SHORT GRASS
LEGEND
SOIL BORING LOCATION
MONITORING WELL LOCATION
N-MW-4 MONITORING WELL NUMBER
286.53 TOP OF CASING ELEVATION
INLET
POWER POLE
UNDERGROUND PIPING VALVE
SOURCE: ALLEN AND HOSHALL
ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS
MILLINGTON, TN
FIGURE 4-6
C-C' / D-D'
LOCATION MAP
N-126 UST SITE
DWG DATE: 11/11/93
DWG NAME: 67CROS46

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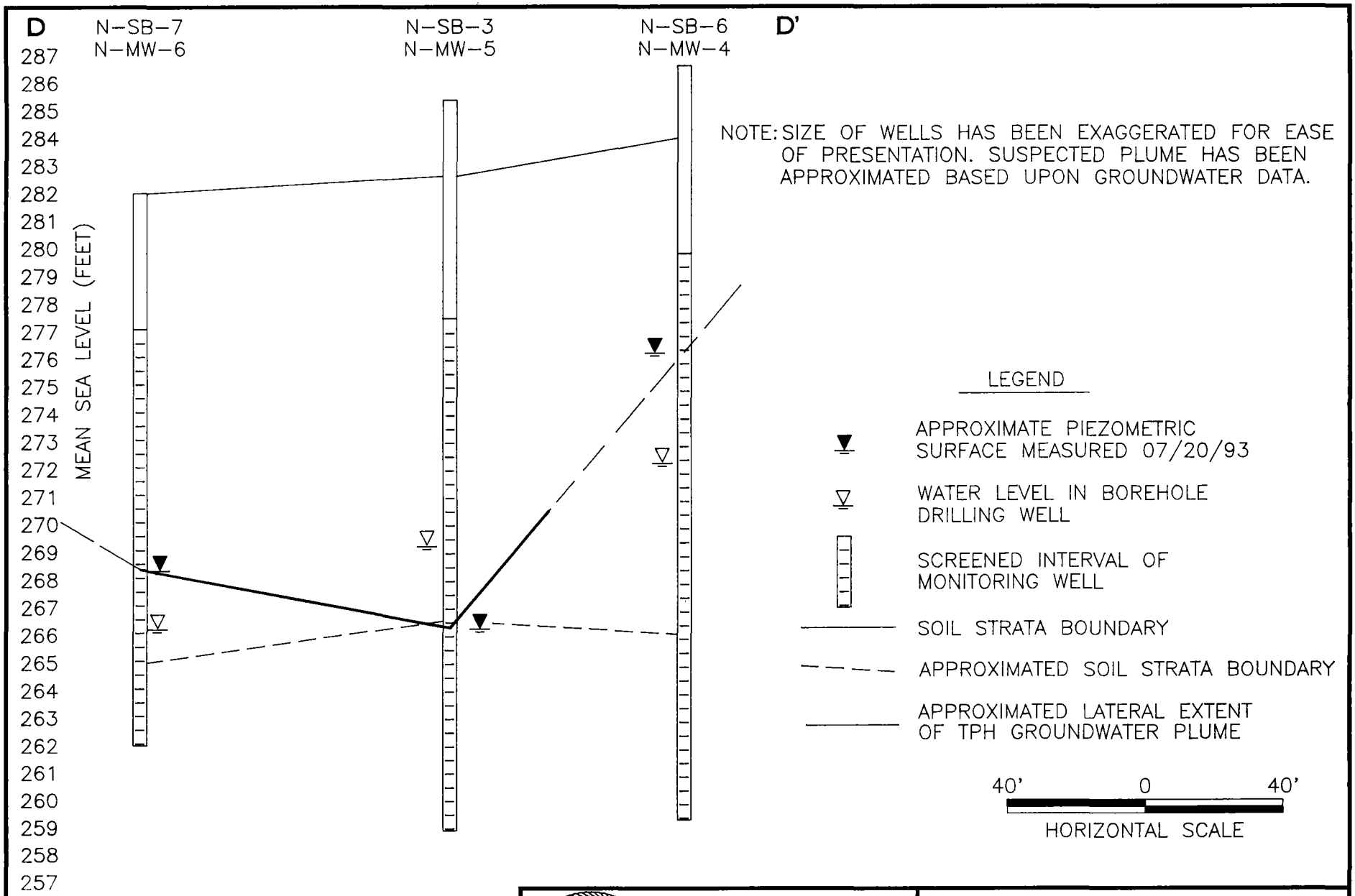
MILLINGTON, TN.

FIGURE 4-7
C-C' HYDROGEOLOGIC CROSS SECTION
N-126 UST SITE

DWG DATE: 11/16/93 | DWG NAME: 67CROS11




ENVIRONMENTAL ASSESSMENT REPORT
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MILLINGTON, TN.

FIGURE 4-8
D-D' HYDROGEOLOGIC CROSS SECTION
N-126 UST SITE

DWG DATE: 11/16/93 | DWG NAME: 67CROS22

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the information gathered during the assessment activities.

**Conclusions:**

- The surficial aquifer can be classified as "non-drinking water" based on a water use survey in the vicinity of the site and groundwater samples collected at the site which did not meet several primary and secondary drinking water standards. TDEC established cleanup levels for groundwater in a "non-drinking water aquifer" are 0.070 ppm benzene and 1.0 ppm TPH.

- TPH concentrations in groundwater exceeded the TDEC cleanup levels for non-drinking water in two monitoring wells — N-MW-5 immediately adjacent to the tank pit and N-MW-6 approximately 100 feet north of the tank pit. No benzene or TPH concentrations in excess of the respective cleanup levels were detected in the remaining monitoring wells installed as part of the environmental assessment.

- BTX and TPH concentrations in soil did not exceed the TDEC cleanup level for a non-drinking water aquifer in any of the analyzed soil samples. TDEC soil cleanup levels for the soil at this site are 500 ppm for BTX and 1000 ppm for TPH.

- The groundwater flow direction beneath the site appears to be toward the tank pit (adjacent to N-MW-5) and has a calculated hydraulic gradient ranging from 0.024 to 0.143 ft/ft.

- Depth to the static water table beneath the site ranges between 8 and 14 feet below grade.

- Free product was not detected in any monitoring wells.

- Permeabilities of soil samples collected in native soils outside the tank pit exhibited average hydraulic conductivities ranging between $2.4 \times 10^{-6}$ and $4.5 \times 10^{-7}$ cm/s, typical permeabilities of clay.

**Recommendations:**

- EnSafe/Allen and Hoshall recommends the development of a Corrective Action Plan to determine the best course of action to remediate groundwater contamination at this site.

# APPENDIX A

## Boring Logs

# DESCRIPTION OF SUBSURFACE MATERIALS

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | |
|---|---|---|---|---|---|
| | | | 0 | CL | MEDIUM BROWN SILTY SOFT CLAY MOTTLED WITH MEDIUM BROWN AND GRAY CLAY. |
| | | | 0 | | |
| | SS | 36 | N/R | 6C | CORE BLOCK AT 1.9' DUE TO LARGE CONGLOMERATE COBBLE. |
| | | | N/R | | |
| 5 | | | N/R | | |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH DARK BROWN TO BLACK AND GRAY CLAY. |
| | | | 0 | | |
| | SS | 100 | 0 | CL | |
| | | | 0 | | |
| 10 | | | 0.5 | | MOIST ZONE AT 9.5' |
| | | | 1.2 | CL | |
| | | | 0 | | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY, LESS DARK BROWN-BLACK. |
| | SS | 100 | 0 | M/L | GROUNDWATER AT 13.3' |
| | | | 0 | | |
| 15 | | | 0 | | |
| | | | 0 | CH | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH DARK BROWN TO BLACK AND GRAY CLAY. |
| | | | 0 | | |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| | | | | CH/CL | MEDIUM GRAY SILTY CLAY MOIST AT 19.8' |
| 20 | | | 0 | | |
| | TD | | | | |
| 25 | | | | | |

ENVIRONMENTAL
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NAS MEMPHIS
CTO-67

N-SB-1
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 09/24/93 | DWG NAME: 067BR1

# DESCRIPTION OF SUBSURFACE MATERIALS

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | |
|---|---|---|---|---|---|
| | | | 0 | CL | MEDIUM BROWN SILTY CLAY MOTTLED WITH GRAY CLAY. |
| | | | 0 | | |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| | | | 0 | | |
| 5 | | | 0 | CL | |
| | | | 0 | CL | MEDIUM BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | SS | 100 | 0 | M L | |
| | | | 0 | CH | GROUNDWATER 8.0', ALSO CONTACT LIGHT BROWN SILTY WET CLAY MOTTLED WITH GRAY CLAY. |
| 10 | | | 0 | SM | LIGHT BROWN SILTY WET SAND AT 10.'- 10.2.' |
| | | | 0 | CH | LIGHT BROWN SILTY WET CLAY MOTTLED WITH GRAY CLAY. |
| | | | N/R | | |
| | SS | 46 | N/R | | CORE BLOCK AT 12.3' NO RECOVERY TO 15.0' |
| | | | N/R | | |
| 15 | | | 0 | | |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | | | 0 | | CONTACT DARK BROWN SILTY SOFT CLAY AT 16.8' |
| | SS | 100 | 0 | CL | |
| | | | 0 | | |
| 20 | | | 0 | | |
| | TD | | | | |
| 25 | | | | | |

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NAS MEMPHIS
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N-SB-2
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 09/24/93 | DWG NAME: 067BR2

# DESCRIPTION OF SUBSURFACE MATERIALS

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | |
|---|---|---|---|---|---|
| | | | 0 | SM | REDDISH ORANGE COARSE SILTY SAND 0.2' - 0.3'. |
| | | | 0 | CL | |
| | SS | 100 | | | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY AND DARK BROWN CLAY. |
| | | | 0 | | |
| | | | 0 | CL | |
| 5 | | | 0 | | GREENISH GRAY SILTY SOFT CLAY AT 4.5'. |
| | | | 0 | CH | GREENISH GRAY SILTY SOFT CLAY, MOIST |
| | | | 0 | CL | |
| | SS | 100 | 3 | | |
| | | | 6 | | |
| 10 | | | 3 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY AT 9.7'. |
| | | | 3 | CL | |
| | | | 0 | | |
| | SS | 83 | 0 | M/L | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY<br>GROUNDWATER AT 13.3'. |
| | | | 0 | | |
| 15 | | | 0 | CL | MEDIUM BROWN SILTY CLAY, SOFT, MOTTLED WITH GRAY CLAY. |
| | | | 0 | CL | DARK BROWN TO GRAY SILTY WET CLAY CONTACT AT 16.2, POSSIBLE CONTAMINATION STAINING |
| | | | 0 | | |
| | SS | 100 | 20 | | |
| | | | 35 | | |
| 20 | | | 18 | | NOTE: HNU BATTERY MALFUNCTION, NO HNU READING FROM 20.0 TO 25.0 BUT ENTIRE INTERVAL EXHIBITED STRONG PETROLEUM ODOR AND MULTI COLOR SHEEN. |
| | | | 15 | | |
| | | | 0 | CL | |
| | SS | 100 | 0 | | |
| | | | 0 | | DARK BROWN TO GRAY SILTY WET CLAY |
| 25 | | | 0 | | MEDIUM, BROWN SILTY CLAY MOTTLED WITH ORANGE/BROWN |
| | TD | | | | |

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NAS MEMPHIS
CTO-67

N-SB-3
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 09/24/93 | DWG NAME: 067BR3

# DESCRIPTION OF SUBSURFACE MATERIALS

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | |
|---|---|---|---|---|---|
| | | | 0 | SM | REDDISH ORANGE COARSE SILTY SAND 0.2'- 0.3'. |
| | SS | 100 | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | | | 0 | | |
| | | | N/R | CL | LIGHT BROWN SILTY CLAY, MOTTLING ABSENT. |
| 5 | | | N/R | | |
| | SS | 66 | 3.5 | | |
| | | | 4 | | |
| | | | 4 | M L | GROUNDWATER AT 7.6' |
| | | | 4.5 | CH | LIGHT BROWN SILTY CLAY. MOTTLING ABSENT |
| 10 | | | N/R | | NO RECOVERY 9.0' - 13.1' |
| | | | N/R | | |
| | | | N/R | | |
| | SS | 20 | N/R | | |
| | | | 0 | CH | MEDIUM BROWN SILTY MOIST CLAY, MOTTLING ABSENT |
| 15 | | | 0 | | GROUND WATER AGAIN AT 14.7' |
| | | | 15 | CH | DARK BROWN SILTY CLAY CONTACT AT 16.4', POSSIBLE PETROLEUM STAINING |
| | | | 15 | | |
| | SS | 90 | 20 | | |
| | | | 30 | | |
| 20 | TD | | | | |
| 25 | | | | | |

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NAS MEMPHIS
CTO-67

N-SB-4
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 09/24/93

DWG NAME: 067BR4

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | DESCRIPTION OF SUBSURFACE MATERIALS |
|---|---|---|---|---|---|
| | | | 0 | GM | ORANGE/BROWN CHERT GRAVEL WITH POORLY SORTED SAND AND SILT. |
| | | | N/R | | SAMPLER CORE BLOCKED AT 1.2', NO RECOVERY TO 5.0. |
| | SS | 2 | N/R | | |
| | | | N/R | CL | CUTTINGS SHOW LIGHT BROWN SILTY SOFT CLAY. |
| 5 | | | N/R | | |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY |
| | | | 0 | | |
| | | | 0 | | |
| | | | 0 | | |
| | | | | M | GROUNDWATER AT 9.8' |
| 10 | | | 0 | L | |
| | | | 0 | | |
| | | | 0 | CH | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY AND MOIST |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| 15 | | | 0 | | |
| | | | 0 | CH | MEDIUM BROWN SILTY WET CLAY |
| | | | 0 | | |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| | | | | CL | REDDISH BROWN SILTY CLAY MOTTLED WITH DARK BROWN TO BLACK AT 19.2, |
| 20 | | | 0 | | |
| | TD | | | | |
| 25 | | | | | |

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NAS MEMPHIS
CTO-67

N-SB-5
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 08/12/93

DWG NAME: 067BR5

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | DESCRIPTION OF SUBSURFACE MATERIALS |
|---|---|---|---|---|---|
| | | | 0 | | |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| | | | 0 | | |
| 5 | | | 0 | CL | LIGHT BROWN SILT/SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | | | 0 | | |
| | SS | 100 | 0 | | MOIST ZONE 8.5' TO 8.7'. |
| | | | 0 | | |
| 10 | | | 0 | | |
| | | | 0 | M L | GROUNDWATER AT 11.6'. |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| 15 | | | 0 | | |
| | | | 0 | CL | MEDIUM BROWN SILT WET CLAY MOTTLED WITH GRAY AND DARK BROWN TO BLACK CLAY. |
| | | | 0 | | |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| 20 | | | 0 | | |
| | | | 0 | ML | MEDIUM BROWN SILTY CLAY MOTTLED WITH DARK BROWN TO BLACK, VERY WET. |
| | | | 0 | | |
| | SS | 100 | 0 | CL | LIGHT BROWN SILTY CLAY MOTTLED WITH ORANGE BROWN CLAY. |
| | | | 0 | | |
| 25 | | | 0 | | |
| | TD | | | | |

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NAS MEMPHIS
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N-SB-6
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 08/10/93

DWG NAME: 067BR6

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | DESCRIPTION OF SUBSURFACE MATERIALS |
|---|---|---|---|---|---|
| | | | 0 | | ASPHALT 0-0.2', CONCRETE 0.2-0.7' |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY. |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| 5 | | | 0 | | |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY |
| | | | 0 | | |
| | SS | 100 | 0 | | |
| | | | 0 | M/L | GROUNDWATER AT 8.9' |
| 10 | | | 0 | | |
| | | | 0 | | VERY MOIST TO 10.5 THEN DRYER |
| | | | 0 | CL | MEDIUM BROWN SILTY WET CLAY |
| | SS | 53 | 0 | | |
| | | | N/R | | |
| 15 | | | N/R | MH | MEDIUM BROWN SILTY CLAY MOTTLED WITH GRAY, VERY WET, SOME SAND 15.9'-16.5' |
| | | | 0 | | |
| | SS | 100 | 0 | | |
| | | | 0 | CL | REDDISH BROWN SILTY CLAY MOTTLED WITH GRAY CLAY, VERY STIFF, MOIST AT 18.9' |
| | | | 0 | | |
| 20 | | | 0 | | |
| 25 | | | | | |

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CTO-67

N-SB-7
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 08/12/93 | DWG NAME: 067BR9

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | DESCRIPTION OF SUBSURFACE MATERIALS |
|---|---|---|---|---|---|
| | | | 0 | | |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| 5 | | | 0 | CL | |
| | | | 0 | CL | |
| | | | | | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH BLACK ORGANIC MODULES |
| | | | 0 | | |
| | SS | 100 | 200 | | DARK GREENISH GRAY SILTY CLAY WITH BLACK VERTICAL STRIATIONS AT 6.0' STRONG PETROLEUM ODOR. |
| | | | 500 | | |
| 10 | | | 600 | | |
| | | | 500 | CL | DARK GREENISH GRAY SILTY CLAY, MOIST. |
| | | | 50 | | |
| | SS | 100 | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY AND DARK BROWN AT 12.4'. |
| | | | 0 | M L | GROUNDWATER AT 13.8'. |
| 15 | | | 0 | | |
| | | | 0 | CH | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY |
| | | | 0 | | DARK BROWN SILTY WET CLAY AT 17.0', POSSIBLE STAINING |
| | SS | 100 | 8 | | |
| | | | 0 | | |
| 20 | | | 0 | | |
| 25 | | | | | |

ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
CTO-67

N-SB-8
BORING LOG
N-126 UST SITE
NAS MEMPHIS

DATE: 09/24/93

DWG NAME: 067BR8

| DEPTH (FEET) | SAMPLE TYPE | % RECOVERY | HNU READING | USCS SYMBOL | DESCRIPTION OF SUBSURFACE MATERIALS |
|---|---|---|---|---|---|
| | | | 0 | | ASPHALT 0-0.2', CONCRETE 0.2-0.7' |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| | | | 0 | | |
| 5 | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY |
| | | | 0 | | |
| | SS | 100 | 0 | | |
| | | | 0 | | |
| 10 | | | 0 | | |
| | | | 0 | | VERY MOIST TO 10.5' THEN DRYER |
| | | | 0 | | |
| | ST | 100 | N/A | | |
| | | | 0 | CL | LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY. |
| | | | 0 | M/L | GROUNDWATER AT 13.3' |
| 15 | | | 0 | | |
| | | | 0 | | |
| | | | 0 | | |
| | ST | 100 | N/A | | |
| | | | 0 | CH | DARK BROWN SILTY WET CLAY, STRONG PETROLEUM ODOR. |
| | | | 0 | | |
| | SS | 100 | N/A | | |
| 20 | | | 0 | CH | DARK BROWN SILTY WET CLAY, STRONG PETROLEUM ODOR. |
| | SS | | | | |
| 25 | SS | | | | |

ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
CTO-67

N-SB-9
GEOTECHNICAL SOIL BORING
N-126 UST SITE
NAS MEMPHIS

DATE: 09/24/93 | DWG NAME: 067BR7

# APPENDIX B

## Soil Analytical Data

# LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54114 |
| Client Sample ID: | N-SB8-20 | Collection Date: | 05/17/93 |
| Lab Sample ID: | XX4338 | Extraction Date: | 05/27/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/27/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 0.1 | U | 0.1 |
| toluene | 0.1 | U | 0.1 |
| ethyl benzene | 0.1 | U | 0.1 |
| xylenes (total) | 0.1 | U | 0.1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 10 | U | 10 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: SOIL Lab Sample I.D. | (72-119%) | (65-129) |
| XX4338 | 111 | 105 |

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54114 |
| Client Sample ID: | N-SB7-17 | Collection Date: | 05/17/93 |
| Lab Sample ID: | XX4339 | Extraction Date: | 05/26/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/29/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 10 | U | 10 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: SOIL | (41-149%) | (59-179%) |
| Lab Sample I.D. | | |
| XX4339 | 95 | 126 |

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54114 |
| Client Sample ID: | N-SB8-9 | Collection Date: | 05/17/93 |
| Lab Sample ID: | XX4340 | Extraction Date: | 05/26/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/29/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 10 | U | 10 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: SOIL | (41-149%) | (59-179%) |
| Lab Sample I.D. | | |
| XX4340 | 86 | 113 |

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54114 |
| Client Sample ID: | N-SB8-9 DUP | Collection Date: | 05/17/93 |
| Lab Sample ID: | XX4341 | Extraction Date: | 05/26/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/29/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 29 | | 10 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: SOIL | (41-149%) | (59-179%) |
| Lab Sample I.D. | | |
| XX4341 | 83 | 116 |

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54114 |
| Client Sample ID: | N-SB8-13 | Collection Date: | 05/17/93 |
| Lab Sample ID: | XX4342 | Extraction Date: | 05/26/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/29/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 58 | | 10 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: SOIL | (41-149%) | (59-179%) |
| Lab Sample I.D. | | |
| XX4342 | 89 | 118 |

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54114 |
| Client Sample ID: | N-SB8-20 | Collection Date: | 05/17/93 |
| Lab Sample ID: | XX4343 | Extraction Date: | 05/26/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/29/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 10 | U | 10 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: SOIL | (41-149%) | (59-179%) |
| Lab Sample I.D. | | |
| XX4343 | 92 | 115 |

# LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54106 |
| Client Sample ID: | N-SB2-8 | Collection Date: | 05/13/93 |
| Lab Sample ID: | XX4244 | Extraction Date: | 05/25/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/25/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 0.1 | U | 0.1 |
| toluene | 0.1 | U | 0.1 |
| ethyl benzene | 0.1 | U | 0.1 |
| xylenes (total) | 0.1 | U | 0.1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 10 | U | 10 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: SOIL | (78-124%) | (50-126) |
| Lab Sample I.D. | | |
| XX4244 | 102 | 104 |

# LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54106 |
| Client Sample ID: | N-SB2-20 | Collection Date: | 05/13/93 |
| Lab Sample ID: | XX4245 | Extraction Date: | 05/25/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/25/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 0.1 | U | 0.1 |
| toluene | 0.1 | U | 0.1 |
| ethyl benzene | 0.1 | U | 0.1 |
| xylenes (total) | 0.1 | U | 0.1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 10 | U | 10 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: SOIL | (78-124%) | (50-126) |
| Lab Sample I.D. | | |
| XX4245 | 113 | 115 |

# LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54106 |
| Client Sample ID: | N-SB3-13 | Collection Date: | 05/13/93 |
| Lab Sample ID: | XX4246 | Extraction Date: | 05/25/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/25/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 0.1 | U | 0.1 |
| toluene | 0.1 | U | 0.1 |
| ethyl benzene | 0.1 | U | 0.1 |
| xylenes (total) | 0.1 | U | 0.1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 10 | U | 10 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: SOIL | (78-124%) | (50-126) |
| Lab Sample I.D. | | |
| XX4246 | 102 | 105 |

# LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54106 |
| Client Sample ID: | N-SB3-13 DUP | Collection Date: | 05/13/93 |
| Lab Sample ID: | XX4247 | Extraction Date: | 05/25/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/25/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 0.1 | U | 0.1 |
| toluene | 0.1 | U | 0.1 |
| ethyl benzene | 0.1 | U | 0.1 |
| xylenes (total) | 0.1 | U | 0.1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 10 | U | 10 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: SOIL | (78-124%) | (50-126) |
| Lab Sample I.D. | | |
| XX4247 | 101 | 104 |

# LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | ENSAFE NAS MEMPHIS | Job Number: | ENFA 54106 |
| Client Sample ID: | N-SB3-21 | Collection Date: | 05/13/93 |
| Lab Sample ID: | XX4248 | Extraction Date: | 05/25/93 |
| Sample Matrix: | SOIL | Analysis Date: | 05/25/93 |
| Concentration Units: | mg/kg | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 0.1 | U | 0.1 |
| toluene | 0.1 | U | 0.1 |
| ethyl benzene | 0.1 | U | 0.1 |
| xylenes (total) | 0.1 | U | 0.1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 10 | U | 10 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: SOIL | (78-124%) | (50-126) |
| Lab Sample I.D. | | |
| XX4248 | 114 | 117 |

# APPENDIX C

## Permeability Results

# Tri-State Testing Services, Inc.

## Measurement of Hydraulic Conductivity

Client: Ensafe/Allen & Hoshall

Date of Report: 06/02/93

Project Name: Naval Air Station @ Millington, TN

Sample I.D.: Boring N-126-SB9 Sample: ST 1, Depth 11'-13'

Soil Description: Brown & Gray Silty Clay

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 121.6 | 124.0 |
| Dry Density (Lbs/ft$^3$) | 96.0 | 97.5 |
| Moisture (% Dry Wt) | 26.7 | 27.2 |
| Porosity (n) | .401 | .406 |
| Degree of Saturation (%) | 97.9 | 100.0 |

**Permeability**

Temperature Correction, $R_t = 1.015$

$K_1 = 6.3 \times 10^{-7}$ cm/sec
$K_2 = 3.6 \times 10^{-7}$ cm/sec
$K_3 = 3.6 \times 10^{-7}$ cm/sec
$K_4 = 4.1 \times 10^{-7}$ cm/sec

Coefficient of Permeability, $K_{20} = 4.5 \times 10^{-7}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. L-93-1010A Reviewed By: David D. McCray

6756 Buckles Cove • Memphis, TN 38133
(901) 385-1199 • Fax (901) 386-6614

# Tri-State Testing Services, Inc.

## Measurement of Hydraulic Conductivity

Client: Ensafe/Allen & Hoshall

Date of Report: 06/03/93

Project Name: Naval Air Station @ Millington, TN

Sample I.D.: Boring # N-126-SB9 Sample: ST 2, Depth 16'-18'

Soil Description: Gray Silty Clay

| | Pre-Test | Post Test |
|---|---|---|
| Wet Density (Lbs/ft$^3$) | 123.4 | 125.1 |
| Dry Density (Lbs/ft$^3$) | 99.6 | 101.0 |
| Moisture (% Dry Wt) | 24.0 | 24.0 |
| Porosity (n) | .384 | .384 |
| Degree of Saturation (%) | 100.0 | 100.0 |

**Permeability**

Temperature Correction, $R_t$ = 1.000

$K_1 = 1.3 \times 10^{-6}$ cm/sec
$K_2 = 4.8 \times 10^{-6}$ cm/sec
$K_3 = 2.0 \times 10^{-6}$ cm/sec
$K_4 = 1.4 \times 10^{-6}$ cm/sec

Coefficient of Permeability, $K_{20} = 2.4 \times 10^{-6}$ cm/sec

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

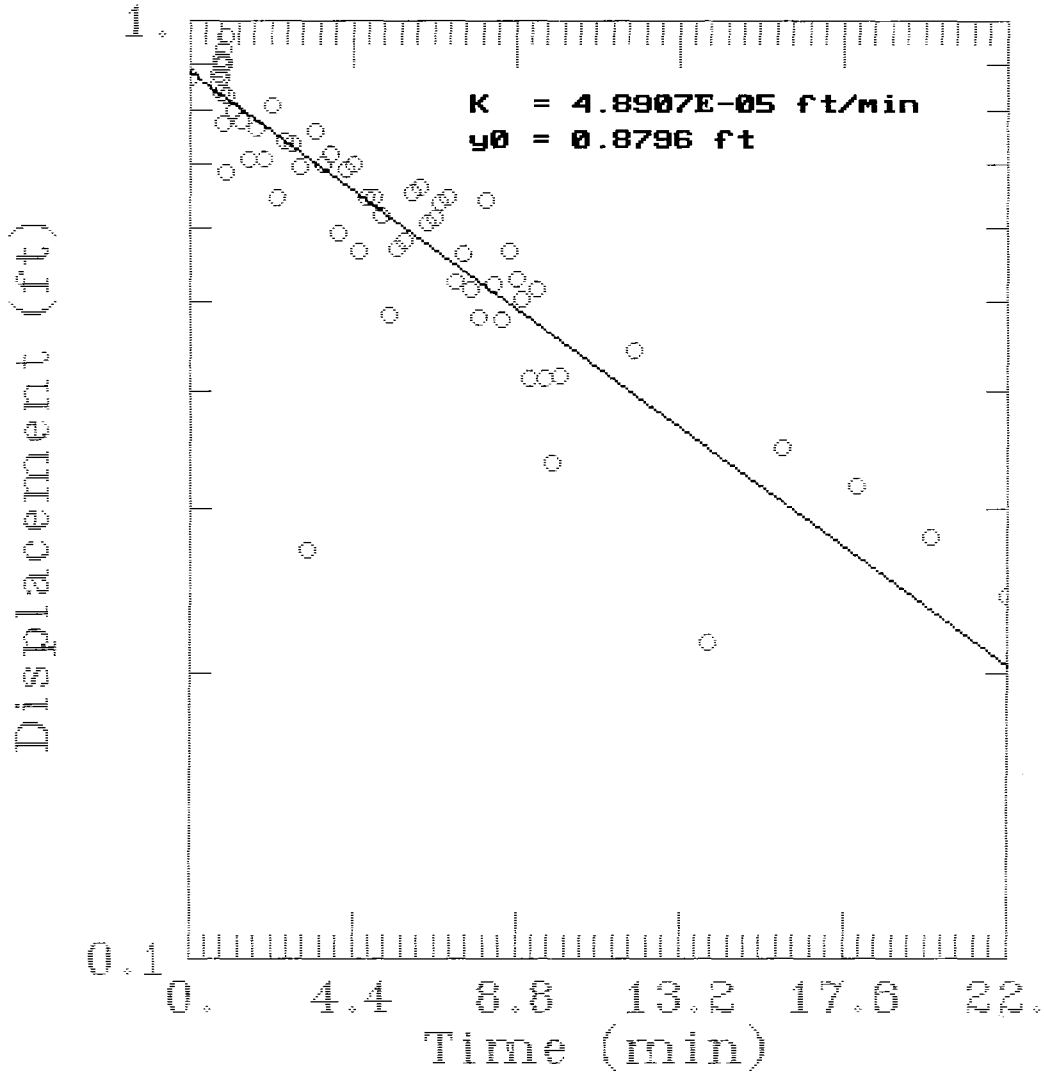
Lab No. L-93-1010B Reviewed By: David D. McCray

6756 Buckles Cove • Memphis, TN 38133
(901) 385-1199 • Fax (901) 386-6614

# APPENDIX D

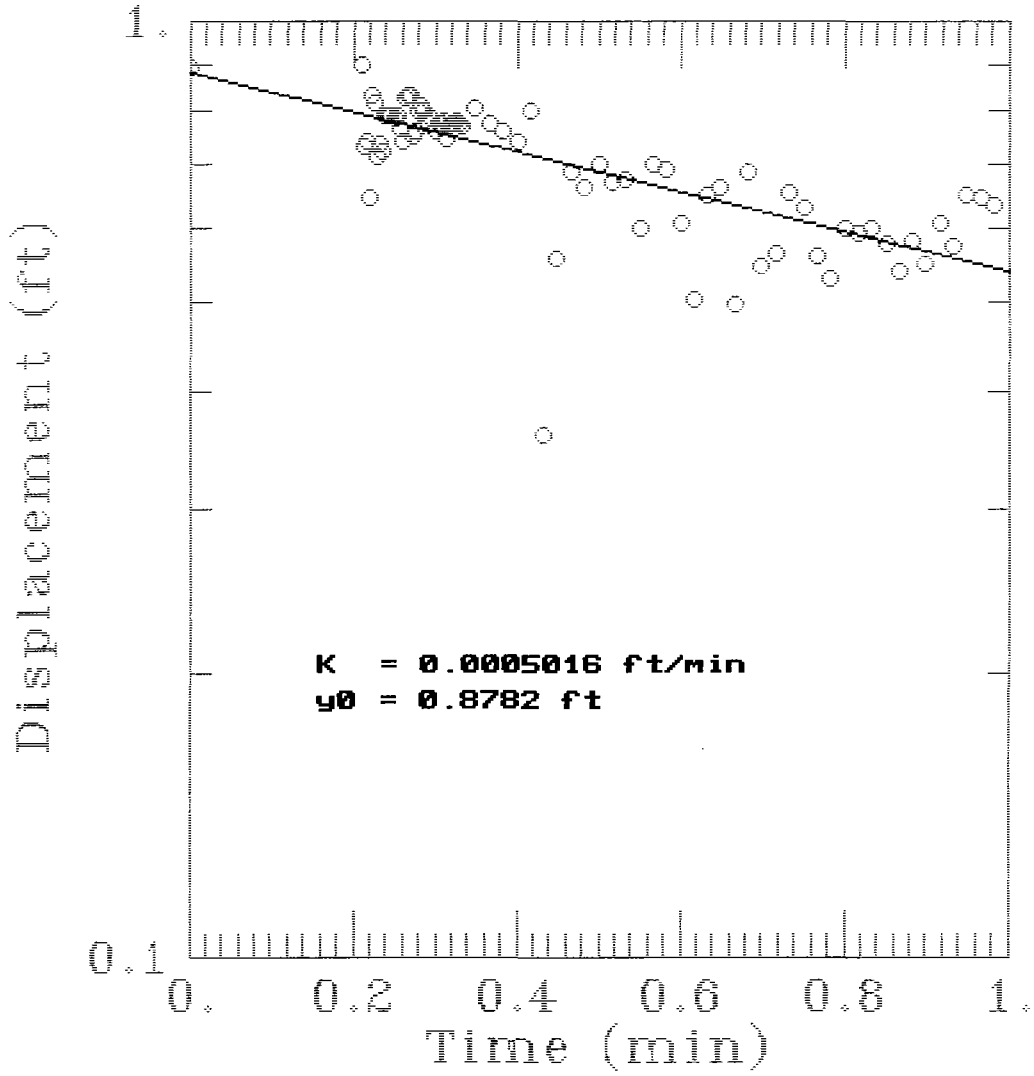
# AQTESOLV Graphs

# Falling Head Slug Test on N-126 MW-1



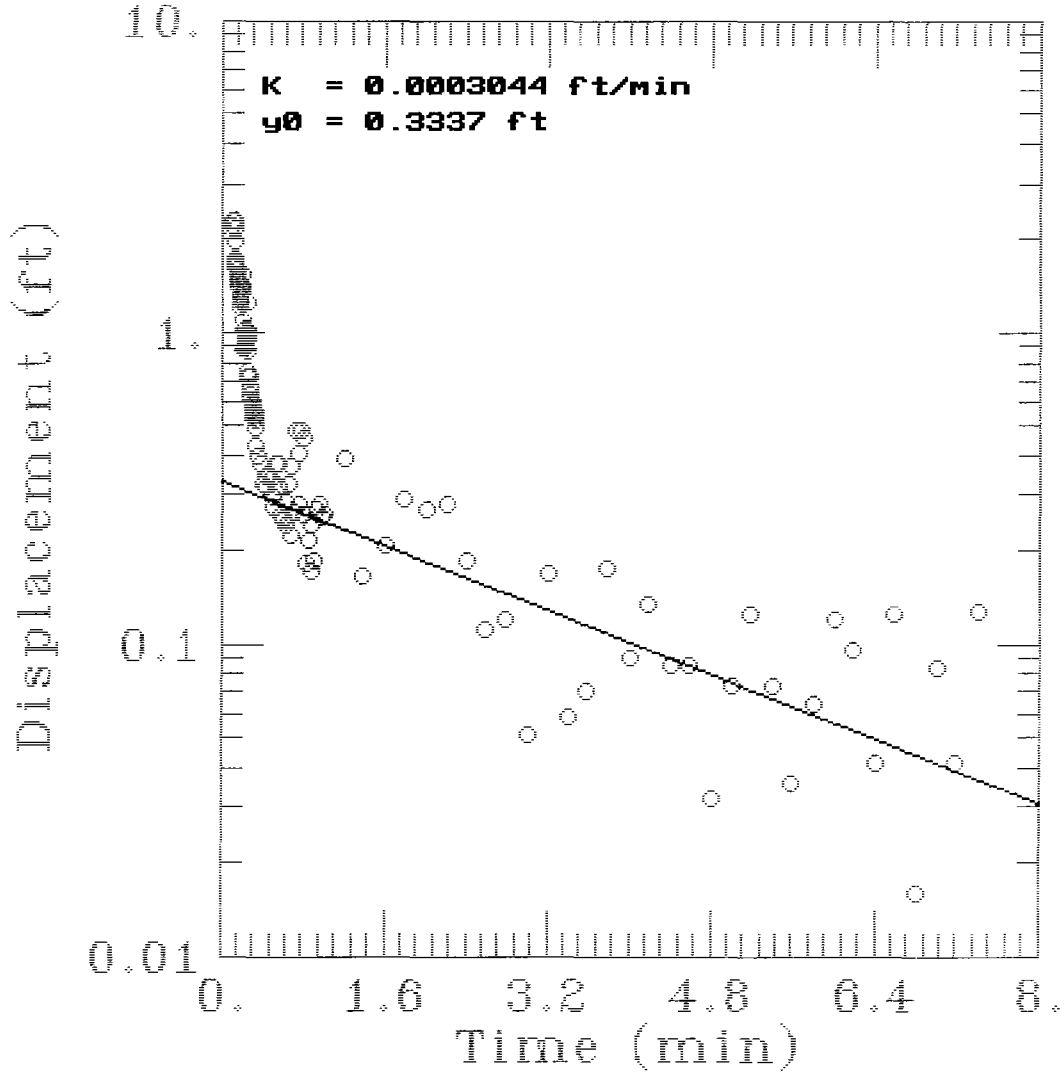

Facility I.D. # 0-791709

# Falling Head Slug Test on N-126 MW-2



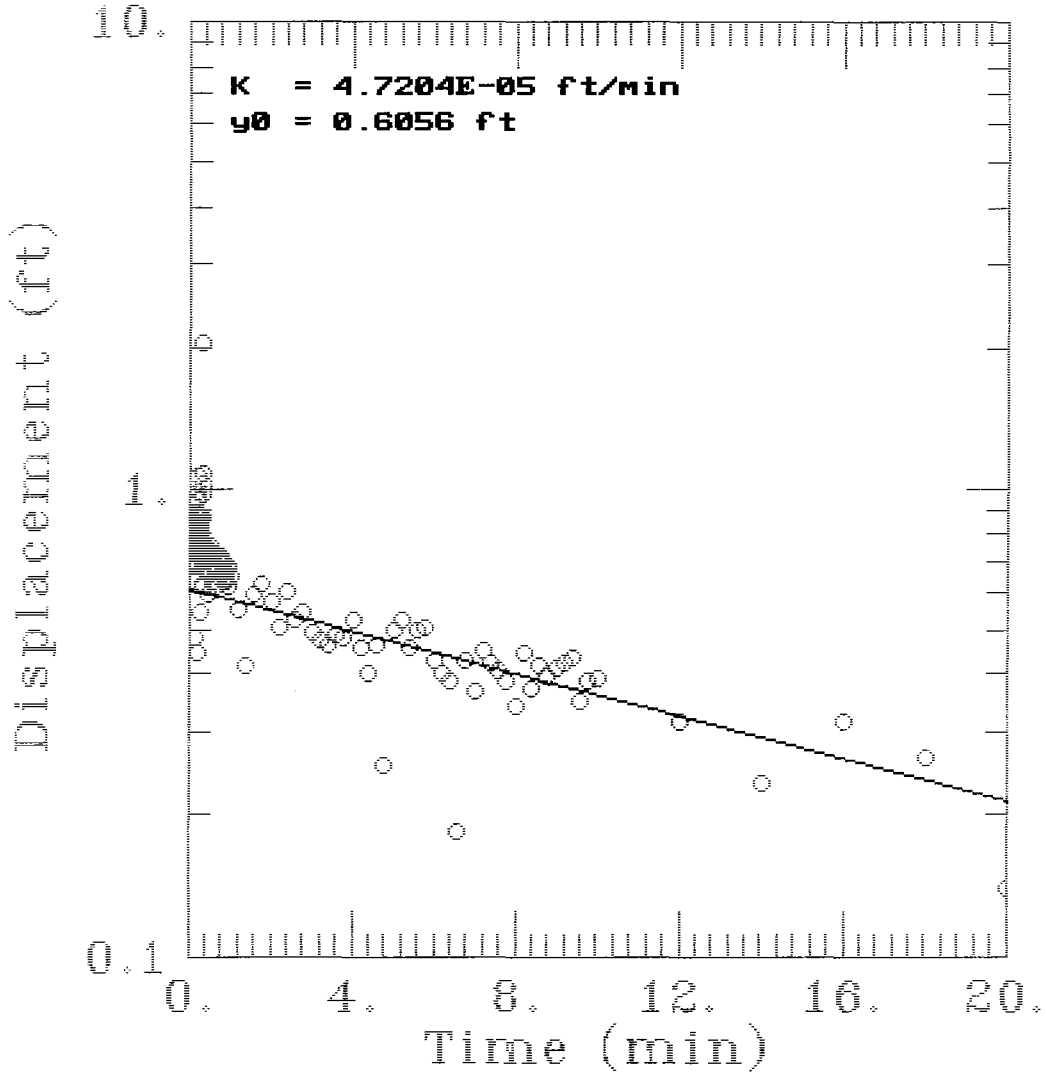

Facility I.D. # 0-791709

# Rising Head Slug Test on N-126 MW-2



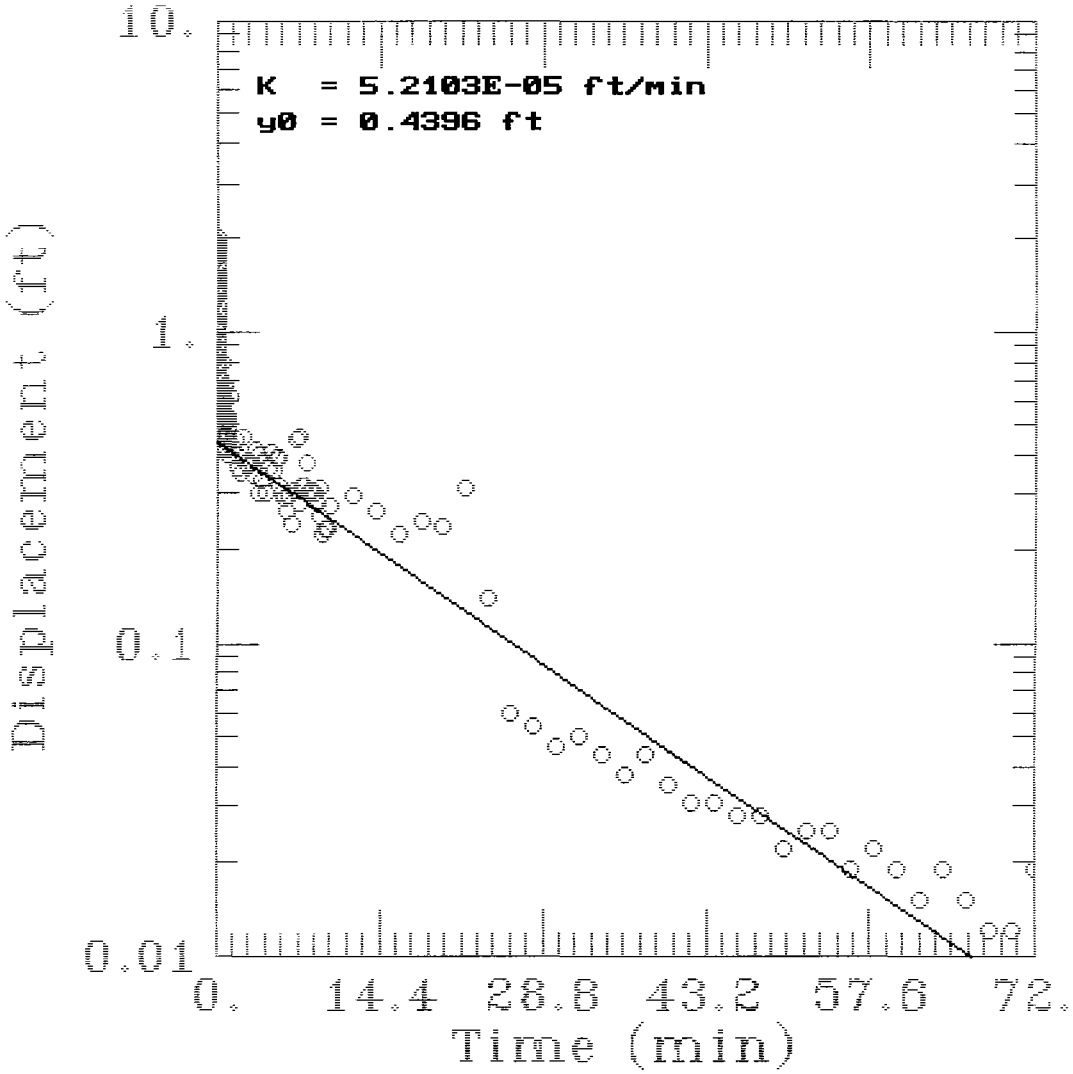

Facility I.D. # 0-791709

# Falling Head Slug Test on N-126 MW-3



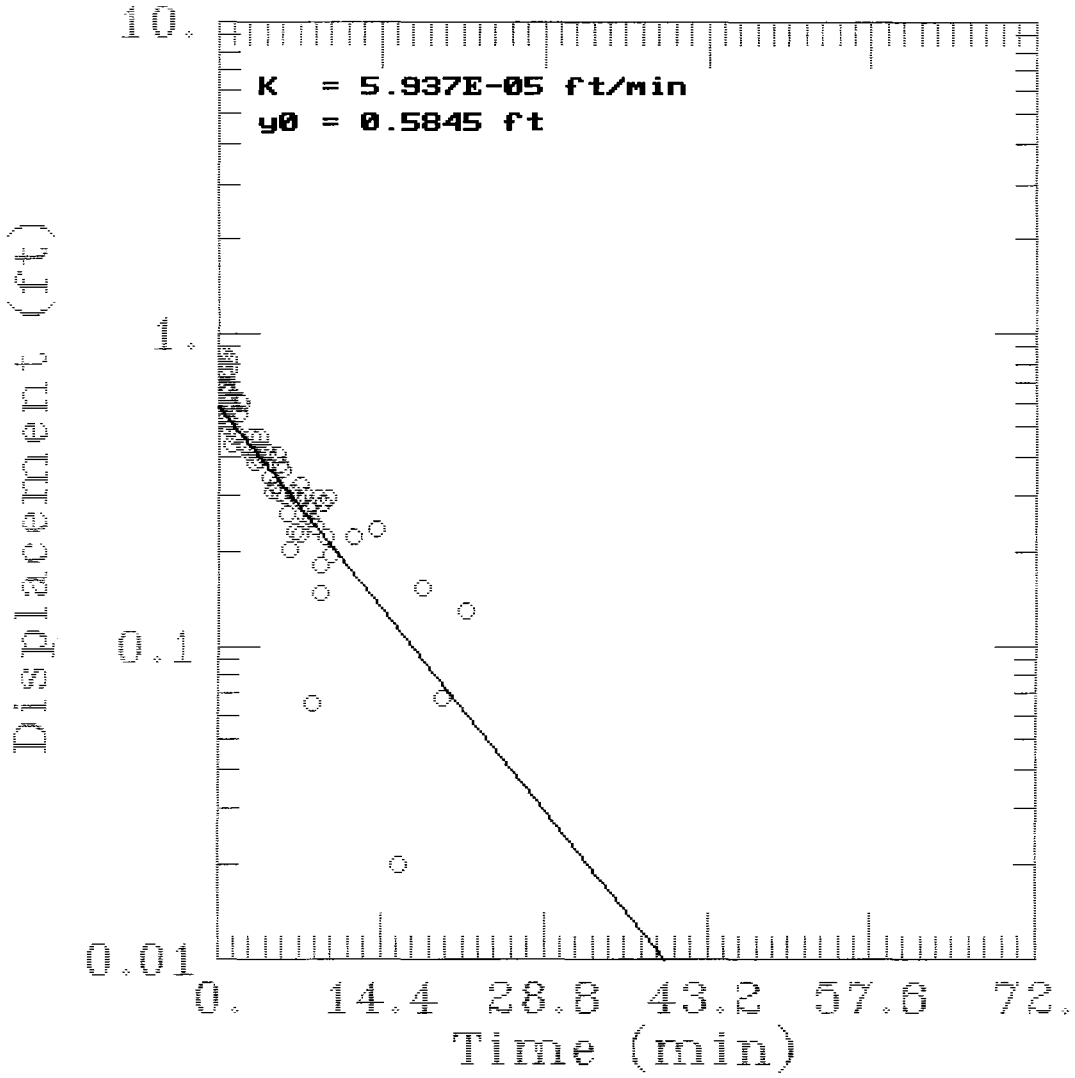

Facility I.D. # 0-791709

# Rising Head Slug Test on N-126 MW-3



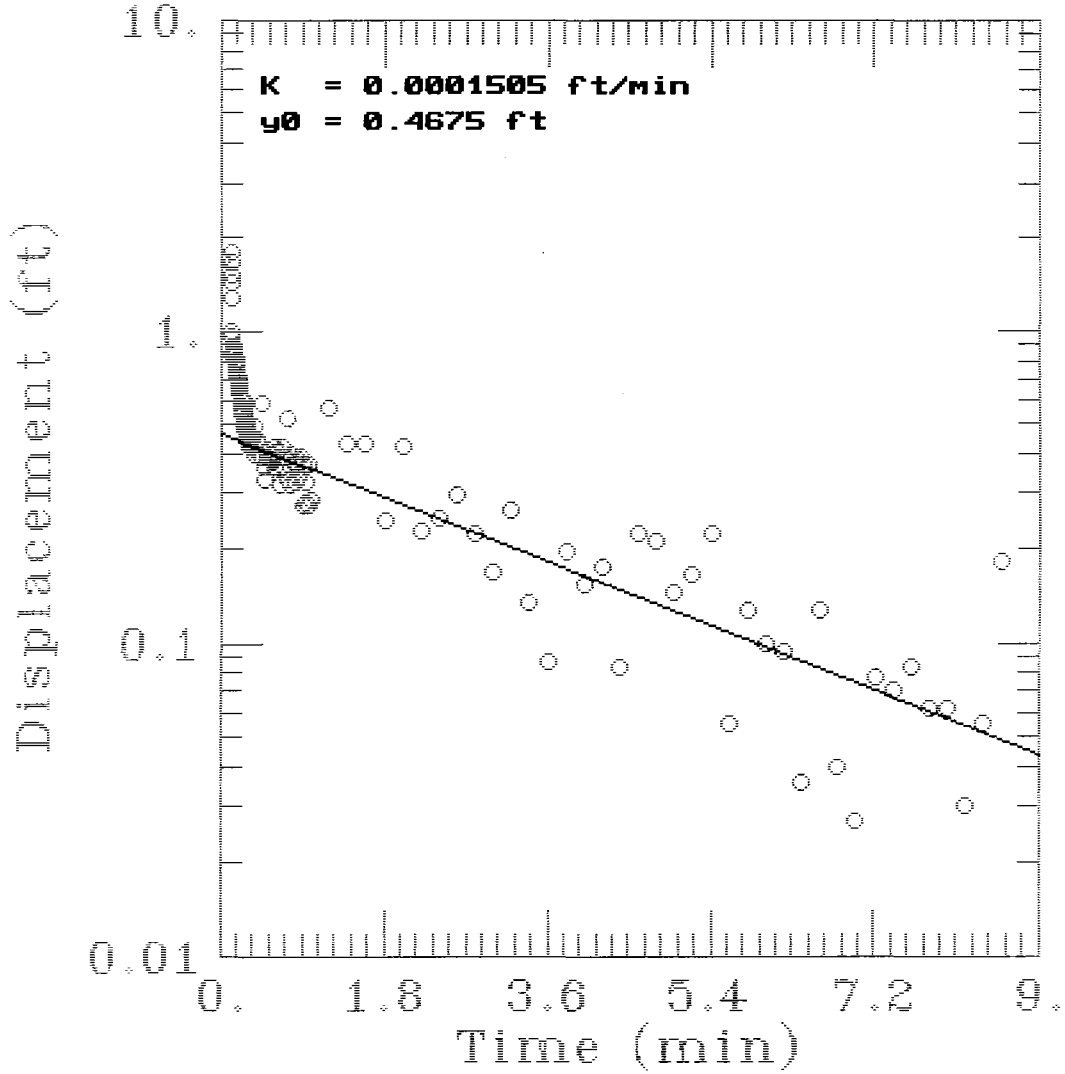

Facility I.D. # 0-791709

# Falling Head Slug Test on N-126 MW-4



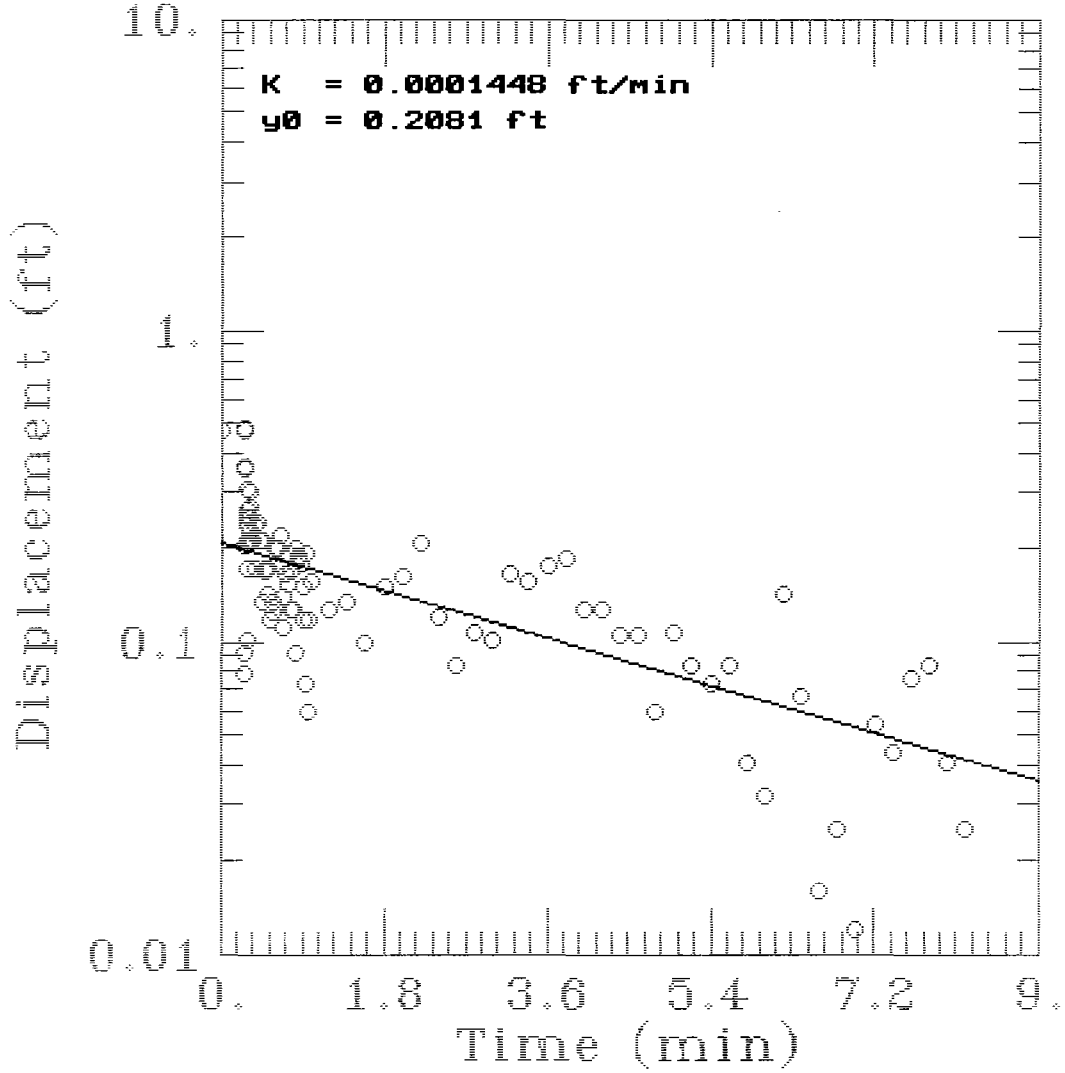

Facility I.D. # 0-791709

# Rising Head Slug Test on N-126 MW-4



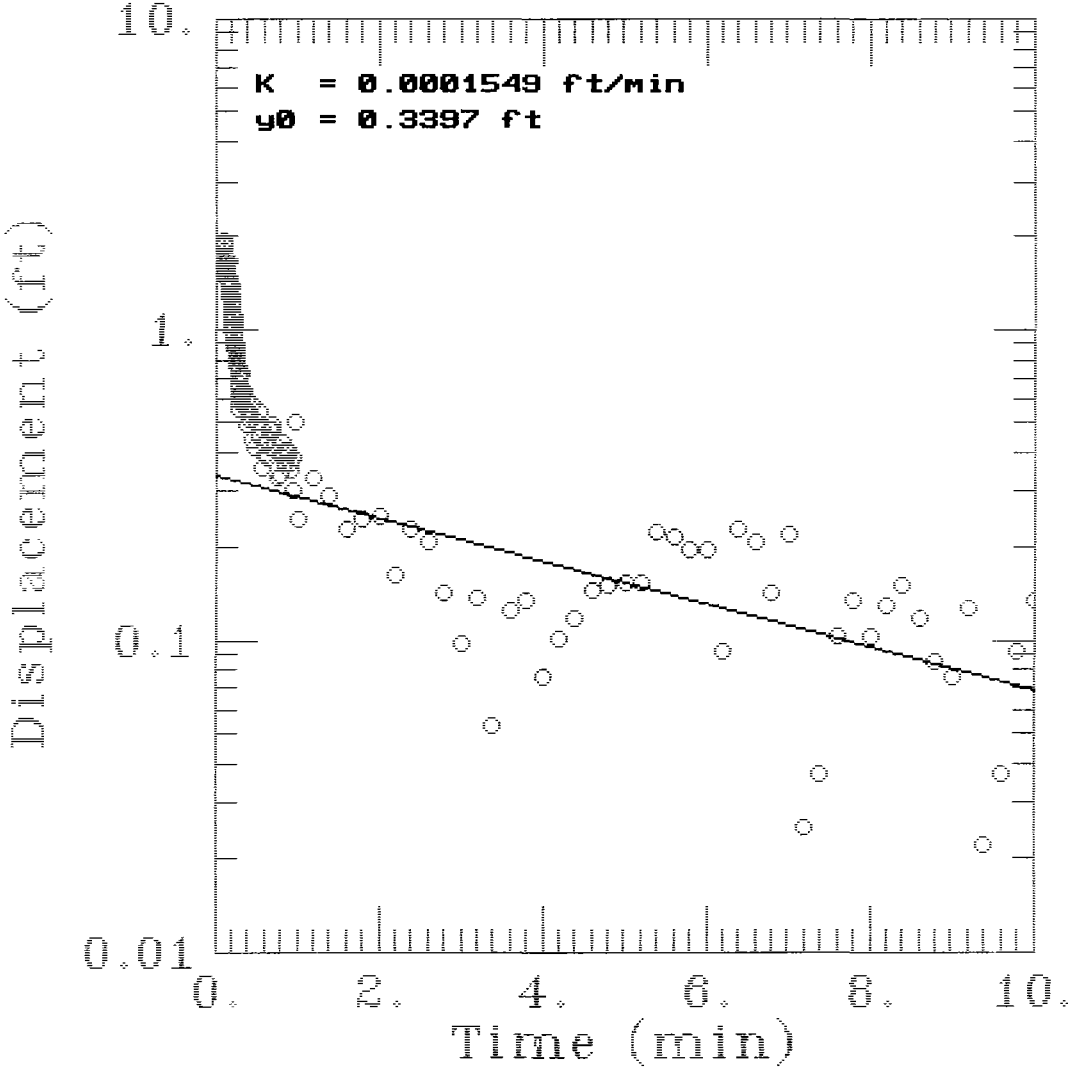

Facility I.D. # 0-791709

# Falling Head Slug Test on N-126 MW-5




**Facility I.D. # 0-791709**

# Rising Head Slug Test on N-126 MW-5




Facility I.D. # 0-791709

# APPENDIX E

## Well Construction Logs

# WELL CONSTRUCTION LOG. N-MW-1

NAS MEMPHIS UST EAR

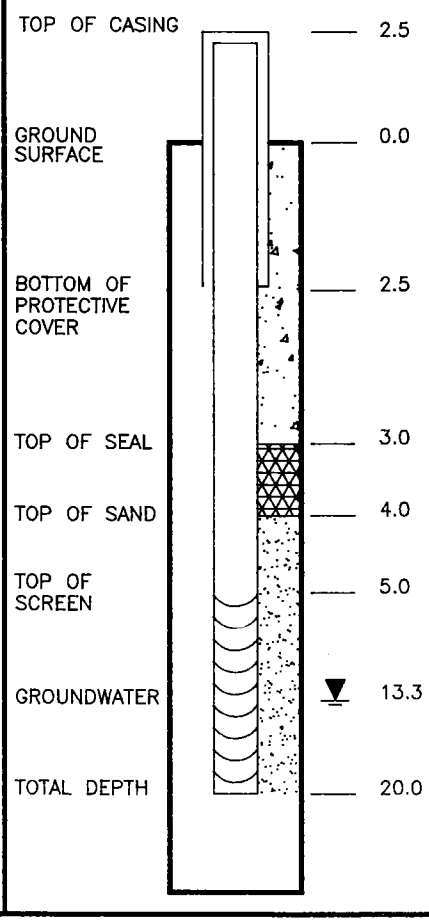
WELL LOCATION BLDG. N-126

DATE INSTALLED 13 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 273.21 (7/20/93)
   a) DEPTH TO SATURATED ZONE 13.3 FEET
3. TOP OF CASING ELEV. 285.95
4. PROTECTIVE CASING YES (NO)
   a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
    QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
    QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
    GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
    METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS UPGRADIENT WELL

## INSTALLATION DESCRIPTION




JOB NUMBER 067-C0109

ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

BUILDING N-126
MONITORING WELL N-MW-1
WELL CONSTRUCTION LOG

DATE: 09/27/93 | DWG NAME: 067NWC1

# WELL CONSTRUCTION LOG. N-MW-2

NAS MEMPHIS UST EAR

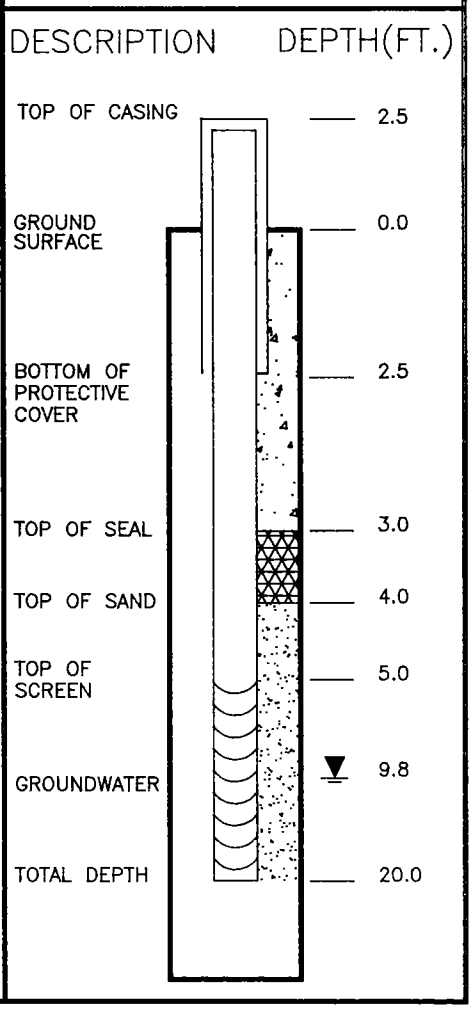
WELL LOCATION BLDG. N-126

DATE INSTALLED 14 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 268.26 (7/20/93)
   a) DEPTH TO SATURATED ZONE 9.8 FEET
3. TOP OF CASING ELEV. 284.76
4. PROTECTIVE CASING YES (NO)
   a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
    QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
    QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
    GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
    METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS

## INSTALLATION DESCRIPTION




JOB NUMBER 067-C0109

ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

BUILDING N-126
MONITORING WELL N-MW-2
WELL CONSTRUCTION LOG

DATE: 09/27/93 | DWG NAME: 067NWC2

# WELL CONSTRUCTION LOG. N-MW-3

NAS MEMPHIS UST EAR

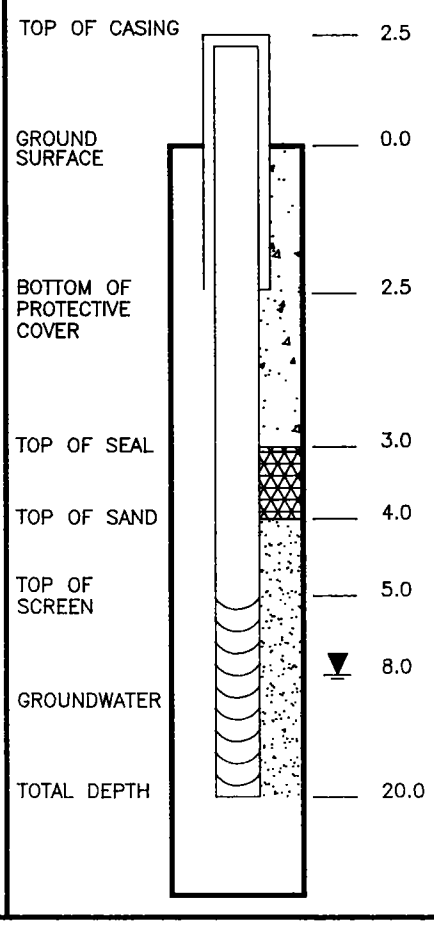
WELL LOCATION BLDG. N-126

DATE INSTALLED 13 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 269.82 (7/20/93)
   a) DEPTH TO SATURATED ZONE 9.8 FEET
3. TOP OF CASING ELEV. 285.90
4. PROTECTIVE CASING YES (NO)
   a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
    QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
    QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
    GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
    METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS

## INSTALLATION DESCRIPTION




JOB NUMBER 067-C0109

ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

BUILDING N-126
MONITORING WELL N-MW-3
WELL CONSTRUCTION LOG

DATE: 09/27/93 | DWG NAME: 067NWC3

# WELL CONSTRUCTION LOG. N-MW-4

NAS MEMPHIS UST EAR

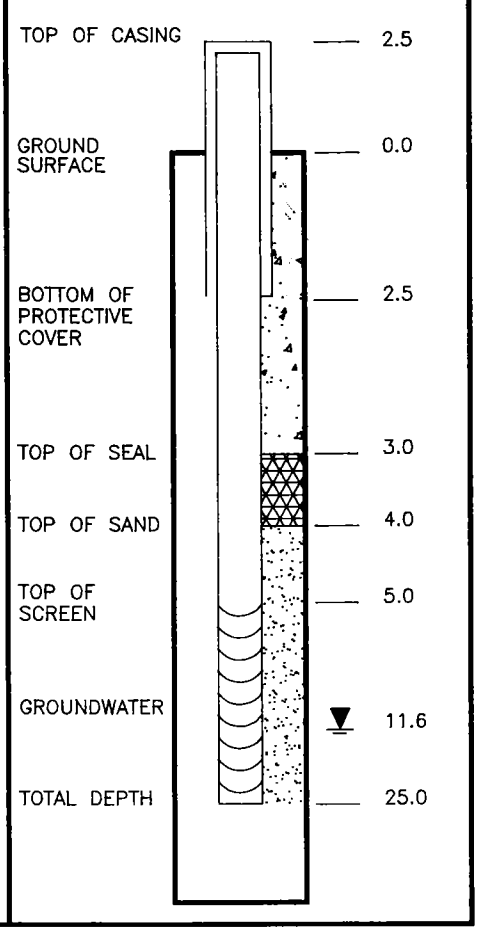
WELL LOCATION BLDG. N-126

DATE INSTALLED 14 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 276.23 (7/20/93)
   a) DEPTH TO SATURATED ZONE 11.6 FEET
3. TOP OF CASING ELEV. 286.53
4. PROTECTIVE CASING YES (NO)
   a) CASING LENGTH N/A
5. LENGTH OF SCREEN 20.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 25.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 25.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
    QUANTITY USED 714 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
    QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
    GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
    METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS TOTAL DEPTH DRILLED TO 25.0 FEET DUE TO APPROXIMATE 3 TO 4 FOOT INCREASE IN TOPOGRAPHIC SURFACE ELEVATION IN RELATION TO OTHER WELLS.

## INSTALLATION DESCRIPTION




JOB NUMBER 067-C0109

ENVIRONMENTAL ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

BUILDING N-126
MONITORING WELL N-MW-4
WELL CONSTRUCTION LOG

DATE: 11/17/93 | DWG NAME: 067NWC4

# WELL CONSTRUCTION LOG. N-MW-5

NAS MEMPHIS UST EAR

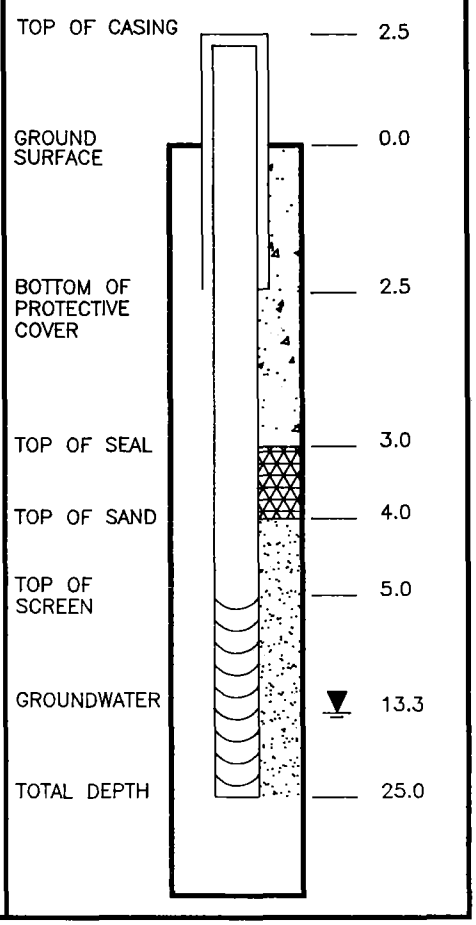
WELL LOCATION BLDG. N-126

DATE INSTALLED 13 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 266.01 (7/20/93)
   a) DEPTH TO SATURATED ZONE 13.3 FEET
3. TOP OF CASING ELEV. 285.19
4. PROTECTIVE CASING YES (NO)
   a) CASING LENGTH N/A
5. LENGTH OF SCREEN 20.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 25.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 25.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
    QUANTITY USED 714 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
    QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
    GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
    METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS EXTRA WELL PLACED IN CONTAMINATION PLUME NEXT TO TANK EXCAVATION

## INSTALLATION DESCRIPTION




JOB NUMBER 067-C0109

ENVIRONMENTAL ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

BUILDING N-126
MONITORING WELL N-MW-5
WELL CONSTRUCTION LOG

DATE: 11/17/93 | DWG NAME: 067NWC5

# WELL CONSTRUCTION LOG. N-MW-6

NAS MEMPHIS UST EAR

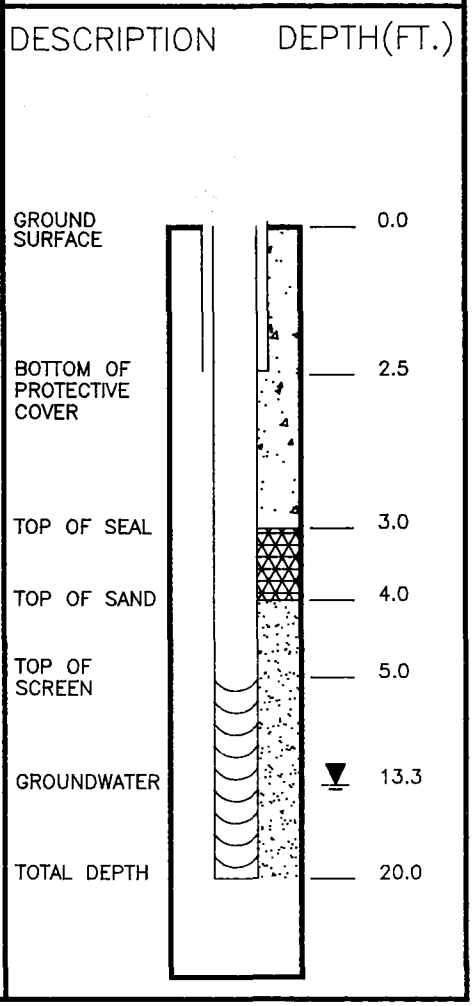
WELL LOCATION BLDG. N-126

DATE INSTALLED 15 JULY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 0 FEET
2. WATER SURFACE ELEV. 268.28 (7/20/93)
   a) DEPTH TO SATURATED ZONE 13.3 FEET
3. TOP OF CASING ELEV. 281.95
4. PROTECTIVE CASING YES (NO)
   a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
    QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
    QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
    GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
    METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS ASSUMED DOWNGRADIENT WELL

## INSTALLATION DESCRIPTION




JOB NUMBER 067-C0109

ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

BUILDING N-126
MONITORING WELL N-MW-6
WELL CONSTRUCTION LOG

DATE: 09/27/93 | DWG NAME: 067NWC6

# APPENDIX F

## Groundwater Analytical Results

## BTEX/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-1 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4840 | Extraction Date: | NA |
| Sample Matrix: | WATER | Analysis Date: | 06/07/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 1 | U | 1 |
| toluene | 1 | U | 1 |
| ethyl benzene | 1 | U | 1 |
| xylenes (total) | 1 | U | 1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 100 | U | 100 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: WATER | (72-119%) | (65-129) |
| Lab Sample I.D. | | |
| XX4840 | 100 | 101 |

**Facility I.D. # 0-791709**

## BTEX/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-2 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4841 | Extraction Date: | NA |
| Sample Matrix: | WATER | Analysis Date: | 06/04/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 1 | U | 1 |
| toluene | 1 | U | 1 |
| ethyl benzene | 1 | U | 1 |
| xylenes (total) | 1 | U | 1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 100 | U | 100 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: WATER | (72-119%) | (65-129) |
| Lab Sample I.D. | | |
| XX4841 | 99 | 100 |

**Facility I.D. # 0-791709**

## BTEX/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-2 DUP | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4842 | Extraction Date: | NA |
| Sample Matrix: | WATER | Analysis Date: | 06/04/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 1 | U | 1 |
| toluene | 1 | U | 1 |
| ethyl benzene | 1 | U | 1 |
| xylenes (total) | 1 | U | 1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 100 | U | 100 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: WATER | (72-119%) | (65-129) |
| Lab Sample I.D. | | |
| XX4842 | 99 | 102 |

**Facility I.D. # 0-791709**

## BTEX/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-3 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4843 | Extraction Date: | NA |
| Sample Matrix: | WATER | Analysis Date: | 06/04/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 1 | U | 1 |
| toluene | 1 | U | 1 |
| ethyl benzene | 1 | U | 1 |
| xylenes (total) | 1 | U | 1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 100 | U | 100 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: WATER | (72-119%) | (65-129) |
| Lab Sample I.D. | | |
| XX4843 | 100 | 109 |

**Facility I.D. # 0-791709**

# MATRIX SPIKE/MATRIX SPIKE DUPLICATE ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-3 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4843, XX4844, XX4845 | Extraction Date: | NA |
| Sample Matrix: | WATER | Analysis Date: | 06/04/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Sample Result | | Conc. Spike Added | Conc. MS | % Rec. | Conc. MSD | % Rec. | RPD |
|---|---|---|---|---|---|---|---|---|
| total low boiling petroleum hydrocarbons, as gasoline range organics | 100 | U | 1,000 | 700 | 70 | 730 | 73 | 4 |

| Surrogate Recovery | Bromofluorobenzene (FID) |
|---|---|
| Acceptance Limits: WATER | (65-129%) |
| Lab Sample I.D. | |
| XX4844 MS | 114 |
| XX4845 MSD | 114 |

**Facility I.D. # 0-791709**

## BTEX/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-4 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4846 | Extraction Date: | NA |
| Sample Matrix: | WATER | Analysis Date: | 06/04/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 1 | U | 1 |
| toluene | 1 | U | 1 |
| ethyl benzene | 1 | U | 1 |
| xylenes (total) | 1 | U | 1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 100 | U | 100 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: WATER | (72-119%) | (65-129) |
| Lab Sample I.D. | | |
| XX4846 | 102 | 101 |

**Facility I.D. # 0-791709**

## BTEX/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-5 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4847 | Extraction Date: | NA |
| Sample Matrix: | WATER | Analysis Date: | 06/04/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| benzene | 1 | U | 1 |
| toluene | 1 | U | 1 |
| ethyl benzene | 1 | U | 1 |
| xylenes (total) | 2 | ⊕ | 1 |
| total low boiling petroleum hydrocarbons, as gasoline range organics | 170 | | 100 |

| Surrogate Recovery | Bromofluorobenzene (PID) | Bromofluorobenzene (FID) |
|---|---|---|
| Acceptance Limits: WATER | (72-119%) | (65-129) |
| Lab Sample I.D. | | |
| XX4847 | 103 | 110 |

⊕ - Analyte confirmed on secondary column on 06/09/93.

**Facility I.D. # 0-791709**

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-1 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4830 | Extraction Date: | 06/01/93 |
| Sample Matrix: | WATER | Analysis Date: | 06/12/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 100 | U | 100 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: WATER | (23-132%) | (31-155%) |
| Lab Sample I.D. | | |
| XX4830 | 90 | 94 |

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-2 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4831 | Extraction Date: | 06/01/93 |
| Sample Matrix: | WATER | Analysis Date: | 06/12/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 100 | U | 100 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: WATER | (23-132%) | (31-155%) |
| Lab Sample I.D. | | |
| XX4831 | 116 | 126 |

**Facility I.D. # 0-791709**

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-2 DUP | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4832 | Extraction Date: | 06/01/93 |
| Sample Matrix: | WATER | Analysis Date: | 06/12/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 100 | U | 100 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: WATER | (23-132%) | (31-155%) |
| Lab Sample I.D. | | |
| XX4832 | 95 | 100 |

**Facility I.D. # 0-791709**

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-3 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4833 | Extraction Date: | 06/01/93 |
| Sample Matrix: | WATER | Analysis Date: | 06/12/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 100 | U | 100 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: WATER | (23-132%) | (31-155%) |
| Lab Sample I.D. | | |
| XX4833 | 110 | 117 |

**Facility I.D. # 0-791709**

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54176 |
| Client Sample ID: | N-MW-3 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4833, XX4834, XX4835 | Extraction Date: | 06/01/93 |
| Sample Matrix: | WATER | Analysis Date: | 06/12/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Sample Result | | Conc. Spike Added | Conc. MS | % Rec. | Conc. MSD | % Rec. | RPD |
|---|---|---|---|---|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 100 | U | 1,200 | 1,700 | 142 | 1,600 | 133 | 7 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: WATER | (23-132%) | (31-155%) |
| Lab Sample I.D. | | |
| XX4843 MS | 98 | 100 |
| XX4835 MSD | 96 | 88 |

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-4 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4836 | Extraction Date: | 06/01/93 |
| Sample Matrix: | WATER | Analysis Date: | 06/12/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 100 | U | 100 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: WATER | (23-132%) | (31-155%) |
| Lab Sample I.D. | | |
| XX4836 | 95 | 103 |

**Facility I.D. # 0-791709**

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name: | ITAS-KNOXVILLE | SDG Number: | NA |
| Contract Name: | NAS MEMPHIS | Job Number: | ENFA 54185 |
| Client Sample ID: | N-MW-5 | Collection Date: | 05/27/93 |
| Lab Sample ID: | XX4837 | Extraction Date: | 06/01/93 |
| Sample Matrix: | WATER | Analysis Date: | 06/14/93 |
| Concentration Units: | $\mu$g/liter (ppb) | Dryness Factor: | NA |

| Compound | Results | Qualifiers | Detection Limits |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel range organics | 17,000 | | 1,000 |

| Surrogate Recovery | $C_{23}$ | $C_{32}$ |
|---|---|---|
| Acceptance Limits: WATER | (23-132%) | (31-155%) |
| Lab Sample I.D. | | |
| XX4837 | 96 | 78 |

**Facility I.D. # 0-791709**

**ITAS-KNOXVILLE**

Job Number: **EMFA 54398**

VOLATILE ORGANICS/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Results in (ug/l (ppb)) mg/kg (ppm) ug/l (ppb) (Circle One)

Sample Matrix: **WATER**

Client Sample I.D.: **N-MW-6**

Lab Sample I.D.: **XX9895**

| Compound | Concentration |
|---|---|
| benzene | ✓ 1u |
| toluene | ✓ 1u |
| ethyl benzene | ✓ 1u |
| xylenes (total) | ✓ 1u |
| MTBE | — |
| total low boiling petroleum hydrocarbons as gasoline | — |
| total low boiling petroleum hydrocarbons, as gasoline range organics | ✓ 100u |

QC ✓ DMW 8.12.93

| SURROGATE RECOVERY | BFB (PID) | BFB (FID) |
|---|---|---|
| ACCEPTANCE LIMITS: WATER | (72-119) | (65-129) |
| SOIL | ~~(78-124)~~ | ~~(50-126)~~ |
| XX9895 | ✓ 98 | ✓ 100 |
| | | |
| | | |

D1 - Analyzed at _____ dilution on _____.
D2 - Analyzed at _____ dilution on _____.
D3 - Analyzed at _____ dilution on _____.
X - _____% of the GRO value was contributed by a single component tentatively identified as methyl tert-butyl ether.

Extraction Date: —

✓ Analysis Date : 8-3-93

Comments: BTX

Facility I.D. # 0-791709

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name | : ITAS-KNOXVILLE | SDG Number | : |
| Contract Name | : NAS MEMPHIS | Job Number | : ENFA 54598 |
| Client Sample I.D. | : N-MW-6 | Collection Date | : 07/20/93 |
| Lab Sample I.D. | : XX9901 | Extraction Date | : 7/26/93 |
| Sample Matrix | : WATER | Analysis Date(s) | : 8/5/93 |
| Concentration Units: | ug/L or mg/Kg | Dryness Factor | : — |

| COMPOUND | RESULTS | QUALIFIERS | DETECTION LIMITS |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel ~~fuel~~ Range Organics | 2000 | | 100 |

| SURROGATE RECOVERY | C23 | C32 |
|---|---|---|
| ACCEPTANCE LIMITS: SOIL<br>WATER | (41 - 149)<br>(23 - 132) | (59 - 179)<br>(31 - 155) |
| LAB I.D. | | |
| XX9901 | 119 ~~143~~ | 179 |
| ~~Surrogate skewed off baseline~~ | ~~119~~ | |
| | | |

QC ✓ 8/12/93

DB = HBH.DTF
DP FORM = REPHBH
LAB FORM = MATHHBH
BLANK SPIKE = HBHBS
MS/MSD = HBHMSMSD

Facility I.D. # 0-791709

ITAS-KNOXVILLE

Job Number: EMFA 54598

VOLATILE ORGANICS/LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Results in ug/l (ppb) mg/kg (ppm) ug/l (ppb) (Circle One)

Sample Matrix: WATER

Client Sample I.D.: N-MW-6-DUP

Lab Sample I.D.: XX9896

| Compound | Concentration |
|---|---|
| benzene | ✓ 1u |
| toluene | ✓ 1u |
| ethyl benzene | ✓ 1u |
| xylenes (total) | ✓ 1u |
| MTBE | — |
| total low boiling petroleum hydrocarbons as gasoline | — |
| total low boiling petroleum hydrocarbons, as gasoline range organics | ✓ 100u |

QC ✓ 8/12.93

| SURROGATE RECOVERY | BFB (PID) | BFB (FID) |
|---|---|---|
| ACCEPTANCE LIMITS: WATER | (72-119) | (65-129) |
| ~~SOIL~~ | ~~(78-124)~~ | ~~(50-126)~~ |
| XX9896 | ✓ 100 | ✓ 94 |
| | | |
| | | |

D1 - Analyzed at _____ dilution on _____.
D2 - Analyzed at _____ dilution on _____.
D3 - Analyzed at _____ dilution on _____.
X - ____ % of the GRO value was contributed by a single component tentatively identified as methyl tert-butyl ether.

Extraction Date: —

Analysis Date : 8-2-93

Comments: BTX

Facility I.D. # 0-791709

# HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

| | | | |
|---|---|---|---|
| Laboratory Name | : ITAS-KNOXVILLE | SDG Number | : |
| Contract Name | : NAS MEMPHIS | Job Number | : ENFA 54598 |
| Client Sample I.D. | : N-MW-6-DUP | Collection Date | : 07/20/93 |
| Lab Sample I.D. | : XX9902 | Extraction Date | : 7/26/93 |
| Sample Matrix | : WATER | Analysis Date(s) | : 8/5/93 |
| Concentration Units: | ug/L or mg/Kg | Dryness Factor | : -- |

| COMPOUND | RESULTS | QUALIFIERS | DETECTION LIMITS |
|---|---|---|---|
| total high boiling petroleum hydrocarbons, as diesel ~~fuel~~ Range Organics | 1500 | | 100 |

| SURROGATE RECOVERY | C23 | C32 |
|---|---|---|
| ACCEPTANCE LIMITS: SOIL | (41 - 149) | (59 - 179) |
| WATER | (23 - 132) | (31 - 155) |
| LAB I.D. | | |
| XX9902 | 107 | 135 |
| | | |
| | | |

8/12/93

DB = HBH.DTF
DP FORM = REPHBH
LAB FORM = MATHHBH
BLANK SPIKE = HBHBS
MS/MSD = HBHMSMSD

Facility I.D. # 0-791709

# APPENDIX G

## Shelby County Well Survey

MEMPHIS AND SHELBY COUNTY
HEALTH DEPARTMENT

RICHARD SWIGGART, M.P.A.
*Director*

SHERMAN KAHN, M.D.
*Health Officer*

DR. W. W. HERENTON
*Mayor of Memphis*

WILLIAM N. MORRIS, JR.
*Mayor of Shelby County*

August 6, 1992

EnSafe / Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134

Attn: Lawson M. Anderson

RE: Environmental Site Assessment
Water Well Search
Millington Naval Air Station-Willis Gate
Intersection Of Navy Road And Third Avenue
Millington, Tennessee

Dear Mr. Anderson:

Please find enclosed a list of quasi-public, commercial, and residential wells located within an approximate two (2) mile radius of the above location that are contained in our files. This list does not contain the location of any public water supply wells that are operated by the Public Utility Division, nor does it contain wells used for groundwater monitoring. Public water well information may be obtained from Memphis Light, Gas, and Water Division, 245 South Main St., Memphis, Tennessee (901)528-4011. Information regarding monitoring wells associated with leaking petroleum storage tanks may be obtained from the Tennessee Department of Environment and Conservation, Division of Water Management, 2500 Mt. Moriah Road, (901)543-6695.

Our records indicate five (5) wells on the Naval Air Station property, however, information regarding the exact location, use, and depth of these wells is not included in our files. You may contact Lt. Ron Gruzesky, NAS Memphis, 873-5230 for additional information about these wells.



wp-0075I/115

Facility I.D. # 0-791709

814 JEFFERSON AVENUE, MEMPHIS, TENNESSEE 38105
PHONE (901) 576-7600 FAX (901) 576-7832

I hope this clarifies the facts for which we have records on file in our office. If Pollution Control can be of further assistance, feel free to contact me at 576-7775.

Sincerely,

S. L. Sherrill, Jr., Asst. Manager
POLLUTION CONTROL

ENCLOSURE

wp-0075I/116
WAS/SLS
HK-199

# WATER WELL LIST

 August 6, 1992

Water Well Number: 1
Owner of Well: James E. Krosp
Location of Well: 7378 Krosp Road
Mailing Address: James E. Krosp
7378 Krosp Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 150 Feet
Well Classification: Residential

Water Well Number: 2
Owner of Well: Clifford O. Longmire
Location of Well: 7431 Krosp Road
Mailing Address: Clifford O. Longmire
7431 Krosp Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 120 Feet
Well Classification: Residential

Water Well Number: 3
Owner of Well: Terry Longmire
Location of Well: 7473 Krosp Road
Mailing Address: Terry Longmire
7473 Krosp Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 130 Feet
Well Classification: Residential

Water Well Number: 4
Owner of Well: Phoenix Zinc
Location of Well: 4525/4599 Big Creek Church Road
Mailing Address: 4525/4599 Big Creek Church Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: Not Listed
Well Classification: Commercial

Water Well Number: 5
Owner of Well: Shelby County Conservation Board
Location of Well: Edmond Orgill Park
Mailing Address: Shelby County Conservation Board
2599 Avery
Memphis, TN 38053
Attn: Ed Price
Number of wells at this location: 1
Well Depth: Depth Not Listed
Well Classification: Irrigation And To Maintain Lake Level

August 6, 1992

Water Well Number: 6
Owner of Well: Harold Bradley
Location of Well: 5230 Bateman Road
Mailing Address: Harold Bradley
5230 Batman Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 150 Feet
Well Classification: Residential