N00639.AR.002233
NSA MID SOUTH
5090.3a

ENVIRONMENTAL ASSESSMENT REPORT BUILDING 376 FACILITY ID # 0-791673
MILLINGTON SUPPACT TN
10/2/1992
ENVIRONMENTAL AND SAFETY DESIGNS, INC.

ENVIRONMENTAL ASSESSMENT REPORT
NAS Memphis
Building 376
Facility I.D. 0-791673

Contract No. N62467-91-D-4550

Submitted to

NAS Memphis
Millington, Tennessee

Prepared by

Environmental and Safety Designs, Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901)372-7962

October 2, 1992

Table of Contents

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

This Environmental Assessment Report (EAR) presents the findings of the assessment of petroleum hydrocarbon contamination associated with two registered gasoline underground storage tanks located at the Naval Air Station Memphis Building 376 fuel facility in Millington, Tennessee. The following conclusions and recommendations are based on the information gathered during the assessment activities.

Conclusions:

- TPH and benzene concentrations in groundwater exceeding the TDEC cleanup levels for a non-drinking water aquifer are isolated to the immediate vicinity of Tank 1482. Petroleum hydrocarbons do not appear to have migrated to downgradient monitoring wells MW-2 and MW-3.

- Benzene and TPH concentrations in groundwater exceeded the TDEC cleanup levels for non-drinking water in two leak detection wells around Tank 1482. No benzene or TPH concentrations were detected in excess of the respective cleanup levels in the four monitoring wells installed as part of the environmental assessment.

- BTEX 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.

- The groundwater flow direction beneath the site is in a westerly direction and has a calculated hydraulic gradient ranging from 0.049 to 0.066 ft/ft.

- Depth to the static water table beneath the site ranges between 4 and 9 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 8.7×10^{-8} to 9.3×10^{-8} cm/s, typical permeabilities of clay.

- 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.

Recommendations:

In lieu of a Corrective Action Plan, EnSafe recommends closure of both tank systems. Life expectancies of asphalt-coated steel tanks commonly range from 12 to 18 years (Steel Tank Institute, telephone conversation, 9/17/92) depending largely on soil conditions and the manner of tank installation. Tank systems 1482 and 1249 have been in service well beyond their life expectancies (25 years and 42 years, respectively).

Tank 1482 (located west of the building) is reportedly empty and temporarily out of service. In order for this tank to remain in compliance, an amended notification form should be filed within 90 days of the date in which the tank was taken out of service, vent lines should remain open and functioning and all other lines, pumps and ancillary equipment should be secured. If the tank system remains out of service for 12 months, the UST system should be permanently closed at the end of this period, unless the UST Division provides a written extension to this closure period (Rule 1200-1-15-07-1C). Contaminated soils and groundwater located within the tank excavation and immediately surrounding it, should be removed during the tank closure.

Tank 1249 may remain in compliance until December 22, 1998 if release detection requirements are followed in accordance with Rule 1200-1-15-.04. This tank system will then be required to be either upgraded, replaced with a new UST system meeting the new performance standards or permanently closed.

Though groundwater contamination appears limited to the immediate vicinity of Tank 1482, Tank 1249 cannot be ruled out as a possible contributor to this contamination. Free product was noted in a leak-detection well in December, 1991 around this tank and was attributed to a faulty tank valve union on the tank. Because Tank 1249 is located hydrologically upgradient, it is possible that groundwater contamination has extended beneath the building and into the Tank 1482 excavation. Therefore closure of Tank 1482 solely, may be only a temporary solution to the current contaminated groundwater in the tank excavation.

If closure of the tank systems is not deemed to be an option at this time and they are intended to remain in service, then EnSafe recommends quarterly monitoring of the two leak detection wells around Tank 1482 and the two downgradient monitoring wells to ensure contaminants do not migrate outside the tank excavation. Considering the relatively impermeable nature of the native soils outside the excavation, the likelihood of contaminants migrating great distances beyond the excavation is minimal.

1.0 INTRODUCTION

On July 9, 1992, EnSafe was retained by the Department of the Navy to conduct an Environmental Assessment at the Building 376 fuel facility located on D Street 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 facility. The source of the release was reportedly a faulty gasket at the fuel island and a leaking tank valve union on the 4,250 gallon gasoline tank (Tank 1249). The quantity of the suspected release was not known. This investigation has been completed in accordance with the Department of Navy Contract N62467-91-D-4550.

1.1 Objectives and Scope

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

Objectives:

- Determine whether soil and/or groundwater are contaminated.
- Determine the horizontal and vertical extent of contamination.
- 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.
- Collect adequate information such that possible corrective action measures (if needed) could be developed.

The scope of work in this investigation included the following:

- A groundwater sampling survey over the site using a Geoprobe sampler and a portable gas chromatograph to determine optimum monitoring well/soil boring locations.

- Installation of six soil borings and four 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, ethylbenzene, and xylenes (BTEX) and total petroleum hydrocarbons (TPH).

- Identification of potential contamination pathways and receptors.

1.2 Previous Work/Background Information

Free product was discovered on December 9, 1991, in leak detection wells surrounding tank 1249. The following day both fuel storage tanks were emptied and the TDEC was notified that a release had occurred. The State was again notified with a letter dated December 24, 1991, addressed to Mr. Hussein Ghelichkhani with the Underground Storage Tank Division.

A tank tightness test was performed by Tri State Testing and Drilling of Memphis, Tennessee, on January 23, 1992. Tank 1247 and the associated piping both passed the tightness test. The Tank 1249 system failed due to a leak in the piping. Further investigation determined that a gasket at the fuel island was faulty and a tank valve union at Tank 1249 needed reseating and repacking. The above repairs were completed on February 24, 1992. The quantity and duration of the release is unknown. A letter from TDEC (April 7, 1992) requested that an environmental assessment of the site be conducted to define the extent of petroleum contamination exceeding the applicable cleanup levels as a result of the release.

2.0 SITE LOCATION

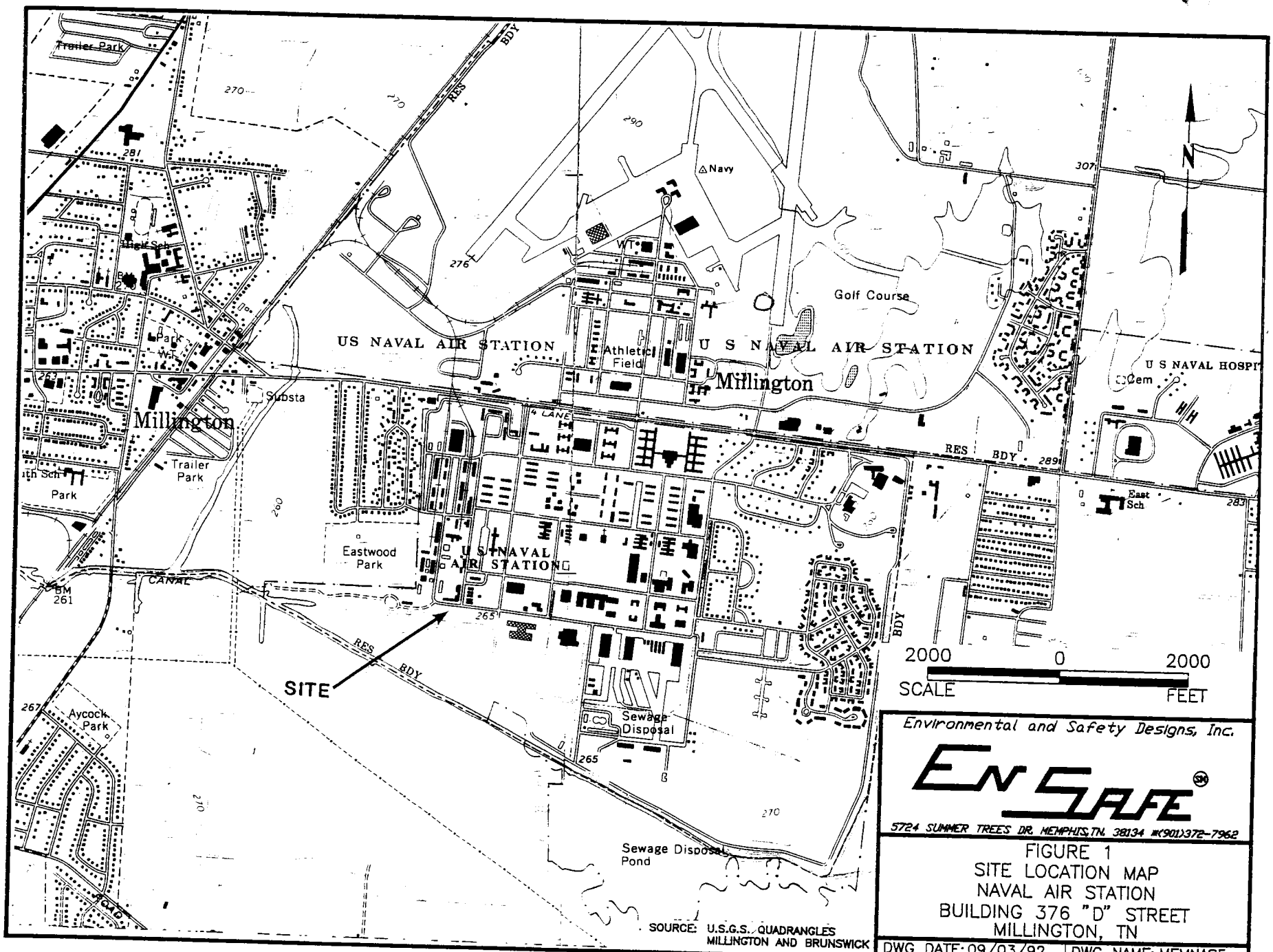
The Building 376 Fuel Facility is located on D Street at the Naval Air Station in Millington, Shelby County, Tennessee. The facility lies at approximately latitude 35° 19' 52" north and longitude 89° 52' 53" east on the U.S.G.S. Millington 7.5 Minute Series Quadrangle map. The subject site location is provided in Figure 1.

The fuel facility is located near the southwest corner of the naval base on the south side of D Street. The facility is at an elevation of approximately 265 feet above mean sea level. Area drainage across the site is toward the south into a low lying grass area which appears to drain to the west. Approximately 2 feet of relief exists between the northern and southern portions of the property. The site is completely covered with either concrete or asphalt.

The fuel facility contains two registered underground storage tanks, both containing gasoline used to service the naval vehicles. Naval Tank Number 1249 (Tank No. 1) has a capacity of 4,250 gallons and is constructed of asphalt coated steel. Naval Tank Number 1482 (Tank No. 2) is 8,000 gallons in capacity and is also constructed of asphalt coated steel. The tanks are manifolded together near the northeast corner of the facility's building where they lead to a single fuel line which services two fuel dispenser pumps near D Street. The tanks are located in two separate pits immediately east and west of Building 376 (shown in Figure 2).

3.0 GROUNDWATER INVESTIGATION

A limited groundwater investigation was completed to assess the extent of groundwater contamination beneath the site and to allow characterization of the surficial aquifer. Before installation of monitoring wells, a soil gas survey was planned for the site to facilitate monitoring well/soil boring placement and minimize the number of monitoring wells which would typically be required for sites with more than a single possible source.



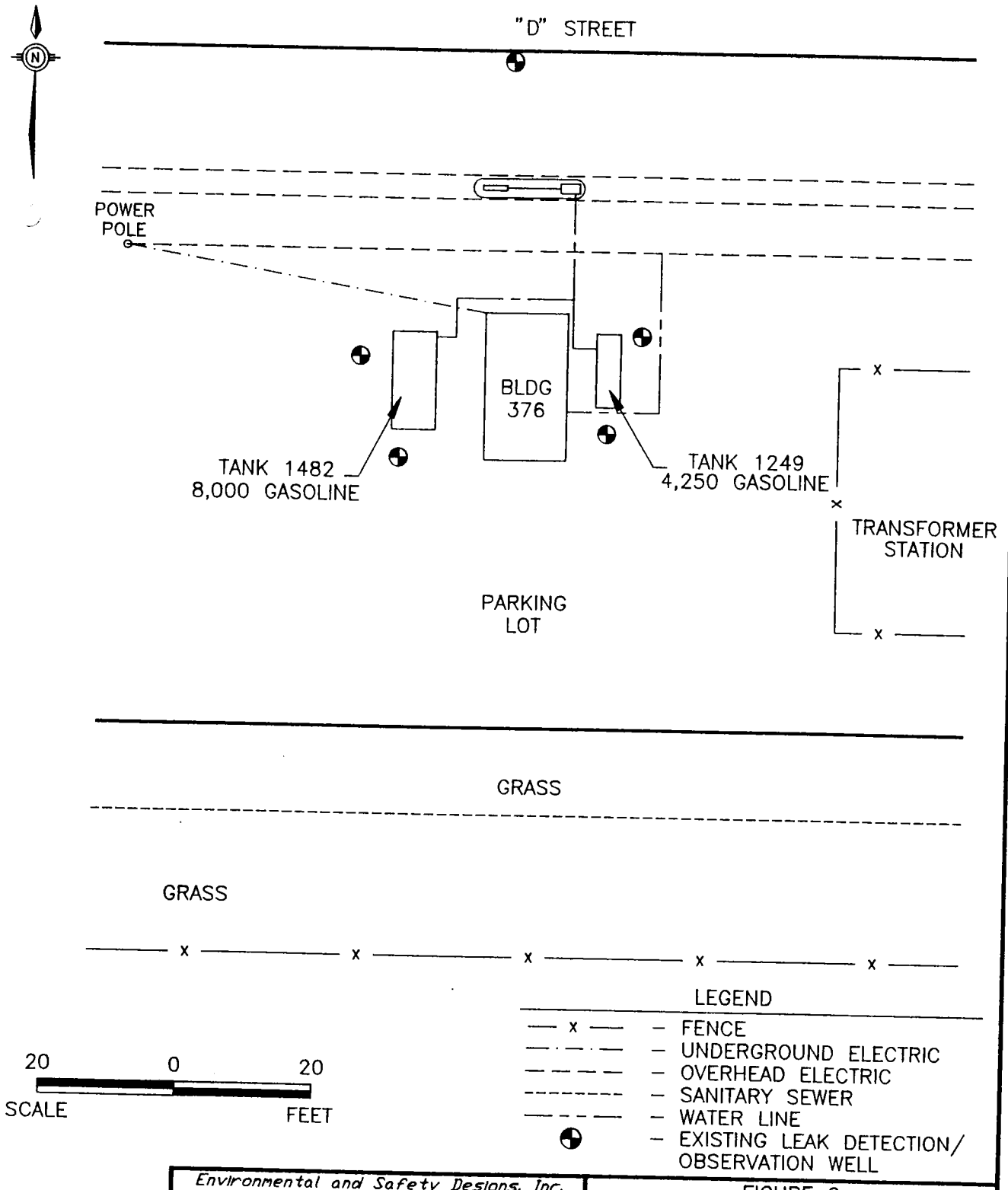
Environmental and Safety Designs, Inc.

ENSAFE®

5724 SUMMER TREES DR. MEMPHIS, TN. 38134 ☎(901)372-7962

FIGURE 1
SITE LOCATION MAP
NAVAL AIR STATION
BUILDING 376 "D" STREET
MILLINGTON, TN

DWG DATE: 09/03/92 | DWG NAME: MEMNAS5



Environmental and Safety Designs, Inc.
EnSafe
5724 SUMMER TREES DR. MEMPHIS, TN. 38134 ☎(901)372-7962

FIGURE 2
NAVAL AIR STATION
BUILDING 376
"D" STREET
MILLINGTON, TN

DATE: 09/08/92

DWG NAME: MEMNAS1

3.1 Soil Gas Survey

Plains Environmental Services (PES) of Salina, Kansas, was subcontracted to perform the soil gas survey. EnSafe and PES personnel were onsite July 23, 1992, to conduct the survey. PES used a self-contained mobile laboratory to perform all of the work onsite. A hydraulically powered percussion probe mounted on the rear of a long wheelbase van was used to collect samples. A laboratory-quality (Shimadzu GC-14A with C-R4A Chromatopac data processor) gas chromatograph/flame ionization detector (GC/FID) was set up inside the van to analyze the samples. Probe accessories were available for collecting soil gas, soil core, or groundwater samples. Because tight and/or wet soil conditions prevented the collection of soil gas samples, EnSafe made the decision to collect groundwater samples for heated headspace analysis.

Groundwater samples were collected by pushing 3-foot sections of 1-inch outer diameter (OD) rods into the ground to the desired sampling depth. The rods were then withdrawn several inches, leaving the disposable rod tip behind and exposing the open end of the rod tip holder. Polyethylene tubing was then inserted through the rods to the boring's terminal depth. A groundwater sample was collected by applying a vacuum to the tubing. At most sample locations, water would not enter the hole until the probe was pushed to a depth of 15 feet. A 40 ml VOC vial was then half filled with groundwater and heated for 30 minutes at 60°C to drive the volatile components from the aqueous phase into the headspace. A headspace sample was then withdrawn from the vial and injected into the GC for BTEX and total volatile organics (TVO) analysis.

Groundwater survey data for Building 376 indicated contamination was isolated to the immediate vicinity of the fuel island and to the west of the building around Tank 1482. A small groundwater plume extending to the west of Tank 1482 suggests a westward groundwater flow direction. Water samples collected around Tank 1249 (the east tank) did not indicate

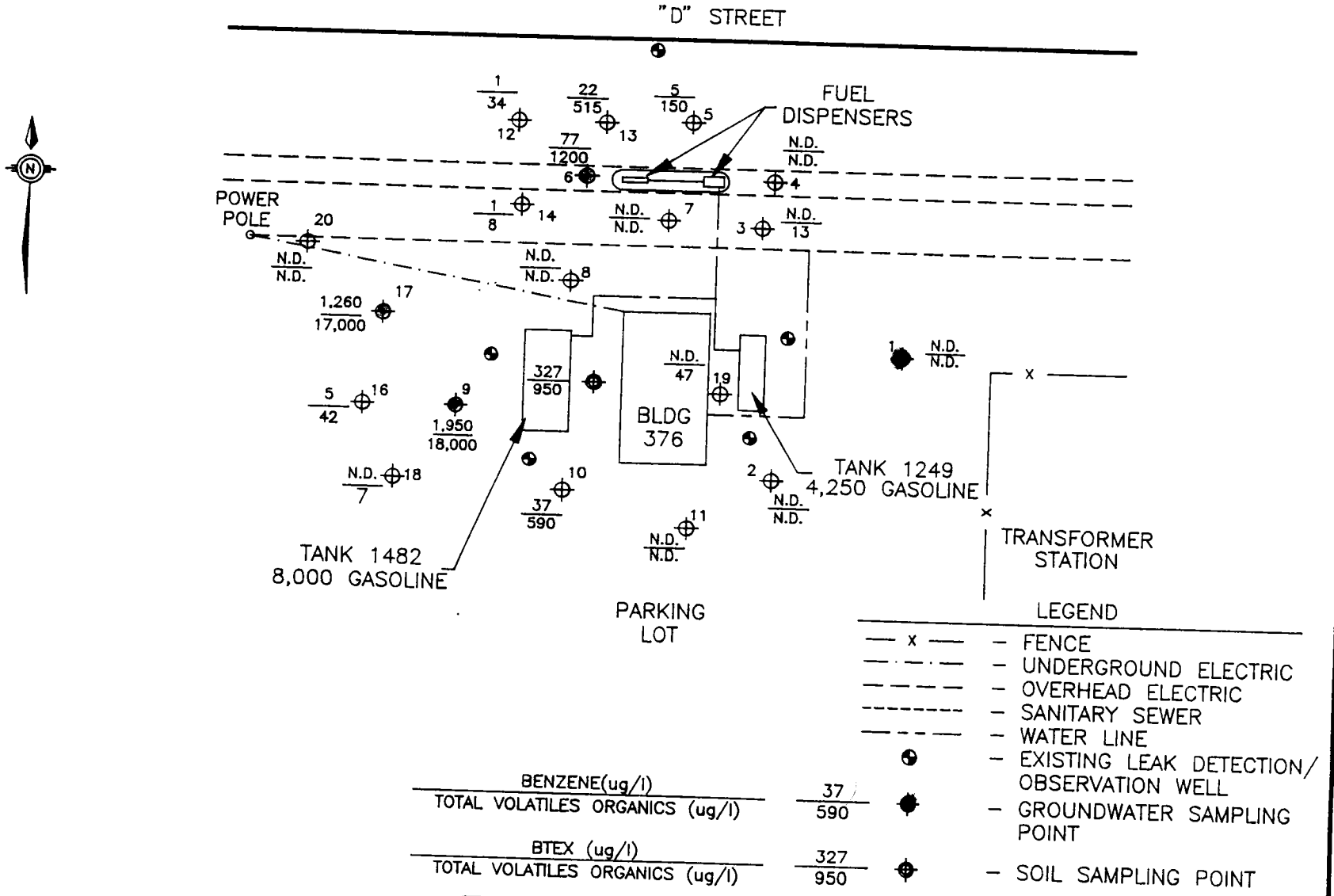
groundwater had been impacted outside the tank pit area. Shown in Figure 3 are the sample locations and the respective TVO and benzene concentrations.

As a result of this groundwater survey, the assumed direction of groundwater flow and the planned locations of groundwater monitoring wells were changed considerably. It must be stressed that these results are a screening tool only. The measurements are intended to indicate the presence and relative degree of contamination. They are not intended to correlate directly with actual levels of soil and/or groundwater contamination. Quantitative laboratory analyses using specific analytical procedures are a more accurate means of determining what levels of contamination may be present. The PES analytical data and report are included in this report as Appendix A.

3.2 Hydrogeology

Groundwater was encountered during boring activities between 7 and 9 feet below grade and was generally noted higher in completed monitoring wells. Groundwater elevations indicate semi confined groundwater conditions at the site. Piezometric surfaces range in elevation from 254.04 to 259.86 feet above mean sea level (8/4/92 data set).

The direction of groundwater flow in the surficial aquifer appears to be to the west with a calculated hydraulic gradient ranging between 0.049 to 0.066 ft/ft. Potentiometric maps are provided for water levels measured on August 3, 1992 (Figure 4) and August 14, 1992 (Figure 5). The groundwater flow direction does not follow the subtle topographic relief across the site (downgradient to the south), but appears to be influenced more by a grass/gravel area located immediately off the east end of the paved parking lot which may act as a groundwater recharge area.



Environmental and Safety Designs, Inc.

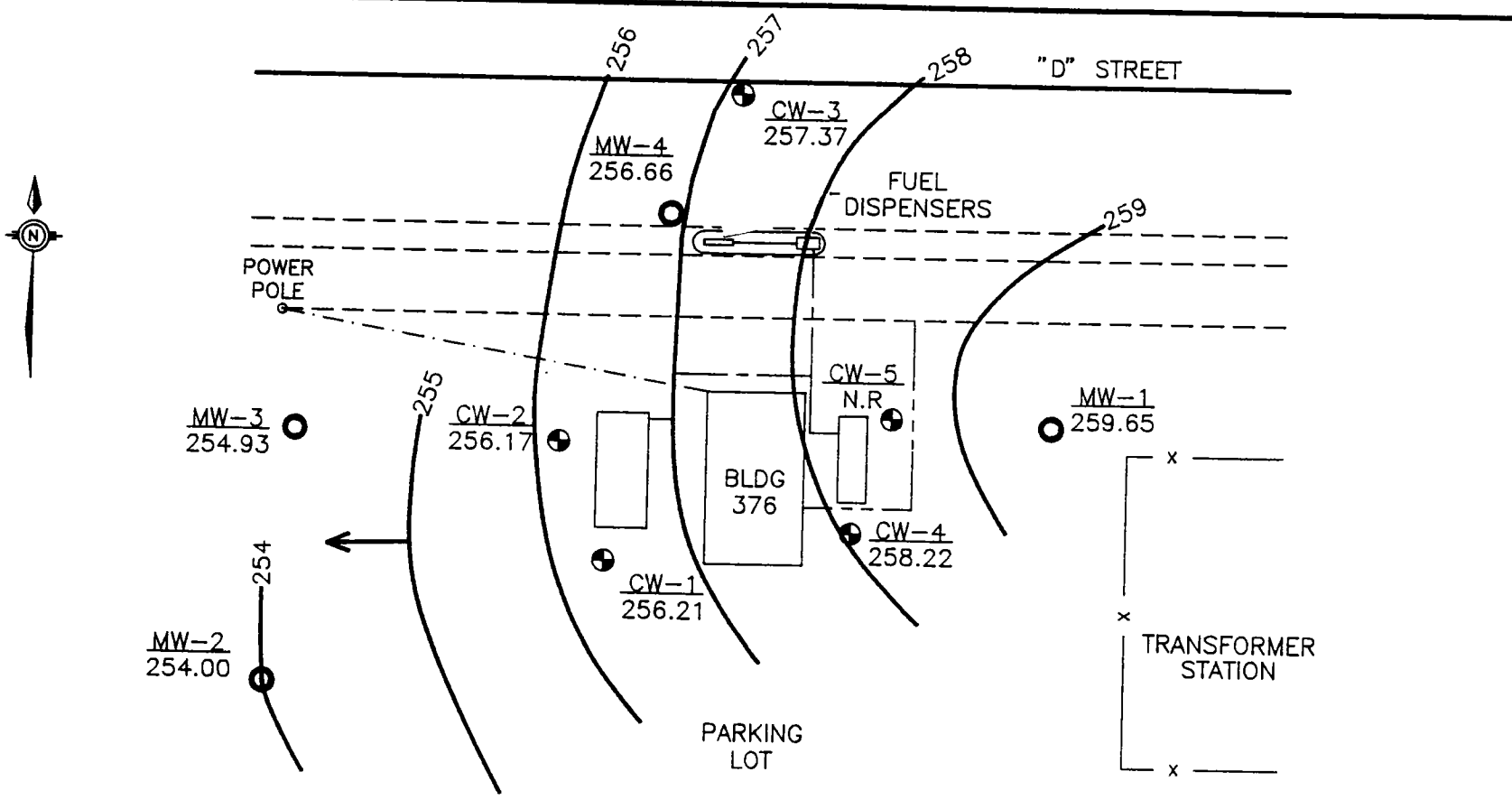
EnSafe

5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962

FIGURE 3
GROUNDWATER FIELD SURVEY
NAVAL AIR STATION
BUILDING 376
MILLINGTON, TN

DATE: 09/11/92

DWG NAME: MEMNAS4



Environmental and Safety Designs, Inc.

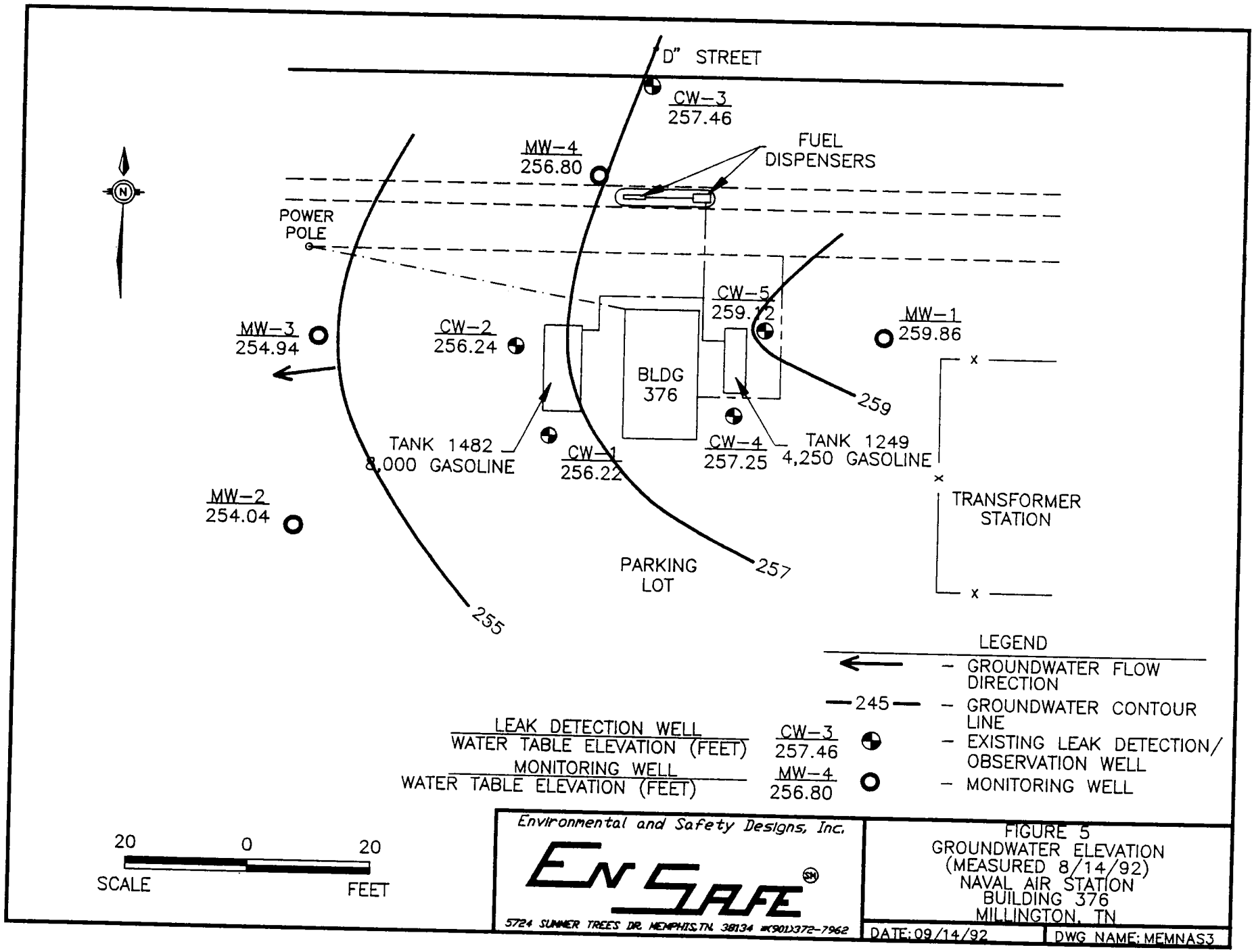
EnSafe

5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962

FIGURE 4
GROUNDWATER ELEVATION
(MEASURED 8/3/92)
NAVAL AIR STATION
BUILDING 376
MILLINGTON, TN

DATE: 09/14/92

DWG NAME: MEMNAS2


"D" STREET
CW-3
257.46
MW-4
256.80
FUEL
DISPENSERS
POWER
POLE
CW-5
259.12
MW-1
259.86
MW-3
254.94
CW-2
256.24
BLDG
376
259
TANK 1482
8,000 GASOLINE
CW-1
256.22
CW-4
257.25
TANK 1249
4,250 GASOLINE
MW-2
254.04
TRANSFORMER
STATION
PARKING
LOT
257
255
LEGEND
GROUNDWATER FLOW DIRECTION
245
GROUNDWATER CONTOUR LINE
LEAK DETECTION WELL
WATER TABLE ELEVATION (FEET)
CW-3
257.46
EXISTING LEAK DETECTION/ OBSERVATION WELL
MONITORING WELL
WATER TABLE ELEVATION (FEET)
MW-4
256.80
MONITORING WELL
20
0
20
SCALE
FEET
Environmental and Safety Designs, Inc.
EnSafe
5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962
FIGURE 5
GROUNDWATER ELEVATION
(MEASURED 8/14/92)
NAVAL AIR STATION
BUILDING 376
MILLINGTON, TN
DATE: 09/14/92
DWG NAME: MEMNAS3

3.3 Monitoring Well Construction

Monitoring wells were installed with a CME 75 rotary drill rig using 4.25-inch inner diameter (8.25-inch outer diameter) hollow-stem augers. Monitoring wells MW-1 and MW-2 were installed on 7/30/92 and MW-3 and MW-4 were installed on 7/31/91. All auger, drilling rod, and sampling equipment were steam cleaned before augering activities. 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 feet of 2" diameter Schedule 40, PVC 0.010" slotted well screen.

The annular space surrounding each monitoring well was filled with a 10/20 silica sand pack from the bottom of the borehole to 2 feet above the screened interval. Sand was poured from the surface through the augers while the augers were retrieved at 2-foot increments. A 2-foot bentonite seal was placed over the sand pack and the remaining annular space was filled to near land surface with a 95/5 percent mixture of Portland Type I cement and bentonite grout. A water-tight locking expansion cap was placed on each well casing and an 8"-diameter steel manhole was installed flush with land surface over each well within a 2-foot diameter square concrete pad.

Monitoring well completion data are provided in Table 1 and calculated and actual well construction materials used are provided in Table 2. Monitoring well construction details are provided in Appendix B.

Table 1
Well Completion Data Building 376
(Facility I.D. 0-791673)

Monitoring Well Identification	Installation Date	Total Depth (ft bls)[a]	Well Diameter (inches)	Screened Interval (ft bls)	Measuring Point Elevation[b]
MW-1	7/30/92	14.80	2	4.8 - 14.8	264.17
MW-2	7/30/92	13.50	2	3.5 - 13.5	263.75
MW-3	7/31/92	16.00	2	6.0 - 16.0	264.02
MW-4	7/31/92	16.50	2	6.5 - 16.5	264.29

Notes:

[a] ft bls = feet below land surface
[b] measuring point is at a designated mark on the top of each well casing

Table 2
Well Construction Materials Building 376
(Facility I.D. 0-791673)

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 94 lb. bag	Cement 80 lb. bag
MW-1	4	1	½	2	4	1	½	2
MW-2	4	½	¼	2	4	½	¼	2
MW-3	4	1	½	2	4	1	½	2
MW-4	4	1	½	2	4	1	½	2

Notes:

[a] Sand = 10/20 sieve size
[b] Bentonite = ¼-inch pellets
[c] Grout = Portland Type I/Bentonite (95/5%) mixture
[d] Cement = Sakrete used in pad construction

3.4 Monitoring Well Placement

Well placement was dictated by the results of the groundwater survey cited above. Monitoring well MW-1 was placed near the eastern portion of the site upgradient to the fuel tanks and fuel island. Monitoring wells MW-2 and MW-3 were placed in the downgradient direction of the plume, west of the fuel tanks and southwest of the fuel island. Monitoring well MW-4 was placed approximately 10 feet west of the fuel pumps. The presence of release detection wells around Tank 1482 and Tank 1249 did not warrant installation of additional monitoring wells into the tank excavations. Monitoring well locations are provided in Figure 4.

3.5 Monitoring Well Development

Monitoring wells were developed the day following well installation with dedicated 3-foot PVC bailers. Between six and eight well volumes were removed from each well and development continued until pH, specific conductance, and temperature stabilized. All monitoring wells remained relatively high in suspended solids. Well development and purge water was containerized in DOT approved 55-gallon drums and left onsite. During monitoring well development and later sampling activities, no free product was discovered on groundwater in any of the monitoring wells.

3.6 Monitoring Well Sampling

Groundwater samples were collected from monitoring wells MW-1 through MW-4 on August 3, 1992. Compliance/leak detection wells CW-1 through CW-4, located around the tanks and fuel dispenser island, were also sampled. Groundwater samples from MW-1 through MW-4 were collected with dedicated PVC single-check valve bailers. Groundwater samples collected from CW-1 through CW-4 were collected with disposable 3-foot Teflon 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 3. Measured water quality parameters were stable (within 10 percent) 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 EPA Method 8020 for volatile organic aromatic compounds (BTEX) and Gasoline Range Organics (GRO) Method for Total Petroleum Hydrocarbons (TPH). Field and equipment blanks were collected in the field and a trip blank accompanied the sample kit as standard QA/QC.

Table 3
Water Quality Data Building 376
(Facility I.D. 0-791673)

Well Volume	Temperature (°C)	Conductivity (ms)	pH (Standard Units)
MW-1			
1	23.1	1.32	7.33
2	24.1	1.31	7.25
3	22.7	1.28	7.43
MW-2			
1	23.6	1.65	6.92
2	22.7	1.54	6.92
3	23.0	1.58	6.94
MW-3			
1	NR	1.62	7.03
2	NR	1.63	7.00
3	NR	1.54	7.02

Table 3
Water Quality Data Building 376
(Facility I.D. 0-791673)

Well Volume	Temperature (°C)	Conductivity (ms)	pH (Standard Units)
MW-4			
1	NR	1.40	7.01
2	NR	1.46	7.08
3	NR	1.39	7.07
CW-1			
1	NR	1.12	6.94
2	NR	1.03	6.93
3	NR	1.02	7.02
CW-2			
1	26.0	0.93	6.83
2	24.8	0.88	6.90
3	23.9	0.87	6.95
CW-3			
1	26.4	1.92	6.90
2	25.6	1.91	6.94
3	25.9	1.88	6.96
CW-4			
1	26.6	0.91	7.00
2	25.8	0.85	7.07
3	25.5	0.91	7.16

NR = Not recorded due to malfunctioning temperature probe.

3.7 Groundwater Analytical Results

Free product was not observed on groundwater in any monitoring wells at the facility. Analytical results indicated benzene concentrations above the TDEC's cleanup level of 70 µg/l (for a non-drinking water aquifer) in CW-2 (130 µg/l). TPH - GRO analytical results above the TDEC's cleanup level of 1000 µg/l were detected in CW-1 (1400 µg/l) and CW-2 (1800 µg/l). Benzene and TPH concentrations were detected in MW-4 (near the fuel island); however, concentrations were below the site's cleanup levels. Benzene and TPH were not detected in water samples collected from the two downgradient monitoring wells and the one upgradient monitoring well. Analytical data indicates the extent of impacted groundwater is limited primarily to the vicinity of Tank 1482. A summary of the analytical results is included in Table 4. Laboratory reports for groundwater analyses are provided in Appendix C.

3.8 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 known elevation on the naval base. Wells were then surveyed by a registered surveyor. Depth to groundwater was measured on August 3 and August 14, 1992 to the nearest 1/100th foot. Water level measurements were converted to water table elevations (Table 5) and are provided in Figures 4 and 5.

3.9 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 D) found the closest well to be located approximately one mile west of the site. Furthermore, there are no reported records of wells local to the site.

phone
615-544-4100
Env. Health
544-4122

Table 4
Groundwater Analytical Results Building 376
(F.I.D. 0-791673)

Constituent	Detection Limit	MW-1	MW-2	MW-3	MW-4	MW-4B (Duplicate)	CW-1	CW-2	CW-3	CW-4	Field Blank	Rinsate Blank
Benzene	1 µg/l	BDL	BDL	BDL	8	2	8	130*	BDL	BDL	BDL	BDL
Toluene	1 µg/l	BDL	BDL	BDL	3	3	6	8	BDL	BDL	BDL	BDL
Ethylbenzene	1 µg/l	BDL	BDL	BDL	3	3	9	140	BDL	BDL	BDL	BDL
Xylenes	1 µg/l	BDL	BDL	BDL	8	8	9	79	BDL	BDL	BDL	BDL
Total BTEX	1 µg/l	BDL	BDL	BDL	22	16	32	357	BDL	BDL	BDL	BDL
TPH - Gasoline Range Organics	100 µg/l	BDL	BDL	BDL	660	660	1400*	1800*	BDL	BDL	BDL	BDL

Notes:
BDL - Below Detection Limit
µg/l - Micrograms per liter (ppb)
* - Concentration exceeds cleanup level

Table 5
Water Table Elevations Building 376
(Facility I.D. 0-791673)

Monitoring Well	Measuring Point Elevation	Date of Measurements			
		August 3, 1992		August 14, 1992	
		Depth to Water (ft btoc)*	Water Level Elevations (ft)	Depth to Water (ft btoc)	Water Level Elevations (ft)
MW-1	264.17	4.52	259.65	4.31	259.86
MW-2	263.75	9.75	254.00	9.71	254.04
MW-3	264.02	9.09	254.93	9.08	254.94
MW-4	264.29	7.63	256.66	7.49	256.80
CW-1	263.93	7.72	256.21	7.71	256.22
CW-2	264.08	7.91	256.17	7.84	256.24
CW-3	264.78	7.41	257.37	7.32	257.46
CW-4	264.15	5.93	258.22	6.90	257.25
CW-5	264.28	not recorded	not recorded	5.16	259.12

* ft btoc = feet below top of casing

A groundwater sample was collected from monitoring well MW-1 on August 26 and analyzed for Primary and Secondary Drinking Water Standards in accordance with the TDEC's Technical Guidance Document 002. Analytical results (included in Table 6) indicate iron, manganese, total dissolved solids (TDS), and turbidity in excess of the respective suggested levels for drinking water.

Table 6
MW-1
Drinking Water Quality Building 376
(Facility I.D. 0-791673)

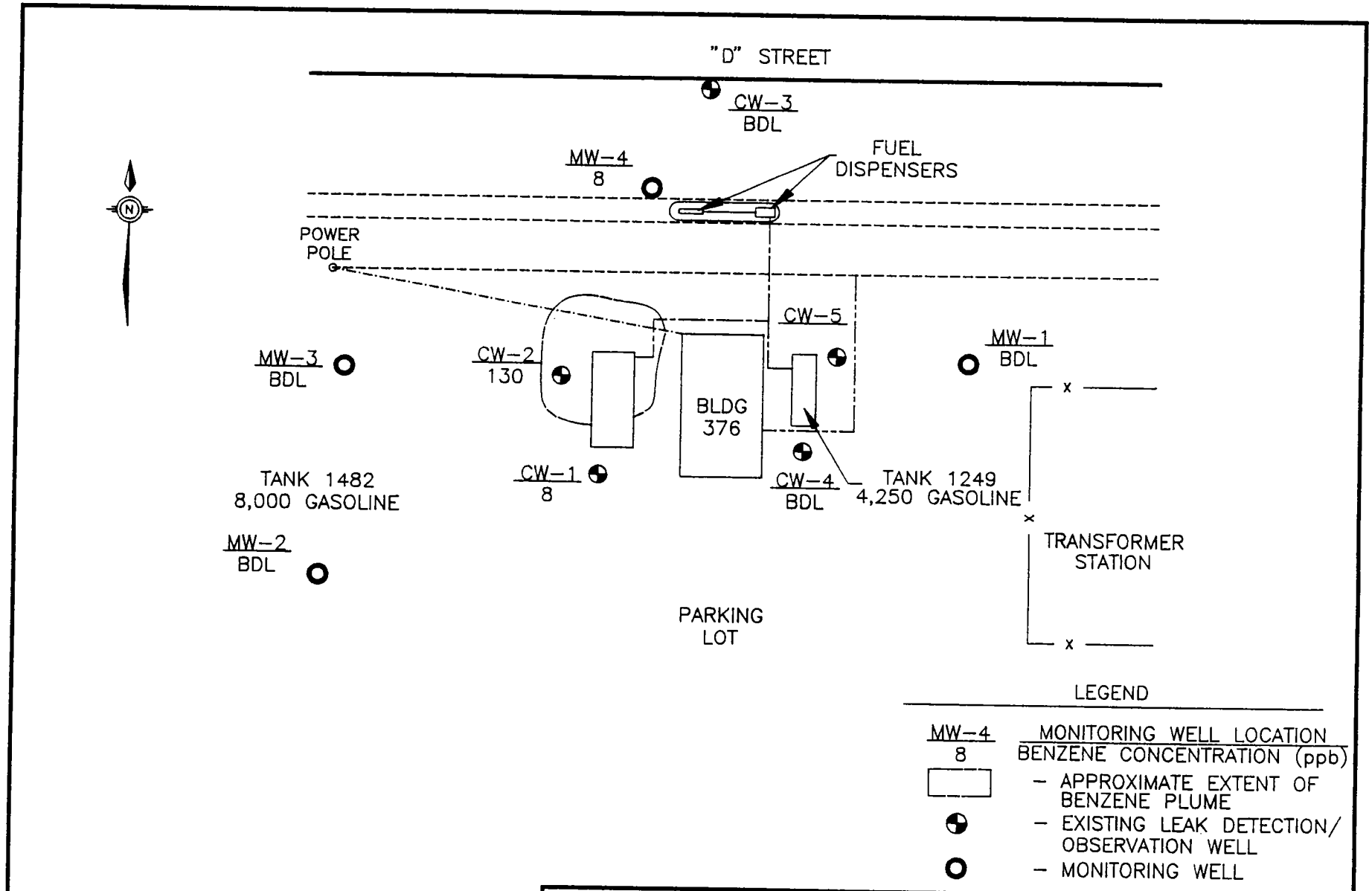
Parameters	Result (mg/l)	Standard (mg/l)
Iron	4.38	0.3
Manganese	0.56	0.05
Total Dissolved Solids	513	500
Turbidity	9.5 NTU	1NTU

Note:
Turbidity is a primary drinking water standard and expressed in Nephelometric Turbidity Units (NTU)

Because the shallow aquifer is not being utilized as a water source (drinking or otherwise) local to the site, and the elevated iron, manganese, TDS, and turbidity content fails to meet the drinking water standards, the aquifer can be characterized as a "non-drinking water" aquifer. Based upon this classification, the TDEC cleanup levels for non-drinking water are 70 μg/l benzene and 1,000 μg/l TPH.

3.10 Groundwater Contaminant Plume

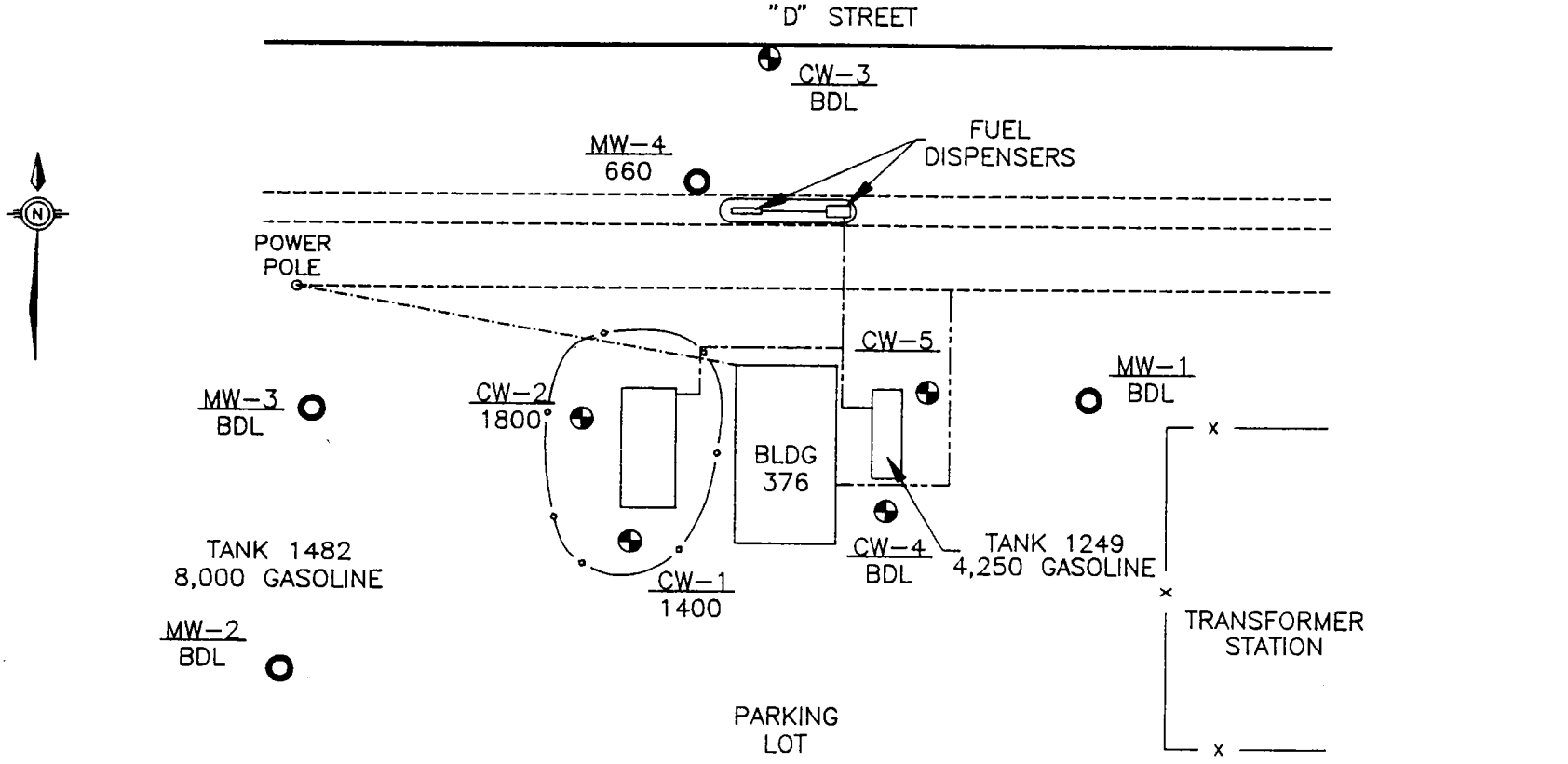
Groundwater contaminant plume maps for benzene (Figure 6) and TPH (Figure 7) indicate the approximate extent of benzene and TPH above the appropriate cleanup levels of 70 μg/l and 1,000 μg/l, respectively. Groundwater contamination exceeding the cleanup levels appears limited to two leak detection wells (CW-1 and CW-2) located immediately west and south of Tank 1482. Benzene and TPH were not detected in down gradient monitoring wells MW-2 and MW-3. Geologic cross sections depicting the site geology, respective well locations, and the extent of the groundwater contaminant plume are provided in Figure 8.



Environmental and Safety Designs, Inc.
EnSafe
5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962

FIGURE 6
GROUNDWATER CONTAMINATION
PLUME MAP (BENZENE)
NAVAL AIR STATION
BUILDING 376
MILLINGTON, TN

DATE: 09/14/92 | DWG NAME: MEMNAS7



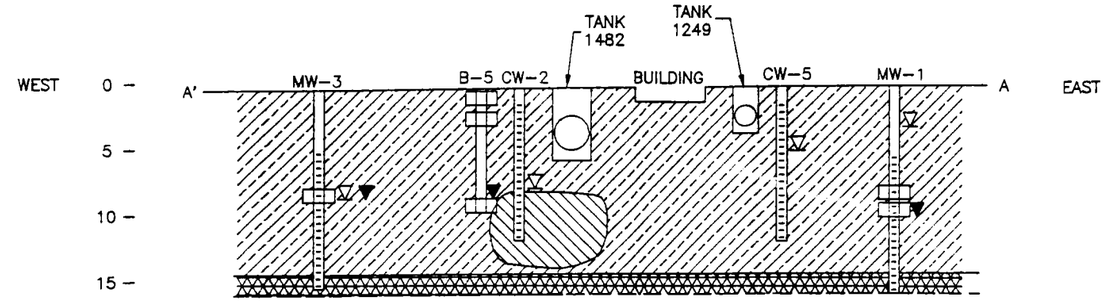
Environmental and Safety Designs, Inc.
EnSafe
5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962

FIGURE 7
GROUNDWATER CONTAMINATION
PLUME MAP (TPH)
NAVAL AIR STATION
BUILDING 376
MILLINGTON, TN

DATE: 09/14/92

DWG NAME: MEMNAS6

CROSS SECTION A-A'

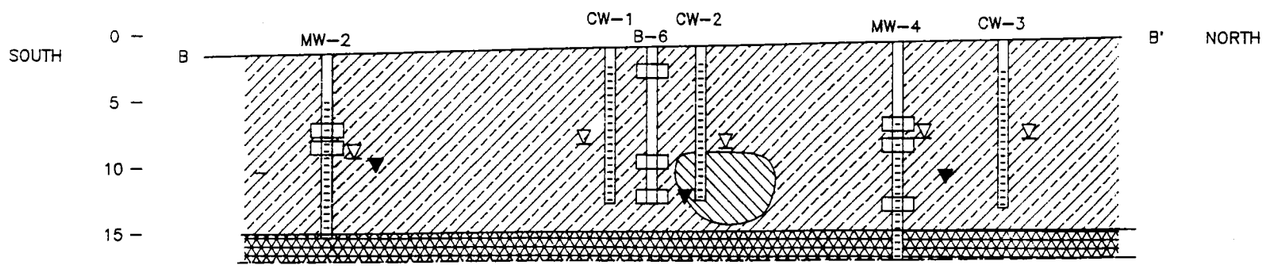


LEGEND

- SILT AND CLAY
- CLAY
- PIEZOMETRIC WATER LEVEL IN WELL
- TOP OF WATER BEARING ZONE
- SCREENED INTERVAL
- LOCATION OF ANALYZED SOIL SAMPLE
- APPROXIMATE PETROLEUM HYDROCARBON PLUME

20 0 20
SCALE FEET

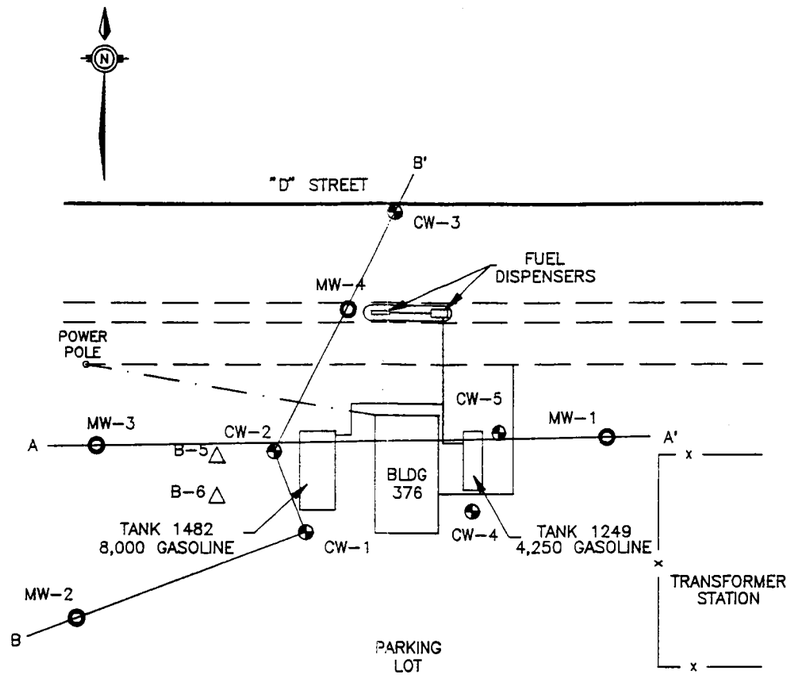
CROSS SECTION B-B'



LEGEND

- SILT AND CLAY
- CLAY
- PIEZOMETRIC WATER LEVEL IN WELL
- TOP OF WATER BEARING ZONE
- SCREENED INTERVAL
- LOCATION OF ANALYZED SOIL SAMPLE
- APPROXIMATE PETROLEUM HYDROCARBON PLUME

20 0 20
SCALE FEET



20 0 20
SCALE FEET

LEGEND

- SOIL BORING
- EXISTING LEAK DETECTION/ OBSERVATION WELL
- MONITORING WELL

Environmental and Safety Designs, Inc.
ENSAFE
5724 SUMMER TREES DR. MEMPHIS,TN. 38134 (901)372-7962

FIGURE 8
GEOLOGICAL CROSS SECTIONS
NAVAL AIR STATION
BUILDING 376
MILLINGTON, TN

DWG DATE:09/23/92 | DWG NAME:MEMNAS10

4.0 SOIL INVESTIGATION

Six 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 with a standard 24 inch (2-inch OD) stainless steel split-spoon sampler. Soil samples were collected continuously from the surface to each boring's terminal depth. Soil retrieved from the split-spoon sampler was placed immediately into 2-ounce pre-cleaned glass containers for laboratory analysis. The remaining portion of the soil sample was placed in a pint Ziploc bag, sealed and allowed to equilibrate for approximately 15 minutes. Organic vapor concentrations in the headspace of the bags were then measured with an HNU GP101 Photoionization Detector (PID). Details of all PID readings are shown on Table 7.

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. Soil samples were sent by overnight express for analysis. Soil samples were analyzed for BTEX by EPA Method 8020 and TPH by the GRO Method.

To prevent possible cross contamination between boreholes, split-spoon samplers were completely disassembled and cleaned between each sample collection. The cleaning procedure consisted of a wash in Alconox detergent and tap water.

Table 7
Head Space Data Building 376
(Facility I.D. 0-791673)

Boring #	Sample Depth (in feet)	Head Space (ppm)
B-1	0 - 2	BDL
	2 - 4	BDL
	4 - 6	BDL
	6 - 8	BDL
	8 - 10	BDL
	10 - 12	BDL
	12 - 14	BDL
	14 - 16	BDL
B-2	0 - 2	BDL
	2 - 4	BDL
	4 - 6	BDL
	6 - 8	0.4
	8 - 10	1.8
	10 - 12	BDL
	12 - 14	BDL
B-3	0 - 2	BDL
	2 - 4	BDL
	4 - 6	BDL
	6 - 8	BDL
	8 - 10	BDL
	10 - 12	BDL
	12 - 14	BDL
	14 - 16	BDL

Table 7
Head Space Data Building 376
(Facility I.D. 0-791673)

Boring #	Sample Depth (in feet)	Head Space (ppm)
B-4	0 - 2	1.2
	2 - 4	2.4
	4 - 6	1.8
	6 - 8	3.2
	8 - 10	1.8
	10 - 12	1.4
	12 - 14	4.8
	14 - 16	1.2
	16 - 18	0.4
B-5	0 - 2	38[1]
	2 - 4	14[1]
	4 - 6	2.4
	6 - 8	2.2
	8 - 10	2.8
B-6	0 - 2	1.2
	2 - 4	2.6
	4 - 6	2.0
	6 - 8	2.2
	8 - 10	2.8
	10 - 12	1.0

Notes:
BDL = Below Detection Limit
[1] = Sample interference from isopopanol used for decontamination.

The samplers were then further decontaminated using a triple rinse procedure consisting of:

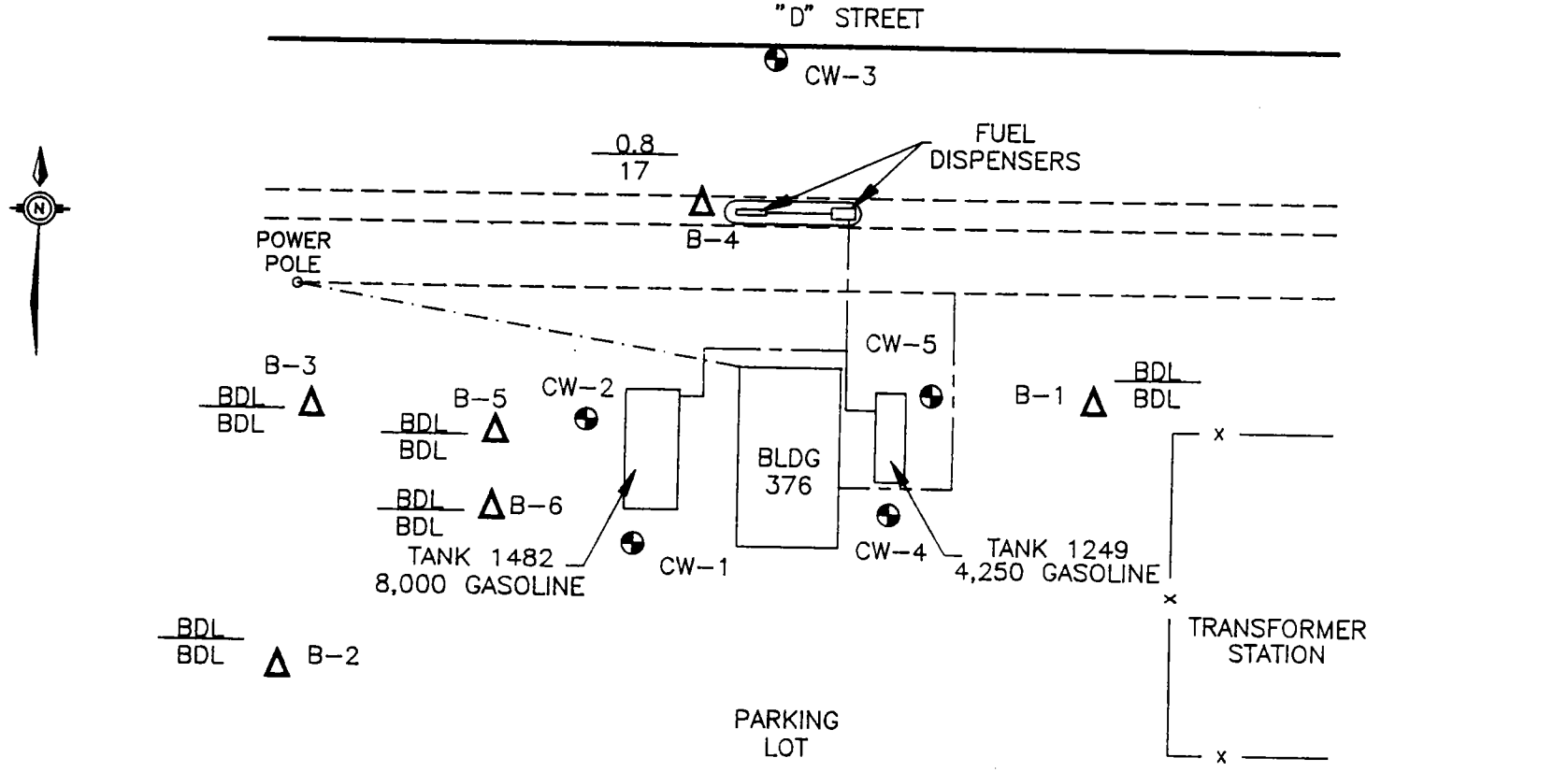
- deionized water
- pesticide grade isopropanol
- final deionized water rinse

Split-spoon samplers were allowed to air dry before reassembly. New disposable latex gloves were worn by field personnel at all times during sampling and decontamination procedures.

Soil borings B-1 through B-4 were drilled to depths between 14 and 18 feet. The placement rationale was consistent with that of monitoring wells MW-1 through MW-4. Borings B-5 and B-6 were drilled to depths of 10 and 12 feet, respectively. Borings B-5 and B-6 were located approximately 10 feet off the western edge of the Tank 1482 excavation. Boring locations are depicted in Figure 9.

4.1 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 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



Environmental and Safety Designs, Inc.

EnSafe

5724 SUMMER TREES DR. MEMPHIS, TN. 38134 (901)372-7962

FIGURE 9
SOIL BORING LOCATIONS
NAVAL AIR STATION
BUILDING 376
MILLINGTON, TN

DATE: 09/11/92

DWG NAME: MEMNAS8

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 the Building 376 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.

Soil types encountered during boring activities consist of clayey silts and silty clays from the surface to a depth of approximately 14 feet below grade. A soft gray clay was encountered below this depth in borings B-1 through B-4. The maximum depth penetrated was 18 feet below grade in boring B-4 which terminated in a soft gray clay. Lithologic cross sections generated from boring log data can be found in Figure 8. Boring logs are included in Appendix B.

Shelby tube samples collected adjacent to boring B-5 at depth intervals of 5 to 7 and 7 to 9 feet indicate average permeabilities of 8.7×10^{-8} and 9.3×10^{-8} cm/s. Shelby tube samples were analyzed through a flexi-wall permeameter per ASTM Method 5084. The samples were

collected from the zones suspected of having the highest permeabilities. Results of the permeability analysis are presented in Appendix E.

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 mg/kg for BTEX and TPH, respectively (as specified under UST Regulations 1200-1-15 Appendix III).

4.2 Soil Analytical Results

Discrete soil samples were collected from each boring and submitted to International Technologies Analytical Laboratory for BTEX and TPH analyses. Laboratory results indicate the only measurable TPH and BTEX concentrations were found in the vicinity of boring B-4 (adjacent to the fuel dispenser island). TPH concentrations of 16 mg/kg and 17 mg/kg were detected at 6 to 8 feet and 12 to 14 feet, respectively. BTEX concentrations of 0.8 mg/kg were detected at these depths as well. The remaining soil samples were below the method detection limits. Figure 9 depicts soil boring locations and the highest measured BTEX and TPH concentrations at each soil boring location. Soil analytical results are summarized in Table 8. Laboratory reports are included in Appendix C.

Headspace analyses performed on soil samples indicate organic vapor concentrations above background levels in borings B-4, B-5, and B-6. Borings B-5 and B-6 were installed approximately 10 feet west of Tank 1249. The highest measured organic vapor concentration in B-5 and B-6 was 2.8 ppm at the 8 to 10-foot interval in both borings. 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 B-4 had the highest measurable organic vapor concentration of 4.8 mg/kg at the depth interval of 12 to 14 feet. As mentioned previously, this soil sample exhibited the most elevated BTEX

Table 8
Soil Analytical Results
(F.I.D. 0-791673)

Sample No.	Depth (feet)	BTEX (mg/kg)	TPH (mg/kg)
B-1	8 - 10	BDL	BDL
B-1	10 - 12	BDL	BDL
B-2	6 - 8	BDL	BDL
B-2	8 - 10	BDL	BDL
B-3	8 - 10	BDL	BDL
B-4	6 - 8	0.8	16
B-4	8 - 10	BDL	BDL
B-4	12 - 14	0.8	17
B-5	0 - 2	BDL	BDL
B-5	2 - 4	BDL	BDL
B-5	8 - 10	BDL	BDL
B-6	2 - 4	BDL	BDL
B-6	8 - 10	BDL	BDL
B-6	10 - 12	BDL	BDL

Notes:

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

Detection Limits:

TPH = 10 mg/kg
BTEX = 0.1 mg/kg

and TPH concentrations. However, the analytical results are well below the 1,000 and 500 mg/kg TPH and BTEX soil cleanup levels.

5.0 CONCLUSIONS AND RECOMMENDATIONS

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

Conclusions:

- TPH and benzene concentrations in groundwater exceeding the TDEC cleanup levels for a non-drinking water aquifer are isolated to the immediate vicinity of Tank 1482. Petroleum hydrocarbons do not appear to have migrated to downgradient monitoring wells MW-2 and MW-3.

- Benzene and TPH concentrations in groundwater exceeded the TDEC cleanup levels for non-drinking water in two leak detection wells around Tank 1482. No benzene or TPH concentrations in excess of the respective cleanup levels were detected in the four monitoring wells installed as part of the environmental assessment.

- BTEX 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.

- The groundwater flow direction beneath the site is in a westerly direction and has a calculated hydraulic gradient ranging from 0.049 to 0.066 ft/ft.

- Depth to the static water table beneath the site ranges between 4 and 9 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 8.7 x 10^{-8} to 9.3 x 10^{-8} cm/s, typical permeabilities of clay.

- 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.

Recommendations:

In lieu of a Corrective Action Plan, EnSafe recommends closure of both tank systems. Life expectancies of asphalt-coated steel tanks commonly range from 12 to 18 years (Steel Tank Institute, telephone conversation, 9/17/92) depending largely on soil conditions and the manner of tank installation. Tank systems 1482 and 1249 have been in service well beyond their life expectancies (25 years and 42 years, respectively).

Tank 1482 (located west of the building) is reportedly empty and temporarily out of service. For this tank to remain in compliance, an amended notification form should be filed within 90 days of the date in which the tank was taken out of service, vent lines should remain open and functioning and all other lines, pumps and ancillary equipment should be secured. If the tank system remains out of service for 12 months, the UST system should be permanently closed at the end of this period, unless the UST Division provides a written extension to this closure period (Rule 1200-1-15-07-1C). Contaminated soils and groundwater located within the tank excavation and immediately surrounding it, should be removed during the tank closure.

Tank 1249 may remain in compliance until December 22, 1998, if release detection requirements are followed in accordance with Rule 1200-1-15-.04. This tank system will then be required to

be either upgraded, replaced with a new UST system meeting the new performance standards or permanently closed.

Though groundwater contamination appears limited to the immediate vicinity of Tank 1482, Tank 1249 cannot be ruled out as a possible contributor to this contamination. Free product was noted in December of 1991, in a leak-detection well around this tank and was attributed to a faulty tank valve union on the tank. Because Tank 1249 is located hydrologically upgradient, it is possible that groundwater contamination has extended beneath the building and into the Tank 1482 excavation. Therefore, closure of Tank 1482 solely, may be only a temporary solution to the current contaminated groundwater in the tank excavation.

If closure of the tank systems is not deemed to be an option at this time and they are intended to remain in service, then EnSafe recommends quarterly monitoring of the two leak detection wells around Tank 1482 and the two downgradient monitoring wells to ensure contaminants do not migrate outside the tank excavation. Considering the relatively impermeable nature of the native soils outside the excavation, the likelihood of contaminants migrating great distances beyond the excavation is minimal.

SIGNATURE PAGE

I, the undersigned, do hereby affirm that the information contained in this report is accurate and correct to the best of my knowledge and belief.

Ben Brantley, P.G.
Registration No. 1602
October 2, 1992