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UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010

GEOHYDROLOGIC STUDY NO. 38-26-0195-83
DEFENSE DEPOT MEMPHIS
MEMPHIS, TENNESSEE
21 JUNE - 2 JULY 1982

DEPARTMENT OF THE ARMY
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

Mr. Curran/csp/AUTOVON
584-2024

REPLY TO ATTENTION OF
HSHB-ES-G/WP

20 JAN 1983

SUBJECT: Geohydrologic Study No. 38-26-0195-83, Defense Depot Memphis, Memphis, Tennessee, 21 June - 2 July 1982

Director
Defense Logistics Agency
ATTN: DLA-WS
Alexandria, VA 22314

EXECUTIVE SUMMARY

The purpose, essential findings, and major recommendations of the inclosed report follow:

a. Purpose. To determine and evaluate the geohydrologic setting, identify sources of potential ground-water contamination, and construct monitoring wells around the sites of greatest potential. During the construction of the wells, well logs and soil samples will be collected. Ground-water samples will be taken for subsequent analysis at this Agency. If significant ground-water contamination is found, a plan for future remedial action will be prepared.

b. Essential Findings.

(1) The geohydrologic setting includes a soil which extends to a depth of 80 feet and consists of fine-grained, Loessial material of Aeolian origin. The ground water exists under water table conditions, has a static level of between 73 and 62 feet below the land surface, and flows to the west. There is a limited perched ground-water system identified in the northern section, which flows to the north.

(2) Two areas of the installation were identified as having a potential for ground-water contamination, Dunn Field and the pentachlorophenol (PCP) Dip Vat. The Dunn Field area was determined to have a greater potential than the PCP Dip Vat and six monitoring wells were installed and logged and sampled in that location.

(3) Data from the monitoring wells indicated that no significant ground-water degradation or contamination exists in the Dunn Field area.

c. Major Recommendations. Perform no remedial ground-water actions at the Dunn Field area.

FOR THE COMMANDER:

NELSON H. LUND, P.E.
Colonel, MSC
Director, Environmental Quality

1 Incl
as (5 cy)

CF:
HQDA (DASG-PSP) wo incl
Cdr, HSC (HSPA-P)
Comdt, AHS (HSHA-IPM)
Cdr, ODEAMC (PVNTMED Actv)
Cdr, MEDDAC, Fort Campbell (PVNTMED Actv)(2 cy)
C, USAEHA-Rgn Div South

Geohydrologic Study No. 38-26-0195-83, DDM, Memphis, TN, 21 Jun-2 Jul 82

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1. AUTHORITY.

a. Letter, DLA-W, HQ DLA, 29 October 1981, subject: USAEHA Mission Services, FY 82, with initial indorsement, HSPA-P, HSC, 3 November 1981.

b. Interservice Support Agreement, W23MWN-78083-001, US Army Environmental Hygiene Agency/Defense Logistics Agency, effective through 30 September 1985.

2. REFERENCES. See Appendix A.

3. PURPOSE.

a. Determine and evaluate the geohydrologic setting.

b. Identify sources of potential ground-water contamination.

c. Construct monitoring wells around the sites of greatest potential. During the construction of the wells, well logs and soil samples will be collected. Ground-water samples will be taken for subsequent analysis at USAEHA.

d. If significant ground-water contamination is found, a plan for future remedial action will be prepared.

4. GENERAL.

a. Abbreviations and Definitions. See Appendix B.

b. USAEHA Personnel Conducting the Study.

(1) Mr. Stephen F. Curran, Jr, Project Officer, Geohydrologist, Waste Disposal Engineering Division (WDED).

(2) Mr. I. Richard Kestner, Physical Science Technician, WDED.

(3) Mr. Thomas Thoner, Student Aide, WDED.

c. Personnel Contacted. See Appendix C.

d. Background. Defense Depot Memphis is located approximately three-fourths of a mile south-southwest of the city of Memphis (see Figure 1). It is a Defense Logistics Agency activity which receives, stores, and ships all Department of Defense commodities except electronics, bulk POL, ammunition, explosives, weapons, and perishable substance items for the various services within the south-central United States. The general layout of DDMT is shown on Figure 2. The annual nominal temperature range is from -15°F to 105°F. The average seasonal temperatures are 80°F in the summer, 40°F in the winter, and 60°F as a mean average (reference 1, Appendix A). Average monthly precipitation varies from 2.72 inches in October to 6.06 inches in January. The average annual snowfall is 6.10 inches. The prevailing winds are from the southwest, and the average relative humidity is 70 percent.

5. FINDINGS AND DISCUSSION.

a. Physiographic Description. Memphis is located in a narrow band, known as the "Loess Hills," which parallels the eastern wall of the Mississippi River Valley. This band lies within the East Gulf Coastal Plain section of the Atlantic and Gulf Coastal Plains Province, and is included in a portion of the section called the Mississippi Embayment. This section is described as a youthfully to maturely dissected, belted coastal plain.

b. Geology. The Mississippi Embayment is a downwarped, partly downfaulted trough in the Paleozoic rocks. The axis of the trough has migrated in past geologic time but now approximates the course of the Mississippi River. The trough has been filled with unconsolidated gravels, sands, and clays, ranging in age from Upper Cretaceous to Recent. In Tennessee, the unconsolidated sediments reach their maximum thickness at Memphis where they are from 2700- to 3000-feet thick (reference 2, Appendix A). Late in the Tertiary Period and early in the Quarternary Period, streams carried extensive quantities of sand and gravel into the area and formed widespread terraces of these materials mixed with varying amounts of silt and clay on top of the older Tertiary deposits. Aeolian deposits or windblown silts and clays (Loess) comprise the presently exposed ground surface in the Memphis area. In general, the Loess is >75 feet thick on the bluffs forming the eastern valley wall but thins out to the east and disappears within about 50 miles of Memphis (reference 3, Appendix A). Appendix B describes the post-Midway geologic units which underlie the Memphis area and some of their environmental significances (references 1 and 2, Appendix A).

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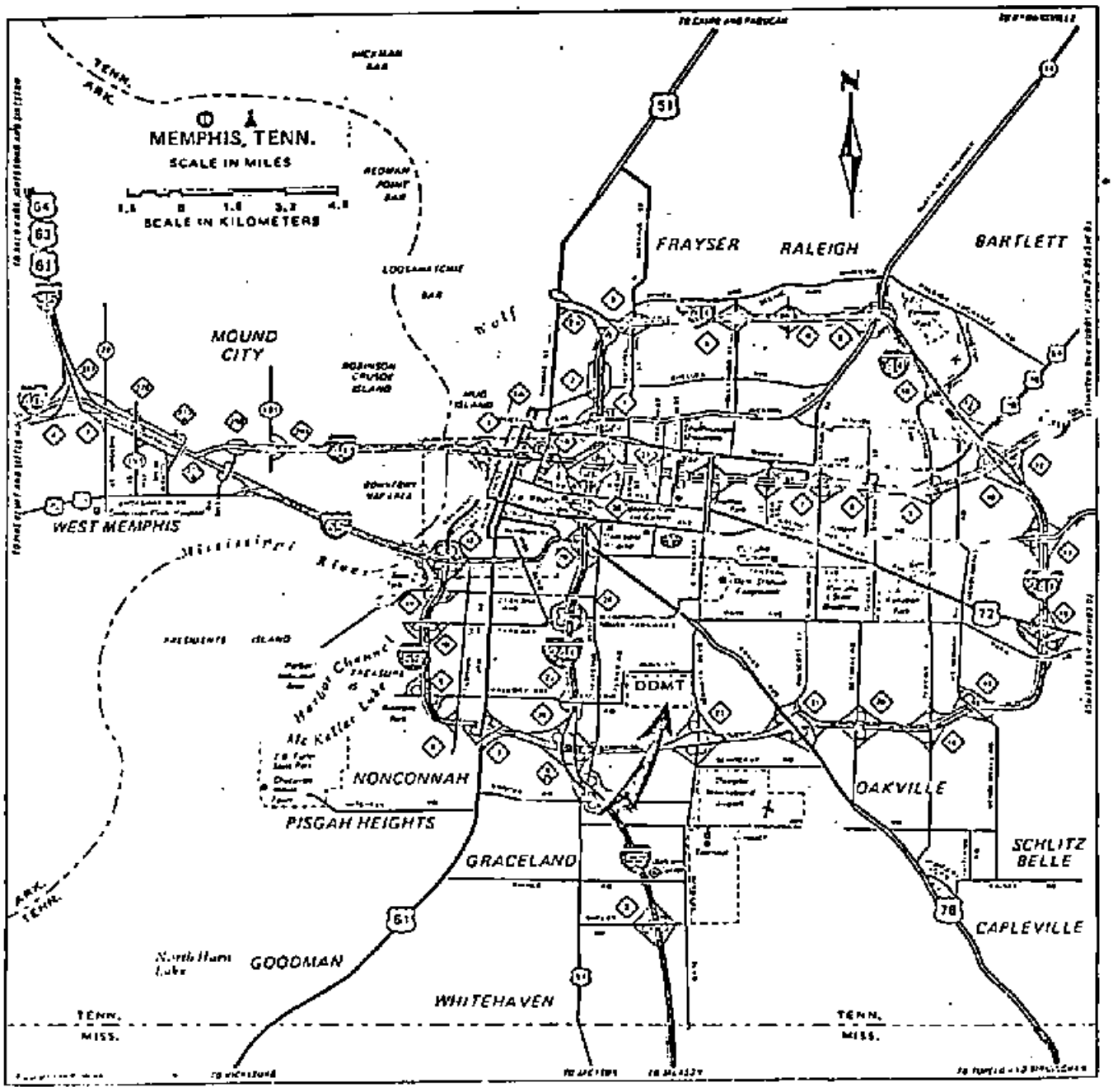

FIGURE 1. DDMT General Location Map

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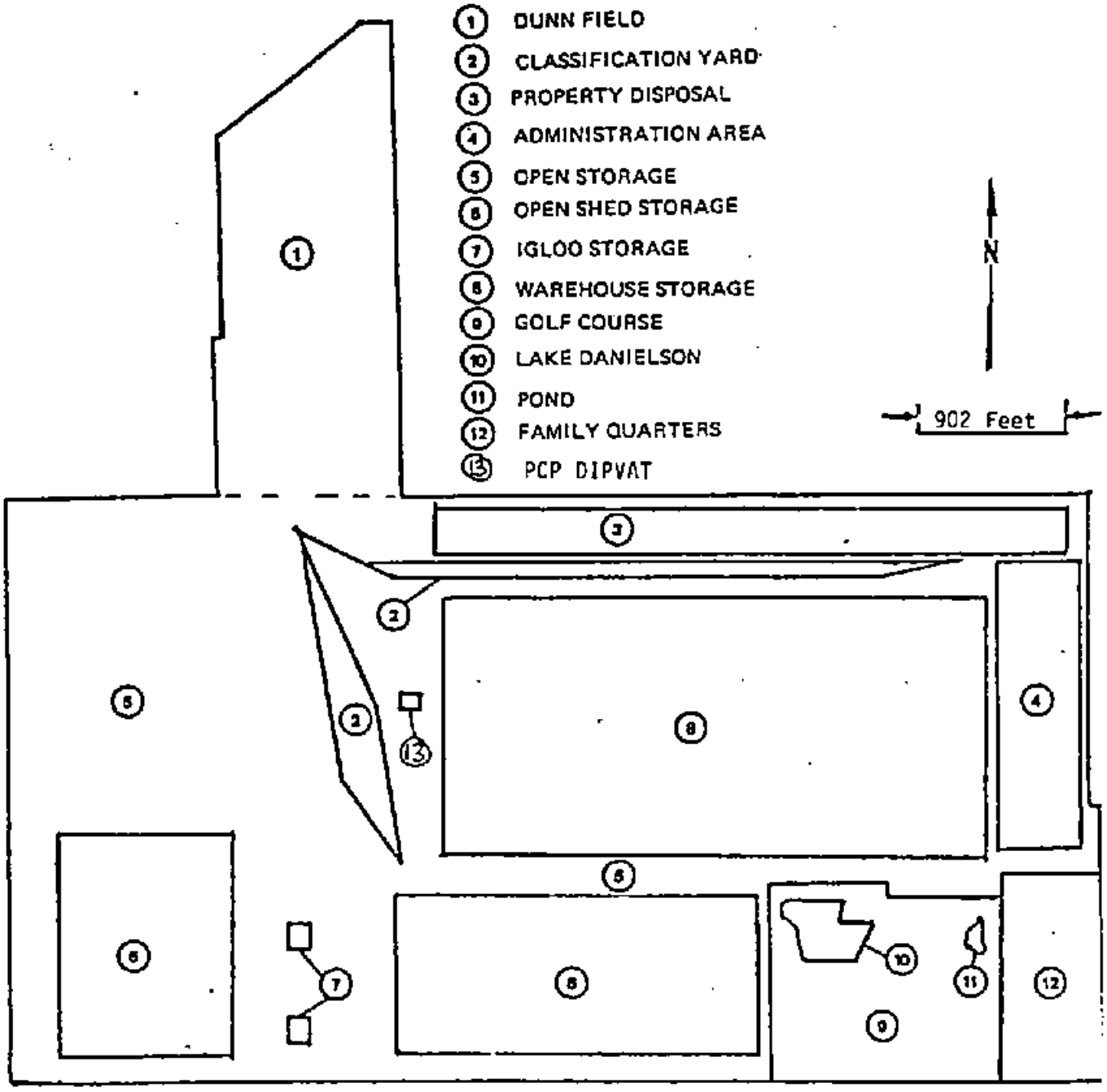

FIGURE 2. General Layout of DDMT

c. Hydrogeology. The city of Memphis depends solely on ground water for its potable and nonpotable water supply. In 1980, an inventory of pumpage in the Memphis area indicated that 97 percent of the water used in the area was derived from the Memphis sand of the Claiborne Group and 3 percent from the Fort Pillow Sand of the Wilcox Group (reference 2, Appendix A). The depot receives all of its water from the city of Memphis and has no ground-water wells. The Memphis Sand is separated from the overlying shallow water-table aquifer by a relatively thick and widespread confining bed consisting chiefly of clay. Studies by the US Geologic Survey (reference 4, Appendix A) have indicated that part of the recharge to the Memphis Sand is derived by vertical leakage from the shallow water-table aquifer by an exchange of water through the confining bed, or by water running through local "windows" of sand in the confining bed. The "windows," if they are located near a possible source of contamination, could provide a pathway through which any contaminants in the shallow water-table aquifer might enter the Memphis Sand (reference 5, Appendix A). The shallow water-table aquifer is most susceptible to contamination in areas which have been or are being used for waste disposal. Memphis and Shelby Counties, along with commercial establishments and industries, have used dumps and landfills in two geologically and topographically different areas - the flood plains of nearby streams and abandoned gravel pits in upland areas (reference 2, Appendix A). The dumps and landfills were closed in the early 1970's with the beginning of State regulation of waste disposal practices. The DDMT operated a waste disposal operation in the Dunn Field area during the late 1940's and early 1950's (trash burning). The Dunn Field area has also been used for the burial of various types of unuseable or contaminated solid wastes. These burial sites and/or storage sites are described in Table 1, and located on Figures 3, and 4.

d. Soils. According to the US Soil Conservation Service which compiled a Generalized Soil Association Map in 1970, the DDMT is in the Memphis-Grenada-Loring association, which is characterized by nearly level to sloping, well-drained and moderately well-drained, silty soils on broad uplands. The soils in this association developed in silty deposits more than 20 feet deep (reference 1, Appendix A). Before construction of DDMT, the soils were identified as Memphis soil, which is well-drained soil on the broader ridgetops and steeper hillsides. Memphis soil has a brown, silty surface layer and subsoil. The construction of DDMT destroyed all of the natural structure of the Memphis soil, except in the northeast corner of Dunn Field and in the golf course area, these two areas retain the original Memphis silt loam. The construction areas have been classified as graded land, with silty materials.

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TABLE 1. DESCRIPTION OF DUNN FIELD DISPOSAL AND STORAGE SITES

Location	
Burial Sites	
1	Training sets, nine each, mustard and Lewisite, 1955
2	7 pounds (lbs) ammonium hydroxide, 1 gal glacial acetic acid, 1955
3	3,000 quarts (qt) chemicals, 5 cubic feet (ft^3) ortho-tolidine dihydrochloride, 1955
4	Thirteen 55-gal drums oil, grease, and paint, date unknown
5	Thirty-two 55-gal drums oil, grease, and thinner, 1955
6	3 ft^3 methyl bromide, 1955
7	40,037 units ointment (eye), 1955
8	1,700 bottles fuming nitric acid, 1954
9	3,768 1-gal cans methyl bromide, 1954
10	Ashes and metal refuse from burning pit, 1955
11	1,433 1-ounce (oz) bottles trichloroacetic acid, 1965
12	Sulphuric/hydrochloric acids, 1967
13	32 cubic yards mixed chemicals and acid, 900 lbs detergent, 7,000 lbs aluminum sulphate, 200 lbs sodium
14	Sodium, 1968
15	Sodium phosphate, 1968
16	Acid, 1969
17	Herbicide, cleaning compound, medical supplies, 1969
18	Acid, date unknown
19	Hardware (nuts and bolts)
22	XXCC3 impregnite
29	Food supplies
30	Burial site prior to bauxite storage; foods, construction debris burned; 1948
33	14 burial pits containing sodium phosphate, sodium, acid, medical supplies, chlorinated lime; 1970
Burn Sites	
21	Sanitary waste, smoke pots, CN canisters
31	Old burn area, 1946
Storage Sites	
25	Pesticide storage
27	Bauxite
28	Fluorspar
32	Bauxite, 1942-72
Other Sites	
20	Asphalt dump
23	Open drain ditches
24	Pistol range
26	Buried drainpipe

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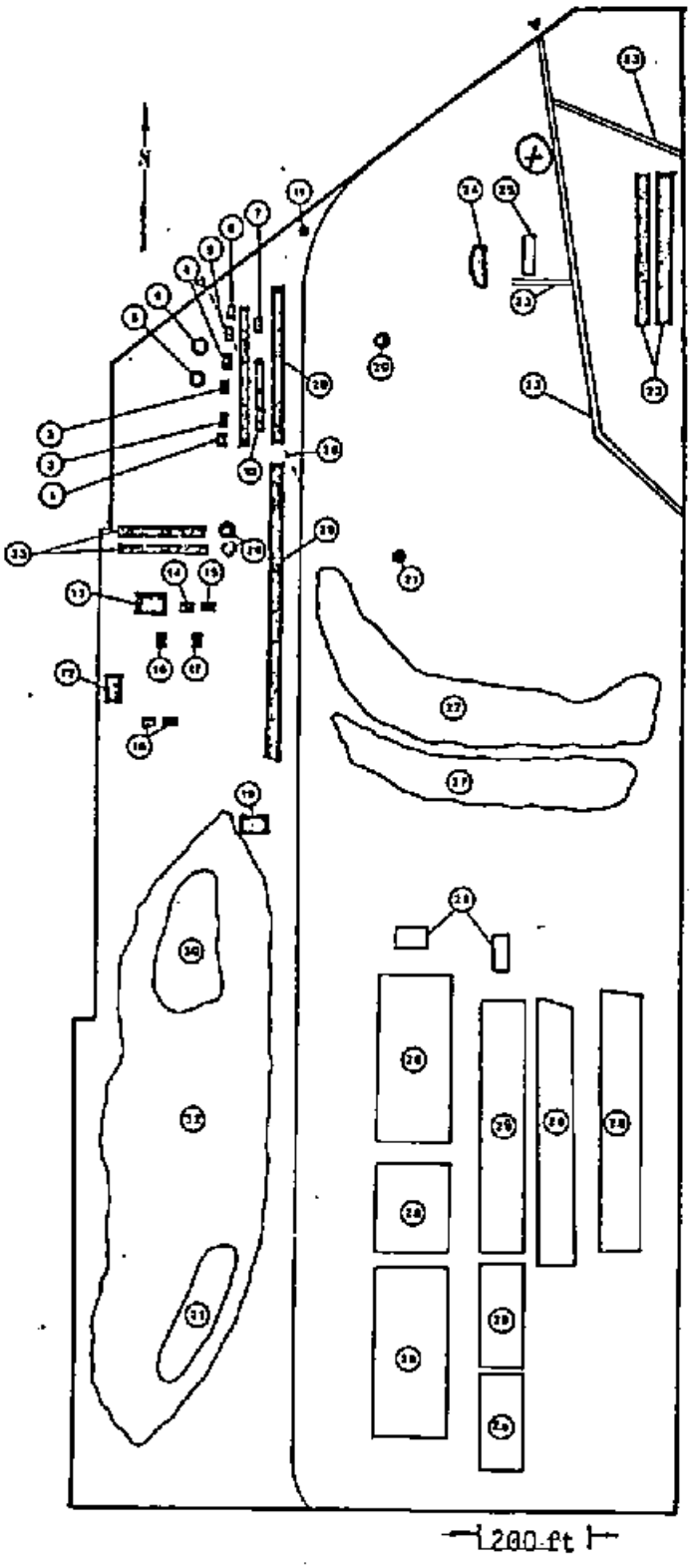
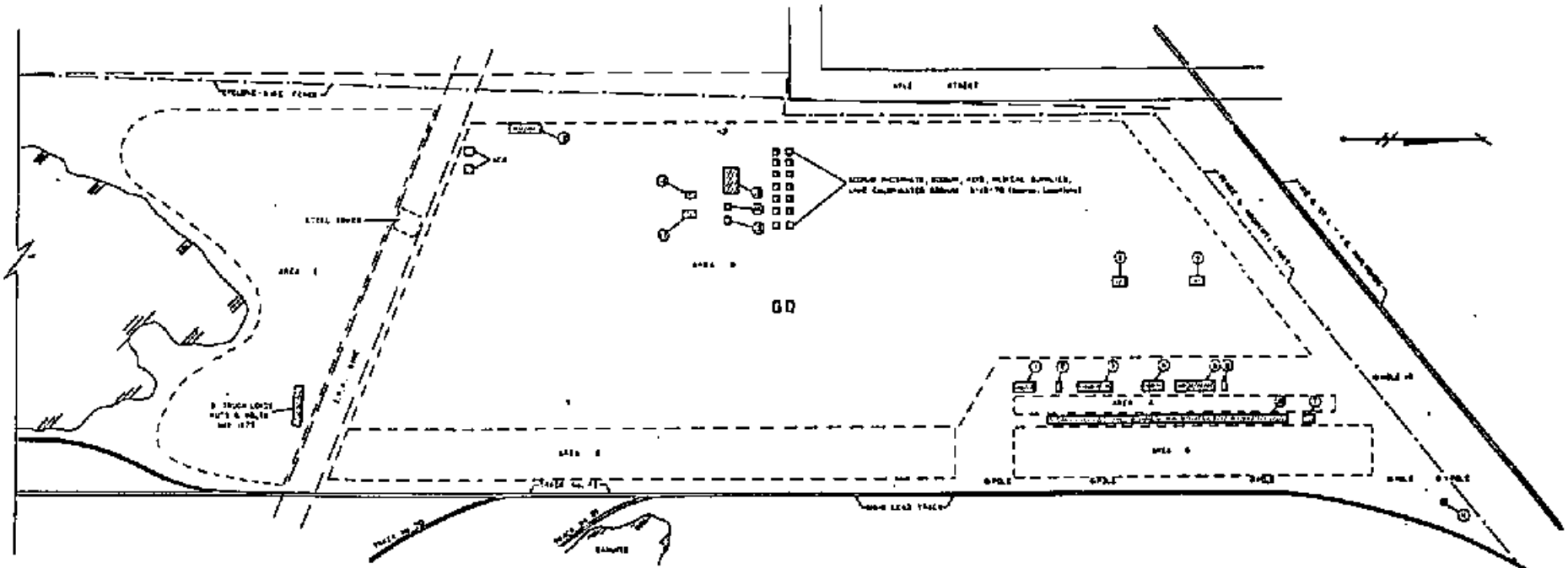


Figure 3. Dunn Field Disposal and Storage Sites



LOCATION of MATERIAL BURIED In DUNN FIELD

e. Sources of Potential Ground-water Contamination. The Dunn Field area of DDMT was identified as the most likely location for an existing potential ground-water contamination problem, based on the fact that waste disposal operations were conducted in that area in the past (see paragraph 5c, this report). This area was identified by USAEHA and USATHAMA personnel (reference 1, Appendix A) as the most likely area of DDMT for ground-water contamination. The PCP Dip Vat area (see Figure 2) was noted as having a potential for future contaminant migration, if a leak were to occur in the tank (12,000 gallon capacity) or if a serious spill were to occur. This facility has received little use since the late 1960's (reference 1, Appendix A). Because of this, and the fact that no leaks or spills have been reported, no ground-water monitoring wells were installed at this location.

f. Monitoring Wells in Dunn Field Area.

(1) Location. Seven ground-water monitoring wells were installed during this study to determine ground-water quality and ground-water table elevations. These well locations are shown in Appendix E and are identified as MW-1 through MW-7. These locations were selected, based on information contained in paragraphs 5a through 5e, this report, to provide ground-water quality information which would indicate if a ground-water contamination problem exists.

(2) Construction. The wells were drilled using an Acker AD-II auger drilling rig with a 6-inch, hollow-stem auger. This type of drilling method allows for the collection of disturbed soil samples (bag samples) and undisturbed soil samples (Shelby tube samples) for soil testing. Each well was constructed by first augering a 6-inch-diameter vertical hole and then inserting a 2-inch ID, Schedule-40, PVC casing with a PVC screen (0.010-inch slots) and sand pack. The depth and length of screen of each well are listed in Table 2. On completion of the installation of the casing, screen, and sand pack, a 3-foot bentonite (clay) seal was emplaced in the annulus, on top of the sand. The annulus (void around the casing) was filled with cement from the top of the seal to the ground surface. The wells were capped with a cast iron casing to physically protect the PVC casing from accidental breakage. See Figure 5 for a generalized description of the monitoring well construction. A survey was conducted by DDMT personnel to establish the elevation of the ground surface at each well (see Table 2).

g. Soil Sampling and Testing.

(1) Sampling Procedure. Thirteen soil samples, eight disturbed and five undisturbed, were collected during the construction of the seven monitoring wells. The soils testing program for these samples included grain size, Atterberg Limits, permeability, void ratio, percent saturation, porosity, dry density, moisture content, and specific gravity. Disturbed soil samples (bag samples) were obtained by collecting the soil which comes

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TABLE 2 - GROUNDWATER MONITOR WELL SUMMARY

PROJECT 38-26-0195-82 DATE 6 JULY 82
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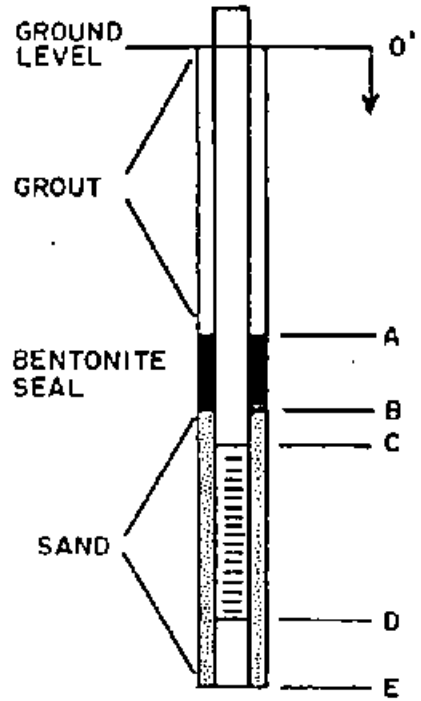

A – TOP OF BENTONITE SEAL
B – TOP OF SAND
C – TOP OF WELL SCREEN
D – TOP OF SEDIMENT TRAP
E – TOTAL WELL DEPTH

WELL NO.	MW 1	MW 2	MW 3	MW 4	MW 5	MW 6	MW 7
A		9'6"	60'-0"	3'-0"	54'-0"	30'-0"	49'-0"
B		13'-0"	63'-0"	3'-0"	57'-0"	33'-0"	54'-0"
C		18'-0"	63'6"	58'-6"	57'-0"	50'-0"	64'-0"
D		32'-0"	73'-6"	78'-6"	77'-0"	70'-0"	74'-0"
E		32'-0"	73'-6"	78'-6"	77'-0"	70'-0"	74'-0"
GROUT THICKNESS		9'-6"	15'-0"	3'-0"	15'-0"	9'-0"	15'-0"
BENTONITE SEAL THICKNESS		3'-6"	3'-0"	0	3'-0"	3'-0"	5'-0"
LENGTH OF PIPE	72'2"	20.0'	65'-6"	60-0'	60'-0"	51'-0"	67'-0"
LENGTH OF STANDPIPE		2'	2'	1'-6"	3'	1'	3'
LENGTH OF SCREEN	10'	10'	10'	20'	20'	20'	10'
LENGTH OF SEDIMENT TRAP	0	0	0	0	0	0	0
SCREEN(in.) SLOT SIZE	0.010	0.010	0.010	0.010	0.010	0.010	0.010
INITIAL(ft.) WATER LEVEL	N/A	274'-3"	228'-5"	230'-4"	228'-6"	229'-7"	231'-6"
24 HOUR(ft.) WATER LEVEL	N/A	269'-5"	228'-10"	230'-3"	228'-6"	229'-1"	231'-1"
GROUND LEVEL ELEVATION ft.		289'-8"	290'-5"	300'-0"	301'-4"	288'-1"	293 -1"
REMARKS Completion Date	casing broken 24 JUNE	24 JUNE	26 JUNE	26 JUNE	27 JUNE	29 JUNE	29 JUNE

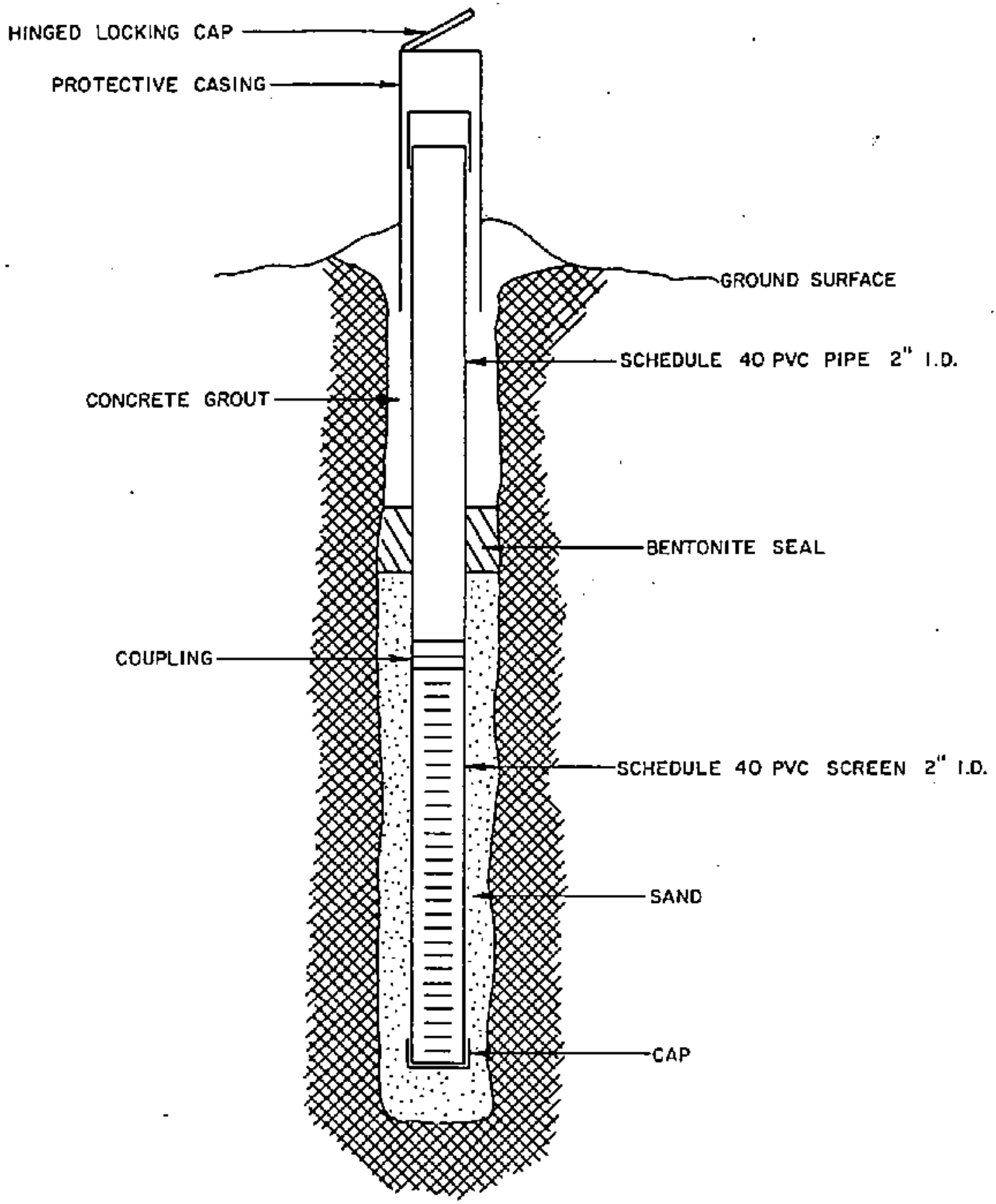

Figure 5. GENERALIZED MONITORING WELL CONSTRUCTION

to the surface on the auger and placing it in a soil sample bag. This type of sample is called a "bag sample" and is identified as "BS" on the drilling logs (see Appendix F). Undisturbed soil samples were obtained using a metal, thin-walled Shelby tube. This tube is pressed into the undisturbed soil through the hollow stem of the auger flights. These samples are identified in the drilling logs (Appendix F) as "ST."

(2) Testing Results. Appendix G shows the results of all the soils testing completed by the WUED Soils Laboratory. The soils range from CL (inorganic clays of high plasticity) to GW-GM (well graded gravels or gravel-sand mixtures with little or no fine-silty gravels, gravel-sand silt mixtures). Table 3 summarizes the soil properties, including the sample type and depth, unified soils classification, and permeability. The permeability data suggest that the upper zone of the area contains soils of very low permeability (3.5×10^{-8} cm/sec). The potential for migration of contaminants is greatly reduced when soils of this type are found in an area. The sandier zones (GW, GC, and SM areas), where the transmittability of water is greater, are located at depths of over 30 feet below the land surface, indicating that the potential for contaminating these zones from the disposal of wastes in the upper 10 feet of soil is minimal.

TABLE 3. SUMMARY OF SOIL PROPERTIES IN STUDY AREA

Monitoring Well	Sample (feet)	Sample Type	Classification (Unified System)	Permeability (cm/sec)
1	0-2.5	BS	CL	-
1	4.5-6.5	ST	ML-CL	7.20×10^{-7}
1	9-10	ST	ML-CL	8.15×10^{-8}
1	19-21	ST	CL	4.71×10^{-8}
1	23-24	BS	CL	3.59×10^{-8}
1	29-31	ST	SM-SC	1.14×10^{-4}
1	39-39.5	ST	GW-GC	8.19×10^{-4}
1	45-50	BS	SM-SC	6.89×10^{-5}
1	55-60	BS	GW-GM	4.27×10^{-3}
3	4-5	BS	ML	-
3	28-30	BS	ML-CL	4.14×10^{-5}
3	41-45	BS	GW-GM	5.92×10^{-3}
5	35-40	BS	SM	6.57×10^{-4}

h. Ground-water Elevations and Flow Direction.

(1) Elevations. The depths to the top of the water table were determined using an electric drop-line and were measured from the ground surface or the top-of-casing (TOC). These depth determinations were made upon the setting of the PVC well casing and 24 hours later. The depths, as measured, can be found in Appendix F. These data were used in conjunction with the ground surface elevations in Table 2 to determine the elevations of the top of the water table at each monitoring well. The elevations, above mean sea level, of the water table are as follows: MW-2 - 269.4 feet, MW-3 - 228.8 feet, MW-4 - 230.25 feet, MW-5 - 228.5 feet, MW-6 - 229.1 feet, and MW-7 - 231.1 feet. These elevations are shown in Table 2 and Appendix H.

(2) Flow Direction. The ground water, as determined from the elevation data, has a very slight flow gradient (0.006 feet per foot) towards the west. The water table in the area has a maximum difference in elevation of 2.6 feet (MW-7 - 231.1 feet to MW-5 - 228.5 feet). The ground-water flow direction is shown on Appendix H. The MW-2 has a measured elevation of 269.4 feet; this is significantly higher than the values obtained from all the other monitoring wells. This water level is indicative of a perched ground water system in this area and reflects a buried drainage system which flows to the north-northwest from the location of the MW-2. This is a localized phenomenon based on the absence of this clay horizon in the logs of all the other monitoring wells.

i. Ground-water Sampling and Analysis.

(1) Well Development. After all the wells were completed, with the exception of MW-1 (casing broken), they were "developed," i.e., the turbid water was removed from the casing to allow better flow into the casing. This "developing" consisted of hand-bailing 15 gallons of water from each well.

(2) Sampling Procedure. Twenty-four hours after the wells were developed, each well was pumped to remove water from the casing. The wells were allowed to recover and then sampling began. The pumping and sampling of monitoring wells MW-2 through -6 was accomplished using a Geofilter® small-diameter well pump (Middleburg Sampler) which is a "bladder-type" sampler pump. Water flows into the sampler under static water column pressure and is then forced to the surface by gas (nitrogen). This type of pump isolates the sample from the gas used to remove the sample. The MW-7 was pumped and sampled using a Kemmerer Samples (bailer) because the Geofilter pump would not drop through the casing. The casing probably has a slight bend in it which would not allow the Geofilter to pass through. This in no way affects the validity of the samples obtained from this well.

® - Geofilter is a registered trademark of Leonard Moldand Die Works, Inc., Denver, CO. Use of trandemarked names does not imply endorsement by the US Army, but is intended only to assist in identification of a specific product.

(3) Filtering and Preserving of the Samples. All samples were filtered and/or preserved onsite and then transported to this Agency for chemical analysis according to Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 15th ed., 1980, for all the inorganic parameters analyzed. All samples obtained from the wells were quite turbid and required a long time to filter.

(4) Parameters Tested. Specific pH and conductivity were determined in the field at the time the samples were taken. The following parameters were analyzed at the USAEHA Radiological and Inorganic Chemistry Division: chemical oxygen demand, chloride sulfate, phenol, specific conductivity, fluoride, nitrate-nitrite nitrogen, mercury, arsenic, barium, cadmium, chromium, lead, selenium, silver, copper, aluminum, manganese, sodium, zinc, and iron.

(5) Results of Analysis. The ground-water quality in the Dunn Field area does not reflect any serious ground-water pollution problems from the disposal operations which have occurred in the past. The EPA Interim Primary Drinking Water Standards or Secondary Drinking Water Criteria (references 6 and 7, Appendix A) are shown in Table 4. The only parameters which were found in excess are: manganese - all wells, lead - MW-2 and MW-7, and cadmium - MW-6. The results of all the analyses are shown in Tables 5 and 6. The secondary criteria for manganese (0.05 mg/L) is the only one which is exceeded by an order of magnitude or greater. High manganese is objectionable in water supplies because of its effect on taste, staining of plumbing fixtures, spotting of laundered clothes, and accumulation of deposits in water distribution systems (reference 8, Appendix A). Manganese is a commonly found constituent in ground water, and its presence at the levels indicated in Table 6 do not pose any significant health hazard. The ground water in the area is not used for drinking water purposes, but, if it were, the manganese would only be a problem from an aesthetic viewpoint. The standards for lead and cadmium are 0.05 mg/L and 0.01 mg/L, respectively, and were only slightly exceeded. The highest lead value was 0.069 mg/L and the highest value for cadmium was 0.014 mg/L. This is also not an indication of a serious ground-water pollution problem.

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TABLE 4. EPA INTERIM PRIMARY DRINKING WATER STANDARDS OR SECONDARY DRINKING WATER CRITERIA

Parameter	Maximum Level (mg/L)
Primary	
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Fluoride	1.4-2.4
Lead	0.05
Mercury	0.002
Nitrate (as)	10
Selenium	0.01
Silver	0.05
Endrin	0.002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4D	0.01
2,4,5 TP Silvez	0.01
Secondary	
Chloride	250
Copper	1
Foaming Agents	0.5
Hydrogen Sulfide	0.05
Iron	0.3
Manganese	0.05
Sulfate	250
Total Dissolved Solids	500
Zinc	5
Color	15 Color Units
Corrosivity	None
Odor	3 Threshold Odor Number
pH	6.5-8.5 standard units

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TABLE 5. ANALYTICAL RESULTS, DEFENSE DEPOT MEMPHIS

Monitoring Well	NO_2NO_3 mg/L	COD mg/L	Cl mg/L	SO_4 mg/L	SpC umhos	Phenol mg/L	F mg/L	pH -
MW-2	0.10	75.0	6.4	35.0	570	<0.04	0.67	6.4
MW-3	1.2	11.0	9.8	41.0	300	<0.04	0.22	6.0
MW-4	2.2	11.0	16.0	17.0	234	<0.04	0.27	6.0
MW-5	2.0	<5.0	24.0	16.0	224	<0.04	0.23	6.2
MW-6	1.9	13	70.0	16.0	431	<0.04	0.30	6.1
MW-7	0.82	11	16.0	21.0	229	<0.04	0.28	6.1

ROGER E. BOLDT, Ph.D.
Chief, Non-Metals Analysis Branch
Radiological and Inorganic Chemistry
Division

Section is Missing from the Official Government Document

APPENDIX B

ABBREVIATION AND DEFINITIONS

Aeolian	Applied to deposits arranged and/or transported by the wind
Annulus	Annular space between drill pipe and casing or between casing and walls
Atterberg Limits	Soil mechanics' indices based on the concept that a fine-grained soil can exist in any of four states, depending on its water content. A soil is solid when dry and, upon the addition of water, proceeds through the semisolid, plastic, and finally liquid state. The water contents at the boundaries between adjacent states are termed shrinkage limit, plastic limit, and liquid limit.
Bailer	A long, cylindrical container with a valve at the bottom, used for removing water from a well
BH	Borehole
BS	Bag Sample
Bentonite	A clay formed from the decomposition of volcanic ash and is largely composed of the clay minerals montmorillonite and beidellite. The clay commonly has great ability to absorb or adosrb water and swell accordingly
Casing	Permanent liner of a well
Cretaceous	The third and latest of the periods included in the Mesozoic era
DDMT	Defense Depot Memphis, Memphis, Tennessee
Embayment	Describes a continental border area that has sagged concurrently with deposition so that an unusually thick section of sediment results
EPA	US Environmental Protection Agency
Grout	Slurry or watery mixture of cement and clay which is used to fill the annular space between the casing and the wall of a borehole to seal out water from the surface
ID	inside diameter
Loess	A homogeneous, non-stratified, unindurated deposit consisting predominantly of silt, with a subordinate amount of very fine sand and/or clay
MW	Monitoring well
NIPDWR	National Interim Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
Paleozoic	One of the eras of geologic time that, between the late Precambrian and Mesozoic eras, comprises the Cambrian, Ordovician,

	Silurian, Devonian, Mississippi, Pennsylvania, and Permian systems
PCP	Pentachlorophenol
pH	The negative logarithm of the hydrogen ion activity
Porosity	The ratio of the aggregate volume of interstices in a rock or soil to its total volume
PVC	Polyvinyl chloride
Quaternary	The younger of the two geologic periods or systems of the Cenozoic era. Comprises all time from Tertiary to present; includes Recent and Pleistocene deposits; 3 million years ago to present
Recent	Time and strata younger than the Pleistocene, considered by some to be the last subdivision of the Pleistocene
Screen	Slotted casing section positioned opposite the producing horizon to prevent in flow of sand into the well
Shelby tube	A type of thin-walled tube sampler for acquiring undisturbed soil samples
SpC	Specific conductivity, which is the numerical expression of the ability of a water sample to carry an electrical current
TD	Total depth
Tertiary	The earlier of the two geologic periods comprised in the Cenozoic era, also, the system of strata deposited during that period
TOC	Top of casing
Unified Soils Classification	System of classifying soils for engineering purposes. This system is based on the identification of soils according to their particle size, gradation, plasticity index, and liquid limit
CH	inorganic clays of high plasticity, fat clays
CL	inorganic clays of low-to-medium plasticity, generally clays, sandy clay, silty clays, lean clays
GC	clayey gravels, gravel-sand-clay mixtures
FP	poorly graded gravels, gravel-sand mixtures, little or no fines
GW	well-graded gravels, gravel-sand mistures, little or no fines
MH	inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
ML	inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
OH	organic clays of medium-to-high plasticity, organic silts
OL	organic silts and organic silty clays of low plasticity

PT	peat and other highly organic soils
SC	clayey sands, sand-clay mixtures
SM	silty sand, sand-silt mixutres
SP	poorly graded sands, gravelly sands, little or no fines
SW	well-graded sands, gravelly sands, little or no fines
USAEHA	US Army Environmental Hygiene Agency
USATHAMA	US Army Toxic and Hazardous Materials Agency
void ratio	ratio of intergranular voids to volume of solid material in a sediment or sedimentary rock
WDED	Waste Disposal Engineering Division, USAEHA
WT	water table

APPENDIX C

PERSONNEL CONTACTED

1. COL William E. Freedman, Jr., Commander, DDMT

2. COL James A. Lovell, Deputy Commander, DUMT

3. Mr. P. S. Mott, Depty Director, Directorate of Installation Services (DIS)

4. MAJ Roger Gorres, Facility Engineering Division, DIS

5. Mr. A. L. Sides, Chief, Buildings and Grounds Branch, DIS

6. Mr. T. Walker, Planner Estimator/Scheduler, Production Control Office, Buildings and Grounds Branch, DIS

7. Mr. T. Bumpus, Chief, Production Control Office, Buildings and Grounds Branch, DIS

8. Mr. R. Montgomery, Supply Clerk, Material Aquisition Division, DIS

9. Mr. J. Gayhart, Pipe Fitter, Utilities Branch, DIS

Geohydrologic Study No. 3B-26-0195-83, DDM, Memphis, TN, 21 Jun-2 Jul 82

APPENDIX D

STRATIGRAPHIC COLUMN - MEMPHIS AREA

System	Series	Group	Stratigraphic Unit	Thickness (feet)	Lithology and Environmental Significance
Quaternary	Holocene and Pleistocene		Alluvium	0-175	Sand, gravel, silt, and clay. Provides borrow material for fills and levees and some aggregates for concrete and bituminous mixes. Used as foundation material or base on which fill is placed for residences and light buildings in flood plains. Lower sand and gravel beneath Mississippi Alluvial Plain used as foundation material for heavy structures. Supplies water to a few industrial wells on President and Mud Islands.
	Pleistocene		Loess	0-65	Silt, silty clay, and minor sand. Used generally as foundation material for residences and light buildings in upland areas. Provides material for fills placed in low places and flood plains. Thick deposits utilized for solid waste disposal.
Quaternary and Tertiary (?)	Pleistocene and Pliocene (?)		Fluvial deposits (terrace deposits)	0-100	Sand and gravel; minor ferruginous sandstone and clay. Provides most commercial aggregates for concrete and bituminous mixes. Used as a foundation material for heavy structures and high-rise buildings in upland areas. Supplies water to many shallow

System	Series	Group	Stratigraphic Unit	Thickness (feet)	Lithology and Environmental Significance
Quaternary and Tertiary -Continued					domestic wells in suburban and county areas. Some abandoned gravel pits utilized for solid waste disposal.
Tertiary	Eocene	?	Jackson Formation and upper part of Claiborne Group ("capping clay")	0-350	Clay, fine-grained sand, and lignite. Used as foundation material for heavy structures and for high-rise buildings where overlying fluvial deposits are thin or absent and where alluvial materials are unsuitable. Supplies water to some shallow wells completed in sands below the fluvial deposits, but generally considered to be of low permeability and to confine water in Memphis Sand. Lower boundary very poorly defined.
		Claiborne	Memphis Sand ("500-foot" sand)	500-800	Fine- to coarse-grained sand; subordinate lenses of clay and lignite. Very good aquifer from which most water for public and industrial supplies is obtained. Upper boundary very poorly defined.
	?	Wilcox	Flour Island Formation	160-350	Clay, fine-grained sand, and lignite. Confines water in Memphis Sand and Fort Pillow Sand.

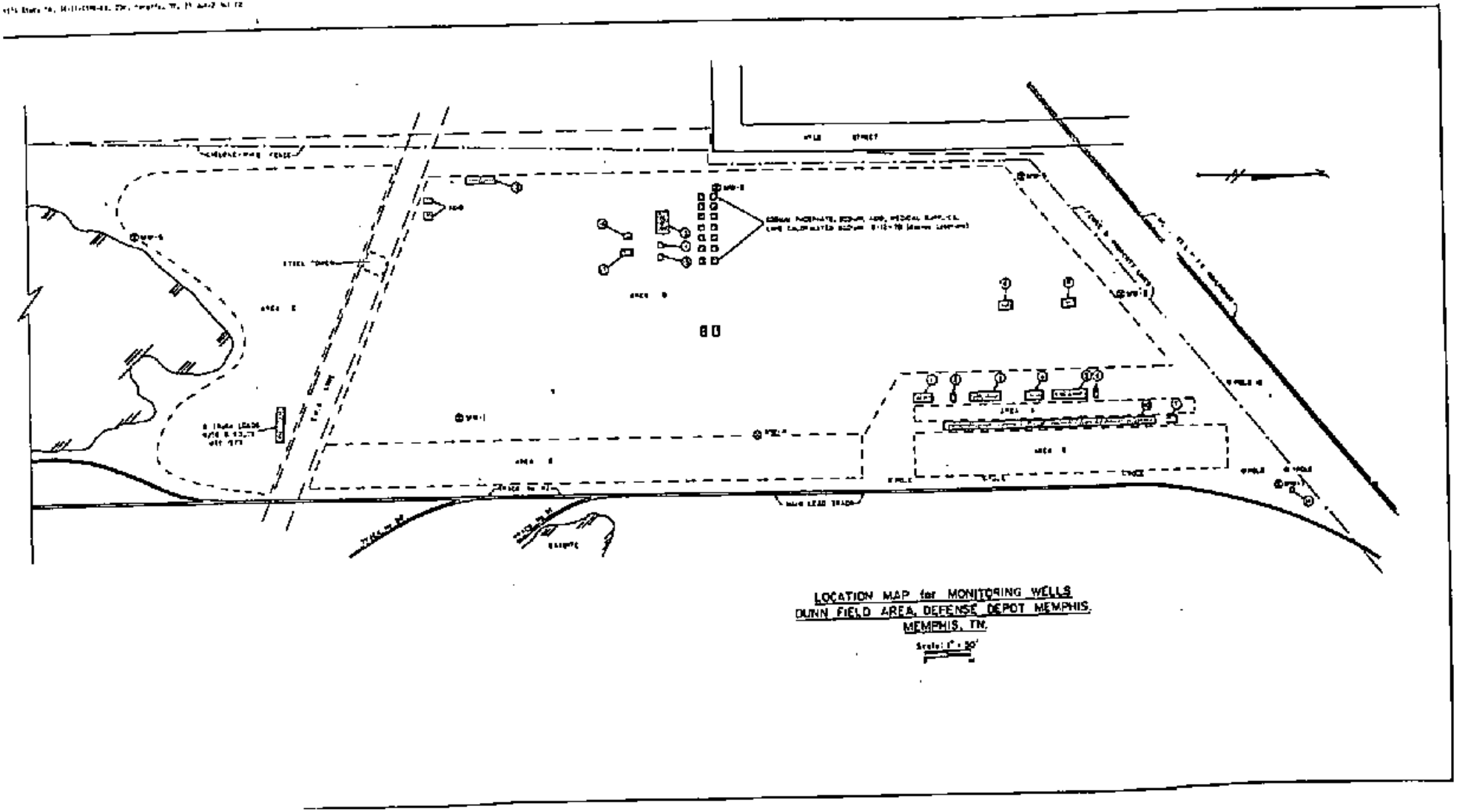
System	Series	Group	Stratigraphic Unit	Thickness (Feet)	Lithology and Environmental Significance
Tertiary -Continued	Paleocene	Wilcox -Continued	Fort Pillow Sand ("1400-foot" sand)	210-280	Fine- to medium-grained sand; subordinate lenses of clay and lignite. Once used as second principal aquifer for Memphis; now reserved for future use. Presently supplies water to a few industrial wells.
			Old Breastworks Formation	200-250	Clay, fine-grained sand, and lignite. Relatively impermeable lower confining bed for water in Fort Pillow Sand.

APPENDIX E

LOCATION MAP FOR MONITORING WELLS

DUNN FIELD AREA

DEFENSE DEPOT MEMPHIS



LOCATION MAP for MONITORING WELLS
DUNN FIELD AREA, DEFENSE DEPOT MEMPHIS,
MEMPHIS, TN.

Scale: 1" = 30'

Geohydrologic Study No. 38-26-0195-83, ODM, Memphis, TN, 21 Jun-2 Jul 82

APPENDIX F

DRILLING LOGS

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 23 June 1982

LOCATION Dunn Field Area - 95' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW -1

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	TD - 80' WL (initial)-no measurements, casing damaged REMARKS
0	BS		
		Lt. brown, plastic, silty clay	
5	ST/P 4.5-6.5	Lt brown, plastic, silty clay, moist	
10	ST/P 9-11	Lt brown plastic, silty clay	
15			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 23 June 1982

LOCATION Dunn Field Area - 95' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW -1

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
19			
20	ST/P 19-21	Lt Red silty clay/minor amount of sand	
	BS		
25			
30	ST/P 29-31		

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 23 June 1982

LOCATION Dunn Field Area - 95' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 1

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
	ST/P 29-31	Red, silty clay/sand	
35		Red, silty clay	
40	ST/P	Red, silty clay/rock fragments, buff colored shale and white colored sandstone	
45			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 23 June 1982

LOCATION Dunn Field Area - 95' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker A011/6" hollow stem auger BORE HOLE MW - 1

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
	BS	No soil return - water?	
50		Red-brown silty sand to sand	
55	BS	Brown-red silty sand/minor clay, subangular quartz grains	
60			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT DD Memphis, TN 38-26-0195-82

DATE 23 June 1982

LOCATION Dunn Field Area - 95' west of RR tracks

DRILLERS Kestner, Thoper, Curran

DRILL RIG Acker AD11/6" hollow stem auger

BORE HOLE MW - 1

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
60		Red-brown silty sand	
65		Red-yellow (lt orange) silty sand - sand	
70		Flowing sand	
75			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 23 June 1982

LOCATION Dunn Field Area - 95' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW -1

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Flowing sand	
80	BOH		Total Depth - 80'

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 24 June 1982

LOCATION Dunn Field Area-190' east of the NW corner of fence & 20' south of fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD II/6" hollow stem auger BORE HOLE MW - 2

GL- 289.69'

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	TD - 30' WL (initial) 17'-5" TOC WL (24 hr) 22'-3" TOC REMARKS
5		Brown, silty clay	
		Blue-gray, clay, moist plastic	
10		Blue-gray, clay, plastic very moist	As the auger was being removed a metalic cylinder approx. 3" long by 1" diameter was noted. A pungent odor was also noted
		Blue-gray, clay, wet	
15			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 24 June 1982

LOCATION Dunn Field Area-190'east of NW corner of fence & 20' south of fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6"hollow stem auger BORE HOLE MW - 2

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Brown-bluegray clay, moist (possibility of a brown silty material mixed with the blue-gray clay	
▼	Initial WL		
20			
▼	24 HR WL		
25			
30		BOH	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 24 June 1982

LOCATION Dunn Field Area-20' south of north fence & 22' east of west fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD II/6" hollow stem auger BORE HOLE MW - 3

GL - 290.38'

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	TD - 75' WL (initial) - 64'-0" WL (24 hr) - 63'-7" TOC REMARKS
		Brown, silty clay	encountered more canisters of unknown material (similar to one found in MW - 2)
5	BS	dark brown, silty clay	
		dark gray-black silty clay	
		brown to dark brown, silty clay	
10			
15			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 24 June 1982

LOCATION Dunn Field Area-20' south of north fence & 22' east of west fence DRILLERS Kestner, Thoper, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 3

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Brown, silty clay	
20			
25		more clay, and moist	
30	BS		

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 24 June 1982

LOCATION Dunn Field Area-20' south of north fence & 22' east of west fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker ADII/6" hollow stem auger BORE HOLE MW - 3

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
			Noise frow auger?
		Lt brown, silty sand	
35			Noise, possibly gravel
			water
		No return, sand sand-silt(red-yellow-lt orange)	
40			
	BS	Red-yellow (lt orange) sand/silt	
45			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DO Memphis, TN

PROJECT 38-26-0195-82 DATE 24 June 1982

LOCATION Dunn Field Area-20' south of north fence & 22' east of west fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 3

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
50		Red-yellow (lt orange) sand/silt	
55		Same/small gravel ½" diameter	
60			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 24 June 1982

LOCATION Dunn Field Area-20' south of north fence & 22' south of west fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 3

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
		Red-yellow(lt orange) sand/silt - moist	Moist flowing
▼	24 HR water level		
▼	Initial water level		
65		Red-yellow (lt orange) silt, sand	Wet
70			Extremely difficult to connect auger flight (flowing sands)
75		BOH	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 26 June 1982

LOCATION Dunn Field Area-due east of Kyle St & 60' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 4

GL- 300.02'

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	TD - 80' WL (initial) - 71'2" TOC WL (24 hr) - 71'3" TOC REMARKS
		Brown silty clay, gravel, noted	
2		Lt brown silty clay	
5		Brown silty clay	
10			
12		Brown silty clay/more silt context	
15			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 26 June 1982

LOCATION Dunn Field Area-due east of Kule St & 60' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 4

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	TD - REMARKS
20			
25		Lt brown silty clay	
30			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 26 June 1982

LOCATION Dunn Field Area-due east of Kyle St & 60' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 4

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
		Red-brown, weak red, silty clay	
35		Red-brown, weak red silty sand	
40			
45			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 26 June 1982

LOCATION Dunn Field Area-due east of Kyle St & 60' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 4

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
50		Red-yellow (lt orange) sand/silt	
55		Lt brown silty sand, minor amounts of sandstone fragments (rounded)	
60			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 26 June 1982

LOCATION Dunn Field Area-due east of Kyle St & 60' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 4

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
		Red-yellow (lt orange) sand/silt	
65			
70			
		Red-yellow- lt brown silty sand	Flowing sands
	initial water level		
	24 hr water level		
75			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 26 June 1982

LOCATION Dunn Field Area-due east of Kyle St & 60' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 4

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
			Flowing sand
80		BOH	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 27 June 1982

LOCATION Dunn Field Area-283' west of MW 4 and 30' east of NS fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 5

GL- 301.33'

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	TD - 80' WL (initial) - 75'-10"TOC WL (24 hr) - 75'-10" TOC REMARKS
		Brown Silty Clay	
5			
10		Dark brown silty clay	Moist
15			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 27 June 1982

LOCATION Dunn Field Area-283' west of MW 4 and 30' east of NS fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 5

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
20		Brown silty clay	not as moist
25		Red-brown (weak red) silty clay	Dry
30			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 27 June 1982

LOCATION Dunn Field Area-283' west of HW 4 and 30' east of NS fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 5

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Red-brown (weak red) silty sand	
35	BS	Red-brown silty sand - red brown sandy silt	
40			
45			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 27 June 1982

LOCATION Dunn Field Area-283' west of MW 4 and 30' east of NS fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 5

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
		Red-brown - brown sandy silt/minor gravel, diameter ½"	
50		Gravel	
		Red-brown-yellow silty sand	
55		Borwn, silty sand/gravel	
		Red-yellow (lt orange) sand/silt	Moist
60			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

E-9A

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT DD Memphis, TN 38-26-0195-82 DATE 27 June 1982

LOCATION Dunn Field Area-283' west of MW 4 and 30' east of NS fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 5

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Brown silty sand/gravel	
		Red-yellow (lt orange) sand/silt	
65			
70			Moist - wet Flowing sand
75			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 27 June 1982

LOCATION Dunn Field Area-283' west of MW 4 and 30' east of NS fence DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker ADII/6" hollow stem auger BORE HOLE MW - 5

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
▼ Initial and 24 hr water level			Flowing sand
80		BOH	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-0195-82 DATE 28 June 1982

LOCATION Dunn Field area-79' east of NS fence and 311' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 6

GL- 288.06'

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	TD - 70' WL(initial) - 59'-6" TOC WL (24 hr) - 60'-0" TOC REMARKS
		Cinders	
		Brown silty clay, moist	
5		Blue-gray silty clay, moist	
		Brown, silty clay, moist	
10			
15			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT DD Memphis, TN 38-26-0195-82

DATE 28 June 1982

LOCATION Dunn Field Area-79' east of NS fence and 311' west of RR tracks

DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger

BORE HOLE MW - 6

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
20			Wet
25			
		Red-brown silty sand to sandy silt (weak red)	Wet
30			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 27 June 1982

LOCATION Dunn Field Area-79' east of NS fence 311' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 6

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
35			Wet
		Lt brown (buff) sandy silt to silty sand	
40			
45			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT DD Memphis, TN 38-26-0195-82 DATE 28 June 1982

LOCATION Dunn Field Area-79' east of NS fence 311' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 6

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
		Lt brown sand/silt, very minor amount of gravel or rock chips	
50			Heavy thunderstorm, stop drilling, after 1 hr resumed drilling. Hole had filled with water; surface water
		No soil return	
55			
▼		initial water level	
60 ▼		24 hour water level	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 28 June 1982

LOCATION Dunn Field Area-79' east of NS fence 311' west of RR tracks DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 6

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
65			
70		BOH	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 28 June 1982

LOCATION Dunn Field Area-26' south of E-W fence, 26' north of RR tracks & 44' east of power pole #47104 DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 7

GL- 293.10'

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	TD - 75' WL(initial)-64'-7" TOC WL(24 hr)-65'-0" TOC REMARKS
		Brown silty clay	
5		Darker brown silt	
10			
15			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 28 June 1982

LOCATION Dunn Field Area-26' south of EW fence, 26' north of RR tracks & 44' east of power pole #4/104 DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 7

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN.	DESCRIPTION	REMARKS
20		Red-brown silty clay (weak read)	
25			
30			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 28 June 1982

LOCATION Dunn Field Area-26' south of EW fence, 26' north of RR tracks & 44' east of power pole #4/104 DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 7

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
35			
40			
		Brown, silty sand, moist	
45		Red-yellow (lt orange) sand/silt	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

DD Memphis, TN

PROJECT 38-26-0195-82 DATE 28 June 1982

LOCATION Dunn Field Area-26' south of EW fence, 26' north of RR tracks & 44' east of power pole #47104 DRILLERS Kestner, Thoner, Curran

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 7

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
		Brown, sand/silt with minor gravel	
		Red-yellow (lt orange) sand/silt	
50		Brown sand/silt	
55		Red-yellow (lt orange) sand/silt	
60			

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

US ARMY ENVIRONMENTAL HYGIENE AGENCY

DRILLING LOG

PROJECT DD Memphis, TN 38-26-0195-82 DATE 28 June 1982

LOCATION Dunn Field Area-26' south of EQ DRILLERS Kestner, Thoner, Curran

EW fence, 26' north of RR tracks & 44' east of power pole #4/104

DRILL RIG Acker AD11/6" hollow stem auger BORE HOLE MW - 7

DEPTH	SAMPLE TYPE / BLOWS PER 6 IN	DESCRIPTION	REMARKS
			Wet, flowing sand
▼	Initial	Water Level	
65 ▼	24 hr Water Level		
		Brown sand/silt	Very wet Water
70		Red-yellow (lt orange) sand/silt	Very wet
75		BOH	

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

Geohydrologic Study No. 38-26-0195-83, ODM, Memphis, TN, 21 Jun-2 Jul 82

APPENDIX G

LABORATORY ANALYSIS OF SOILS

LABORATORY ANALYSIS OF SOILS

The proponent of this form is HSE-ES.

PROJECT NO. 38-26-0195-82

LOCATION DEFENSE DEPOT MEMPHIS, MEMPHIS, TN.

BORE HOLE NO	1	1	1	1	1	1	1	1	1	3	3	3
DEPTH OF SAMPLE	4.5-6.5'	9.0-10.0'	19.0-21.0'	29.0-31.0'	39.0-39.6'	0-2.5'	28-29'	45-50'	55.60'	4-5'	28-30'	41-45'
SAMPLE TYPE	ST	ST	ST	ST	ST	BS	BS	BS	BS	BS	BS	BS
GRAIN SIZE ANALYSIS					½-87.8				¼-94.6			
% PASSING NO. 4 (SIEVE)	100.0	100.0	100.0	100.0	79.7	98.6	99.9	100.0	84.8	99.0	99.8	99.5
% PASSING NO.10 (SIEVE)	100.0	100.0	99.9	100.0	75.7	98.0	99.8	99.9	81.7	97.2	99.6	99.0
% PASSING NO.20 (SIEVE)	100.0	99.9	99.7	99.9	73.1	97.5	99.6	98.8	77.6	93.9	99.1	95.6
% PASSING NO.40 (SIEVE)	99.9	99.7	99.2	99.7	62.6	96.2	99.1	88.8	64.8	90.3	96.3	74.2
% PASSING NO.100 (SIEVE)	99.6	99.0	79.3	25.8	7.9	95.4	83.6	56.3	7.6	84.8	75.7	9.8
% PASSING NO.200 (SIEVE)	99.2	98.3	75.4	21.4	7.4	95.1	80.6	33.1	6.7	83.3	73.9	9.0
% PASSING NO.0.02 (HYDROMETER)												
% PASSING NO. 0.002 (HYDROMETER)												
% PASSING NO. 0.001 (HYDROMETER)												
ATTERBERG LIMITS												
LIQUID LIMIT ^{W}L	27.5	25.8	22.0	27.5	NON	32.0	28.9	21.3	NON	33.0	28.2	NON
PLASTIC LIMIT ^{W}P	21.9	21.7	13.2	20.8	PLASTIC	21.5	20.2	16.7	PLASTIC	24.5	21.6	PLASTIC
PLASTIC INDEX ^{I}P	5.6	4.1	8.8	6.7		10.5	8.7	4.6		8.5	6.6	
UNIFIED SOIL CLASSIFICATION	ML-CL	ML-CL	CL	SM-SC	GW-GC	CL	CL	SM-SC	GW-GM	ML	ML-CL	GW-GM
STANDARD PROCTOR DENSITY												
gm/cm^3												
lb/ft^3												
OPTIMUM MOISTURE CONTENT (OMC%)												
NATURAL MOISTURE CONTENT %												
PERMEABILITY Cm/sc (k)												
"IN SITU" (SHELBY TUBE/SPLIT SPOON)												
PROCTOR DENSITY- COMPACTION MOLD												
PROCTOR DENSITY- HAND REMOLDED	2.20×10^{-7}	8.15×10^{-8}	4.21×10^{-8}	1.14×10^{-4}	8.19×10^{-4}		3.59×10^{-6}					
3-VOID								6.89×10^{-5}	4.27×10^{-5}		4.14×10^{-5}	5.92×10^{-3}
VOID RATIO (k)	0.761	0.727	0.500	0.40	0.605		0.570	0.789	0.620		0.875	0.669
% SATURATION (k)	100.37	95.85	94.53	139.23	94.18		97.07	94.84	89.21		97.17	94.00
POROSITY (k)	43.2	42.1	33.3	29.1	37.7		37.1	44.1	38.3		46.7	40.1
DRY DENSITY (k)	1.58	1.56	1.80	1.93	1.68		1.70	1.51	1.67		1.44	1.62
MOISTURE CONTENT (k)	28.3%	25.8%	17.5%	21.2%	21.1%		21.2%	27.7%	20.5%		31.5%	23.3%
SPECIFIC GRAVITY	2.7	2.7	2.7	2.7	2.7		2.7	2.7	2.7		2.7	2.7
CATION EXCHANGE CAPACITY (CEC)												
% BASE SATURATION												

COMPLETED BY [signature] DATE 9-3-82 APPROVED BY [signature] DATE 9 Sep 82

AEHA Form 92, 1 Dec 81

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G-3

Richard M. Carnevale

RICHARD M. CARNEVALE
1LT, MSC
Sanitary Engineer
Waste Disposal Engineering
Division

LABORATORY ANALYSIS OF SOILS

The proponent of this form is HSE-ES.

PROJECT NO. 38-26-0195-82

LOCATION DEFENSE DEPOT MEMPHIS, MEMPHIS, TN.

BORE HOLE NO	5												
DEPTH OF SAMPLE	35-46'												
SAMPLE TYPE	BS												
GRAIN SIZE ANALYSIS													
% PASSING NO. 4 (SIEVE)	99.1												
% PASSING NO. 10 (SIEVE)	97.3												
% PASSING NO. 20 (SIEVE)	95.8												
% PASSING NO. 40 (SIEVE)	89.2												
% PASSING NO. 100 (SIEVE)	35.1												
% PASSING NO. 200 (SIEVE)	30.1												
% PASSING NO. 0.02 (HYDROMETER)													
% PASSING NO. 0.002 (HYDROMETER)													
% PASSING NO. 0.001 (HYDROMETER)													
ATTERBERG LIMITS													
LIQUID LIMIT W_L	19.0												
PLASTIC LIMIT W_P	17.8												
PLASTIC INDEX I_P	1.2												
UNIFIED SOIL CLASSIFICATION	SM												
STANDARD PROCTOR DENSITY													
gm/cm^3													
lb/ft^3													
OPTIMUM MOISTURE CONTENT (OMC %)													
NATURAL MOISTURE CONTENT %													
PERMEABILITY Cm/sc (k)													
"IN SITU" (SHELBY TUBE/SPLIT SPOON)													
PROCTOR DENSITY- COMPACTION MOLD													
PROCTOR DENSITY- HAND REMOLDED													
3-VOID	6.57×10^{-4}												
VOID RATIO (k)	0.789												
% SATURATION (k)	92.79												
POROSITY (k)	44.1												
DRY DENSITY (k)	1.51												
MOISTURE CONTENT (k)	27.1%												
SPECIFIC GRAVITY	2.7												
CATION EXCHANGE CAPACITY (CEC)													
% BASE SATURATION													

COMPLETED BY | DATE | APPROVED BY [signature] | DATE 7 Sep 92

AEHA Form 92, 1 Oct 81

Richard M. Carnevale

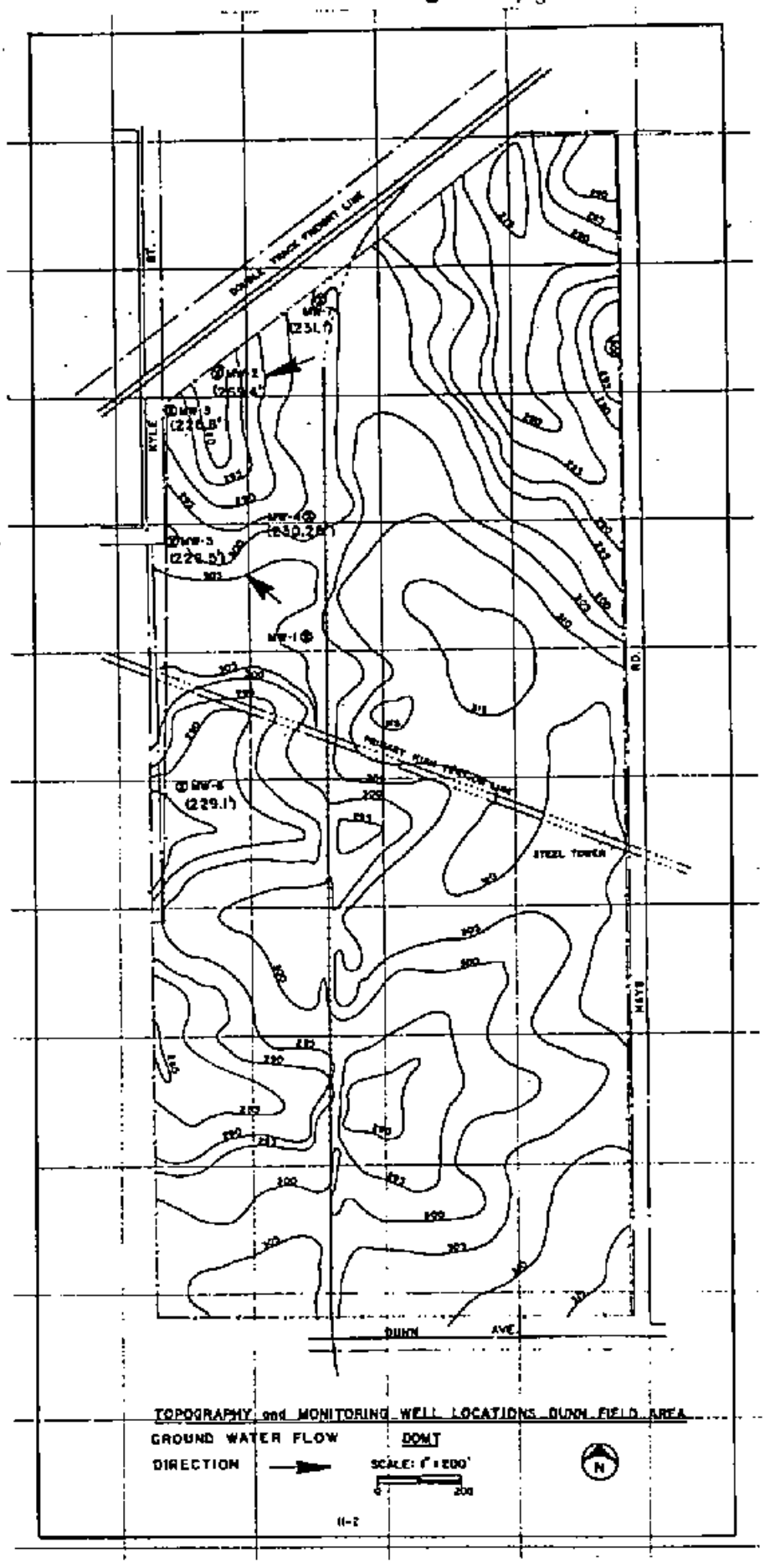
RICHARD M. CARNEVALE
1LT, MSC
Sanitary Engineer
Waste Disposal Engineering

APPENDIX H

TOPOGRAPHY AND MONITORING WELL LOCATIONS

DUNN FIELD AREA

SHOWING GROUND WATER FLOW DIRECTION



TOPOGRAPHY and MONITORING WELL LOCATIONS DUNN FIELD AREA

GROUND WATER FLOW DOWN

DIRECTION

SCALE: 1" = 200'

0 200

N

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FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE