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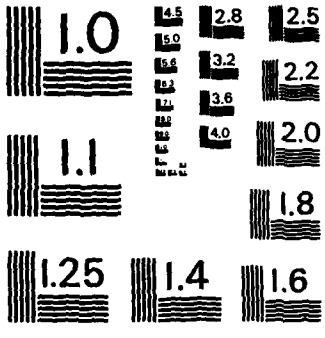

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INSTALLATION RESTORATION
PROGRAM RECORDS SEARCH

FOR

AIR FORCE PLANT 4, TEXAS

Prepared for

AIR FORCE ENGINEERING AND SERVICES CENTER
DIRECTORATE OF ENVIRONMENTAL PLANNING
TYNDALL AIR FORCE BASE, FLORIDA 32403

and

AIR FORCE SYSTEMS COMMAND
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August 1984

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This report provides an introduction, description, and environmental setting of Air Force Plant 4, Ft Worth Texas. It reviews past and present practices of wastewater treatment, landfills, waste oil pits, chrome and die yard pits, disposal and spill sites. A total of 20 sites were ranked using the HARM (Hazard Assessment Rating Methodology) rating system. Of the 20 sites ranked, 19 were recommended for Phase II.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

A. INTRODUCTION

1. CH2M HILL was retained on March 15, 1984, to conduct the Air Force Plant 4 records search under Contract No. F08637-80-G0010-5009-02, with funds provided by Aeronautical Systems Division (ASD). This study will satisfy the documentation requirements of the National Contingency Plan.

2. Department of Defense (DoD) policy, directed by Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, is to identify and fully evaluate suspected problems associated with past hazardous material disposal sites on DoD facilities, control the migration of hazardous contamination from such facilities, and control hazards to health and welfare that may have resulted from these past operations.

3. To implement the DoD policy, a four-phase Installation Restoration Program has been directed. Phase I, the records search, is the identification of potential problems. Phase II (not part of this contract) consists of the necessary field work to confirm the direction, rate of movement, and extent of contamination. Phase III (not part of this contract) consists of technology base development to support the development of project plans for controlling migration or restoring the installation. Phase IV (not part of this contract) includes those efforts which are required to control identified hazardous conditions.

4. The Air Force Plant 4 records search included a detailed review of pertinent installation records, including Official Contract Records, agency contacts for documents

relevant to the records search effort, and an onsite base visit conducted by CH2M HILL during the week of May 7 through May 11, 1984. Activities conducted during the onsite base visit included interviews with past and present employees, ground tours, and a detailed search of relevant installation records. (The Public Affairs Office provided a press release announcing the study and requesting persons knowledgeable of past disposal practices at the installation to contact Air Force Plant 4.)

B. MAJOR FINDINGS

1. The total quantity of waste oils, recoverable fuels, solvents, paint residues, and spent process chemicals generated at Air Force Plant 4 is estimated to be approximately 5,500 to 6,000 tons per year. This information was developed from interviews with General Dynamics personnel, previous reports, and monthly waste shipment records. The total waste quantities may have been higher in the past during periods of heavier contractor workload.

2. Major procedures for the disposal of the majority of industrial wastes in the past have included:

	1942-1955	1955-1966	1966-1970	1970-1975	1975-1983	1983-Present
Burning and/or burial at on-site landfills	X	X	X	X		
Burning in fire department training exercises		X	X	X	X	
Contractor removal off-site			X	X	X	X
Treatment via chemical waste treatment system				X	X	X

3. Ground- and surface-water investigations have been in progress at Air Force Plant 4 since late 1982. Ground-water contamination has been confirmed in the vicinity of abandoned waste disposal sites. Contaminants have consisted of heavy metals and organic priority pollutants, particularly volatile organic compounds such as the solvents trichloroethylene and 1,2-trans-dichloroethylene.

4. Remedial activities that have been implemented at Air Force Plant 4 include excavation of contaminated soils and ground-water recovery and disposal in the area of some former waste oil pits; and excavation of contaminated soils in two areas (chrome pit and die yard pits) where former chromium sludge disposal pits were located.

5. Interviews with current and former employees and review of previous reports and aerial photographs resulted in the identification of 20 disposal or spill sites at Air Force Plant 4. Figure 1 shows the location of the identified sites.

C. CONCLUSIONS

1. Each identified site was rated using the Hazard Assessment Rating Methodology. Table 1 presents a priority listing of the rated sites and their overall scores.

2. Information obtained through the review of available reports, interviews with present and former employees, plant records, aerial photographs, and field observations indicates that hazardous wastes have been disposed of on Air Force Plant 4 property in the past.

3. No direct evidence was found to indicate that migration of hazardous contaminants beyond the Air Force Plant 4 boundary has occurred.

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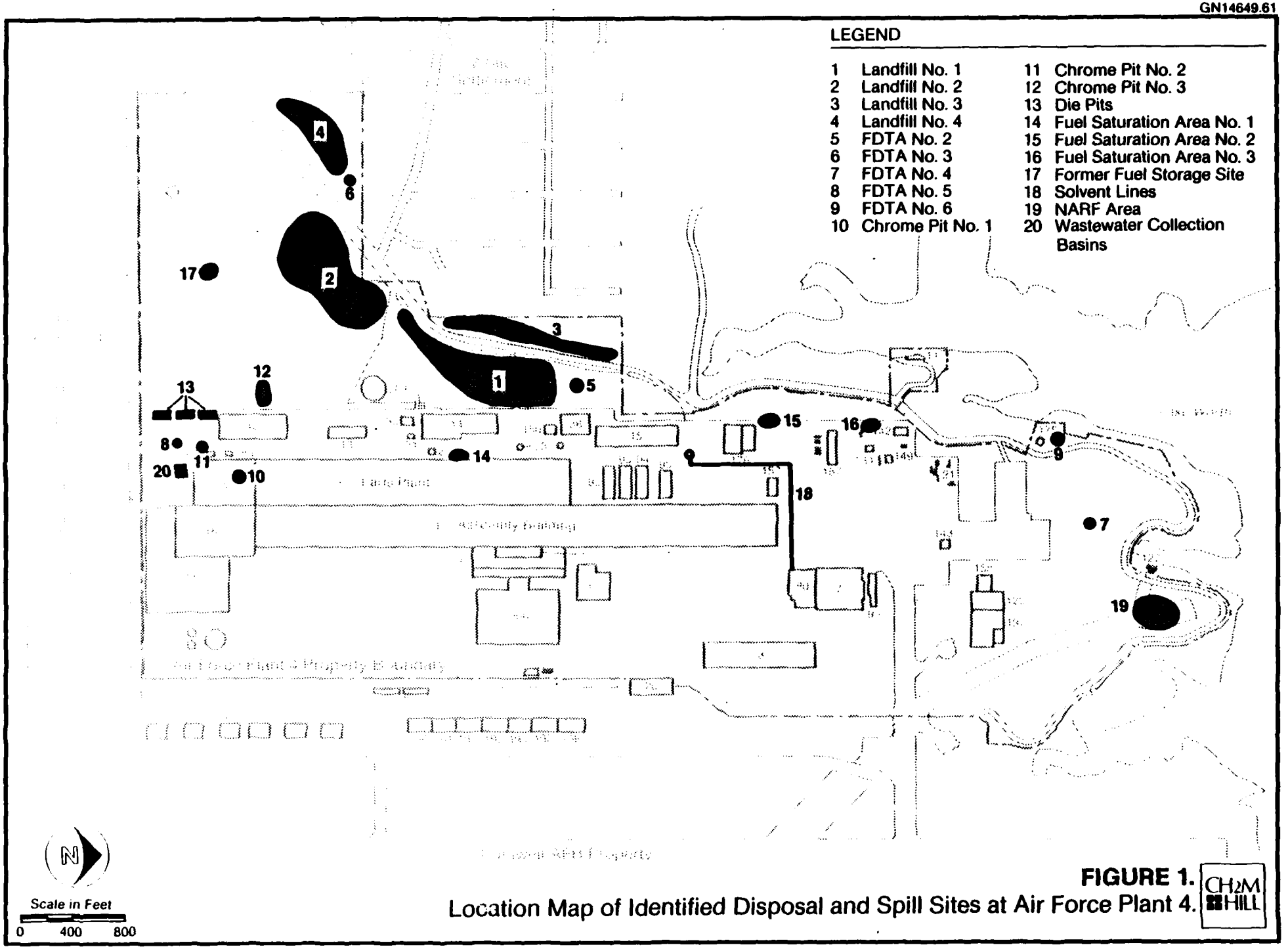

FIGURE 1.
Location Map of Identified Disposal and Spill Sites at Air Force Plant 4.

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Table 1
PRIORITY LISTING OF DISPOSAL AND SPILL SITES

Ranking	Site No.	Site Name	Overall Score
1	1	Landfill No. 1	88
2	3	Landfill No. 3	86
3	12	Chrome Pit No. 3	74
4	17	Former Fuel Storage Site	73
--	2	Landfill No. 2	73
5	4	Landfill No. 4	66
6	13	Die Pits	64
7	20	Wastewater Collection Basins	63
8	16	Fuel Saturation Area No. 3	62
9	9	FDTA No. 6	58
--	6	FDTA No. 3	58
--	7	FDTA No. 4	58
--	18	Solvent Lines	58
10	10	Chrome Pit No. 1	55
--	11	Chrome Pit No. 2	55
11	15	Fuel Saturation Area No. 2	54
12	8	FDTA No. 5	53
13	5	FDTA No. 2	51
--	14	Fuel Saturation Area No. 1	51
14	19	NARF Area	6

4. Indirect evidence indicates that migration of hazardous contaminants beyond the Air Force Plant 4 boundary has occurred in the past. Contaminated ground water beneath the west employee parking lot was determined in late 1982 to be seeping into a buried stormwater pipe and subsequently discharging into Meandering Road Creek. This condition was eventually eliminated through remedial activities in the vicinity of the parking lot. Continued findings of metals and volatile organic compounds in water samples collected from Meandering Road Creek, adjacent to Air Force Plant 4, suggest that contaminated ground water from Air Force Plant 4 may be leaching into the creek.

5. Studies completed to date by General Dynamics have confirmed ground-water contamination in the upper zone over much of Air Force Plant 4 property. The upper zone ground water is not known to be used as a potable water source in the vicinity of Air Force Plant 4. A potential exists for contamination of the Paluxy Aquifer, a potable water source for the neighboring city of White Settlement, in those areas where the overlying confining bed separating the aquifer from the contaminated upper zone is absent. Contamination in the Paluxy Aquifer has been confirmed at one location east of the west employee parking lot, less than 100 feet east of the excavation of the former waste oil pits. However, the absence of contaminants in other Paluxy monitoring and production wells on and near Air Force Plant 4 property has indicated that contamination of this aquifer is not widespread. Additional Paluxy wells to better define the vertical and horizontal extent of contamination within the Paluxy Aquifer are currently being installed.

6. The presence of volatile organic compounds, including trichloroethylene (40 to 4,000 μg/L) and 1,2-trans-dichloroethylene (13 to 1,800 μg/L) in upper zone

monitor wells HM-11 and HM-31, located along the south property boundary, causes concern that migration of hazardous contaminants beyond the Air Force Plant 4 property may be occurring to the south. However, EPA monitor wells located approximately 700 to 800 feet further south have been free of these contaminants. The presence of volatile organic compounds, including trichloroethylene (10 to 500 μg/L) and 1,2-trans-dichloroethylene (120 to 10,000 μg/L) in upper zone monitor wells HM-21, 26, and 27, located near the west property line causes concern for potential contaminant migration beyond Air Force Plant 4 property to the west.

7. No evidence of significant environmental stress due to past disposal/spills of hazardous wastes was observed at Air Force Plant 4.

8. The potential exists for surface-water migration of hazardous contaminants due to the proximity of identified sites to Meandering Road Creek and to Lake Worth. In addition, upper zone ground water carrying dissolved contaminants may discharge to these surface waters.

9. The remaining site (Site 19, NARF Area) was not considered to present significant concern for adverse effects on health or the environment.

D. RECOMMENDATIONS

1. A program to supplement on-going monitoring efforts at Air Force Plant 4 is recommended. More specifically, monitoring, including soil borings and/or monitor wells, has been recommended at each of the 20 identified sites with the exception of one, the NARF Area (Site No. 19). The recommended sampling sites are shown in Figures 24 through 28 in Section VI., "Recommendations."

2. The priority for continued monitoring at Air Force Plant 4 is considered high in light of confirmed findings of ground-water contamination. Details of the proposed monitoring program are included in Section VI. of this report.

3. The specific details of the monitoring program, including exact locations of sampling points, should be finalized by the Phase II contractor.

4. Off-site wells, including the EPA monitor wells (EPA-1, 2, and 3), and the City of White Settlement wells (No. 1, 6, and 12), should be sampled at least semi-annually to detect possible contamination. Analysis should include volatile organic compounds.

5. Outfall No. 1 should be sampled and analyzed for volatile organic compounds to determine if this outfall could be the source of VOC contamination found by Carswell AFB downstream of the outfall discharge point.

6. The buried sanitary, storm, and industrial wastewater lines that run parallel with the south property line and past monitor well HM-31 should be sampled and analyzed for VOCs to determine if a potential exists for contamination of HM-31 from these lines. If VOCs are detected at levels that could explain the findings in HM-31, the respective pipeline(s) should be investigated for leaks and appropriate corrective actions taken.

7. Other IRP recommendations include: (1) locate abandoned wells on Air Force Plant 4 property and cap or plug each well, depending on their physical condition, and (2) sample the contents (if any) of three known inactive buried POL tanks, and based upon the analyses, recommend appropriate remedial actions (IRP Phase IV) be taken.

I. INTRODUCTION

I.
INTRODUCTION

A. BACKGROUND

The United States Air Force (USAF), due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner.

The Department of Defense (DoD) developed the Installation Restoration Program (IRP) to ensure compliance with hazardous waste regulations. The current DoD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Headquarters Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DoD policy is to identify and fully evaluate suspected problems associated with past hazardous material contamination, and to control hazards to health and welfare that may have resulted from these past operations. The IRP will be the basis for assessment and response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as implemented by Executive Order 12316 and provisions of Subpart F of 40 CFR 300 (National Contingency Plan). CERCLA is the primary Federal legislation governing remedial actions at uncontrolled hazardous waste sites.

To conduct the IRP Hazardous Materials Disposal Sites Records Search for Air Force Plant 4, Texas, CH2M HILL was retained on March 15, 1984, under Contract No. F08637-80-G0010-5009-02 with funds provided by Aeronautical Systems Division (ASD). A location map of Air Force Plant 4 is shown in Figure 2.

The records search, Phase I of the DoD IRP, is intended to review installation records for the purpose of identifying possible hazardous waste-contaminated sites and assessing the potential for contaminant migration. Phase II (not part of this contract) consists of the necessary fieldwork to confirm the direction, rate of movement, and extent of contamination. Phase III (not part of this contract) consists of technology base development to support the development of project plans for controlling migration or restoring the installation. Phase IV (not part of this contract) includes those efforts which are required to control identified hazardous environmental conditions.

B. AUTHORITY

The identification of hazardous waste disposal sites at Air Force installations was directed by Defense Environmental Quality Program Policy Memorandum 81-5 (DEQPPM 81-5) dated 11 December 1981, and implemented by Headquarters Air Force message dated 21 January 1982, as a positive action to ensure compliance of Air Force installations with existing environmental regulations.

C. PURPOSE OF THE RECORDS SEARCH

The Phase I records search is designed to identify and evaluate suspected problems associated with past hazardous material disposal sites and spill sites on DoD facilities.

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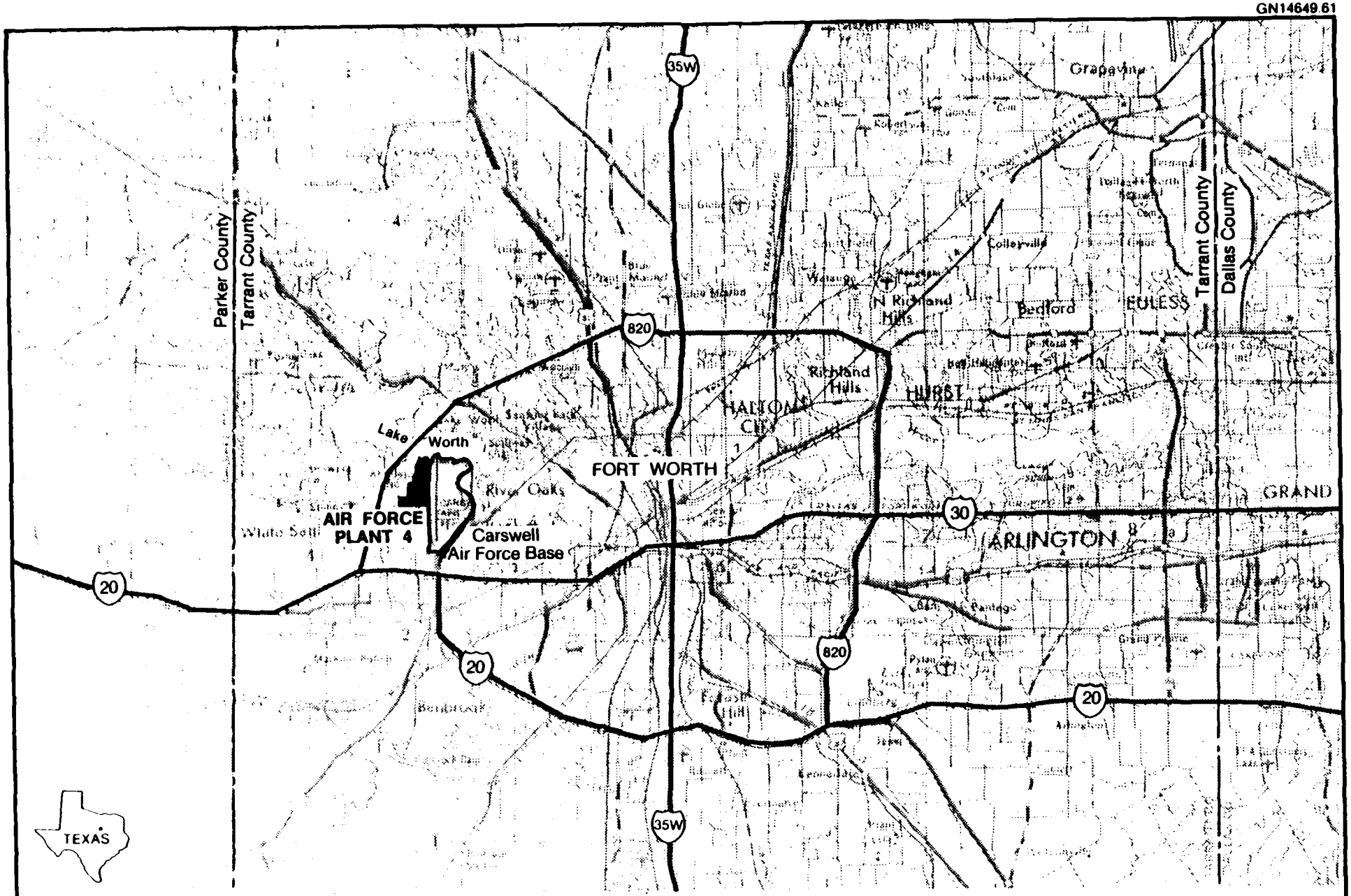

FIGURE 2.
Location Map of Air Force Plant 4.

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The existence and potential for migration of hazardous material contaminants were evaluated at Air Force Plant 4 by reviewing the existing information and conducting an analysis of installation records. Pertinent information included the history of operations, the geological and hydrogeological conditions which may have contributed to the migration of contaminants, and the ecological settings which indicated environmentally sensitive habitats or evidence of environmental stress. The evaluation is to determine which identified sites, if any, exhibit a significant potential for environmental impact and warrant further investigation. Sampling is not conducted during Phase I.

D. SCOPE

The records search program included a pre-performance meeting, an onsite installation visit, a review and analysis of the information obtained, and preparation of this report.

The pre-performance meeting was held at Air Force Plant 4, Texas, on April 12, 1984. Attendees at this meeting included representatives of the Air Force Engineering and Services Center (AFESC), Aeronautical Systems Division (ASD), Air Force Systems Command, Air Force Plant Representatives Office, Air Force Regional Civil Engineer Office, Carswell AFB, General Dynamics, and CH2M HILL. The pre-performance meeting provided detailed project instructions, provided clarification and technical guidance by AFESC, and defined the responsibilities of all parties participating in the Air Force Plant 4 records search.

The on-site installation visit was conducted by CH2M HILL from May 7 through May 11, 1984. Activities performed during the onsite visit included a detailed search of installation records, facility and ground tours, and

interviews with past and present installation personnel. At the conclusion of the on-site visit, the base commander, representatives of the Air Force Plant Representatives Office, and General Dynamics personnel were briefed on the preliminary findings. The CH2M HILL records search team included the following individuals:

1. Mr. David Moccia, Project Manager (B.S. Chemical Engineering, 1971)

2. Dr. Robert Knight, Ecologist (Ph.D. Systems Ecology, 1980)

3. Mr. Gary Eichler, Hydrogeologist (M.S. Engineering Geology, 1974).

Resumes of these team members are included in Appendix A.

Government organizations were contacted for information and relevant documents. Appendix B lists the organizations contacted.

Individuals from the Air Force who assisted in the Air Force Plant 4 records search include:

1. Captain Gail Graban, AFESC, Program Manager, Phase I

2. Tom Brown, AFPRO, Air Force Plant 4

E. METHODOLOGY

The methodology used in the Air Force Plant 4 records search is shown in Figure 3. First, a review of past and present industrial operations was conducted at the

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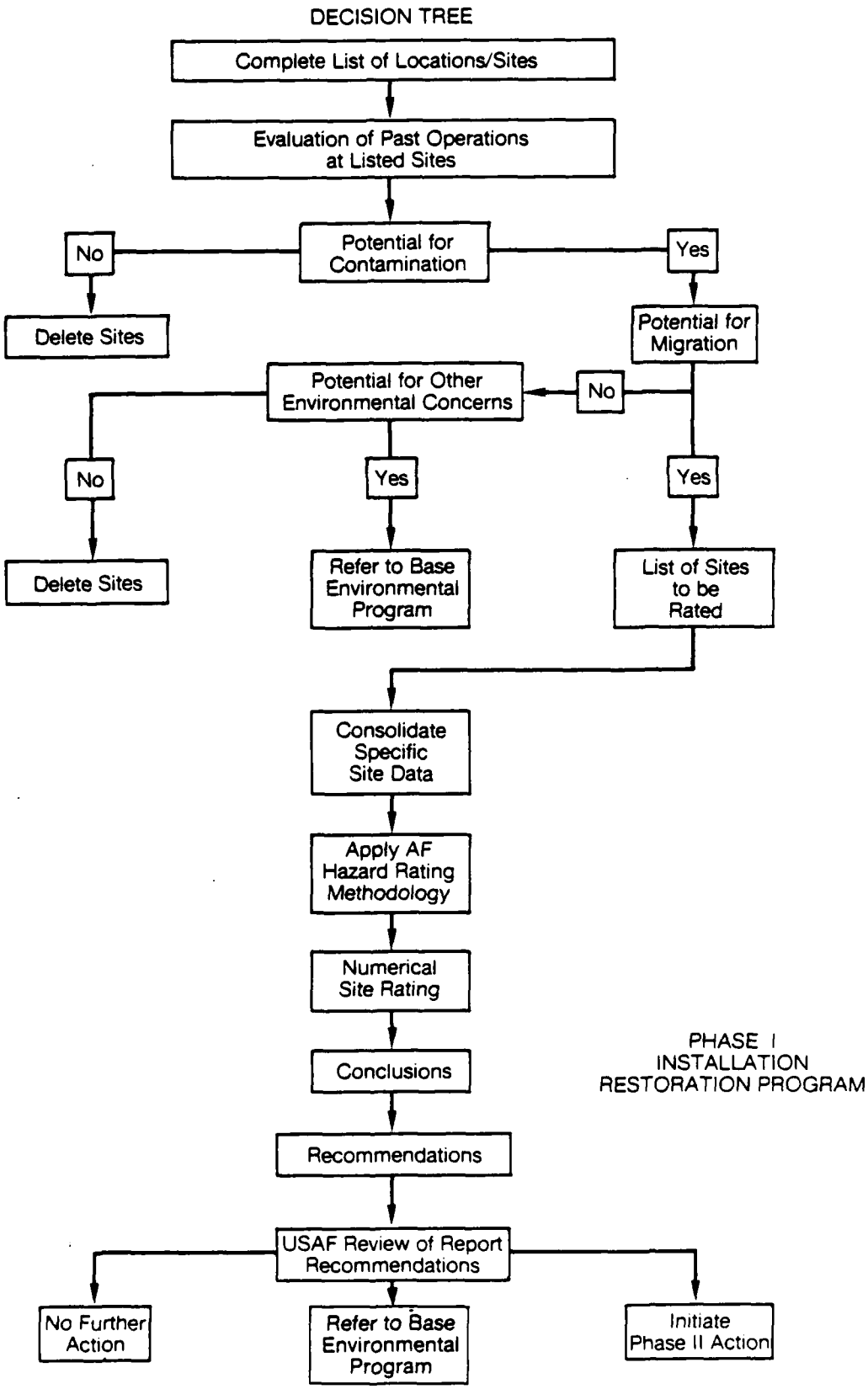

PHASE I
INSTALLATION
RESTORATION PROGRAM

FIGURE 3.
Records Search Methodology.

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installation. Information was obtained from available records that included Official Contract Records dating from 1942 to 1984, shop files and real property files, as well as interviews with past and present base employees from the various operating areas of the installation. The information obtained from interviewees on past activities was based on their best recollection. A list of interviewees from Air Force Plant 4, with areas of knowledge and years at the installation, is presented in Appendix C.

The next step in the activity review process was to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from all the industrial operations at the installation. This part of the activity review included the identification cf past landfill sites and burial sites; as well as other possible sources of contamination such as major PCB or solvent spills, or fuel-saturated areas resulting from significant fuel spills or leaks.

The records search team conducted a general ground tour of identified sites to gather site-specific information including evidence of environmental stress and the presence of nearby drainage ditches or surface-water bodies. These water bodies were visually inspected for any evidence of contamination or leachate migration.

A decision was then made, based on all of the above information, as to whether a potential existed for hazardous material contamination from any of the identified sites. If not, the site was deleted from further consideration.

For those sites at which a potential for contamination was identified, the potential for migration of this contamination was evaluated by considering site-specific soil and ground-water conditions. If there was no potential for

contaminant migration, but other environmental concerns were identified, the site was referred to the installation environmental program. If no further environmental concerns were identified, the site was deleted from consideration. If the potential for contaminant migration was identified, then site specific information was evaluated and the site was rated and prioritized using the site rating methodology described in Appendix J, "Hazard Assessment Rating Methodology."

The site rating indicates the relative potential for adverse environmental impact at each site. For those sites showing a significant potential, recommendations were made to conduct a more detailed investigation of the potential contaminant migration problem under Phase II of the Installation Restoration Program. For those sites showing a low potential, no Phase II work was recommended.

It should be noted that some interim responses in accordance with the National Contingency Plan have already been conducted at Air Force Plant 4. This involved removal through excavation of contaminated soils and liquids at three different past hazardous waste disposal sites. A discussion of these activities is provided in Section IV.

II. INSTALLATION DESCRIPTION

II.
INSTALLATION DESCRIPTION

A. LOCATION

Air Force Plant 4 is located on 602 acres of land in Tarrant County, Texas, 7 miles west of the center of Fort Worth. The plant is bordered on the north by Lake Worth, on the east by Carswell AFB, and on the south and west by the community of White Settlement. AF Plant 4 shares a runway and several facilities with Carswell AFB, the home of the Strategic Air Commands's 7th Bombardment Wing. The plant is located in the midst of a rapidly growing suburban area. The current installation boundaries are shown in Figure 4.

B. ORGANIZATION AND MISSION

Air Force Plant 4 is a government-owned aircraft production facility assigned to the U.S. Air Force and operated under contract by the General Dynamics Corporation. As such, the mission of AF Plant 4 is to manufacture military aircraft. General Dynamics is currently engaged in the production of F-16 aircraft, including spare parts, radar units, and missile components. The work force at AF Plant 4 totals approximately 17,000 people. A detailed history of the facility is included in Appendix D, "Installation History."

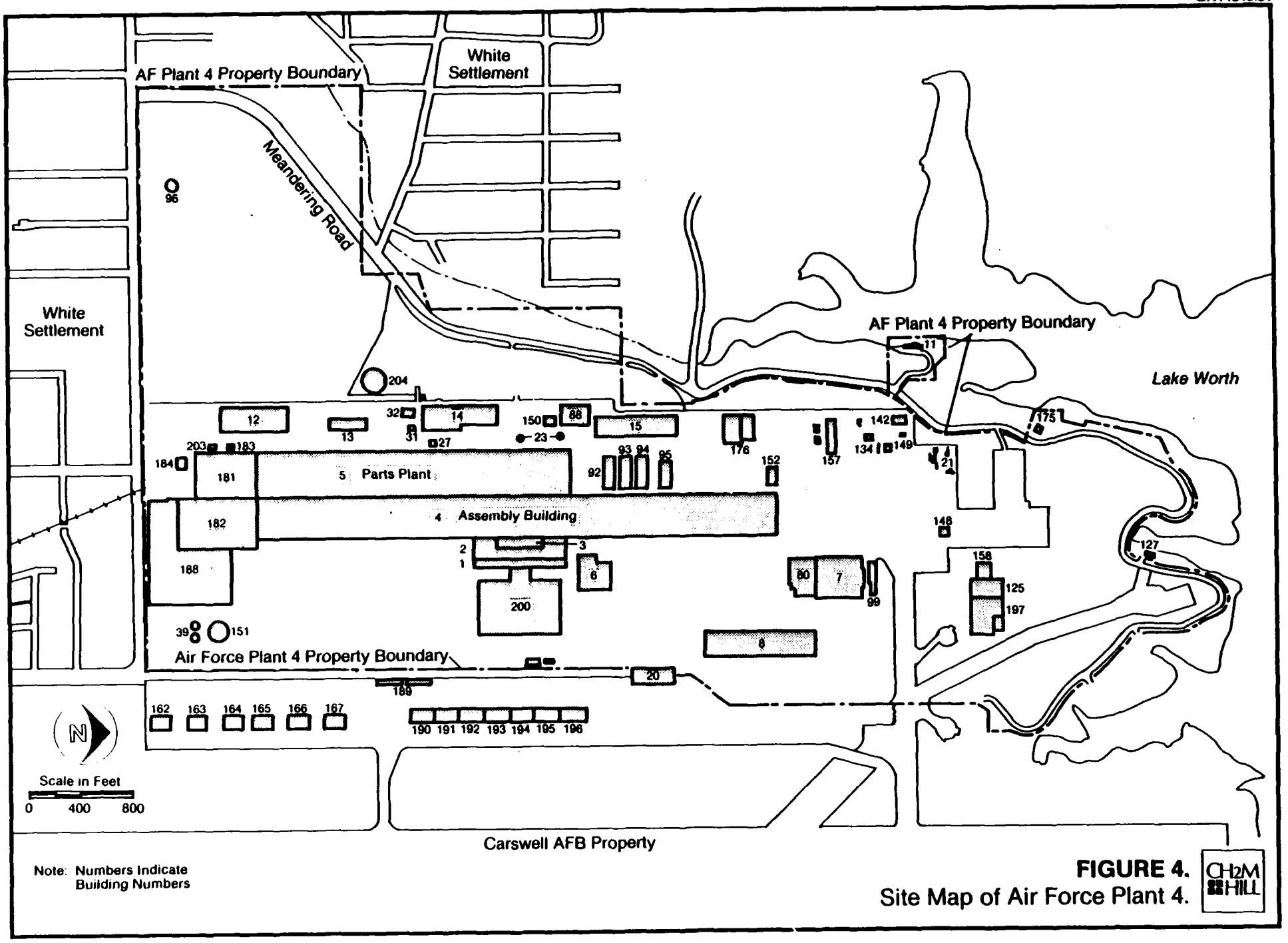

FIGURE 4.
Site Map of Air Force Plant 4.

III. ENVIRONMENTAL SETTING

III.
ENVIRONMENTAL SETTING

A. METEOROLOGY

Air Force Plant 4 is located near 33° north latitude in north central Texas. The climate is humid subtropical with hot summers and mild, dry winters. Tropical maritime air masses control the weather during much of the year; however, the passage of polar cold fronts and continental air masses create large variations in winter temperatures. Meteorological data summarizing the period 1949 through 1982 are presented in Table 2 and discussed briefly below.

The average annual temperature for AF Plant 4 is 66°F and monthly mean temperatures vary from 45°F in January to 86°F in July. The average daily minimum temperature in January is 35°F and the lowest recorded temperature is 2°F. The average daily maximum temperature in July is 96°F and the highest temperature recorded at nearby Carswell AFB was 111°F in the month of June. On the average, freezing temperatures occur at AF Plant 4 on 33 days per year.

Mean annual precipitation recorded in the vicinity of AF Plant 4 is 32 inches. The wettest month is May with a secondary maximum in September. The period from November to March is generally dry with a secondary minimum in August. Snowfall accounts for a small percentage of the total precipitation between November and March. On the average, measurable snowfall occurs on 2 days per year. Lake evaporation at AF Plant 4 is estimated to be approximately 57 inches per year. Evapotranspiration over land areas may be greater or less than lake evaporation depending on vegetative cover type and moisture availability. Average net precipitation is expected to be equal to the difference

Table 2
METEOROLOGICAL DATA SUMMARY FOR AIR FORCE PLANT 4, TEXAS
(1949-1982)

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Temperature (°F)													
Mean	45	50	57	66	74	82	86	85	78	68	56	49	66
Average Daily Maximum	55	60	67	76	83	91	96	95	88	78	66	59	76
Average Daily Minimum	35	39	46	56	64	72	76	75	68	57	46	38	56
Highest Recorded	88	88	85	89	100	111	109	110	107	105	89	91	110
Lowest Recorded	2	6	11	31	42	55	61	60	46	33	17	11	2
Precipitation (inches)													
Mean	1.8	1.8	2.3	3.8	4.4	2.9	2.4	1.9	3.6	3.2	1.7	1.8	31.6
Maximum Monthly	5.9	4.7	6.5	14.2	15.2	8.8	9.0	6.0	9.6	10.7	6.3	6.7	15.2
Minimum Monthly	0.1	0.1	a	1.2	0.6	0.1	a	a	a	a	a	a	a
Maximum in 24 hours	2.8	3.0	3.4	3.3	5.7	3.5	5.9	3.1	4.0	3.2	2.0	2.5	5.9
Days with Thunderstorms	1	2	4	6	8	6	5	5	4	3	1	1	46
Snowfall (inches)													
Mean	1	1	b	0	0	0	0	0	0	0	b	b	2
Maximum Monthly	8	12	7	0	0	0	0	0	0	0	4	3	12
Maximum in 24 hours	5	8	7	0	0	0	0	0	0	0	4	3	8
Relative Humidity (%)													
Mean	61	61	61	64	70	64	56	56	63	61	63	59	62
Surface Winds (knots)													
Mean	8	8	9	8	7	7	6	6	5	6	7	7	7
Maximum	50	63	69	64	68	65	56	54	80	45	54	58	80
Prevailing Direction	N	S	S	S	S	S	S	S	S	S	S	S	S

[a] Less than one-tenth inch

[b] Less than 1 inch

Source: United States Air Force, Carswell AFB, Texas. Period of Record: 1949-1982.

between average total precipitation and average lake evaporation or approximately minus 25 inches per year.

Thunderstorm activity occurs at AF Plant 4 an average of 46 days per year. The greatest number of these storms occurs between April and June. Hail falls on 2 to 3 days per year and the maximum precipitation recorded in a 24-hour period is 5.9 inches.

Mean cloud cover averages 50 percent at AF Plant 4 with clear weather occurring frequently during all months. Some fog is present on an average of 90 days per year. Wind speed averages 7 knots; however, a maximum of 80 knots has been recorded. Wind direction is predominantly from the south during all months, except for January. During January the predominant wind direction is from the north.

B. PHYSICAL GEOGRAPHY

The physiographic subdivisions in the vicinity of Air Force Plant 4 are coincident with geologic formations which outcrop at the surface. As an example, the Grand Prairie section is underlain by alternating limestones and marls of the Washita and Fredericksburg groups. The outcrop, surface exposure of this formation, defines the areal extent of the Grand Prairie physiographic section. Figure 5 illustrates a general geologic map in the vicinity of Air Force Plant 4. This figure can also be used to locate physiographic subdivisions once the relationship between physiography and the underlying geology is understood.

Physiographic subdivisions, like geologic outcrops are arranged in north-south trending bands as illustrated in Figure 5.

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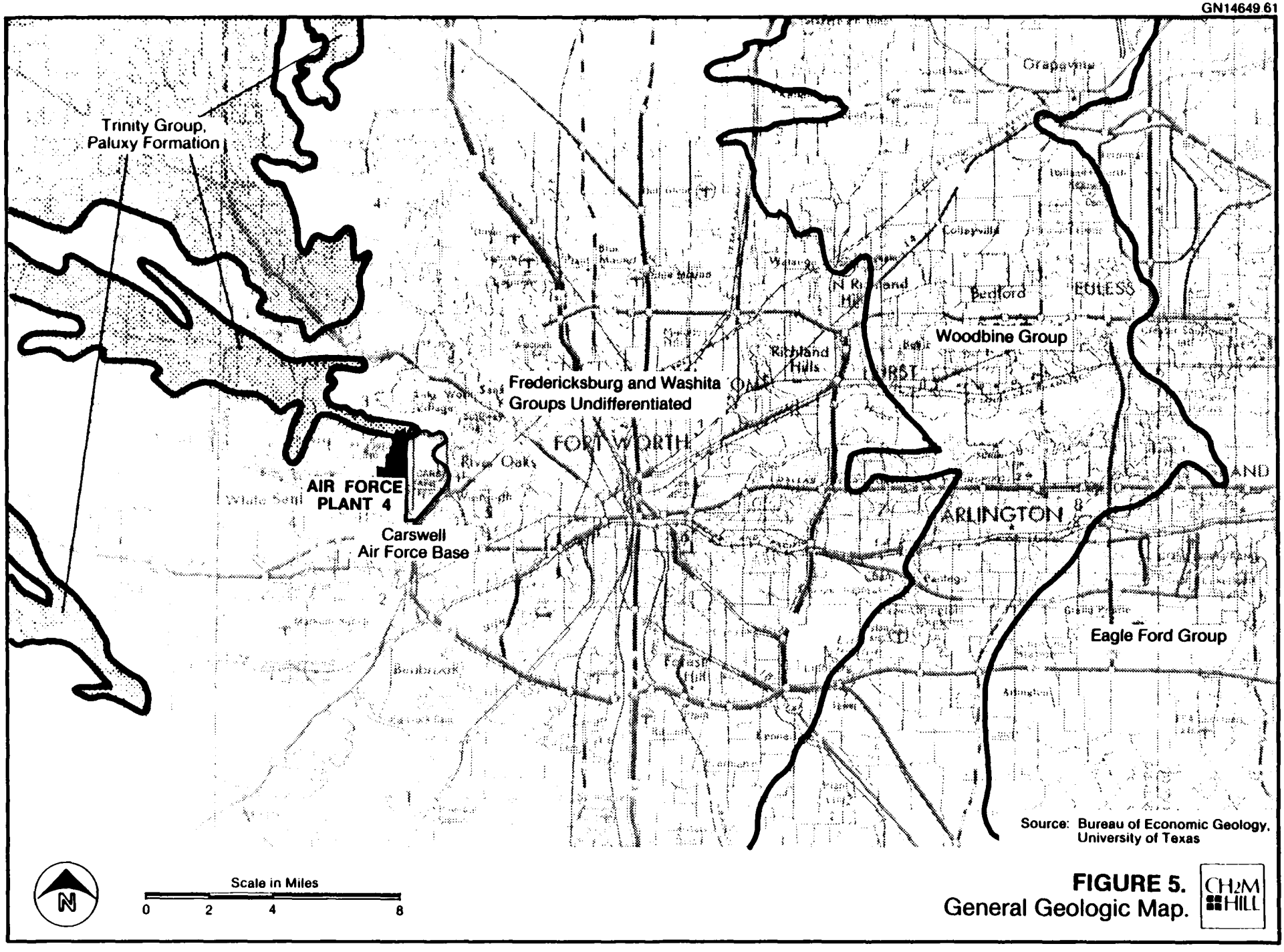

FIGURE 5.
General Geologic Map.

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Air Force Plant 4 is located within the Grand Prairie section of the Central Lowlands physiographic province which is coincident with the Fredericksburg and Washita Groups (see Figure 5). This section is characterized by terrace surfaces which slope gently eastward, interrupted throughout by westward-facing escarpments. The Grand Prairie section is, in general, mantled by a thin layer of light brown to black loamy soil with characteristics differing somewhat, depending on the nature of the underlying material. The broad, gently sloping terrace is grass covered and typically treeless except for isolated stands of upland timber.

The Grand Prairie section is bounded on the east by the Eastern Cross Timbers section. This section, coincident with the narrow band of the Woodbine Group (see Figure 5), is characterized by low, rounded, wooded hills which occur primarily along the eastern margin. The section is well dissected by streams, leaving some areas rugged in appearance. Typical soils occurring in this section are reddish sand with iron concretions and some clay.

The Western Cross Timbers physiographic section lies west and adjacent to the Grand Prairie section. Parts of Air Force Plant 4, particularly the northwest corner, lie within the Western Cross Timbers section, although most of the plant is located within the Grand Prairie section. The Western Cross Timbers section, underlain by the Trinity Group (see Figure 5), is characterized by a rolling to hilly topography that is dissected into steep hills and deep ravines. This section is typified by sandy soils supporting a heavy growth of post oak and blackjack oak.

The plant itself is located due south of Lake Worth. The shoreline of the lake is the north plant boundary. This lake was man made, created by damming the West Fork Trinity

River at a point just northeast of Air Force Plant 4 and is used as a potable water reservoir for the City of Fort Worth. Elevation of lake water surface is fairly constant at approximately 594 feet mean sea level (msl), the fixed elevation of the dam spillway.

Topography at the plant is generally flat except for areas adjacent to the creek parallel to Meandering Road, which discharges to Lake Worth (see Figure 6). Elevations range from approximately 670 feet msl at the southwest corner of the plant and slope gently north towards Lake Worth and west towards the Meandering Road Creek. Elevations at Lake Worth north of the plant are approximately 600 feet msl. Elevations along the main north-south runway shared with Carswell AFB and elevations in the vicinity of the Assembly Building are approximately 650 feet msl.

Two soil associations have been identified by the U.S.D.A. Soil Conservation Service at the plant (see Figure 7). Both of the soil associations can be generally described as nearly level to gently sloping clayey soils. Soil associations occurring at Air Force Plant 4 include the Sanger-Purves-Slidell Association and Aledo-Bolar-Sanger Association.

The U.S.D.A. Soil Conservation Service describes the soil associations at Air Force Plant 4 as follows:

- <u>Sanger-Purves-Slidell Association</u>--Nearly level and gently sloping, deep and shallow, clayey soils; on uplands.

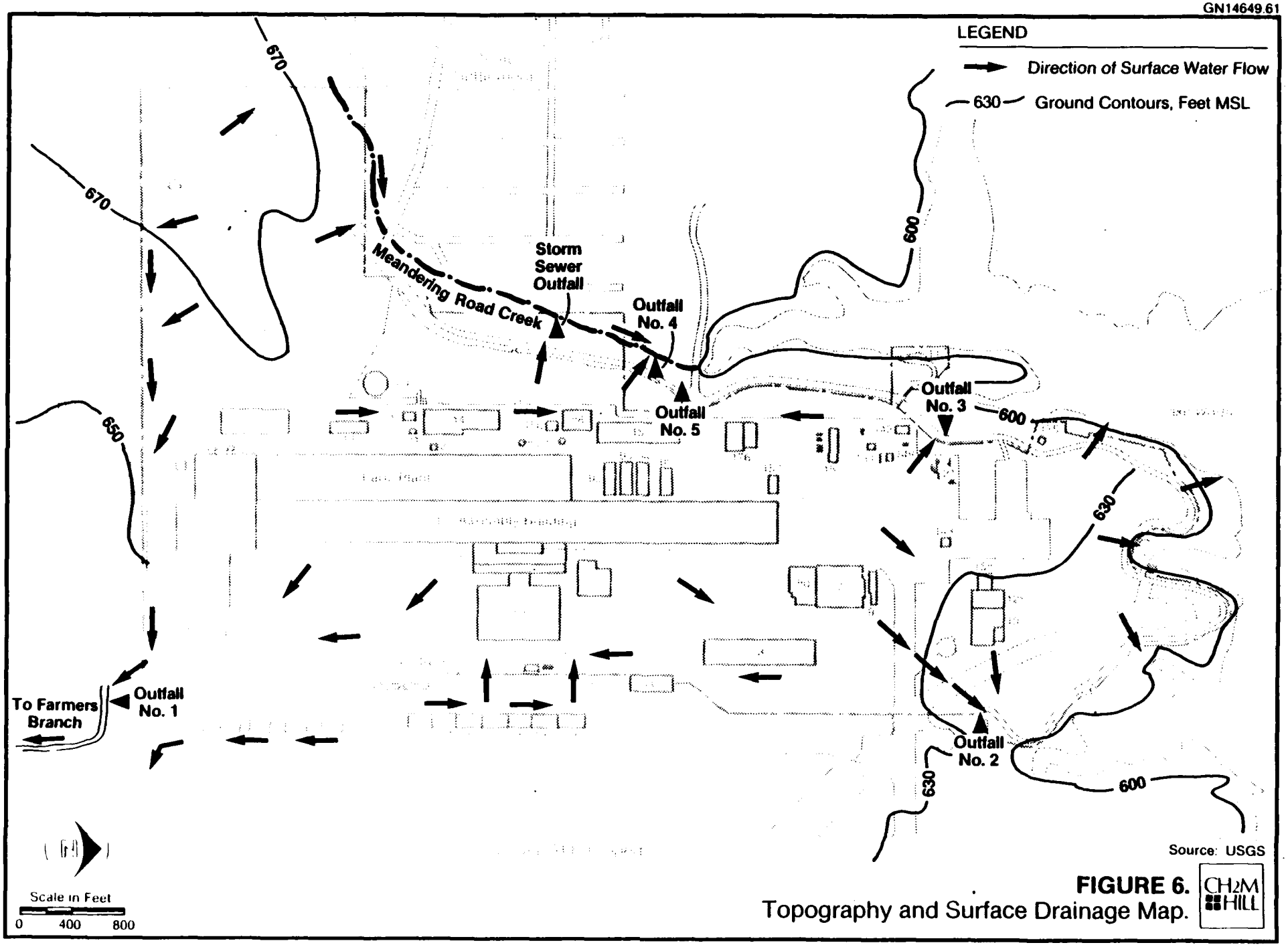

FIGURE 6.
Topography and Surface Drainage Map.

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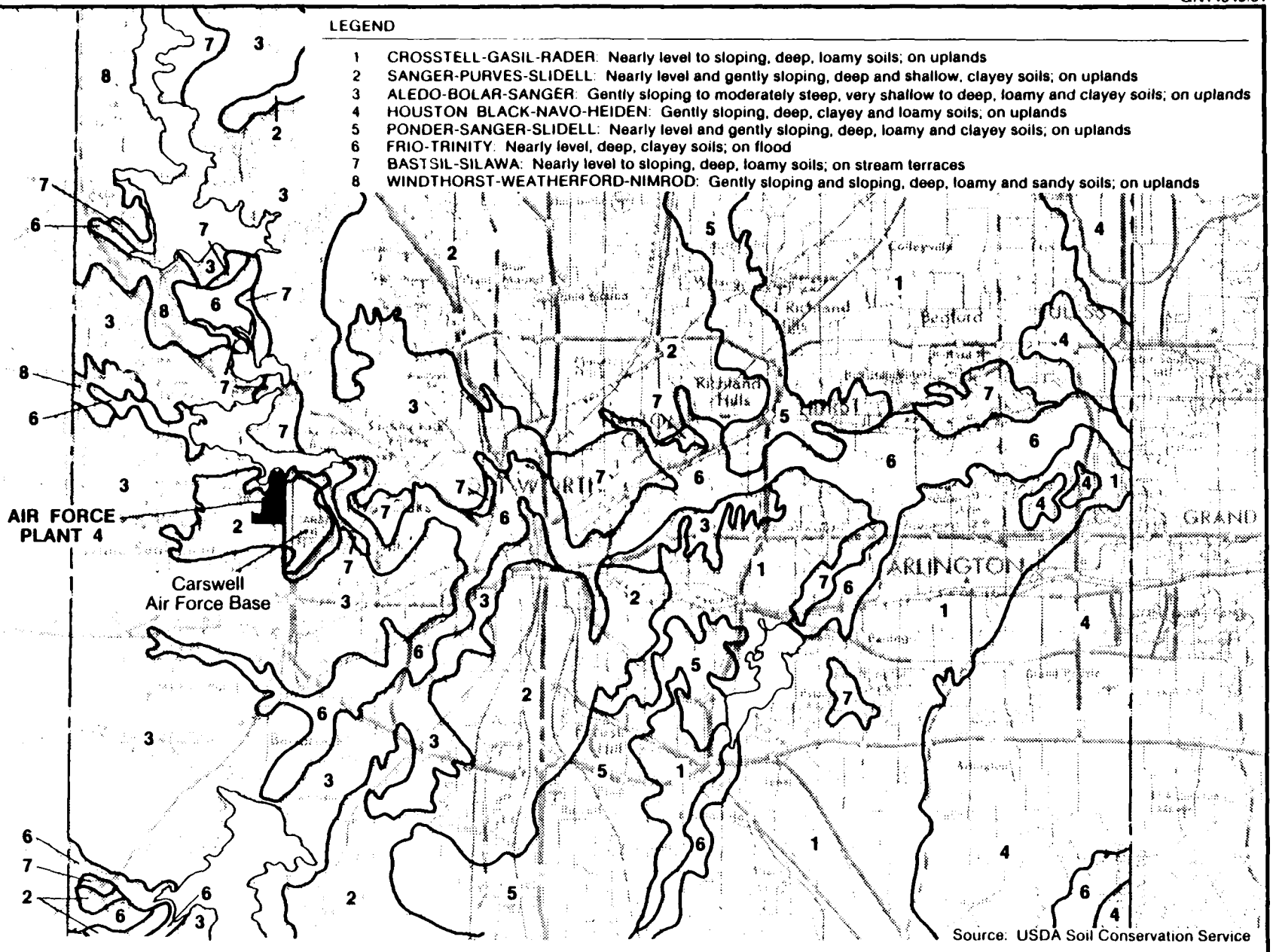

Scale in Miles

0 2 4 8

FIGURE 7.
General Soil Map.

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- Aledo-Bolar-Sanger Association--Gently sloping to moderately steep, very shallow to deep, loamy and clayey soils; on uplands.

A more complete description of these soil associations is presented in Appendix E. Properties of soils occurring at the plant are summarized in Table 3.

The geologic history of Tarrant county and north-central Texas is quite complex. The sedimentary rock record goes back to Cambrian times (approximately 540 million years ago), when the area where Air Force Plant 4 is located was a large, northwest-trending depositional trough, called the Fort Worth Basin. From the Cambrian period to the Pennsylvanian period (approximately 300 million years ago), sediments eroded from upland areas and accumulated in the Fort Worth Basin.

The Paleozoic era ended (240 million years ago) with considerable orogenic (mountain building) movement which resulted in the westward tilting of the Pennsylvanian strata.

The Triassic (230 million years ago) and the Jurassic (170 million years ago) periods were marked by an uplift of the land surface in north-central Texas. This uplift brought the marine sediments above sea level and changed the direction of surface-water flow.

What was once a depositional basin receiving sediments from nearby upland areas, became a source of sediments, which were removed by stream erosion, transported and deposited in the Gulf Coast Embayment. This period of erosion led to extensive truncation of Pennsylvanian strata

Table 3
SOIL PROPERTIES

Soil Associations	USDA Texture	Permeability (cm/sec)	Shrink-Swell Potential	Erosion[a] Factor (K)	Depth to Bedrock (in)	Depth to High Water Table (ft)
Sanger	Clay Loam	$<4.2 \times 10^{-5}$	High	0.32	>60	>6
Purves	Clay Over Bedrock	3×10^{-4}	High	0.32	8-20	>6
Slidell	Silty Clay	$<4.2 \times 10^{-5}$	High	0.32	>60	>6
Aledo	Clay Loam Over Bedrock	9×10^{-4}	Moderate to Low	0.32	8-20	>6
Bolar	Clay Loam over Bedrock	9×10^{-4}	Moderate	0.32	20-40	>6

[a]Erosion factor indicates soil susceptibility to sheet and rill erosion by water. K factor used in Universal Soil Loss Equation. K values range from 0.05 to 0.69, the higher the value the more susceptible the soil is to erosion.

Source: U.S.D.A. Soil Conservation Service

in the Fort Worth Basin. At the end of the Jurassic period, Paleozoic age rocks were reduced by erosion to a nearly flat surface. This flat, eroded surface was then covered by marine sediments deposited during the invading seas of the Cretaceous period (100 million years ago). Two major invasions of the sea during Cretaceous time are evident from the rock record represented by the Comanche and Gulf series.

As the Cretaceous period ended and the seas withdrew, the land surface rose above sea level. Throughout the Tertiary period (2 to 65 million years), except for minor periods of subsidence, the surface was eroded and modified by streams flowing toward the Gulf. During the Quaternary period, streams deposited alluvium on top of the Cretaceous sediments, producing the surface features present today.

Figure 8 illustrates a more detailed geologic map in the vicinity of Air Force Plant 4. This map shows that most of the plant is covered with alluvium, indicated by the geologic symbol Qa. Only in small sections of Air Force Plant 4 has the alluvium been removed by erosion, exposing the underlying Goodland Limestone (Kgo), or the older Paluxy Formation (Kpa). These formations outcrop along the north and northwest boundary of Air Force Plant 4, adjacent to Meandering Road Creek and Lake Worth.

Alluvium overlying the older formations at Air Force Plant 4 was deposited by the Trinity River during flood stages, over the past million years. The alluvium varies in thickness and permeability throughout, resulting in a non-homogeneous, unconsolidated deposit. In general, alluvium thickness and permeability increases towards the east in the direction of the Trinity River. Alluvium occurs over most of the plant site and ranges in thickness from zero feet, along the north and west boundaries, to as much

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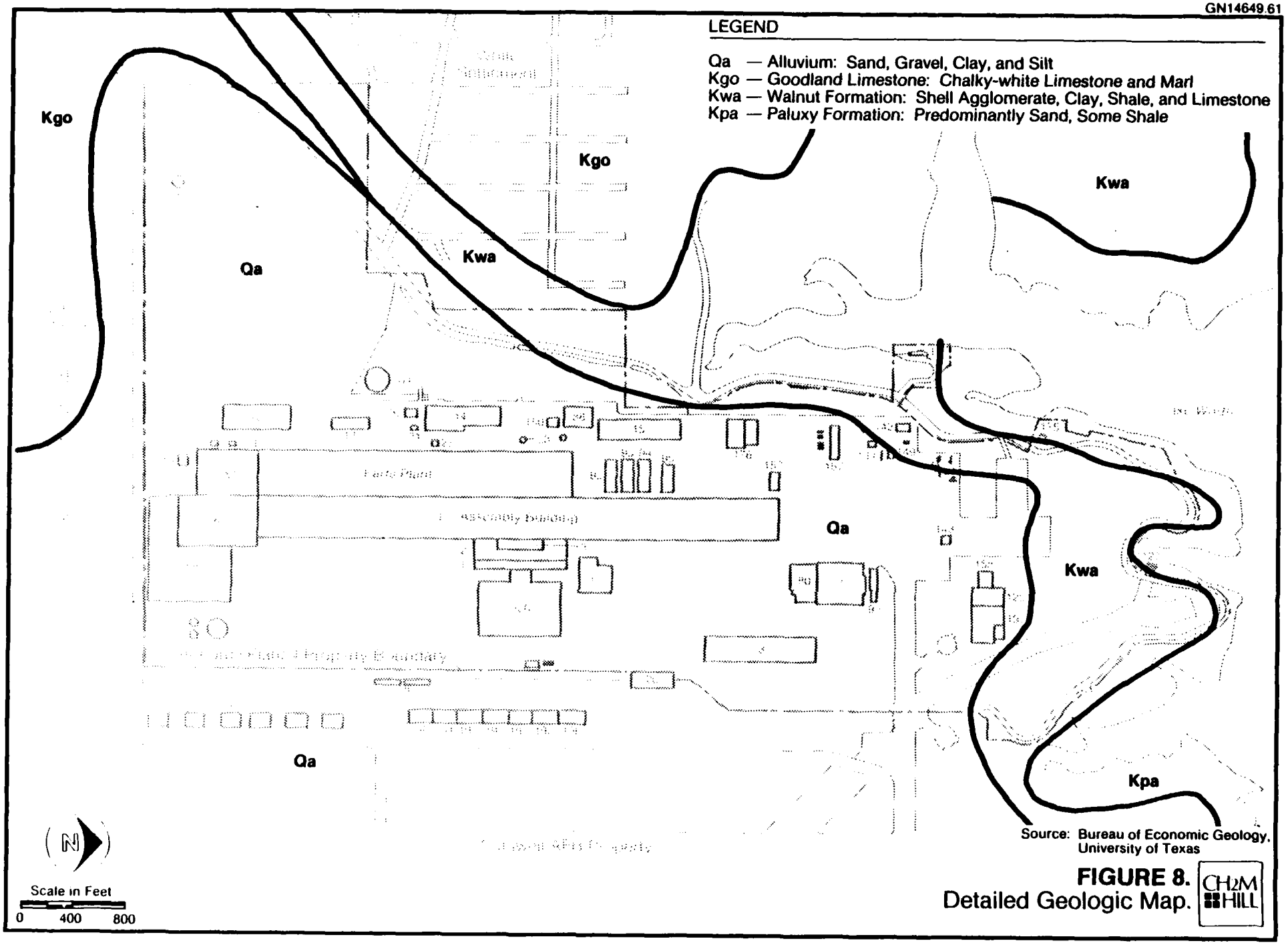

Source: Bureau of Economic Geology, University of Texas

FIGURE 8.
Detailed Geologic Map.

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as 45 feet. The thickest sections of alluvium occur east of the Assembly Building coincident with a relict, eroded stream channel occurring in the upper surface of the Walnut Formation. During flood stage, when the river overtopped its banks, unconsolidated sediments would be deposited within the flood plain. The coarser, heavier material would be deposited nearest to the river with finer and finer material being carried farther away. Successive flooding events cause the buildup of the alluvium at Air Force Plant 4. This alluvium would be quickly removed by erosion in the vicinity of surface streams such as the Meandering Road Creek, thus exposing the older, underlying formations.

The varying intensity of the flood events resulted in varying deposition. This, together with the ever changing course of the river itself, results in the non-homogeneous nature of the alluvium.

Figure 9 illustrates a general geologic cross section typical of Air Force Plant 4.

Geologic formations important to this study include the surficial alluvium, and the Cretaceous strata which outcrop at or occur below the plant. Table 4 lists these formations, includes a brief description of each, and gives an indication of the water-bearing properties. Of most significance to ground-water contamination are the alluvium deposits; the Kiamichi, Goodland limestone, and Walnut formation of the Fredericksburg group; and the Paluxy sand, Glen Rose limestone, and the Twin Mountains formations (formerly identified as the Travis Peak Formation), of the Trinity group.

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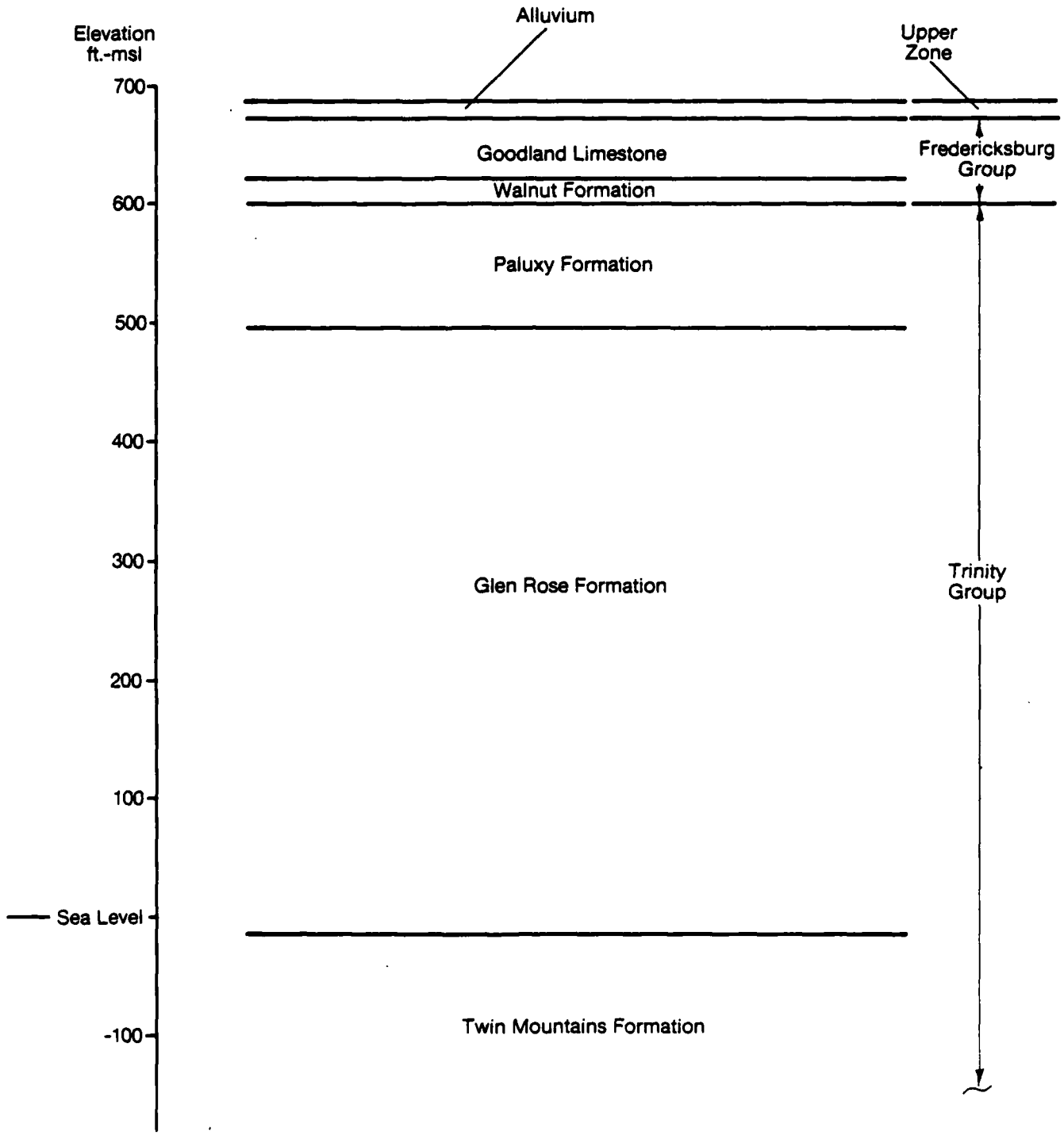

Modified from E. R. Leggat.

FIGURE 9.
General Geologic Cross Section.

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Table 4
GEOLOGIC FORMATIONS IN TARRANT COUNTY, TEXAS

System	Series and Group	Formation and Member	Thickness (ft)	Character of Rocks	Topographic Expression	Water-Bearing Properties
Quaternary	Recent and Pleistocene	Alluvium	0-45	Sand, gravel, clay, and silt.	Terrace and flood-plain deposits.	Small to moderate yields. Water unsatisfactory for use unless treated.
Cretaceous	Gulf Series[1]	Eagle Ford Shale	0-200	Bluish-black shale; thin sandstone and limestone beds.	Gently, rolling, treeless, black waxy soil. Forms Black Prairie belt.	Not known to yield water to wells in Tarrant County.
		WOODBINE FORMATION				
		Louisville Member	0-200+	Ferruginous sandstone, vari-colored clay and sandy clay, lignite, and gypsum.	Low hills, sandy soils, heavily wooded with oaks. Forms Eastern Cross Timbers belt.	Yields small supplies of water, generally more mineralized than water from Dexter member. Water in some areas highly mineralized.
		Dexter Member	0-110	Crossbedded ferruginous fine-grained sandstone, clay, and sandy clay.	Ditto	Important source of water for domestic supplies in eastern Tarrant County. Water typically is high in iron.
		UNCONFORMITY				
	Comanche Series[1] Washita Group	Grayson Shale	0-85	Yellowish-brown and grayish-blue fossiliferous marl, clay, and thin limestone.	Slope, generally covered with wash from the Woodbine formation.	Not known to yield water to wells in Tarrant County.
		Main Street Limestone	0-45	Hard white limestone and marl.	Conspicuous and extensive upland prairie, westward facing escarpment.	Ditto
		Pawpaw Formation	0-40	Reddish-brown shale characterized by dwarfed pyrite fossils.	Narrow treeless slope separating terraces on Weno and Main Street formations.	Ditto

Table 4--Continued

System	Series and Group	Formation and Member	Thickness (ft)	Character of Rocks	Topographic Expression	Water-Bearing Properties
Cretaceous	Comanche Series[1] Washita Group	Weno Clay	0-75	Bluish-Gray marl and limestone, fossiliferous.	Terrace topography produced by limestones of middle and upper parts of the Weno.	Not known to yield water to wells in Tarrant County.
		Denton Clay	0-35	Blue-gray marl, marly ledges, shell agglomerate in upper part.	Grassy slope between resistant Fort Worth and Weno formations.	Ditto
		Fort Worth Limestone	0-35	Alternating limestone and marl, fossiliferous.	Upland prairie and black-land soils.	Ditto
		Duck Creek Formation	0-90	Impure limestone and marl, which is blue when fresh and straw-colored when weathered. Fossiliferous with distinctive ammonities.	Bench topography produced by lower limestone unit. Upper marl forms slope separating the Duck Creek from Fort Worth limestone.	Ditto
	Commanche Series[1] Fredericksburg Group	Kiamichi Formation	0-40	Blue and brownish-yellow marl, thin limestone and sandstone flags.	Grassy slope separating scarps of Goodland and Duck Creek formations.	Ditto
		Goodland Limestone	0-130	Chalky-white fossiliferous limestone, and blue to yellowish brown marl.	Prominent glaring-white escarpment along streams.	Ditto
		Walnut Clay	0-28	Shell agglomerate fossiliferous clay and limestone, sandy clay, and black shale.	Forms conspicuous escarpment and waterfalls in western Cross Timbers belt.	Ditto

Table 4--Continued

System	Series and Group	Formation and Member	Thickness (ft)	Character of Rocks	Topographic Expression	Water-Bearing Properties
		UNCONFORMITY				
Cretaceous	Comanche Series Trinity Group	Paluxy Sand	140-190	Fine-grained sand, shale, sandy shale, lignite and pyrite.	Sandy soil, hummocky topography, heavily wooded with oaks.	Source of supply for most households, smaller cities, and some industries.
		Glen Rose Limestone	250-450	Fine-grained limestone, shale, marl, and sandstone.	Not exposed in Tarrant County.	Sands yields small supplies to wells in Fort Worth and western Tarrant County. Water too highly mineralized east of Fort Worth.
		Twin Mountains Formation (Formerly Travis Peak Formation)	250-450	Course to fine-grained sandstone, red shale, red and yellow clay at base.	Ditto	Principal aquifer in Tarrant County. Yields large supplies for municipal and industrial purposes. Water in upper sands east of Fort Worth may be highly mineralized.
		MAJOR UNCONFORMITY				
Pennsylvanian	Undifferentiated		6,000-7,000	Gray, sandy shale, tight quartzitic sandstone, black limestone. Probably represents Strawn formation.	Ditto	Not tested. Probably would not yield fresh water.

[1]The Gulf Series, the Washita Group (Commanche Series), and the Kiamichi Formation of the Fredericksburg Group (Commanche Series) do not occur at Air Force Plant 4.

Source: E. R. Leggat

E. R. Leggat of the U.S. Geological Survey described the Cretaceous and younger strata in a report on the geology and ground-water resources of Tarrant County as follows:

- The Trinity group, the outcrop of which underlies the Western Cross Timbers physiographic section, includes the Twin Mountains formation, the Glen Rose limestone, and the Paluxy sand and has a maximum thickness of approximately 1,090 feet in Tarrant County. The Twin Mountains formation was deposited on an eroded surface by a shallow northward-transgressing sea. Seaward of this area of deposition, limestone, shale, and sand were deposited. These constitute the Glen Rose limestone, which represents the seaward facies of part of the Twin Mountains formation, being deposited simultaneously to the north. Overlying the Glen Rose limestone is the Paluxy sand, which is considered to be a deposit of the regressive phase of the sea.

  The sands of the Trinity group are the most important sources of ground water in Tarrant County.

The Twin Mountains formation is the oldest formation used for water supply in the vicinity of Air Force Plant 4. Leggat describes this formation as follows:

- In ascending order, the Twin Mountains formation is divided into the Sycamore sand member, the Cow Creek limestone member, and the Hensell sand member. The Twin Mountains formation does not crop out in Tarrant County.

The thickness of the Twin Mountains formation increases eastward (downdip), ranging from approximately 250 feet at the Lake Worth to 430 feet at Arlington. The formation maintains a fairly uniform thickness of approximately 370 to 400 feet along the strike.

The Twin Mountains formation consists of a basal conglomerate of chert and quartz, grading upward into coarse- to fine-grained sand interspersed with varicolored shale.

The depth to the Twin Mountains increases toward the east, ranging from 550 feet at Lake Worth to 1,490 feet at Arlington. The average dip of the formation is about 40 feet per mile.

The Twin Mountains formation is the most productive aquifer in the county. Water from the Twin Mountains generally is satisfactory for most purposes; however, some sand strata may contain highly mineralized water.

The Glen Rose formation is described as follows:

- The Glen Rose limestone does not crop out in Tarrant County but is penetrated in wells drilled to the underlying Twin Mountains formation. The Glen Rose consists primarily of calcareous sedimentary rocks (limestone) and some sands, clays, and anhydrite.

  The Glen Rose limestone is not an important source of water in Tarrant County. In the Lake Worth-Eagle Mountain Lake area, the Glen Rose

> furnished small quantities of water to wells for domestic use. East of Fort Worth, wells were reported to obtain highly mineralized water from the Glen Rose. The driller reported that he encountered highly mineralized water at a depth of 1,120 to 1,140 feet.

The Glen Rose acts as a confining bed or at least an aquitard between the Twin Mountains and Palùxy sand aquifers, as evident by differing water levels in both formations.

The Paluxy sand is the uppermost aquifer at the base and is therefore most vulnerable to ground-water contamination. This stratum outcrops on the extreme northwest corner of the base and within the bed of Lake Worth. In fact, Lake Worth is a recharge area for the Paluxy sand.

Leggat provides a more complete description of the Paluxy sand as follows:

> The Paluxy sand crops out in the northwestern part of the county; it forms the surface of the Western Cross Timbers belt in that area and underlies the rest of the county. Above one-half to three-fourths of the Paluxy is sand; the remainder consists of clay, sandy clay, shale, lignite, silicified wood fragments, and nodules of pyrite. In general, coarse-grained sand is in the lower part of the Paluxy and grades upward into fine-grained sand with variable amounts of shale and clay.

> The Paluxy sand ranges in thickness from 140 to 190 feet and averages about 160 feet in Tarrant County. Northward, in Denton and Cooke Counties, the Paluxy sand, Glen Rose limestone, and Twin Mountains formation are not differentiated; southward the Paluxy sands are extremely thin at Whitney Dam, Hill County. The approximate altitude of the Paluxy sand in Tarrant County is shown in Figure 12. The Paluxy dips uniformly at a rate ranging from 35 to 40 feet per mile and averaging 37 feet per mile. It is encountered at increasing depths eastward, reaching a maximum depth of about 900 feet.
>
> The Paluxy sand may be divided into upper and lower sand members. The sands in the upper part of the Paluxy are reported by drillers to be fine-grained and shaley. Most wells drilled to the Paluxy, therefore, are completed in the lower sand member which ranges from 100 to 120 feet in thickness. The lower sand member generally consists of two separate and distinct sand strata, but the individual sand beds do not maintain constant thickness or lithology over long distances.

Sections of the Fredericksburg group overlie the Paluxy sand over most of the base. Leggat describes the Fredericksburg group as follows:

> The Fredericksburg group in Tarrant County includes the Walnut clay, the Goodland limestone, and the Kiamichi formation, in ascending order. During the deposition of the Fredericksburg group, the seas were shallow, the depths ranging between

> 42 and 120 feet. The sedimentary rocks of the Fredericksburg group are mainly limestone and marl and lesser amounts of sandstone, shale, and shell aggregate. The thickness of the group ranges from 135 to 185 feet, increasing southward; and the rocks dip southeastward at a uniform rate of 38 feet per mile. The Kiamichi wedges out toward the south between the Goodland and the overlying Washita group.

The Fredericksburg group is not a source of ground water in Tarrant County, but is rather a confining bed for the underlying Paluxy sand. The Goodland Limestone has been removed by erosion over much of the plant site, occurring in south and southeast portions of the site. The Walnut Formation, also removed by erosion, outcrops over parts of the site, but may be absent over others.

The alluvium deposits occurring at the plant consist primarily of clay, silt, sand, and gravel deposited by the once meandering course of the Trinity River. Alluvium for the most part, is low in permeability due to the preponderance of clay and silt. However, permeable gravel strata occur within the alluvium which represent former stream channel deposits. Leggat describes the alluvium deposits in the vicinity of Air Force Plant 4 as follows:

> Detrital alluvial deposits veneer the Cretaceous rocks in Tarrant County, particularly along the incised stream valleys and on the uplands. The alluvium is probably Pleistocene and Recent in age but is undifferentiated on the geologic map. The oldest alluvial deposits, known as upland gravels, are scattered patches of unconsolidated sand and gravel capping interstream divides. Because of

their small areal extent and relative thinness, most of these deposits were not mapped. Younger deposits, known as bottom-land gravels, form terraces or benches closer to the stream valleys. These terraces become more distinct toward the present stream channel. The lowermost terrace is the present flood plain, which includes the stream bed.

The alluvial deposits consist of material derived from formations that crop out within the drainage basin. The upland gravels are composed of angular gravel, sand, red clay, and silt. The sand and gravel is composed mostly of poorly sorted fragments of platy limestone. The lower terraces and flood-plain deposits consist of rounded gravel, sand, and clay. The thickness of the alluvial deposits ranges from a feather-edge to approximately 45 feet.

Flood-plain deposits are extensive along the West Fork and Clear Fork of the Trinity River, and range in width from a few feet in the upper reaches of the stream course to more than 2 miles. The most extensively developed terrace is in the Haltom City-northeast Fort Worth area, where the deposits extend a distance of more than 4 miles from the present river channel and as much as 110 feet above it. This extensive deposit probably consists of several terraces formed by the gradual shift southward of the ancestral channel of the West Fork of Trinity River, but the typical terrace or bench topography has been obscured by erosion and slumping.

The alluvial deposits in Tarrant County furnish small to moderate quantities of ground water, the larger yields coming from wells on the lower terraces and flood plains. The water generally is polluted from street runoff, fertilizer, and septic tanks and is used only for irrigation of lawns and crops. Where treatment is economical, the water from the alluvium may be used for public supply. The primary importance of the alluvial deposits, however, is a source of sand and gravel for building and road construction.

C. HYDROLOGY

Air Force Plant 4 is located within the Trinity River basin just south of Lake Worth, a man-made reservoir on that river. Part of the plant is drained by Farmers Branch which discharges into the West Fork Trinity River just east of Carswell Air Force Base. Farmers Branch begins within the community of White Settlement and flows eastward. Just south of Air Force Plant 4, Farmers Branch flows under the runway within two large culverts.

Most of the plant surface drainage is intercepted by a series of storm drains and culverts and discharged to Lake Worth, the Meandering Road Creek, or to a tributary to Farmers Branch.

Ground water occurs under perched water table, water table, and artesian conditions at Air Force Plant 4. Within the alluvium deposits as discussed above, discontinuous strata of higher permeability are associated with relict or ancient stream channel deposits. Although variable in occurrence, these strata are limited in areal extent and

isolated by surrounding low permeability alluvium deposits. Ground water occurs within these coarse sand and gravel deposits and, in parts of Tarrant County, is developed for irrigation and residential potable use. Wells once located near the USAF Hospital at Carswell AFB developed water from the alluvium deposits for the community of River Oaks. More than likely, some of the homes which were occupied prior to constructing Air Force Plant 4 or Carswell AFB had wells completed into the alluvium deposits. As discussed above, the alluvium is generally thickest and most permeable closer to the River, where some of the early residents lived. The wells at the Carswell AFB hospital were located within a few hundred feet of the river and downgradient from a continuous source of recharge--Lake Worth. These wells were abandoned immediately after Carswell AFB purchased this property for hospital construction. No records exist relative to location, well construction, or abandonment methods of any wells which may have served early area residences.

Ground-water within the alluvium occurs as a perched water table and, in general, is not hydraulically connected to the underlying aquifers.

Recharge to these deposits is local and, for the most part, direct from rainfall and via ditches and stream channels where hydraulically connected. Direction of ground-water flow is controlled by surface topography, recharge/discharge areas (natural or by way of ponds, lagoons, drainage ditches or leaking pipelines), permeability, strata thickness and hydraulic gradient. Although site-specific information is available, it is still difficult to identify local flow direction within the alluvium deposits; in general, however, ground-water within the alluvium most likely mirrors the surface drainage pattern, influenced somewhat by the potentiometric high

created by Lake Worth. Flow within the alluvium cannot be defined at this time because of complexity of the ground-water system at the plant. Lenticular deposits and other inhomogeneities require further site-specific studies before ground-water flow directions in the upper zone can be established. For the most part, ground water is not economically developable within the alluvium due to its limited distribution and susceptibility to surface/ stormwater pollution.

Studies conducted by Hargis and Montgomery, Inc. for General Dynamics refer to both the alluvium and/or fill as the upper zone and correctly do not refer to this zone as an aquifer.

In general, ground water occurring within the upper zone is isolated from the deeper aquifers by the occurrence of low permeability members of the Fredericksburg Group. The Fredericksburg Group, specifically the Goodland limestone and the Walnut formation, is irregular in occurrence and may have been removed by erosion under parts of the plant. If the upper zone is in contact with the underlying Paluxy sand (uppermost aquifer), ground water could infiltrate from the upper zone to the Paluxy aquifer.

The Paluxy Formation is the uppermost, economically developable aquifer at Air Force Plant 4. This formation, together with the deeper Twin Mountains aquifer are the primary sources of potable ground water in the Fort Worth area. The communities surrounding the plant, primarily White Settlement, develop municipal water supplies from these aquifers.

Ground water occurs under both water table and confined conditions within the Paluxy sand. As discussed above, Cretaceous strata dip to the east in north central Texas.

Erosion has in turn truncated the deposits, resulting in a relatively flat plain, with variations due to differences in erosional resistance of the different geologic materials. This geologic history has resulted in the surface expression evident today, in that eastward dipping strata outcrop as successive, parallel bands, as seen in Figure 5. Where permeable strata outcrop, recharge to that aquifer occurs. In those areas of outcrop, ground water occurs under water table or unconfined conditions.

As recharge water moves downgradient it becomes confined by the occurrence of overlying, low permeability strata. In those areas, ground water occurs under confined or artesian conditions and the water surface is restricted from rising above the top of the aquifer, and is, therefore, under pressure.

The regional direction of ground-water flow within the Paluxy sand is generally down dip or eastward. At Air Force Plant 4 ground-water flow is influenced by the Lake Worth recharge area creating a potentiometric high and the ground-water withdrawals of White Settlement, which produces a potentiometric low. At the plant, the direction of ground-water flow in the Paluxy Formation is probably more south than east because of these two local influences.

The Paluxy sand, as discussed above, outcrops north and west of the plant but, more importantly, it outcrops within the bed of Lake Worth. Lake Worth is a recharge area for the Paluxy sand. The aquifer occurs under water table conditions at areas where the Paluxy sand outcrops.

With the exception of the outcropping at the extreme north end of the plant and with the possible exception of areas where the Walnut Formation may be discontinuous, the Goodland limestone and the Walnut formations confine the

Paluxy sand under artesian conditions. Figure 10 depicts the altitude and configuration at the top of the Paluxy sand. At Air Force Plant 4, the top of the Paluxy occurs at approximately 550 feet msl, or approximately 100 feet below land surface (bls). Figure 11 illustrates the approximate saturated thickness of the Paluxy sand. At Air Force Plant 4 the Paluxy aquifer is approximately 100 feet thick.

The Paluxy sand is used extensively in the vicinity of the plant for water supply. As a result, water levels within the aquifer throughout most of Fort Worth have declined significantly over the years. Figure 12 illustrates the potentiometric surface of the Paluxy aquifer as it appeared in 1955. At that time, water levels at Air Force Plant 4 were approximately 550 feet msl, which is near the top of the aquifer. Since the plant does not develop water from the Paluxy sand and because of the proximity to a constant recharge source (Lake Worth), water levels at the base have not declined to the extent evident in other parts of the county. Figure 13 illustrates a more recent potentiometric surface of the Paluxy aquifer. Water levels at that time (1976) in the vicinity of the plant were at approximately 500-feet msl, a decline of 50 feet in 21 years.

Transmissivities within the Paluxy aquifer range from 1,263 to 13,808 gallons per day per foot (gpd/ft) and average 3,700 gpd/ft. Given an aquifer thickness of approximately 100 feet at Air Force Plant 4, permeabilities range from 13 to 140 gpd/ft^2 and average 37 gpd/ft^2. Well yields within the Paluxy aquifer range from 10 to 480 gallons per minute (gpm) and average approximately 100 gpm.

Water quality within the Paluxy aquifer is generally good for potable use. Table 5 lists the range of chemical constituents occurring within the Paluxy sand in Tarrant County.

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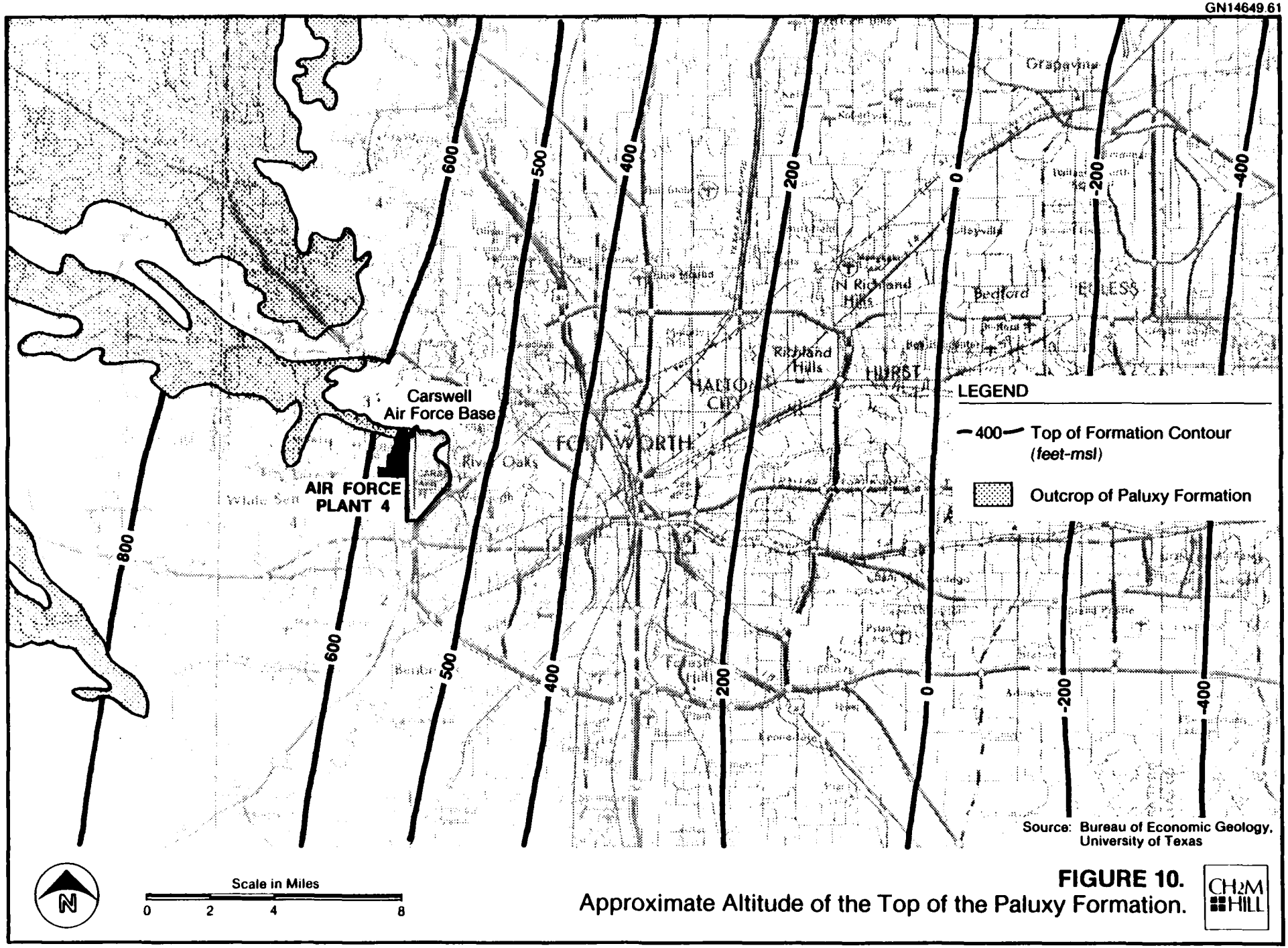

FIGURE 10.
Approximate Altitude of the Top of the Paluxy Formation.

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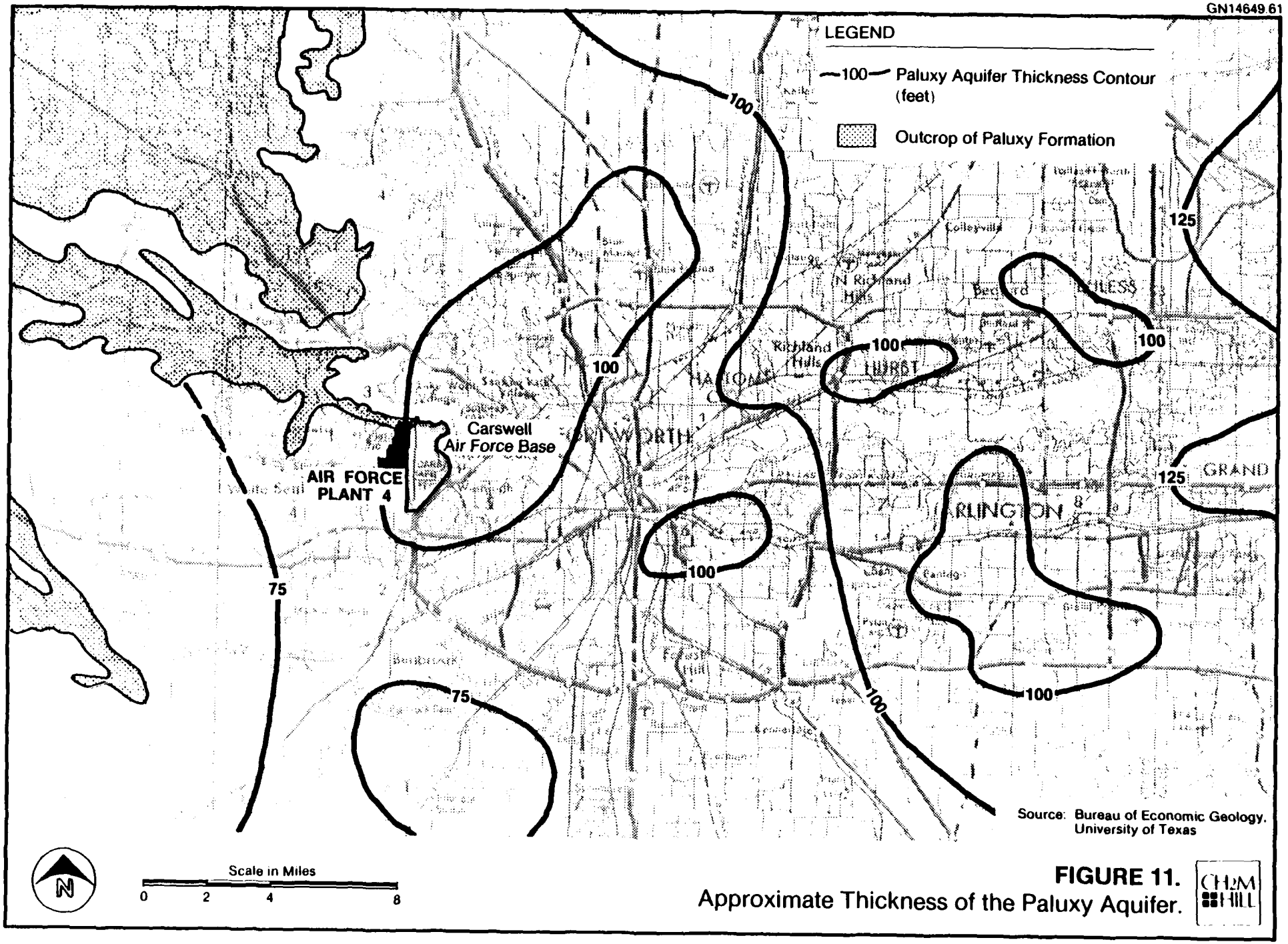

FIGURE 11.
Approximate Thickness of the Paluxy Aquifer.

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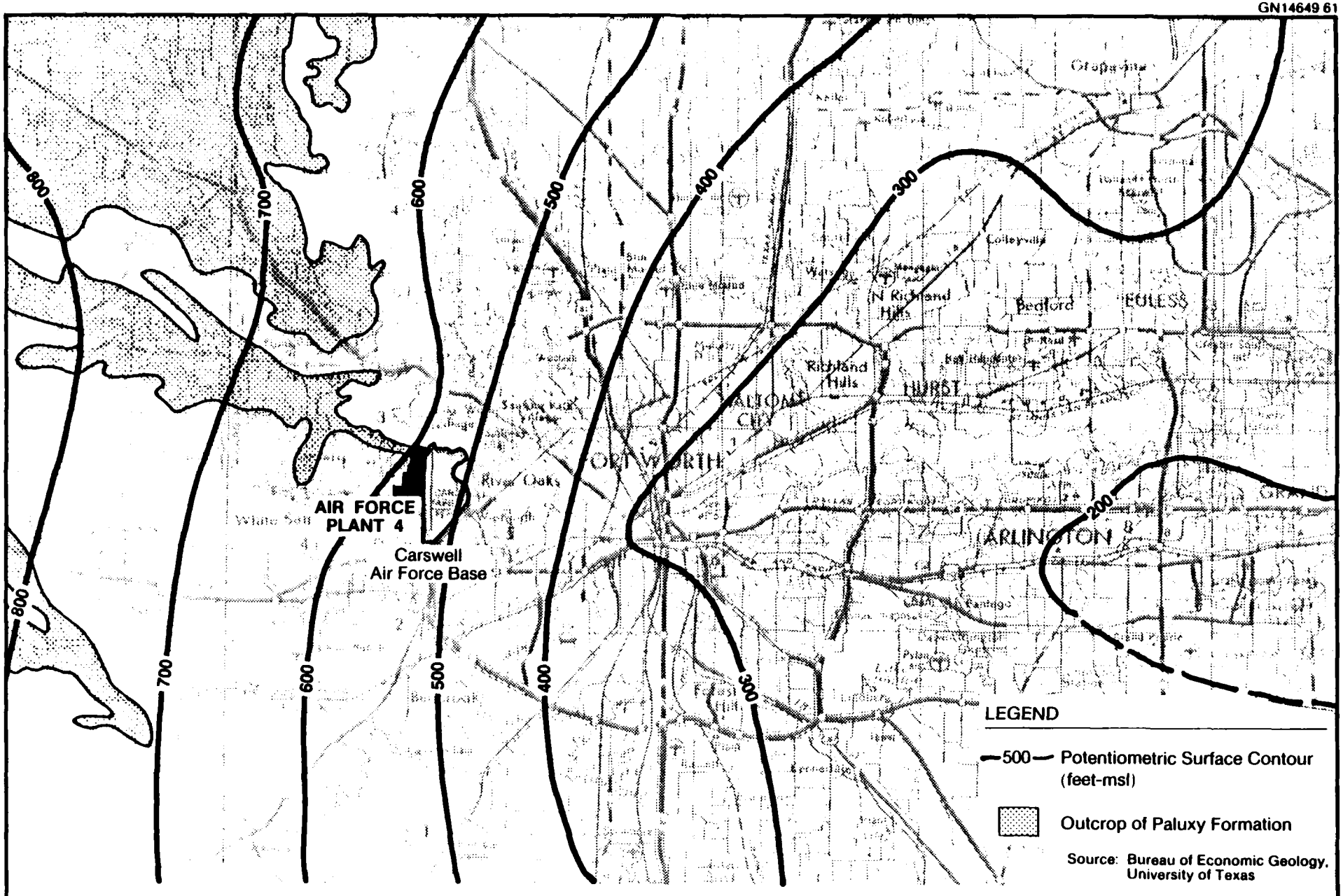

FIGURE 12.
Potentiometric Surface of the Paluxy Aquifer, 1955.

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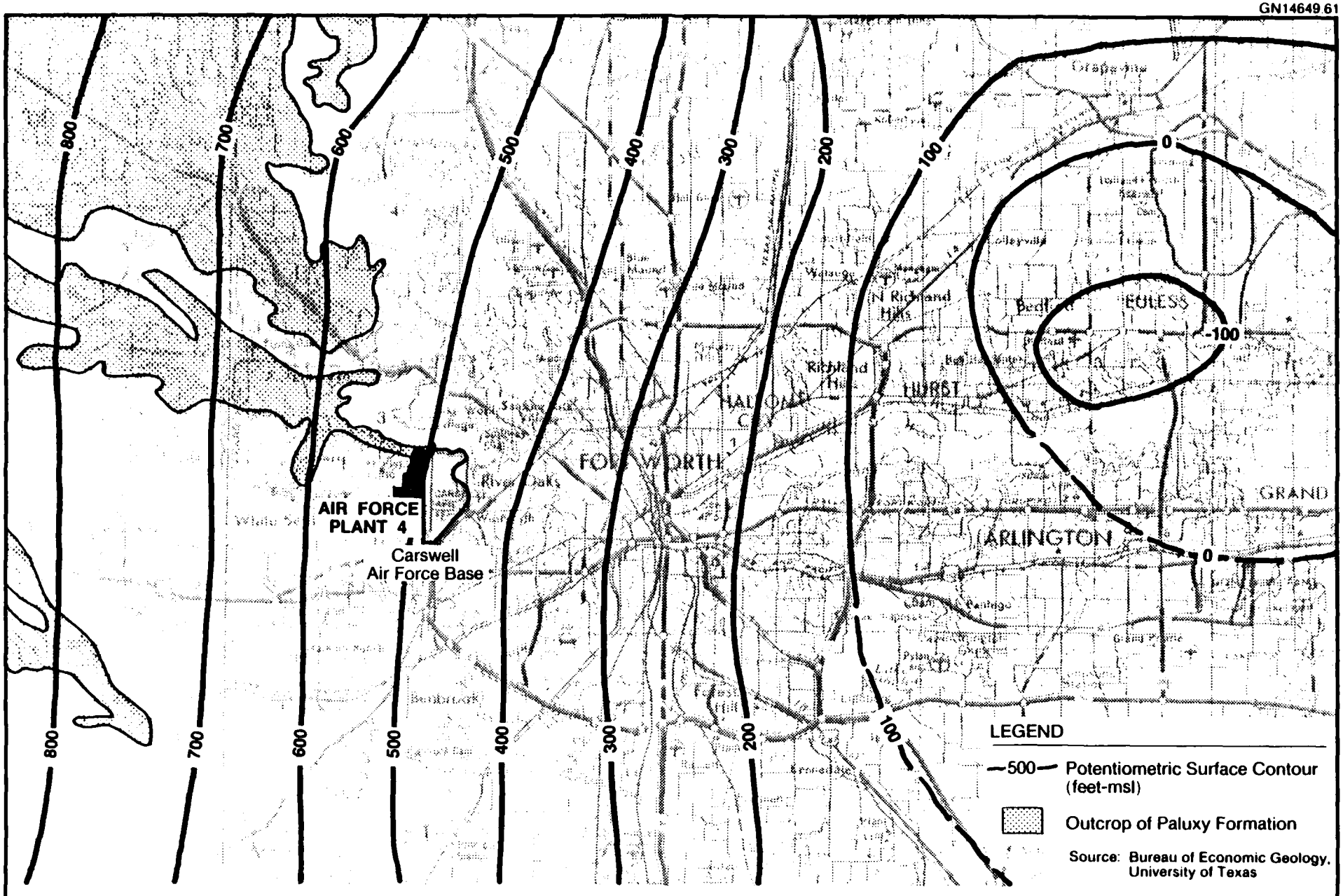

FIGURE 13.
Potentiometric Surface of the Paluxy Aquifer, 1976.

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Table 5
RANGE OF CONSTITUENTS IN GROUND WATER FROM
SELECTED WELLS IN THE PALUXY FORMATION
TARRANT COUNTY, TEXAS

Constituent or Property	
Silica (SiO_2)	1-30
Iron (Fe)	0-9.9
Calcium (Ca)	0-120
Magnesium (Mg)	0-43
Sodium (Na)	11-740
Bicarbonate (HCO_3)	177-689
Sulfate (SO_4)	6-1,080
Chloride (Cl)	5-117
Fluoride (F)	0-4.5
Nitrate (NO_3)	0-10.0
Boron (B)	0.1-.6
Dissolved Solids	264-2,176
Total Hardness ($CaCO_3$)	2-401
Percent Sodium (%)	7.1-99.5
pH	7.1-9.2
Sodium-Absorption Ratio (SAR)	0.2-68.8
Residual Sodium Carbonate (RSC)	0-10.0
Specific Conductance (μmhos at 25°C)	427-3,193

Note: Analyses given are in milligrams per liter except percent sodium, specific conductance, pH, SAR, and RSC.

Source: Texas Department of Water Resources, 1982.

The Paluxy aquifer is separated from the deeper Twin Mountains formation by the Glen Rose limestone. As discussed above, the Glen Rose formation consists of calcareous sedimentary rock, limestone interbedded with sands, clays, and anhydrite. This formation is absent north and west of Fort Worth and in those areas the Paluxy sand and the Twin Mountains formation coalesce and become the Antlers formation.

At Air Force Plant 4, the Twin Mountains formation is hydraulically separated from the younger Paluxy sand by the Glen Rose formation. Figure 14 illustrates the elevation of the top of the Twin Mountains formation in Tarrant County. At Air Force Plant 4, the top of the Twin Mountains formation is at approximately 80 feet msl or 545 ft bls.

Recharge to the Twin Mountains formation, like the Paluxy sand, occurs in areas of outcrop, located west of Air Force Plant 4. Here ground water occurs under water table conditions and flow is generally eastward. Like the Paluxy sand, the formation dips to the east, and east of the recharge area ground water occurs under confined, artesian conditions.

Also, like the Paluxy sand, ground-water withdrawals from the Twin Mountains aquifer have resulted in declining water levels. Figure 15 illustrates the 1955 potentiometric surface of the Twin Mountains aquifer. At that time, the potentiometric surface of this aquifer at Air Force Plant 4 was approximately 250-feet msl. Figure 16 illustrates the 1976 potentiometric surface of the same aquifer. In 1976, the potentiometric surface was at elevation 0-feet msl, indicating a decline of approximately 250 feet from 1955 to 1976. Most of the decline was due to ground-water withdrawals for municipal water supply.

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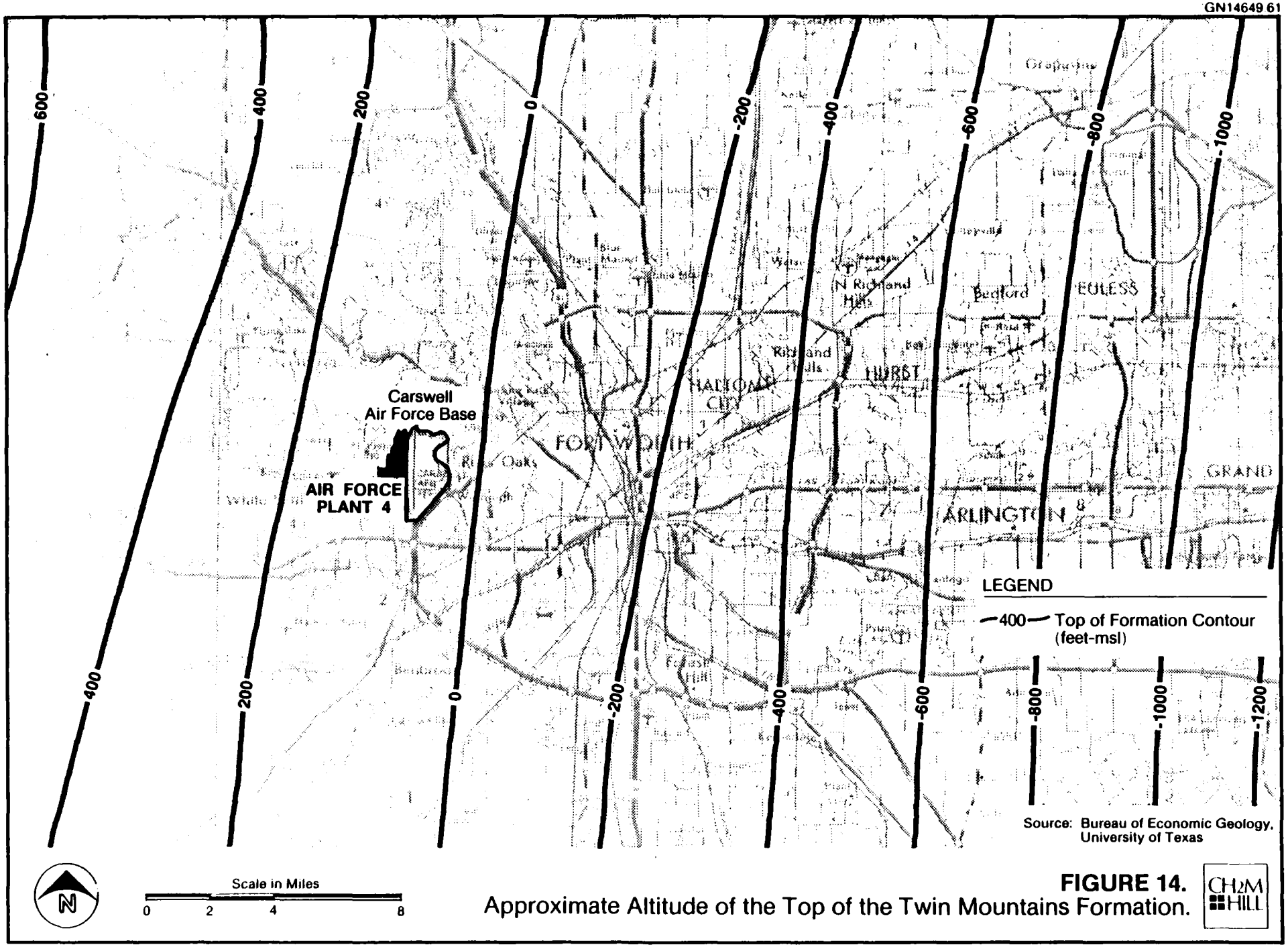

FIGURE 14.
Approximate Altitude of the Top of the Twin Mountains Formation.

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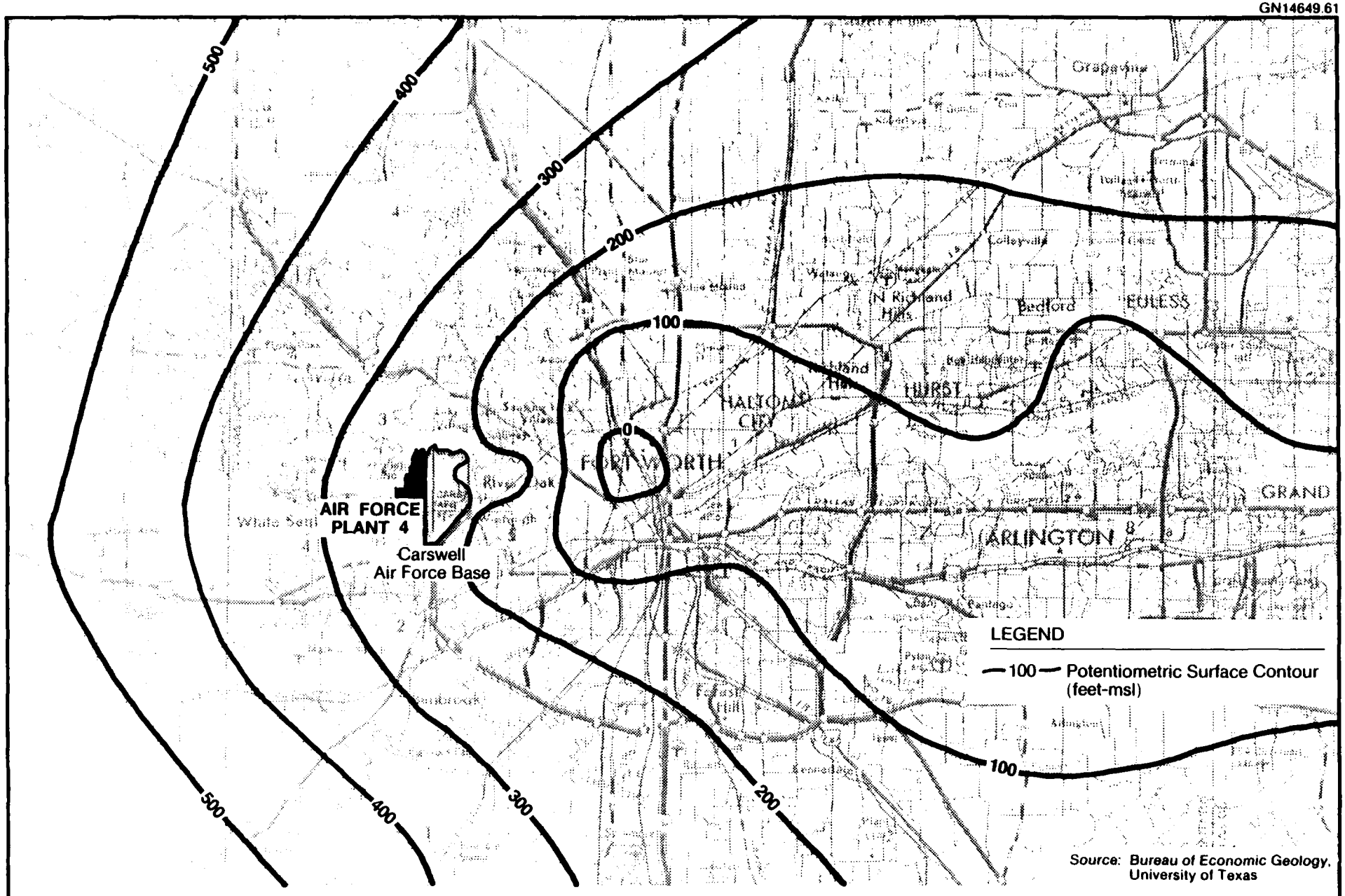

FIGURE 15.
Potentiometric Surface of the Twin Mountains Aquifer, 1955.

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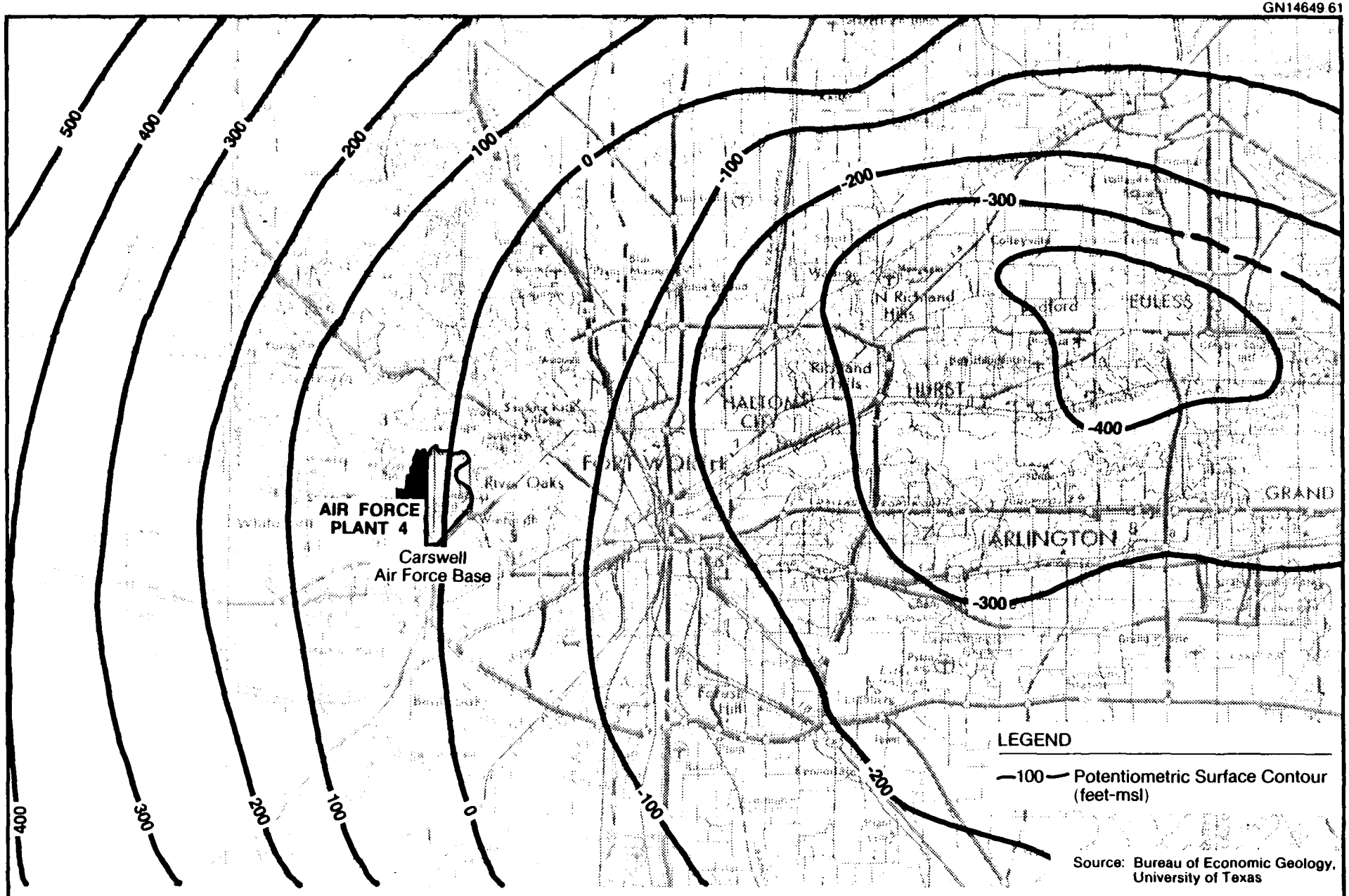

FIGURE 16.
Potentiometric Surface of the Twin Mountains Aquifer, 1976.

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Transmissivities within the Twin Mountains aquifer range from 1,950 to 29,700 gpd/ft and average 8,450 gpd/ft in Tarrant County. Permeabilities range from 8 to 165 gpd/ft^2 and average approximately 68 gpd/ft^2 in Tarrant County.

Water quality within the Twin Mountains aquifer is suitable for potable water supply with regard to chemical concentrations. Table 6 lists the range of chemical constituents found in Tarrant County.

In general, the potential for upper-zone ground-water contamination from past plant activities is fairly high, as documented by recent studies conducted by Hargis and Montgomery for General Dynamics. In those areas where surface contamination has reached the ground water occurring in the upper zone, migration could occur laterally through relict buried stream channels discharging to Lake Worth or the Meandering Road Creek, or seeping downward to the Goodland and Walnut formations. In areas where these strata are absent, hydraulic connection between the permeable sections of the upper zone and the Paluxy sand may provide a pathway to that aquifer. The occurrence of buried sewer and pipelines may also act as permeable conduits similar to the buried stream channels.

Although the Goodland limestone and the Walnut formation are low in permeability, leakage through these strata is possible, especially in those areas where it has been thinned by erosion. In areas where it is thin, and there is a continuous driving force (i.e., pit, lagoon, or ditch) contaminants could migrate from the upper zone, through the Goodland and Walnut formations to the Paluxy sand. Another possible contaminant pathway is by way of Lake Worth. Most of the plant stormwater ultimately

Table 6
RANGE OF CONSTITUENTS IN GROUND WATER FROM
SELECTED WELLS IN THE TWIN MOUNTAINS FORMATION
TARRANT COUNTY, TEXAS

Constituent or Property	
Silica (SiO_2)	5-79
Iron (Fe)	0-2.6
Calcium (Ca)	1-114
Magnesium (Mg)	0-11
Sodium (Na)	141-670
Bicarbonate (HCO_3)	288-659
Sulfate (SO_4)	21-579
Chloride (Cl)	14-650
Fluoride (F)	0-7.0
Nitrate (NO_3)	0-5.9
Boron (B)	0.2-1.9
Dissolved Solids	381-1,735
Total Hardness ($CaCO_3$)	5-302
Percent Sodium (%)	12.8-99.3
pH	7.4-9.1
Sodium-Absorption Ratio (SAR)	0.4-72
Residual Sodium Carbonate (RSC)	0-10.1
Specific Conductance (μmhos at 25°C)	607-3,317

Note: Analyses given are in milligrams per liter except percent sodium, specific conductance, pH, SAR, and RSC.

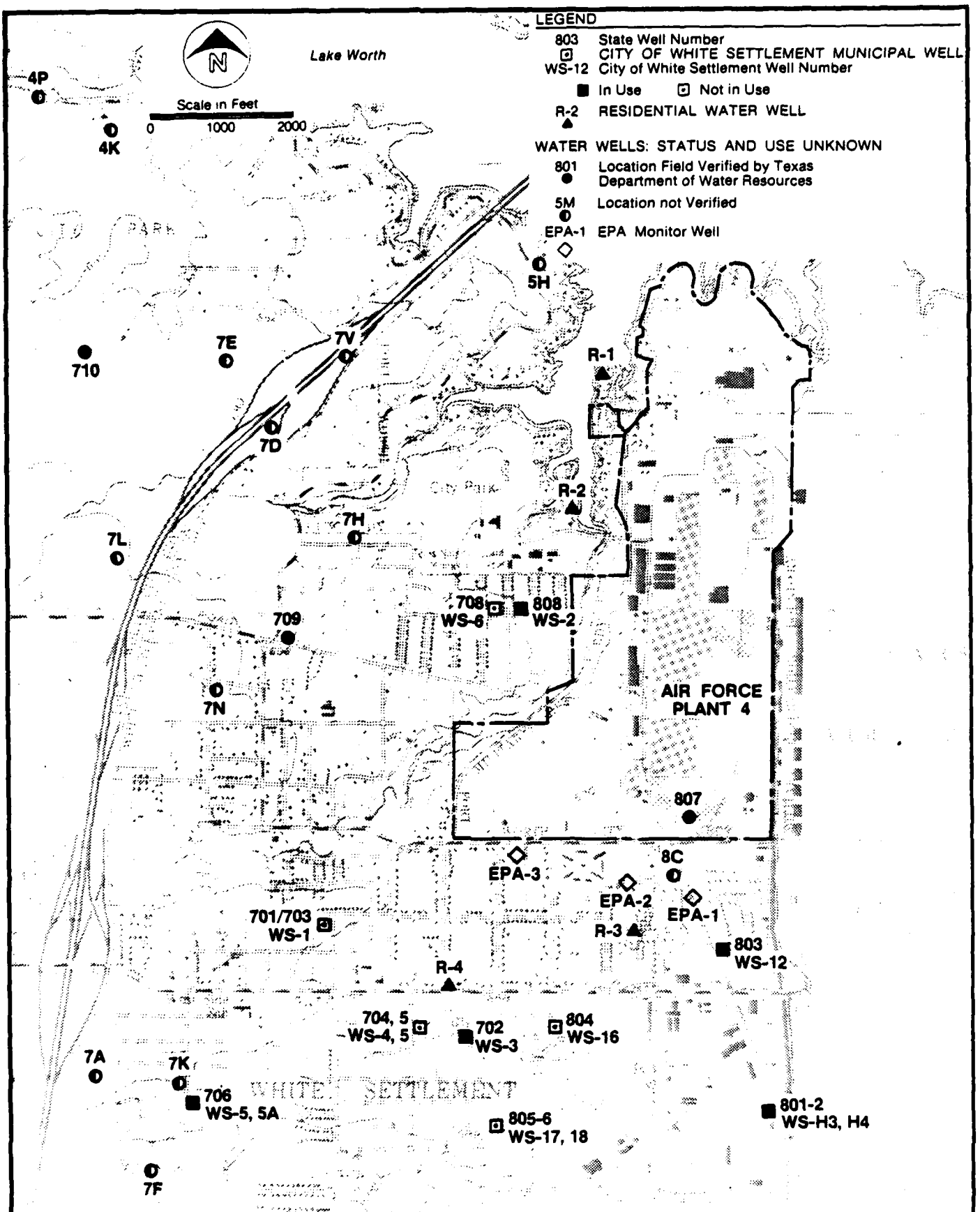
Source: Texas Department of Water Resources, 1982.

discharges to Lake Worth. Not only is this a water supply reservoir for the City of Fort Worth but it is also a recharge area for the Paluxy Aquifer. Any contaminants entering Lake Worth would result in both surface- and ground-water degradation. The Twin Mountains formation is protected from direct recharge via downward leakance by the overlying Paluxy aquifer, and interbedded, low permeable confining beds.

Still, another potential pathway to the uppermost aquifers (Paluxy and Twin Mountains) is the existence of old, abandoned water wells, particularly the well identified as Well No. 807, located beneath the General Warehouse Building (see Figure 17). The records search indicated that a number of abandoned wells could possibly exist near the north end of the plant, in the location of early residences.

Wells, especially those constructed years ago by cable tool methods, sometimes provide a direct pathway to the aquifer via the annular space between the casing and hole. A recommendation is provided in Section VI, "Recommendations," to locate and determine the condition of any abandoned wells that may exist on Air Force Plant 4 property.

Studies conducted by Hargis and Montgomery have focused on contaminant location, migration, and quantification at the plant. This effort is still in progress, and during the site visit drilling activities directed by Hargis and Montgomery included installation of additional Paluxy sand and upper zone monitoring wells. As of this date, 33 monitor wells and 56 test holes have been completed into the upper zone, and 4 monitor wells have been completed in the Paluxy sand at the



Note: This map was prepared from open file well inventory maps of Tarrant County compiled by the Texas Department of Water Resources. Residential wells drilled prior to 1965 may not be shown on the inventory map. Residential wells in addition to those shown may exist in the area.

Source: Hargis & Montgomery, 1983.

FIGURE 17.
Regional Well Locations.

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plant. In addition, EPA has installed three upper zone monitor wells between the plant and White Settlement. Also, 4 additional Paluxy sand monitor wells, 8 additional upper zone wells, and 25 exploratory borings are currently being constructed by Hargis and Montgomery. A more detailed summary of the Hargis and Montgomery study is given in Section IV-B, "Previous Investigations and Remedial Activities."

Water samples have been collected and analyzed from all monitoring wells installed at the plant several times over the past 2 years. In addition, samples have been taken from nearby White Settlement production wells, off-site EPA monitor wells, four residential water wells, and in-plant water taps, one served by White Settlement wells, one served by Fort Worth (Lake Worth Reservoir). Samples have been collected from general plant and stormwater outfalls discharging to Meandering Road Creek, the creek itself at several locations, Lake Worth, the french drain system under the west parking lot, and Tank No. 561. As a result of these efforts, some past disposal areas have been located and remedial action has been taken. Chrome Pit No. 3 (Site No. 12), the Die Pits (Site No. 13), and the waste oil pits, part of Landfill No. 1 (Site No. 1), have been evaluated and contaminated soil and materials removed. In addition, a french drain system and a semi-impervious cap (parking lot pavement) has been installed at Site No. 1.

In spite of the effort expended to date, questions still remain regarding past disposal sites, direction and rate of ground-water movement, vertical migration to underlying potable aquifers, and others. It is important to note that the complexities of the ground-water

regime, especially the near surface strata, at Air Force Plant 4, are such that continued data collection and review/revisement of past conclusions is essential.

Specifically, the direction and rate of ground water movement within the upper zone should be determined in order to assess contaminant migration. Since saturated thickness, permeability, the occurrence of ground-water barriers, and hydraulic gradient, all of which control ground-water flow, vary widely within the upper zone, a large amount of data should be collected to confirm local variations in the vicinity of a past disposal site. Equally important, site-specific data on the hydraulic connection between the contaminated upper zone and the underlying potable aquifers should be collected to determined the impact and potential for migration from specific past disposal sites.

On the basis of existing data, the direction of ground-water flow within the upper zone in general is northward, controlled by local topography, and the occurrence of an eroded trough in the top of the Walnut Formation. This is a general statement which means that, over the long term, perhaps decades, water entering the upper zone south of Air Force Plant 4 will move northward. However, the flow from south to north will follow a tortuous, meandering path, controlled by local variations in gradient, thickness, permeability, etc. In fact, at any one point, local ground-water flow could be in any direction.

The Paluxy sand, a locally used potable aquifer, has been contaminated by past disposal practices at least at the site of Well P-4, adjacent to the waste oil pits (part of Site No. 1). The extent of contamination at this site has not yet been confirmed. Ongoing studies by Hargis and Montgomery are aimed at determining the areal extent of

Paluxy sand contamination, and the hydrogeologic nature of the aquifer itself. Early data suggests that the Paluxy Aquifer is subdivided into an upper and a lower zone separated by low permeability semi-confining beds. Data currently being collected by Hargis & Montgomery will be used to assess this condition.

Existing data also suggests contamination, by way of ground-water seepage from the upper zone, is still reaching the Meandering Road Creek; however, it is low-level. Analyses of creek samples collected in January 1984, indicated the presence of 1,2-trans-dichloroethylene and trichloroethylene at two locations. Concentration ranges were 19 to 48 μg/L and 16 to 58 μg/L for 1,2-trans-dichloroethylene and trichloroethylene, respectively (see Table 23, Section IV). Further monitoring, especially during stages of high upper zone ground-water levels would be required to confirm this fact. For more complete data on monitoring well construction, sampling and analysis results and conclusions and recommendations from studies conducted by Hargis and Montgomery, refer to Section IV.B., "Previous Investigations and Remedial Activities," and to documents cited in Appendix N, "References."

D. ECOLOGY

1. Habitat

Air Force Plant 4 lies in the Western Cross Timbers vegetational zone of the Texas Biotic Province. Natural vegetation in this area was formerly transitional between the prairie grasslands to the west and the pine-hardwood forests to the east. No significant natural plant or animal communities currently exist on AF Plant 4 property. However, approximately 160 acres of disturbed,

successional plant communities are found along Meandering Road Creek on the west side of the installation and along the northern end of the installation bordering Lake Worth. Plant communities in the upland areas are dominated by native and introduced grasses and weeds. Forested areas are confined to the areas near lakes and water courses. Common tree species include oaks, cottonwood, ash, willows, elm, hackberry, and pecan.

Typical wildlife on the installation includes black-tailed jackrabbits in the grassy areas and cottontail rabbits, gray squirrels, and opossums in the wooded areas. Common birds include mourning doves, meadowlarks, mockingbirds, grackles, killdeer, and starlings. Over 300 species of birds are known to occur in the Tarrant County area. Hunting and trapping are not allowed on Air Force Plant 4 property.

There are no water bodies entirely enclosed on AF Plant 4 property; however, Lake Worth borders the northern edge of the installation. More than 50 species of fish are reported to be present in area reservoirs and their tributary headwaters, including most gamefish species such as black bass, sunfishes, and catfish.

2. Threatened or Endangered Species

According to the Texas Department of Parks and Wildlife and the United States Fish and Wildlife Service, there are no threatened or endangered species known to occur on AF Plant 4. None of the federally-listed plant species for Texas are known to occur within 100 miles of Tarrant County. Of the federally-listed animal species only the peregrine falcon (endangered), the bald eagle (endangered), and the whooping crane (endangered) are known to

occasionally occur in the area; however, none of these are expected to reside in the vicinity of AF Plant 4. Several state-listed wildlife species are known or suspected to occur in Tarrant County (Table 7), but no inventory of these species has been made at AF Plant 4. No plant species listed by the Texas Organization for Endangered Species (TOES) as rare or endangered are known to occur in Tarrant County.

Table 7
FEDERAL AND STATE LISTED THREATENED OR ENDANGERED SPECIES KNOWN OR SUSPECTED TO OCCUR IN TARRANT COUNTY, TEXAS

Common Name	Scientific Name	State[a]	Federal[a]	Habitat
Bald Eagle	*Haliaeetus leucocephalus*	E	E	Near rivers and lakes
Peregrine Falcon	*Falco peregrinus*	E	E	Migrant
Whooping Crane	*Grus americana*	E	E	Migrant
Interior Least Tern	*Sterna albifrons athalassos*	E	E	Migrant
White-faced Ibis	*Plegadis chihi*	T	--	Near ponds
Swallow-tailed Kite	*Elanoides forficatus*	T	--	River swamps
Osprey	*Pandion haliaetus*	T	--	Lakes and rivers
Wood Stork	*Mycteria americana*	T	--	Wetlands
Golden-cheeked Warbler	*Dendroica chrysoparia*	T	--	Cedar/oak woodlands
American Alligator	*Alligator Mississippiensis*	E	E	Permanent waterways
Texas Horned Lizard	*Phrynosoma cornutum*	T	--	Brushlands, grasslands
Louisiana Milk Snake	*Lampropeltis triangulum amaura*	T	--	Throughout
Paddle Fish	*Polyodon spathula*	E	--	Permanent waterways
Blue Sucker	*Cycleptus elongatus*	T	--	Permanent waterways

[a]E = endangered; T = threatened.

Source: Texas Parks and Wildlife Department; USFWS.

IV. FINDINGS

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A. ACTIVITY REVIEW

1. INDUSTRIAL WASTE DISPOSAL PRACTICES

Industrial operations have been continuous since Air Force Plant 4 went into production in 1942. Plant operations center around the production of military aircraft and associated equipment. Manufacturing of aircraft and associated equipment results in the generation of varying quantities of waste oils (including lubricating oils, hydraulic fluids, and coolants), recoverable fuels, solvents (including degreasers and paint thinners), paint residues (including waste liquid paints and paint booth sludges), and spent process chemicals (including acids, caustics, chromium, and cyanide solutions). The total quantity of these wastes currently ranges from about 5,500 to 6,000 tons/year. This information was developed based upon interviews with General Dynamics personnel, previous reports, and Monthly Waste Shipment Reports for 1981 through 1983. Waste quantities are dependent on the levels of contractor activity and may have varied from one time period to the next. The total waste quantities may have been higher in the past during periods of heavier contractor workload.

Practices for past (based on information obtained from files and on the best recollection of interviewees) and present waste disposal are summarized below:

	1942-1955	1955-1966	1966-1970	1970-1975	1975-1983	1983-Present
Burning and/or burial at on-site landfills	X	X	X	X		
Burning in fire department training exercises		X	X	X	X	
Contractor removal off-site			X	X	X	X
Treatment via chemical waste treatment system				X	X	X

- 1942-1955: In general, waste oils, solvents, recoverable fuels, paint wastes, and spent process chemicals were disposed of at on-site landfills. Some of these materials, e.g., oils, solvents, and fuels, were burned at the landfill in surface pits. Water wastes containing process chemicals, including chromium and other metals, were discharged to the sanitary sewer system, which discharged to the City of Fort Worth for treatment. Washwater from paint booths and water containing residual oils also discharged to the sanitary sewer system.

- 1955-1966: Wastes were handled in the same manner as in the previous period of 1942 through 1955, with few changes. Waste oils, recoverable fuels, and spent solvents were disposed of in the landfills and also burned in fire department training exercises at designated fire department training areas.

- 1966-1970: Waste oils and fuels continued to be disposed of at on-site landfills and burned in fire department training exercises. Solvents, waste paints, and process cyanide solutions were disposed of by contractor removal. Other wastes continued to be discharged to the sanitary sewer system.

- 1970-1975: Waste oils and fuels continued to be disposed of at on-site landfills and through burning at fire department training areas. Solvents, process cyanide chemicals, and paint wastes continued to be disposed of through contractor removal. Other process chemical solutions and rinse waters and paint booth washwater were treated through a newly installed chemical waste treatment system that removed metals and neutralized acids and bases.

- 1975-1983: Waste oils were disposed of by contractor removal, and to a lesser extent by burning at fire department training exercises along with recoverable fuels. Solvents, process cyanide chemicals, and paint wastes continued to be disposed of through contractor removal. During this period of time, paint booth washwaters and some waters containing residual oils were discharged to the chemical waste treatment system and also to the industrial wastewater collection system, which combines with the sanitary sewer system with no prior treatment. Other process chemical solutions continued to be discharged to the chemical waste treatment system.

- 1983 to present: Wastes are disposed of in the same manner as the previous 1975-1983 period, except that all waste oils and recoverable fuels are disposed of through contractor removal as opposed to burning in fire department training exercises.

2. INDUSTRIAL OPERATIONS

Industrial operations at Air Force Plant 4 have been primarily involved with the manufacturing of military aircraft and associated equipment.

The types of aircraft manufactured, including dates and numbers of each, are given in Table 8. With the exception of the B-24 and C-87 aircrafts, production included parts manufacturing as well as sub- and final assembly. Parts for the B-24 and C-87, manufactured elsewhere, were shipped to Air Force Plant 4 for assembly. The contractor, General Dynamics, is currently engaged in the production of the F-16 aircraft, including spare parts, radar units, and missile components.

Most of the liquid wastes generated by the industrial operations can be categorized as waste oils, recoverable fuels, spent solvents, spent process chemicals, and paint residues. Waste oils generally refer to lubricating fluids, such as machine coolants, crank case oils, and hydraulic fluids. Recoverable fuels refer to aircraft fuel drained from tanks and includes JP-4 and possibly some JP-5 purge.

Spent solvents refer to liquids used for degreasing and general cleaning. Included in this category are safety solvent (similar to PD-680, Type II) and various

Table 8
AIRCRAFT HISTORY

Dates	Aircraft Description	Type	Number Produced
1942-44	B-24 Liberator	Bomber	2,743
1942-44	C-87 (B-24 conversion)	Cargo	291
1944-45	B-32 Dominator	Bomber	124
1947-54	B-36 Peacemaker	Bomber	385
1957-62	B-58 Hustler	Bomber	116
1964-76	F-111 Fighter Bomber	--	562
1977-Present	F-16 Fighting Falcon	Fighter	1,000+

chlorinated organic solvents such as trichloroethylene (TCE) and trichloroethane. Of the chlorinated organic solvents, TCE is the most commonly used. In 1983, 845 gallons of safety solvent, 69,870 gallons of TCE, and 2,995 gallons of trichloroethane were consumed in industrial operations. In previous years, the use of these solvents, especially TCE, has been higher. For example, in 1982, total TCE usage was 216,872 gallons. Over the past 4 years (1980 through 1983), TCE usage averaged 154,340 gallons/year. The TCE is normally stored in heated tanks referred to as vapor degreasers. It is estimated by Air Force Plant 4 personnel that approximately 95 percent of the TCE stored in these tanks evaporates. This would suggest that approximately 5 percent of the TCE used ends up as spent solvent. Based on the 154,340 gallons/year TCE usage over the past 4 years, approximately 7,700 gallons/year of spent TCE solvent would have been generated at Air Force Plant 4.

Other solvents that are in common use include mask solvent, naphtha, methyl-ethyl ketone (MEK), methyl-iso-butyl ketone (MIBK), kerosene, and iso-butyl alcohol. Mask solvent is a mixture of toluene and xylene.

Spent process chemicals include acids, caustics, chromium solutions, and cyanide solutions. These process chemicals result from the various metal preparation and treatment processes employed at Air Force Plant 4.

Paint residues include waste liquid paints, contaminated with thinners and solvents, and sludges collected during the periodic cleaning of paint booths. The sludges primarily contain paint particles and chromium.

The major types of industrial operations that generate the majority of wastes referred to above, along with a description of the waste types, are given in Table 9. The first four listed operations apply to the preparation of metal surfaces for subsequent operations such as chromium or cadmium plating.

a. Aluminum Etching

Aluminum etching as used at Air Force Plant 4 is a caustic process and results in the generation of spent caustic baths. Under current practice these wastes are pumped to holding tanks (T-852, 853) for subsequent removal by a private contractor.

b. Metal Surface Preparation, Anodizing, and Plating

These operations result in the generation of concentrated acid wastes. Wastes are typically mixed sulfuric, nitric, hydrofluoric, and chromic acids. Currently, these wastes are pumped to storage tanks (T-11, 12), for subsequent removal by a private contractor.

c. Chrome Plating, Anodizing, and Aluminum Etching Rinse Steps

These operations generate wastes consisting of dilute acid and dilute alkaline solutions. Acid rinses are generated by the plating and anodizing operations and alkaline rinses are generated by the etching rinse operations. Under current practice, these wastes are pumped to the chemical waste treatment plant and neutralized through mixing followed by discharge to the City of Fort Worth sanitary sewer system.

Table 9
INDUSTRIAL OPERATIONS AND WASTE TYPES

Operations	Characteristic Wastes
Aluminum etching	Concentrated caustics--spent etching baths
Metal surface preparation, anodizing and plating	Concentrated acids--mixed nitric, sulfuric, hydrofluoric, and chromic acid baths
Chrome plating, anodizing, and aluminum etching rinse steps	Rinses--dilute acid and alkaline rinses
Plating--cadmium, nickel, electroless nickel, and chromium	Plating--concentrated spent plating baths; rinse waters; cyanide
Painting	Paint strippers and thinners; waterwash and paint sludge from paint booths
Vapor degreasing	Spent trichloroethylene (TCE), oils, dirt
Machine tool servicing and coolant replacement	Coolant oil/water mixture
Engine maintenance and testing	Waste oils, fuels
Chemical waste treatment	Sludge containing chromium and other heavy metals (cadmium, lead, silver)

d. Plating--Cadmium, Nickel, Electroless Nickel, and Chromium

These operations result in the generation of spent concentrated plating baths and rinse waters. Chrome plating solutions, including dilute chromium rinse waters, are currently pumped to the chemical waste treatment plant for chromium reduction and removal prior to discharge to the City of Fort Worth sanitary sewer system. Cadmium, nickel, and electroless nickel plating solutions and rinse waters contain cyanide and are collected in storage tanks (T-870, 861) for subsequent removal by a private contractor.

e. Painting

Painting of aircraft, aircraft components, and support equipment results in the generation of waste paints, paint thinners, strippers, paint sludge, and waterwash. Waste paints, thinners, and strippers are generally drummed in 55-gallon containers and subsequently removed and disposed of by a private contractor.

Paint sludge and washwater result from paint spray booth operations. About once every 2 weeks, paint booths located at Air Force Plant 4 are cleaned. The washwater is discharged to the sewers. According to General Dynamics personnel, about two-thirds of the washwater goes to the chemical waste treatment facility and the other one-third goes directly to the City of Fort Worth sanitary sewer system. Solids (sludge) collected from the bottom of the paint booths are put into 55-gallon drums for subsequent removal by a private contractor. The paint sludge contains paint particles and chromium.

f. Vapor Degreasing

Vapor degreasing wastes primarily contain trichloroethylene, oils, and dirt. The wastes are generated from the periodic cleaning of approximately 20 operating degreasers located throughout the facility. Five of the larger degreasers are equipped with operating stills (T-460, 464, 466, 534, 544). Frequency of cleaning depends heavily on the extent of use. The larger degreasers are cleaned about once every 1 to 3 months. Stills are drained about once every 2 months. Wastes collected from degreasers and the stills are put into 55-gallon drums for subsequent pickup and disposal by a private contractor.

g. Machine Tool Servicing and Coolant Replacement

This operation results in the generation of coolant oil/water mixtures. These wastes are treated in a magnesium sulfate coagulation process to separate the oil and water phases. The water is subsequently discharged to the City of Fort Worth sanitary sewer system. The recovered oil is temporarily stored for subsequent pickup and disposal by a private contractor.

h. Engine Maintenance and Testing

This operation results in the generation of waste oils and some residual fuels. Fuels are stored in specially-marked fuel carts and when full are emptied into a tank truck. When full, contents of the tank truck are sold to a private contractor. Waste oils are drummed in 55-gallon containers and temporarily stored for subsequent pickup and disposal by a private contractor.

i. Fueling and Defueling

Fueling and defueling results in the generation of recoverable fuels. Residual fuels drained from flightline aircraft are collected in specially-marked fuel carts and subsequently emptied into a tank truck. When full, the contents of the tank truck are sold to a private contractor.

j. Chemical Waste Treatment

Chemical waste treatment results in the generation of chromium and other heavy metals (e.g., cadmium, lead, and silver) bearing sludges. Dilute acidic and alkaline wastewaters (neutralized) and chromium plating and rinse solutions are treated with sodium bisulfate for the reduction of hexavalent chromium to trivalent chromium. A subsequent coagulation step precipitates the chromium and other heavy metals out as sludge. This sludge is subsequently dewatered on a filter press and removed from the plant by a private contractor.

The foregoing has been a discussion of the types of operations that generate the majority of wastes at Air Force Plant 4. Table 10, Major Industrial Operations Summary, summarizes the major industrial operations by department, location, type, approximate current quantity of hazardous waste generated, and provides a chronology of waste management methods from 1942 to the present.

3. FUELS

Aircraft, motor, and fuel oils are received and stored at Air Force Plant 4. A list of the various fuel types, locations, and storage tank capacities is given in Table 11. Aircraft fuels include JP-4 and JP-5 and are

Table 10
MAJOR INDUSTRIAL OPERATIONS SUMMARY

Department/Shop No.	Department/Shop Name	Present Location Bldg.	Present Location Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940–1990)
4-0	Material Stores	30	--	Flammable solvents	176	LF; LF, FDT2; LF, FDT6; CR
		14	--	Flammable solvents	176	
17-2	Photographic Services	5	66N	Water containing photographic chemicals	5.48×10^6	SANS; CWTX
25-6	Equipment Maintenance	5	49-73T	Water and oil	73,000	
		157	--	Water containing residual oil and naphtha	365,000	SANS; IWS-SANS
				Paint booth washwater containing pigments and thinners	52,000	
		80	--	Oils	2,464	
		88	--	Oil and coolant	2,112	LF; LF, FDT2; LF, FDT6; CR; CR, FDT6
		93	--	Oils	176	
		125	--	Oils	352	
		138	--	Flammable solvents	264	
			--	Oils	440	LF, FDT6; CR
		157	--	Oils	704	
				Antifreeze	88	

Notes:

LEGEND
LF = Land fill
FDT2 = Fire Department Training Area No. 2 (wastes burned during fire department training exercises)
FDT6 = Fire Department Training Area No. 6 (wastes burned during fire department training exercises)
CR = Contractor removal (wastes sold to private contractor)
CWTX = Chemical wastewater treatment system (Chemical sludge is removed by private contractor. Supernatant is discharged to sanitary sewers.)
IWS-SANS = Discharge to industrial wastewater collection sewers with ultimate discharge to sanitary sewers.
SANS = Discharge to sanitary sewers with ultimate discharge to City of Fort Worth treatment plant.

1. Flammable solvents may include mask solvent (mixture of xylene and toluene), high-flash naphtha, safety solvent (similar to PD-680, Type II), trichloroethylene, methyl-ethyl ketone (MEK), methyl-iso-butyl ketone (MBK), iso-butyl alcohol, kerosene, and xylene.
2. Oil includes waste coolant oils, lubricating oils, and hydraulic fluids

Table 10
(continued)

Department/Shop No.	Name	Present Location Bldg.	Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940 1950 1960 1970 1980 1990)
25-6	Equipment Maintenance			Flammable solvents	1,410	LF, FDT6 CR
		182	--	Oils and coolant	1,060	FDT6, CR CR
		11	--	Antifreeze	90	LF LF, FDT1 LF, FDT6 CR, FDT6 CR
				Oils	90	
25-7	Construction and Maintenance	5	970 Mez	Paint booth washwater containing pigments and thinners	12,000	SANS IWS-SANS
25-8	Boiler House Services	3	87BF	Demineralizer, regenerant (acids, caustics)	2.19×10^6	SANS CWTX
			77BF	Water containing residual oils	73,000	SANS IWS-SANS
			--	Flammable solvents	352	LF LF, FDT2 LF, FDT6 CR
25-5	Maintenance Services	4&5	--	Degreaser sludge containing trichloroethylene, oils, dirt	352	LF CR
				Oils	3,350	
				Oils and coolant	62,830	LF LF, FDT2 LF, FDT6 CR, FDT6
				Flammable solvents	880	
		24&25	--	Oils	175	LF, FDT2 LF, FDT6 CR, FDT6
		88	--	Oils and coolant	2,110	CR

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Table 10
(continued)

Department/Shop No.	Department/Shop Name	Present Location Bldg.	Present Location Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940 1950 1960 1970 1980 1990)
30	Numerical Control Machining	4	--	Water containing residual oils	1.8×10^5	SANS; CWTX
		5	--	Water containing residual oils	1.8×10^5	
31	Sheet Metal	5	26F	Water containing residual oils	1.1×10^6	SANS; IWS-SANS
			10L	Rinse water containing sodium dichromate	29.4×10^6	
		182	--	Degreaser sludge containing trichloroethylene, oils, dirt	6,340	CR
32	Welding	4	67CU	Water containing alodine	36,500	SANS; CWTX
		5	33G	Water containing alodine	5.5×10^5	SANS; IWS-SANS
			31H	Water containing caustics, acids	16.8×10^6	
33	Bonded Structures	4	25-33D	Rinse water containing chromium	2.45×10^6	SANS; CWTX
				Chromic acid	8,600	
35-0	Fiberglass and Composites	5	32 Mez	Water containing acids, copper, iron, and phosphorus	7.3×10^5	SANS; CWTX
		4&5	--	Flammable solvents	175	LF, FDT2; LF; LF, FDT6; CR
		8	--	Flammable solvents	350	

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Table 10
(continued)

Department/Shop No.	Name	Present Location Bldg.	Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940 1950 1960 1970 1980 1990)
36-0	Special Projects	5	53 0	Polypropylene glycol	1.83×10^6	SANS; IWS-SANS
39	Chemical Processing	181	V_3 PS	Cyanides	5,300	CR
		181	--	Penetrant rinse water; zyglo	3.65×10^6	SANS; IWS-SANS
				Caustic solution, containing copper and aluminum	400,000	SANS; CWTX
				Chromic acid	441,000	
				Acids	42,400	LF, FDT2; CR, FDT6
64	Structures and Design	21	--	Oils	350	LF; LF, FDT6; CR
				Water contaminated with residual JP-4	7.3×10^6	SANS; IWS-SANS
		134	--	Flammable solvents	90	LF, FDT6
		135	--	Flammable solvents	700	LF, FDT2; CR
		149	--	Flammable solvents	350	
68	Electronic Systems and Labs	20	--	Waste alodine	350	LF; CR
		2	--	Copper chloride	3,350	LF; CR
				Flammable solvents	880	LF, FDT2; LF; LF, FDT6; CR
				Degreaser sludge containing trichloroethylene, oils, dirt	700	LF; CR

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2. Oil includes waste coolant oils, lubricating oils, and hydraulic fluids

Table 10
(continued)

Department/Shop No.	Department/Shop Name	Present Location Bldg.	Present Location Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940–1990)
68	Electronic Systems and Labs	2A	--	Chemical solutions containing acids, caustics, metals, organic cleaners, formaldehyde, 2-butoxyethanol	3.65×10^6	SANS; CWTX
72	EMH Assembly and Test, F-16 and F-111 Repair	4,5	--	Flammable solvents	88	LF; LF, FDT2; LF, FDT6; CR
73	Electrical Bench	4,5	--	Flammable solvents	88	
74	Finishing	4	143C	Paint booth washwater containing pigments and thinners	52,000	SANS; IWS-SANS
			--	Flammable paints	12,800	LF; CR
			--	Flammable solvents	700	LF; LF, FDT2; LF, FDT6; CR
		5	69H	Paint booth washwater containing pigments and thinners	1.35×10^6	
			10-15T	Paint booth washwater containing pigments and thinners	4×10^5	SANS; CWTX
			17T	Water containing epoxy, stripper, naphtha	1.39×10^6	
			41N Mez	Water contaminated with solvents	52,000	SANS; IWS-SANS

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Table 10
(continued)

Department/Shop No.	Name	Present Location Bldg.	Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940–1990)
74	Finishing	8	--	Flammable paints	700	LF, CR
		92	--	Flammable paints	1,060	LF, CR
		176	10C	Paint booth washwater containing pigments and solvents	8.5×10^5	SANS, IWS-SANS
		182	--	Epoxy stripper	1,320	LF, FDT2, CR
76	Fuel and Oil Tank Sealing	4,5	--	Flammable solvents	350	LF, LF, FDT6, CR
84	Procurement Planning and Control	20	--	Flammable solvents	1,050	LF, FDT2, LF, FDT6, CR
95	F-111 Aircraft Modernization	4,5	--	Oils	2,650	LF, FDT2, LF, FDT6, CR, FDT6, CR
106	Field Operations and Electronics	165,166	--	Flammable solvents	175	LF, FDT6, CR
		191 A	--	Flammable solvents	90	CR
		193 A	--	Flammable solvents	90	
140	F-16 Fuselage Mate /Primary and Final Mate/Primary	4,5	--	Flammable solvents	350	LF, FDT2, LF, FDT6, CR
				Oils	90	
141-1	F-16 Center/Aft Fuselage/Wing Fin Sub-Assy Auto Rivet and Panel Rout	4,5	--	Flammable solvents	90	

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2. Oil includes waste coolant oils, lubricating oils, and hydraulic fluids

AD-A160 057 INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR AIR FORCE PLANT 4 TEXAS(U) CH2M HILL INC GAINESVILLE FL AUG 84 F08637-83-G-0007 2/5

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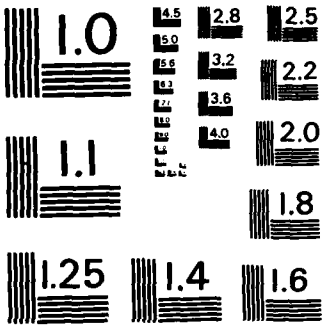

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table 10
(continued)

Department/Shop No.	Department/Shop Name	Present Location Bldg.	Present Location Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940–1990)
146	F-16 Aft Fuselage Vertical Fin Structures & I&A	4,5	--	Oils	175	LF, FDT2; LF; LF, FDT6; CR
170	F-16 Final Assembly	4,5	--	Oils	175	
178	Field Operations	62,64	--	Flammable solvents	350	
		99	--	Degreaser sludge containing trichloroethylene, oils, and dirt	175	LF; CR
			--	Flammable solvents	175	LF, FDT2; LF; LF, FDT6; CR
		152	--	Flammable solvents	175	LF, FDT6; CR
		156	--	Flammable solvents	175	
		162-167	--	Oil, JP-4 residual	36,500	LF, FDT6; FDT6; IWS-SANS
		190-196	--	Oil, JP-4 residual	36,500	FDT6; IWS-SANS
			--	Recoverable fuels	175	FDT6; CR
220-4	Numerical Control Machining	4	11A	Water containing oils	18,250	SANS; IWS-SANS
		5	20T	Water containing oils	18,250	
230-4	Prod Integration Lab	5	46H Mez	Water and sodium dichromate	18,250	
240	Pattern Shop	4,5	--	Flammable solvents	880	LF, FDT2; LF; LF, FDT6; CR; SANS; IWS-SANS
		5	77N Mez	Water containing epoxy stripper and naphtha	72,000	

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2. Oil includes waste coolant oils, lubricating oils, and hydraulic fluids

Table 10
(continued)

Department/Shop No.	Name	Present Location Bldg.	Column	Waste Material[1,2]	Current Estimated Quantity (gal/yr)	Waste Management Methods (1940 1950 1960 1970 1980 1990)
240	Pattern Shop		81N Mez	Water, solvents	12,000	SANS; IWS-SANS
			87L Mez	Water, solvents	12,000	
243	MSE Manufacturing	4,5	--	Oils	175	LF; LF, FDT2; LF, FDT6; CR, FDT6; CR
273	Process Control	4,5	88D	Flammable solvents	175	LF; LF, FDT2; LF, FDT6; CR
				Flammable solvents	260	
				Chlorinated hydrocarbons	90	LF; CR
				Waste mercury	90	
273	Process Control	183	--	Demineralizer regenerant (acids, caustics)	1.8×10^6	SANS; CWTX
		4	36C Mez	Water (containing sodium dichromate, H_2SO_4)	3.65×10^5	SANS; IWS-SANS
274-5	Inspection Functional Test Lab	188	--	Oils	350	CR, FDT6; CR
612-4	Electronic Fab Center	4,5	73E Mez	Flammable paints	1,940	LF; CR
				Degreaser sludge containing trichloroethylene, oils, dirt	1,230	
		8	--	Oils	175	LF; LF, FDT2; LF, FDT6; CR, FDT6; CR

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2. Oil includes waste coolant oils, lubricating oils, and hydraulic fluids

GNR226

Table 11
FUEL STORAGE TANKS

Facility No.	Location	Fuel Type	Tank Capacity (Gallons)	AG	BG
Aircraft Fuels:					
96	Radar Range	JP-4	100,000	X	
149	Engine Run Station West Test Area	JP-4	15,000		X
64	Mechanical Fuel Storage-- North of Building 8 (Hangar)	JP-4	25,000		X
64	Mechanical Fuel Storage-- North of Building 8 (Hangar)	JP-4	25,000		X
64	Mechanical Fuel Storage-- North of Building 8 (Hangar)	JP-4	25,000		X
64	Mechanical Fuel Storage-- North of Building 8 (Hangar)	JP-4	25,000		X
64	Mechanical Fuel Storage-- North of Building 8 (Hangar)	JP-4	25,000		X
	Flightline (adjacent to Mechanical Fuel Storage)	JP-5 Purge	30,000	X	
	Flightline (adjacent to Mechanical Fuel Storage)	JP-5 Purge	30,000	X	
28	JP-4 Unloading Area	JP-5	12,000		X
29	JP-4 Unloading Area	JP-5	10,000		X
Motor Fuels:					
26	Vehicle Gas Pumps	Gasoline	12,000		X
26	Vehicle Gas Pumps	Gasoline	10,000		X
Fuel Oil:					
204	West Parking Lot	#2 Fuel Oil	1,000,000	X	
3A	Boiler Room	#2 Fuel Oil	10,000		X
3A	Boiler Room	#2 Fuel Oil	10,000		X

AG: Above ground
BG: Below ground

stored in eleven tanks located in five different areas. Each tank is buried, with the exception of the radar range tank and two JP-5 purge tanks. Motor fuels include regular and unleaded gasoline and are stored in two buried tanks located at the northwest corner of Warehouse No. 2 (Building No. 13). No. 2 fuel oil is stored in three tanks at two different locations--the west parking lot area and the boiler room. The 1,000,000-gallon tank located at the west parking lot is above ground and is the main storage reservoir. The boiler room tanks, each with a capacity of 10,000 gallons, are below ground in the boiler house area. An inventory of major POL storage tanks (and solvent storage tanks) is included as Appendix F.

Both JP-4 and JP-5 fuels are received by truck at the JP-4 unloading area located between the parts plant (Building No. 5) and Warehouse No. 3 (Building No. 14). From this point JP-4 is pumped into the three 25,000-gallon buried tanks located at the Mechanical Fuel Storage area. Fuel in excess of the capacity of these tanks is pumped to the 100,000-gallon tank located on the radar range. JP-4 fuel is trucked from the unloading area tank to the 15,000-gallon tank located at the engine run station. The three buried JP-4 tanks at the mechanical fuel storage area supply fuel to two hydrant stations used for refueling aircraft.

JP-5 is used as a purge fluid rather than a jet fuel. JP-5 (with lubrication oil added) is used to test valves, lines, and tanks in new aircraft and to purge JP-4 fuel from flightline aircraft prior to inspection and repair. JP-5 used to test new aircraft is stored in the two buried 25,000-gallon tanks located at the mechanical fuel storage area. After use, the JP-5 purge fluid is returned to these tanks.

JP-5 purge used on the flightline is stored in the two above ground 30,000-gallon tanks located on the flightline, near the mechanical fuel storage area. After use, the JP-5 purge is returned to these two tanks. The tanks are heated to drive off the JP-4 residual in the purge fluid.

POL tanks are inspected and, if necessary, cleaned once every 5 years. The most recent cleaning involved the JP-5 storage tank located at the JP-4 unloading area (cleaned in 1983). Cleaning is performed by a private contractor. Residual fuel and sludge collected from the tanks is put into 55-gallon drums and removed by the tank cleaning contractor or is taken to the hazardous waste drum collection area south of Warehouse No. 3, where it is later removed by a private contractor. In the past, residual fuel and sludge removed from tanks was taken to the fire department training areas and burned during training exercises. No past sludge drying or weathering areas were identified at Air Force Plant 4.

Residual fuels drained from aircraft are collected in small flammable fuel carts located on the flightline. These are periodically emptied into a 5,000-gallon tank truck. When full, the contents of the tank truck are sold to a private contractor. The contents will generally consist of JP-4, hydraulic oils, and some JP-5 purge.

In addition to the active POL storage tanks discussed above, there are several known empty and/or abandoned tanks. These include a buried 10,000-gallon gasoline tank located at the JP-4 unloading area and two buried 8,000-gallon gasoline tanks located at the northeast corner of Warehouse No. 1 (Building No. 12). These tanks should be inspected to determine if empty or not. If found

to contain fluids, the contents should be sampled and analyzed, and based on the findings of the analyses, appropriate remedial actions (Phase IV) should be taken.

Fuel spills have occurred in the flightline areas and were normally washed down by fire department personnel. Runoff would have entered the nearest storm drain or seeped into the ground when the spill occurred near unpaved areas. Spills that may have entered storm drains would have discharged to Lake Worth or to Farmers Branch. A fuel spill that was identified during the records search involved the rupture of a B-36 wing near the former B-36 flightline Station No. 19 (north of Building No. 20 and east of Building No. 8), resulting in the release of an undetermined quantity of fuel. It is likely that runoff from this spill entered Farmers Branch through the storm sewers. Details on dates and quantities were not available; however, because the B-36 bombers were present at Air Force Plant 4 during the 1950s (see Table 8), it is probable that the spill occurred during that era. Since 1972, fuel spills have been reported and controlled in compliance with the Spill Prevention Control and Countermeasure Plan requirements of 40 CFR Parts 112.1 through 112.7 of the Federal Water Pollution Control Act.

Interviewees have reported that other fuel leaks have been caused by leaking fuel lines. Section IV.D., "Disposal Sites Identification and Evaluation," discusses suspected areas of fuel saturation due to line leaks.

4. FIRE DEPARTMENT TRAINING EXERCISES

Since the opening of the plant in 1942, fire department training exercises (open burning of fuels and other flammable liquids) at Air Force Plant 4 have taken

place at six locations (see Section IV.D., "Disposal Sites Identification and Evaluation"). No formal training exercises were held from 1942 to 1945. From 1945 to 1955 training exercises were conducted in an area located within Landfill No. 1 (Site No. 1--see Section IV.D), west of Warehouse No. 3. Between 1955 and 1956, these exercises were held west of Warehouse No. 4 at Fire Department Training Area No. 2 (FDTA No. 2, Site No. 5). During the mid-1960s fire department training was conducted at FDTA No. 3 (Site No. 6), located west of Meandering Road, and during the late 1960s at FDTA No. 4 (Site No. 7), on "Tater Hill" at the northern end of Air Force Plant 4. From the late 1960s until 1983 fire department training exercises were held at FDTA No. 6 (Site No. 9). In addition, a small area (10-feet by 20-feet), FDTA No. 5 (Site No. 8), located south of Warehouse No. 1, was used for fire extinguisher training during the mid-1960s. Since 1980, Air Force Plant 4 fire department training exercises have been conducted at Carswell AFB. Fire department training exercises are not currently conducted at Air Force Plant 4.

Waste oils, fuels, and solvents have been used in fire department training exercises. The wastes were generally poured onto the ground prior to a practice burn. No means of subsurface containment were employed. Earthen berms and grading were employed to prevent runoff. Most of the liquid wastes burned at the fire department training areas would probably have been consumed in the fires; however, small quantities are suspected to have infiltrated into the ground.

From 1970 to 1983, fire department training exercises were conducted once per month consuming roughly 250 gallons/month of waste oils and fuels. Prior to 1970 exercises were conducted approximately twice per year.

Accordingly, approximately 55,000 gallons of waste oils, fuels, and solvents have gone to fire department training areas since the opening of the plant.

5. POLYCHLORINATED BIPHENYLS (PCBs)

Typical sources of PCBs at Air Force Plant 4 include transformers, fused cutouts, circuit breakers, and capacitors. All installation transformers were inventoried and sampled in 1983. A total of 25 active transformers were found to contain PCBs. Of these, three contained PCBs in excess of 50 ppm. Personnel report that all transformers known to contain PCBs are fenced, have secondary containment, and are inspected quarterly. Five PCB-containing circuit breakers have been identified, one of which contains PCBs in excess of 50 ppm. Oil fused cutouts were inventoried and sampled during the spring of 1984; however, analytical results have not been received.

PCB-containing capacitors are known to exist at the main electrical substation. These, however, belong to the local electrical utility. Plans call for removing these capacitors within the next 1 to 2 years during a substation rehabilitation project.

A designated area exists in Warehouse No. 2 (Building No. 13) for the temporary storage of PCB-contaminated material (oils, liquids, rags, etc.). There are no PCB materials presently located in this area.

A PCB spill occurred in March 1984. According to an internal report, the failure of a transformer located in the electrical substation adjacent to Warehouse No. 3 (Building No. 14) resulted in the release of "a relatively small but undetermined quantity of oil contaminated with

approximately 10.9 parts per million (ppm) of polychlorinated biphenyls (PCBs)." The oil was deposited on the concrete pad and also onto soil to the west of the transformer. The oil spilled on the concrete was cleaned up and the soil excavated so that the remaining soil contained less than 1 ppm PCBs. Excavated soils were put into 55-gallon drums and were placed in the hazardous waste drum accumulation area (south of Warehouse No. 3) pending final disposition. The failed transformer has been removed and is currently located on the west side of the assembly plant (Building No. 4) near column No. 140, awaiting final disposition. No other reports of PCB spills or related problems were determined during the records search.

6. PESTICIDES

Small quantities of pesticides are in use at Air Force Plant 4 for the control of pests and have been stored in Building 17 since the early 1950s. It is not known where pesticides were stored prior to that time. The major insecticides and herbicides in use are shown below:

Insecticide	Pests	Usage (gal/yr)
Chlordane	Termites	1
Diazinon	Roaches, crickets	4-5
Malathion	Mosquitoes	8-10
Pyrethrum	Flies (flying insects)	55
Herbicide		
Hyvar	Weeds	60

Used pesticide containers are delivered to the hazardous waste drum storage area and subsequently removed by a private contractor. Rinsewaters generated during the

cleaning of pesticide application equipment are reused to mix additional pesticides. Pesticide residues are not discharged to any of the sewer systems serving the facility. The records search found no indication of disposal of unused pesticides in the past landfills or other burial sites. However, it is possible that empty pesticide containers were disposed of in this manner.

7. WASTEWATER TREATMENT

Wastewaters at Air Force Plant 4 are discharged into four different collection systems: 1) storm sewers, 2) sanitary sewers, 3) industrial sewers, and 4) chemical waste sewers.

Storm water runoff and once-through cooling water are discharged to the storm sewer system. This water enters Farmers Branch (Outfall 001) and Lake Worth (Outfalls 002, 003, 004, 005) untreated (see Figure 6, Section III). The discharges are authorized by NPDES and State of Texas permits. The average estimated flow through this system for the period April 1983 through March 1984 was 15.70 mgd--44 percent of the permitted flow of 36 mgd. The discharges are generally within defined parameters and there have been no continuing problems.

General domestic sewage, including wastewater from toilets, wash stations, showers, and dishwashers, along with a small amount (less than 0.1 mgd) of once-through cooling water and condensate, are discharged to the sanitary sewer system. The total wastewater flow to the sanitary sewer system is estimated to be 745,000 gpd. This flow is collected in a plant-wide gravity sewer system and is discharged untreated to the City of Fort Worth sanitary sewer system.

Industrial wastewaters considered to have low levels of contamination not requiring treatment are discharged to the industrial waste system. The four largest sources of wastewater in this system are: 1) once-through cooling water from air compressors; 2) water containing $Na_2Cr_2O_7$ from heat treating operations performed in Building 5; 3) water containing caustics and acid from spot welding cleaning; and 4) water containing jet fuel residual from engine test cells. The total flow through this system is estimated to be 345,000 gpd. This wastewater is also discharged untreated to the city sewer system.

Process wastewater considered to be toxic, corrosive, or otherwise polluted and requiring treatment prior to disposal is discharged to the chemical waste sewer system. This wastewater contains chromic acid, process caustics, process acids, photo chemicals, ammonia, plating chemicals, and smaller amounts of other chemicals. The total flow through this system is estimated to be 350,000 gpd.

Dilute acid and alkaline wastewaters are pumped to two 7,500-gallon tanks (T-39 and T-41) for neutralization. This neutralized waste is then pumped to two 10,000-gallon storage tanks (T-870 and T-871). If this wastewater contains less than 5.0 ppm chromium, it is pumped directly to the city sewer system. If, however, it contains more than 5.0 ppm chromium, it is pumped, along with other more concentrated chrome wastes, to a tank (T-872) for reduction from Cr^{+6} to Cr^{+3} by addition of sulfuric acid and sodium bisulfate. This reduced solution is pumped to a precipitation tank (T-880) where a polymeric coagulant is added to precipitate solids. Treated effluent from the precipitator is drained through two 85,000-gallon settling tanks to the city of Fort Worth sewer system. The bottoms

slurry from the precipitator is pumped to a secondary precipitator (T-886) where more coagulant is added before dewatering by filter press. The press filtrate is pumped through the two 85,000-gallon settling tanks to the city sewer system. The sludge from the filter press operation is placed in a collection hopper located south of Building 181 for subsequent removal by a private contractor.

General domestic sewage, industrial wastewater, and treated effluent from the chemical waste treatment system combine and discharge to the City of Fort Worth sanitary sewer system. Up until approximately 1982, the combined discharge had several City of Fort Worth ordinance violations, consisting primarily of concentrations of metals (particularly chromium) exceeding the ordinance limitations. Table 12 shows the City of Fort Worth ordinance limits applicable to Air Force Plant 4. The violations were apparently due to discharges into drain lines that had not yet been identified for connection to the chemical waste treatment system. These drain lines have since been identified and connected to the chemical waste treatment system. Based on a review of City of Fort Worth analyses of the Air Force Plant 4 discharge, there were no violations of the city ordinance in 1983 through April 1984, the latest analysis reviewed for this report.

8. WATER RESOURCES

Potable water for Air Force Plant 4 is supplied primarily by the City of Fort Worth. A small amount of additional water is supplied to the tool retention areas west of the radar range, by the City of White Settlement. The City of Fort Worth draws some of its water from Lake Worth, while White Settlement obtains water from local wells

Table 12
CITY OF FORT WORTH
INDUSTRIAL WASTEWATER DISCHARGE LIMITATIONS

Parameters	Under New Ordinance 8895[a]		Under Old Ordinance 8158
Temperature, °F	<150		<150
Solidifying substances	No waxes, greases		No waxes, greases
Flammable substances	None allowed		None allowed
Sewer obstructions	None allowed		None allowed
Gases	No noxious or malodorous gases allowed		No noxious or malodorous gases allowed
Inhibitors	None allowed		--
Colors	Dyes, etc. not allowed		--
Slugs (discharge)	None allowed		--
Oil and grease, mg/L	<100		<100
pH	5.0-11.0		5.5-10.0
Cyanides, mg/L	2.0		2.0
Toxic pollutants	In accordance with EPA limits (40 CFR 403)		--
Dilution	Not allowed		--
Metals, mg/L:	Under New Ordinance		Under Old Ordinance
	Maximum Daily Avg.	Maximum Grab	Daily Average
As	0.1	0.3	0.05
Ba	2.0	6.0	5.0
B	1.0	3.0	1.0
Cd	0.3	0.9	0.02
Cr	5.0	15.0	5.0
Cu	3.0	9.0	1.0
Pb	3.0	9.0	0.1
Mn	5.0	15.0	1.0
Hg	0.01	0.03	0.005
Ni	2.0	6.0	1.0
Se	0.05	0.15	0.02
Ag	0.5	1.5	0.1
Zn	5.0	15.0	5.0

[a]Ordinance 8895 became effective 23 September 1983.

or from the City of Fort Worth. Air Force Plant 4 consumes an average of about 3 mgd of City water for potable and industrial uses. An additional 8.4 mgd of Lake Worth water is pumped directly by Air Force Plant 4 for once-through cooling of condensers. The water storage system at Air Force Plant 4 consists of two 200,000-gallon ground storage tanks, a 2-million-gallon ground storage tank, and two 100,000-gallon water towers.

Lake Worth is a water storage reservoir in the West Fork Trinity River system and is contiguous with the north and northwest boundary of Air Force Plant 4. Lake Worth has a usable conservation storage capacity of 38,130 acre-feet and a surface area of approximately 2,500 acres.

There are no known operating water wells located on Air Force Plant 4 property; however, at least one abandoned well is known to be present. One well was drilled to supply water to Air Force Plant 4 during the 1940s and is located near the south boundary of the facility. This well has an internal casing diameter of 6 inches, and a total depth of 810 feet. This well was put out of service and capped in 1967, when the General Warehouse Building, Facility No. 188, was constructed over it. Other abandoned wells are suspected to be present within the boundaries of Air Force Plant 4. One well is suspected to exist under the Parts Plant (Facility No. 5), which, according to one interviewee, was the former location of a dairy barn. Also, several domestic water supply wells are suspected to have existed along the northern margin of Air Force Plant 4 property. This suspicion is based on early aerial photographs which show residences located along the shoreline of Lake Worth.

Air Force Plant 4 discharges waste waters under Federal National Pollutant Discharge Elimination System (NPDES) Permit No. TX 0000353, and Texas State Permit No. 01764. Until May 1984, Air Force Plant 4 had five permitted outfalls, 001 through 005, shown in Figure 6. In the revised permits effective May 2, 1984, Air Force Plant 4 has four NPDES-permitted outfalls (001, 002, 004, 005). Outfall 003 was dropped from the NPDES permitting program becuase it was no longer being used for waste water and was receiving only storm water ruknoff. The state of Texas, however, still recognizes Outfall 003 and inspects it regularly along with the other four.

Outfall 001, at the southeast corner of Air Force Plant 4, discharges into a tributary to Farmers Branch which flows east across Carswell AFB, and then to the West Fork of the Trinity River. Base flow at this outfall point is reported to consist of once-through cooling water. Major flow at this station is caused by stormwater discharge from much of the east side of the facility and some floor drains. Table 13 summarizes one year of monitoring data from Outfall 001. No violations of permit conditions have been observed during this period; however, low levels of volatile organic compounds (VOCs) have been found in the tributary downstream from the outfall discharge. Carswell AFB has a surface-water sampling program that includes this tributary to Farmers Branch. The stream is sampled quarterly and analyzed for volatile organic compounds. In the Carswell AFB IRP Records Search report prepared by CH2M HILL in February 1984, it was reported that VOCs were found in this stream during the summer of 1983. A more recent sampling event, in March 1984, also detected VOCs. Concentrations of VOCs found during the summer of 1983, and in March 1984, are shown in Table 14.

Table 13

SUMMARY OF NPDES SAMPLING DATA FROM OUTFALL 001, AIR FORCE PLANT 4, TEXAS

Date	Discharge (Days)	Water Temperature (°F)		ph (Units)		Oil/Grease (mg/L)	TOC (mg/L)	Flow (mgd)	
		Average	Maximum	Maximum	Minimum	Maximum	Minimum	Average	Maximum
April '83	21	72	78	7.97	7.71	3.8	14	0.876	1.086
May	21	80	83	8.0	7.7	5.8	14	1.012	1.407
June	22	84	88	8.2	7.9	3.0	4.8	1.074	2.006
July	20	86	93	8.20	7.28	3.0	26.7	0.829	2.276
August	23	82	91	8.30	7.20	2.2	14	0.985	1.338
September	21	84	89	8.08	7.52	4.6	11	0.804	1.486
October	21	75	83	8.10	7.15	3.4	9	0.917	1.780
November	20	72	83	8.20	7.00	6.2	21	1.214	1.578
December	15	63	69	8.0	7.8	1.8	25	0.748	1.088
January '84	22	54	62	8.20	7.90	6.0	10	0.716	2.245
Feb	21	61	66	8.30	8.00	2.8	14	0.737	1.460
Mar	22	65	70	8.44	7.25	1.3	14	0.762	1.685
Permit Limit	31	95	100	9.00	6.00	10.00	35.00	2.000	10.000

Source: Monthly Effluent Reports, Texas Department of Water Resources

GNR226

Table 14
VOLATILE ORGANIC COMPOUNDS DETECTED IN
TRIBUTARY TO FARMER'S BRANCH

Parameter	Concentration µg/L		Detection Limits µg/L
	Summer, 1983	March, 1984	
Bromodichloromethane	0.9	1.6	0.1
Bromoform	--	2.8	0.2
Chloroform	Trace	1.3	0.1
Dibromochloromethane	--	4.4	0.1
1,2-Dichloroethylene	0.4	--	0.1
Trichloroethylene	2.7; 51.3	2.7	0.1

Source: Carswell Air Force Base, Texas

Methodology: EPA Method 601

Laboratory: USAF OEHL, Brooks Air Force Base, Texas

A potential source of contamination in this tributary is the Outfall No. 1 discharge; however, other potential sources include surface drainage from areas south of Air Force Plant 4. The tributary receives the flow from at least two separate ditches. One ditch runs east-west and parallel with the south side of Clifford Road, the road bordering the south Air Force Plant 4 property line. A second ditch runs north-south and parallel with the west side of Grant Lane, the main entrance road leading to Air Force Plant 4.

To determine if Outfall No. 1 is the source of contamination to the tributary, it is recommended (see Section VI.) that samples be collected from the outfall during a dry period when only base flows exist and again during a wet period when Outfall No. 1 flows include Air Force Plant 4 storm water. The samples should be analyzed for volatile organic compounds.

Outfall 002 releases once-through cooling water and stormwater drainage into Lake Worth at the northeast corner of Air Force Plant 4. Table 15 summarizes NPDES monitoring data for the past year for this outfall location, and no violations of the permit requirements have been observed during this period. Cooling water flows average about 14 million gallons per day (mgd) at this point.

Outfall 003 periodically releases once-through cooling water and stormwater from the northwest portion of Air Force Plant 4 to Lake Worth. Table 16 indicates that during the past year of monitoring, discharges at this outfall have occurred on only 20 days. No violations in the permitted levels of oils and grease or of total organic carbon were noted at this location. As mentioned above, this site is no longer designated as an NPDES sampling location.

Table 15
SUMMARY OF NPDES SAMPLING DATA FROM OUTFALL 002
AIR FORCE PLANT 4, TEXAS

Date	Discharge (Days)	ph (Units)		Flow (mgd)	
		Maximum	Minimum	Average	Maximum
April '83	21	8.54	7.39	5.03	11.37
May	21	8.30	7.31	13.53	25.92
June	22	8.31	7.29	20.86	32.40
July	20	8.07	7.11	26.13	32.40
August	23	8.38	7.20	27.32	38.88
September	21	8.50	7.77	21.84	35.00
October	21	8.25	7.55	12.62	23.73
November	20	8.30	7.30	9.78	12.96
December	15	8.04	7.22	6.76	7.91
January '84	22	8.54	7.54	7.00	21.00
February	21	8.43	7.64	7.30	13.08
March	22	8.44	7.25	5.610	12.960
Permit Limit	31	9.00	6.00	30.00	45.00

Source: Monthly Effluent Reports, Texas Department of Water Resources

Table 16
SUMMARY OF NPDES SAMPLING DATA FROM OUTFALL 003
AIR FORCE PLANT 4, TEXAS

Date	Discharge Days	ph (Units) Maximum	ph (Units) Minimum	Oil/Grease (mg/L) Maximum	TOC (mg/L) Maximum
April '83	1	8.49	8.49	1.0	17
May	4	7.61	7.38	9.6	10
June	3	7.68	6.70	2.4	4.5
July	1	7.90	7.90	3.6	4.3
August	1	7.57	7.57	2.4	20
September	0	.....No Flow.....			
October	2	7.63	7.22	1.6	11
November	1	7.70	7.70	1.0	--[a]
December	1	7.8	7.8	0.2	10
January '84	2	7.60	7.41	1.2	6
February	3	7.85	7.70	1.2	10.4
March	1	7.65	7.65	1.6	9
Permit Limit	31	9.00	6.00	15.0	35.0

[a]Sample lost

Source: Monthly Effluent Reports, Texas Department of Water Resources

Outfall 004 is a stormwater and once-through cooling water discharge on the west side of Air Force Plant 4. Cooling water is released from an air compressor in Shed "B", Facility No. 93. Measured flows at this station (see Table 17) during the past year averaged about 0.6 mgd. No permit violations were recorded at Outfall 004 during the past year.

Outfall 005 is located on the west side of Air Force Plant 4 and receives stormwater drainage from the north side of Warehouse 4 (Facility No. 15) and once-through cooling water from condensers in the Aircraft Paint Facility (Facility No. 176). This outfall drains into an arm of Lake Worth. Table 18 summarizes NPDES sampling data from this location for the past year. During this period, flows averaged 0.6 mgd and no permit violations were noted.

B. PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIVITIES

1. INTRODUCTION

Detection of contaminants in a stormwater discharge pipe in 1982 resulted in the discovery of contaminated soils and groundwater at Air Force Plant 4. Test holes and monitoring wells have been installed to confirm and quantify the extent of contamination that exists. In several cases, remedial activities consisting of soil and/or ground water removal have taken place. Studies are currently being conducted to better define the extent of contamination at Air Force Plant 4. Findings of past studies and remedial activities along with a discussion of on-going investigations, including the current program strategy, are presented below.

Table 17
SUMMARY OF NPDES SAMPLING DATA FROM OUTFALL 004
AIR FORCE PLANT 4, TEXAS

Date	Discharge (Days)	ph (Units)		Flow (mgd)	
		Maximum	Minimum	Average	Maximum
April '83	21	8.42	6.90	0.604	0.663
May	21	8.10	7.60	0.666	0.819
June	22	8.1	7.9	0.609	0.874
July	20	8.07	6.80	0.770	1.593
August	23	8.15	7.70	0.701	0.826
September	21	8.18	7.81	0.534	0.755
October	21	8.24	7.26	0.330	0.763
November	19	8.02	7.82	0.281	0.869
December	15	8.13	7.59	NS[a]	NS
January '84	22	8.45	7.33	NS	NS
February	21	8.57	7.90	NS	NS
March	22	8.29	7.55	NS	NS
Permit Limit	31	9.00	6.00	2.000	4.000

[a]NS = not sampled

Source: Monthly Effluent Reports, Texas Department of Water Resources

Table 18
SUMMARY OF NPDES SAMPLING DATA FROM OUTFALL 005
AIR FORCE PLANT 4, TEXAS

Date	Discharge (Days)	ph (Units) Maximum	ph (Units) Minimum	Flow (mgd) Average	Flow (mgd) Maximum
April '83	3	8.36	7.90	1.584	1.634
May	11	8.36	7.54	0.334	0.812
June	18	8.27	7.19	0.615	1.064
July	17	8.09	7.10	0.843	2.985
August	21	8.34	7.36	1.141	2.985
September	17	8.36	7.80	0.628	1.064
October	7	8.36	7.78	0.485	0.582
November	3	8.37	7.76	0.767	1.341
December	0	.....No Flow.....			
January '84	0	.....No Flow.....			
February	0	.....No Flow.....			
March	1	7.81	7.81	0.812	0.812
Permit Limit	31	9.00	6.00	2.000	4.000

Source: Monthly Effluent Reports, Texas Department of Water Resources

2. FINDINGS

a. Groundwater Contamination Detected

In September 1982, the Fort Worth Water Department was anonymously notified of odors coming from a stormwater outfall adjacent to the west property line of Air Force Plant 4. Analyses of samples subsequently collected from the outfall identified several contaminants, the most prevalent of which was trichloroethylene (TCE). The immediate source of the contamination was concluded by General Dynamics personnel to be infiltration from beneath the employee west parking lot. Ground water was apparently seeping into the joints of a buried 36-inch stormwater pipe that connects two stormwater inlets and ultimately discharges into Meandering Road Creek. This buried pipe runs parallel with the western boundary of the parking lot, between the lot and Meandering Road. To prevent further infiltration General Dynmics installed a french drain system (November 1982) parallel and hydraulically upgradient (east) of the buried pipe. Ground water was pumped from the french drain system to maintain a lowered water level beneath the parking lot and to minimize the chances of contaminated ground water reaching the buried stormwater pipe.

b. Hargis & Montgomery Phase I Investigation

In late 1982, General Dynamics, under the Air Force Facilities Contract, retained the hydrogeological consulting firm Hargis & Montgomery, Inc. (H&M), of Tucson, Arizona, to investigate sources of potential ground-water contamination at Air Force Plant 4. In an initial investigation, eight hazardous waste disposal or spill sites were identified as potential sources of ground- and/or surface-water contamination. Table 19 presents a listing of the sites along with the corresponding designation given to these same or approximate sites in this report (CH2M HILL).

Table 19
DISPOSAL OR SPILL SITES IDENTIFIED DURING H&M PHASE I INVESTIGATION AND CORRESPONDING CH2M HILL-IDENTIFIED SITES

Hargis & Montgomery		CH2M HILL
1.	Chemical waste pit in die yard	Die pits; Site No. 13
2.	Solid waste landfill	Landfill No. 4; Site No. 4
3.	Site of abandoned fuel storage tank	Former fuel storage site; Site No. 17
4.	Waste pit located west of process building	Chrome Pit No. 3; Site No. 12
5.	Burn pit	Landfill No. 2; Site No. 2
6&7.	Waste oil pits (2)	Landfill No. 1; Site No. 1
8.	Fire training pit	FDTA No. 6; Site No. 9

The H&M burn pit (No. 5) is located within the boundary of Landfill No. 2 as designated by CH2M HILL. The H&M waste oil pits (No. 6 and 7), the suspected sources of contamination beneath the west parking lot, are located within the boundary of Landfill No. 1 as designated by CH2M HILL. For a description of the CH2M HILL identified sites including those listed in Table 19, see Section IV.D., "Disposal Sites Identification and Evaluation."

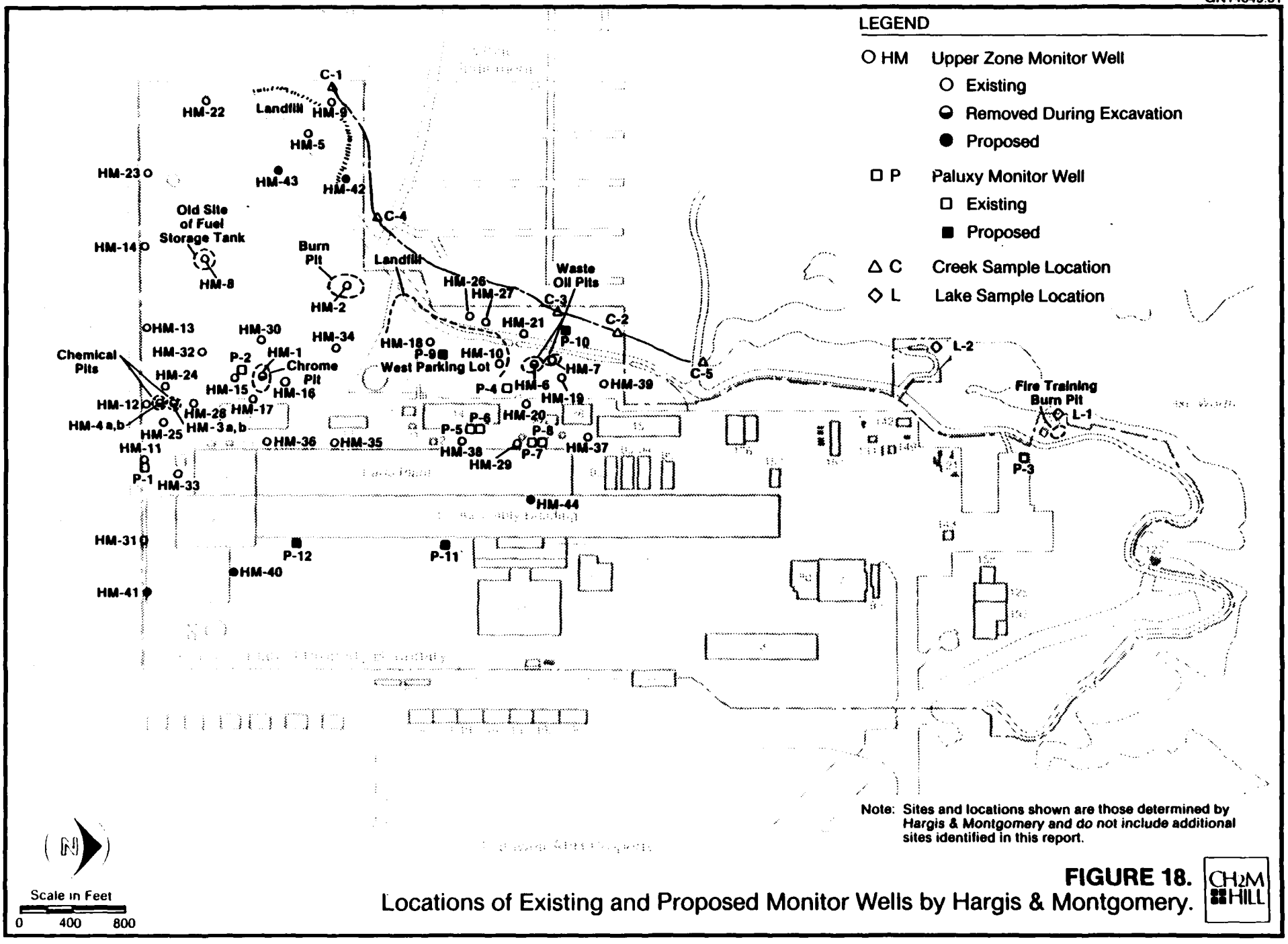
As part of a Phase I investigation recommended by H&M, 25 test holes and 12 monitor wells were completed into the top of the Walnut formation at the identified sites. Figure 18 shows the locations of the monitor wells. Soil and ground water samples were collected and analyzed by Allied Analytical and Research Laboratories for trace metals, cyanide, oil and grease, jet fuel, and organic priority pollutants. All the field work associated with the Phase I investigation was completed in 1982. Results of soil and ground-water analyses are presented in Appendix G.

Metal analyses included antimony, arsenic, beryllium, cadmium, total and hexavalent chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, thallium, zinc, strontium. Using the EPA National Drinking Water Standards (NPDWS) shown in Table 20 as a standard, elevated levels of arsenic, chromium, and mercury were detected in some of the upper zone monitoring wells. Arsenic concentrations ranging from 0.11 to 0.28 mg/L were measured in monitor wells HM-1, 2, 5, 6, and 8. The highest concentration, 0.28 mg/L, was detected in wells HM-1 and HM-6. Chromium (total) was detected in well HM-1 at a concentration of 44.9 mg/L. HM-1 is located in the center of the site identified as a former chrome pit (see Figure 18). Mercury concentrations exceeding the NPDWS were

Table 20
EPA NATIONAL PRIMARY DRINKING WATER STANDARDS (NPDWS)
METALS ONLY

Parameter	Maximum Level (mg/L)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium (total)	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05

GN14649.61



Note: Sites and locations shown are those determined by Hargis & Montgomery and do not include additional sites identified in this report.

FIGURE 18.
Locations of Existing and Proposed Monitor Wells by Hargis & Montgomery.

CH2M HILL

measured in monitor wells HM-1, 2, 6, 8, 9, and 10. Concentrations ranged from a low of 0.05 mg/L in HM-2 and 10 to a high of 0.12 mg/L in HM-1.

Monitor well HM-1 was also found to contain 4.61 mg/L of cyanide. The other wells contained less than 0.02 mg/L cyanide.

One or more organic contaminants were detected in all ground water samples from the upper zone. The greatest number of organic compounds and, in general, the highest concentrations were detected in ground water obtained from monitor well HM-6 located at the abandoned waste oil pits where concentrations of trichloroethylene were as high as 500,000 µg/L. Organic contaminants were also detected in ground water samples obtained from monitor well HM-1 and test hole TH-3, the latter located in the vicinity of the chemical pits at the die yard. The volatile organic compounds most commonly detected in ground water in the upper zone at the plant include trichloroethylene (0 to 500,000 µg/L), toluene (0 to 200,000 µg/L), methylene chloride (0 to 345 µg/L), 1,1-dichloroethylene (0 to 40,000 µg/L), ethylbenzene (0 to 15,000 µg/L), and tetrachloroethylene (0 to 80,000 µg/L). Of these organic compounds, the maximum concentrations cited were found in HM-6, the monitor well located at the abandoned waste oil pits.

Results of laboratory analyses indicated that ground water in the upper zone at the abandoned waste oil pits (HM-6, HM-7) and the old site of the fuel storage tank (HM-8) was contaminated with oil and grease and jet fuel. A concentration of 550,000 mg/L oil and grease was measured in ground water sampled from HM-6. In addition, traces of jet fuel were detected in ground water obtained from HM-6 and

HM-7. Traces of jet fuel were also detected in ground water obtained from HM-8 at the former site of the fuel storage tank. Ground water from HM-8 also contained 3.6 mg/L of oil and grease.

Based on the analytical results referenced above, H&M concluded in their February 1983 Phase I report ("Phase I, Investigation of Subsurface Conditions at U.S. Air Force Plant No. 4, Fort Worth, Texas") that "...groundwater in the upper zone beneath the plant is contaminated with a variety of metals, cyanide, oil/grease, organic priority pollutants, jet fuel, and other organic compounds..." and that residual concentrations of these contaminants in soil extracts indicate that the "waste oil pits" (located within Landfill No. 1, this report), "chrome waste pit" (Chrome Pit No. 3, this report), and "the chemical pits in the Die Yard," (Die Pits, this report), are "major sources of groundwater contamination in the upper zone." H&M also concluded that 1) the potential exists for contamination of ground-water supplies at nearby municipal and domestic wells, 2) contaminated ground water may have migrated south of the plant property line, and 3) that, based on a comparison of water levels there might be a potential for ground-water movement from the upper zone to the creek west of the plant (Meandering Road Creek).

c. Hargis & Montgomery Phase II Investigation

In order to define the areal extent of contaminated groundwater in the upper zone, and to determine if contaminants have percolated to the underlying Paluxy Aquifer, the investigations were expanded in 1983. From March through June, 1983, 21 additional upper zone monitoring wells (HM-11 through HM-31) and 4 Paluxy Aquifer monitoring wells (P-1 through P-4) were installed (see

Figure 18 for locations), bringing the total number of onsite monitoring wells to 35. These wells were analyzed several times during March through June for volatile organic compounds, base/neutral compounds, organic acid compounds, pesticides/PCBs, metals, cyanide, oil and grease, and jet fuel.

To determine if contaminated ground water may have migrated beyond Air Force Plant 4 property, the United States Environmental Protection Agency (EPA), at the request and expense of the U.S. Air Force, installed and sampled 4 monitoring wells south of the plant. In addition, three City of White Settlement wells (No. 1, 2, 12) and four residential water wells (Spudick, Stines, Walker, Johnson), were sampled. Samples were collected at three sites on Meandering Road Creek (C-1, 2, 3). Results of these analyses are presented in Appendix G and briefly discussed below.

1) Trace Metals and Cyanide. In the upper zone monitor wells, concentrations of arsenic (As), Cadmium (Cd), chromium (Cr), Mercury (Hg), Lead (Pb), and Selenium (Se) were detected at levels exceeding the National Primary Drinking Water Standards (NPDWS). A summary of the wells and ranges of concentrations that exceeded the NPDWS is shown in Table 21. Cyanide was detected in HM-1 (2.8 to 4.45 mg/L) and HM-3b (0.28 to 1.8 mg/L).

In the analyses of the Paluxy wells P-1 through P-4, no metals were detected at levels exceeding the NPDWS. Cyanide was not detected.

2) Volatile Organic Compounds. Results for volatile organic compounds obtained from Wells HM-1, HM-16, and HM-17 in the vicinity of the chrome pit confirmed the

Table 21
SUMMARY OF UPPER ZONE GROUNDWATER METAL CONCENTRATIONS
THAT EXCEEDED NPDWS[1]
MARCH 1983 THROUGH JUNE 1983 SAMPLING

Parameter	NPDWS mg/L	Monitor Wells HM-1	3b	4a	4b	6	7	12	13	20	29	21
Arsenic	0.05	0.31-.43	0.13	--	.14	.13-.28	.08	--	--	--	--	--
Cadmium	0.01	0.015	.011	--	.026	.011	--	--	--	--	--	--
Chromium	0.05	37-46	--	.25	.15	--	--	--	.25	.064-.15	.31-.42	--
Mercury	0.002	.003	.008	--	--	--	--	--	--	--	--	--
Lead	0.05	--	--	--	.06-.12	.07-.12	--	.07	--	--	--	.059
Selenium	0.01	.03-.08	.035	--	.15	--	--	--	--	--	--	--

[1]National Primary Drinking Water Standards

Source: Hargis & Montgomery

presence of trichloroethylene in concentrations ranging from 904 to 124,000 µg/L. In the vicinity of the die pits, analyses of samples obtained from Wells HM-3a, 3b, 4a, and 4b confirmed the presence of benzene (35 to 1,603 µg/L), chloroform (210 to 3,405 µg/L), dichloroethylene (0 to 5,476 µg/L), ethylbenzene (4 to 7,400 µg/L), methylene chloride (10 to 170,000 µg/L), toluene (30 to 80,000 µg/L), and trichloroethylene (68 to 130,000 µg/L).

VOC analyses of samples obtained from Wells HM-6, HM-7, and HM-20 in the vicinity of the waste oil pits confirmed the presence of trichlorofluoromethane (0 to 17,000 µg/L), toluene (0 to 30,000 µg/L), ethylbenzene (0 to 1,200 µg/L). Other volatile organic compounds detected in the vicinity of the waste oil pits include carbon tetrachloride (0 to 5,100 µg/L), chloroform (0 to 1,000 µg/L), dichloroethylene (0 to 1,500 µg/L), methylene chloride (7 to 100,000 µg/L), tetrachloroethylene (0 to 77,000 µg/L), 1,1,1-trichloroethane (0 to 2,900 µg/L), trichloroethylene (389 to 77,000 µg/L), and vinyl chloride (0 to 6,600 µg/L).

VOC analyses of samples obtained from monitor well HM-5 (solid waste landfill) indicated concentrations of methylene chloride at 2,300 µg/L, and toluene and trichloroethlyene at 290 µg/L and 300 µg/L, respectively.

Analyses of samples collected in May 1983 from Wells HM-2 and HM-8 did not detect volatile organic compounds. However, earlier analyses from these wells had detected chloroform (1,000 µg/L), ethylbenzene (61 µg/L), methylene chloride (2,000 µg/L), toluene (21 µg/L), and trichloroethylene (1,442 µg/L) in HM-2; and benzene (8 µg/L), chloroform (198 µg/L), ethylbenzene

(5 μg/L), methylene chloride (142 μg/L), toluene (52 μg/L), and trichloroethylene (160 μg/L) in HM-8.

VOC analyses of samples obtained from HM-25 indicated the presence of methylene chloride (250 to 1,200 μg/L), 1,2-trans-dichloroethylene (93 to 260 μg/L), benzene (250 to 320 μg/L), chlorobenzene (660 μg/L), and toluene (23 to 110 μg/L). Trichloroethylene (40 to 8,700 μg/L), and 1,2- trans- dichloroethylene (870 to 3,100 μg/L) were detected in both HM-27 and HM-31. Trichloroethylene (2,200 μg/L) was detected in HM-29.

Some VOCs were detected in Paluxy wells. In P-4, 1,2-trans-dichloroethylene (49 to 470 μg/L), vinyl chloride (14 μg/L), and methylene chloride (3.2 μg/L) were detected. No VOCs were detected in P-2 or P-3. Although earlier analysis of P-1 detected the presence of benzene (2 μg/L), followup confirmation samples were negative.

It is important to note the findings of trichloroethylene (8,700 μg/L) and 1,2-trans-dichloroethylene (3,100 μg/L) in monitor well HM-31, especially since no past disposal or spill sites have been identified in the vicinity. Monitor well HM-11, the nearest well to HM-31 and located between HM-31 and the nearest identified disposal sites, has also contained these same VOCs; however, at much lower concentrations. Since no disposal sites have been identified near HM-31, it is difficult to say whether the suspect d source of contamination is due to on-site or off-site sources. However, possible on-site sources should be investigated. Potential sources that should be investigated include the wastewater collection pits (identified in this report by CH2M HILL as Site No. 20--see Section IV.D.), and three buried pipelines (sanitary, storm water, and industrial) that run along the south property line and past HM-31. The sanitary line includes sanitary

wastewater and discharge of wastewater from the wastewater collection pits. The storm-water line receives cooling water discharges, storm flows, and some floor drains. The industrial line receives water with low concentrations of contaminants and also combines with the sanitary discharge line prior to pumping to the City of Fort Worth for treatment.

Monitoring of ground water in the vicinity of the waste collection pits has been recommended in Section VI. of this report. A recommendation has also been made to analyze samples from each of the three buried pipelines for VOCs. If VOCs are determined to be present in any of these pipelines, and at concentrations that could possibly explain the levels detected in HM-31, the respective pipeline(s) should be investigated for possible leaks and the appropriate corrective actions taken.

3) Pesticides/PCBs. Analyses for pesticides and PCBs have all been negative for both upper zone wells and the Paluxy wells.

4) Offsite Ground-Water Monitoring. In the offsite EPA upper zone monitoring wells (EPA-1-4), cadmium was detected in EPA-1 and EPA-3 at concentrations of 0.012 and 0.014 mg/L, respectively. These values exceed the NPDWS concentrations of 0.01 mg/L (see Table 20). It was noted by H&M in their July 12, 1983, Interim Progress Report, that a potential source of contamination to the EPA-1 well is offsite buried gasoline tanks, approximately 150 feet southeast of the well.

Analyses of samples from the City of White Settlement wells have detected chloroform at concentrations less than 5 μg/L; trace amounts of three base/neutral compounds at concentrations less than 19 μg/L;

no organic acids; and no pesticides or PCB. Trichloroethylene was detected in White Settlement Well No. 12 at 1 μg/L in March 1983. However, three subsequent analyses for trichloroethylene were all negative. Trace metal concentrations in the water samples obtained from these wells do not exceed NPDWS. In the most recent analyses (September 1983), no VOCs or base/neutral compounds were detected.

Analyses of samples from the Spudich, Stines, Walker, and Johnson domestic wells have detected only chloroform at concentrations of about 5 μg/L or less; no base/neutral compounds; no organic acids, except for 7 μg/L phenol in the Walker well; and no pesticides or PCB. Concentrations of metals in water samples obtained from these domestic wells do not exceed National Primary Drinking Water Standards.

5) Test Holes. In addition to the analytical work described above, 30 additional test holes (TH-27 through TH-56) were drilled. Holes were drilled at 27 sites in the area of the waste oil pits to further delineate the area of contamination. Holes were also drilled at three sites between Meandering Road and Meandering Road Creek to locate an appropriate site for a monitoring well.

6) Geophysical Investigation. A seismic refraction study was conducted in the southeast employee parking lot, an area of approximately 50 acres. The study, completed in December 1983, by D'Appolonia of Houston, Texas, was conducted to establish the depth and configuration of the near surface Walnut Clay Formation at Air Force Plant 4. The top of the formation was mapped with the objective of evaluating the continuity of the Walnut Clay and locating possible erosional thinning caused by past

stream actions. The survey was successful at mapping the upper surface of the Walnut Clay Formation, as well as defining the depth to the top of the unit. However, due to a velocity inversion between the underlying Paluxy Formation and the Walnut Clay Formation, the base, and, therefore, the thickness of the Walnut Clay Formation, could not be determined.

Findings of the study indicated that a depression exists in the top of the Walnut Clay Formation near the center of the parking lot. Possible erosional channels were identified as passing through this depression and oriented in a northerly direction, indicating that movement of ground water within the area of the southeast parking lot would likely flow in a northerly direction if the flow is controlled by the surface shape of the Walnut Clay Formation.

d. Current Program Strategy

Subsequent analyses of monitoring wells continued to confirm the presence of contaminated ground water beneath some areas of Air Force Plant 4. Consistent findings of 1,2-trans-dichloroethylene and vinyl chloride in Paluxy well P-4 after four rounds of sampling resulted in a decision in January 1984, to install additional Paluxy wells to delineate flow direction in the Paluxy Aquifer and to determine the extent of contaminated ground water. Data obtained from the drilling of Paluxy wells P-1 through P-4 suggested that a clay and shale unit occurs between upper and lower sand units in the Paluxy Aquifer. It was concluded by H&M that if the clay and shale unit is laterally continuous, the upper sand unit may not be connected hydraulically with the lower sand unit, and contaminant migration may be restricted to the upper sand unit. A strategy was developed that includes a multi-staged installation of new Paluxy wells:

- Stage I: Install two suites of monitor wells (P-5, P-6, and P-7, P-8) located approximately 600 feet southeast and 500 feet east of the former waste oil pits (see Figure 18). Each suite will comprise one well completed in the upper sand unit of the Paluxy Formation and one well completed in the lower sand unit. Data obtained from these first four wells will be used to define the vertical distribution of contaminants in the aquifer. Design of the additional recommended Paluxy wells (P-9, 10, 11, 12) will be based on results obtained from these wells.

- Stage II: Based on the results obtained from wells P-5 through P-8, well P-9 will be installed in the upper or lower sand member to define limits of contaminant migration to the south of the waste oil pits. Well P-10 will be installed in the upper or lower sand member to the northwest of the waste oil pits and in a direction believed to be upgradient of the pits to determine if the pits are the sole source of contamination found in P-4.

  If sample results from P-9 are clean there will be no further drilling to the south. If found to be contaminated, an additional Paluxy well in the vicinity of HM-34 will be installed and monitored. Since existing P-2 lies further to the south and is clean, no further drilling will be conducted.

If laboratory results from P-5, 6, 7, and 8 are clean, there will be no additional wells installed to the east. However, if results show contamination, Wells P-11 and 12 will be completed into the contaminated sand member.

If P-11 and 12 are uncontaminated, no additional wells will be installed. If, however, P-11 and/or 12 are contaminated, additional wells will be installed further east.

Installation and sampling of the Phase I wells (P-5, 6, 7, 8) was completed by June 1984. Analyses of groundwater samples have not been received at the writing of this report.

Strategies were also developed for the installation of additional upper zone monitoring wells. The purpose of these wells is to further define the limits of contaminated ground water and to obtain water level and lithologic data:

Landfill

- Stage I: Existing upper zone monitor wells HM-5 and HM-9 (Figure 18) are to have additional samples taken and analyzed. If the laboratory results are clean, no additional drilling will be done in the area. If the samples are contaminated, then HM-42 and HM-43 will be drilled to define the limits of migration.

- Stage II: If the samples from HM-42 and HM-43 are clean, no additional drilling will be done. If HM-42 and/or HM-43 are contaminated, then high density shallow exploratory tests will be drilled to define the configuration of the source material, and evalution of methods for corrective action.

Waste Oil Pits

- Stage I: Upper zone monitor wells HM-37 and HM-38 (Figure 18) are to be drilled to define the limits of contaminant migration from the waste oil pits beyond HM-20 and HM-29. If these two wells are clean, there will be no further drilling to the east. If contaminated, HM-44, to be located inside the plant on the "D" aisle, will be drilled.

  Upper zone monitor well HM-39 will be drilled for water level and lithologic control.

- Stage II: If HM-44 is clean, there will be no further drilling to the east. If contaminated, locations to the east in the vicinity of Building No. 200 will be selected for further drilling.

Chrome and Die Yard Pits

- Stage I: Monitor wells HM-32 through HM-36 will be drilled to define the limits of contaminant migration beyond existing wells that now surround the

chrome and die yard pits. If these wells are clean there will be no additional drilling in this area. If wells HM-33, HM-36, or HM-35 are contaminated, wells HM-40 and HM-41 will be drilled.

- Stage II: If HM-40 and HM-41 are clean, there will be no further drilling in this area. If HM-40 and/or HM-41 are contaminated, additional wells will be drilled at locations based on the refraction survey of the southeast parking lots.

Installation and sampling of wells HM-32 through 39 were completed in May 1984. Analyses of ground-water samples have not been received at the writing of this report.

Twenty-five exploratory wells were also completed in May 1984. The purpose of these wells is to define the thickness of the upper zone and provide water level data.

e. Remedial Activities

The remedial activities have been interim responses conducted in accordance with the National Contingency Plan.

1) Excavation of waste oil pits. Analyses of soil extracts and ground-water samples and the continued analysis of groundwater being pumped from the french drain installed in November 1982 confirmed the presence of

contamination in the area of the former waste oil pits. Based on the test holes referenced above, the approximate area of the contamination was delineated and the parking lot pavement and subsurface soils were excavated down to bedrock during the summer of 1983. Approximately 11,000 cubic yards of soils and contaminated liquids were removed and disposed of offsite at an approved hazardous waste facility. Six 24-inch drain lines were installed on the bottom of the excavation and connected to a collector box for surface collection of percolate. The pit was backfilled and has been repaved. Percolate from this new drain is periodically pumped, combined with percolate pumped from the previously installed french drain system (November 1982), and any discharge collected from the stormwater discharge pipe, and stored in Tank 561.

The constituents of primary concern in these collected ground waters are volatile organic compounds, particularly trichloroethylene. General Dynamics received a permit from the State of Texas to treat this water through an onsite cooling tower that would effectively strip out the volatile organic compounds. This practice was effective for removing the VOCs from the water. However, it also resulted in an excess buildup of metals and potentially some organic compounds in the cooling tower blowdown. The permit expired in October 1983. Permission from the State of Texas was received in December 1983 to resume treatment by this method. As a result, General Dynamics is presently in the process of procuring a stripping tower dedicated to treatment of this water.

During the time that the cooling tower treatment was not in effect, the ground water was removed offsite by a private contractor.

As part of an on-going sampling program, the storm sewer outfall was sampled and analyzed in September 1983. Findings of trichloroethylene (570 µg/L), 1,2-trans-dichloroethylene (2,100 µg/L), and vinyl chloride (140 µg/L) caused concern and prompted an investigation by General Dynamics. It was concluded that ground water moving toward the buried storm-water collection pipe was apparently infiltrating into the pipe. To correct this problem, General Dynamics installed a PVC pipe liner within the buried pipeline and also within the north storm sewer inlet box. During installation of the plastic liner, two 6-inch perforated steel pipelines were discovered connected to the storm-water pipe north of the french drain. One pipeline runs southeast from the point of connection and the other, a much shorter line, runs to the northeast. Black, oily fluid from the upper zone was reportedly seeping into the longer pipeline through the perforations. The ends of the pipelines, which are adjacent to the storm drain, were sealed to prevent further flow. A steel riser pipe was installed in the longer pipe to provide access for sampling and removal of fluid. Subsequent samples collected from the riser pipe are identified as the "pipe drain" samples.

General Dynamics' consultant, Hargis & Montgomery, has recommended continued removal and disposal of the ground water collected in the original french drain, the new drain system installed in the bottom of the excavation, and the pipe drain, as an interim measure to remove contaminated ground water that still remains in the area of the excavation. Permanent remedial measures cannot be designed until definition of the extent of ground-water contamination in the upper zone is completed.

Since the installation of the french drain system in 1982, all ground water removed from the site, including that removed from the french drain, the

drain pipes installed in the bottom of the excavation, the storm-water pipe, and the pipe drain, has been periodically sampled and analyzed. Recent analyses (April 1984) are presented in Appendix H.

With reference to the excavation, allegations were made that significant areas of contamination within the exavation were not removed and that materials removed were not properly disposed of. An investigation was completed in December 1983 by the EPA National Enforcement Investigations Center (NEIC) to determine the validity of the allegations. The investigation concluded that "there is no merit to the allegations."

2) Excavation of Chrome Pit and Die Pits. It was concluded in 1983, based on soil and ground-water data developed since December 1982, that both the chrome pit and the die yard pits were sources of soil and ground-water contamination. Plans were developed, and in December 1983 and January 1984 via contract with Chemical Waste Management, both the chrome pit and the die yard pits were excavated. Approximately 8,900 cubic yards and 1,100 cubic yards of contaminated material and soils were removed from the chrome pit and die yard pits, respectively. The material was transported from the site by the contractor and disposed of at an approved hazardous waste facility. Evaluation of the excavation was based on analysis of soil samples collected from the walls and floors of the excavation by General Dynamics personnel. Analyses were performed by Allied Analytical and Research Laboratories in Dallas, Texas. Summary tables of analyses are included in Appendix I. At the conclusion of the chrome pit excavation, a small area of soils in the western portion of the floor still contained some trichloroethylene (4,287 μg/Kg). It

was thought that since concentration of trichloroethylene (TCE) in ground water beneath the site was greater than 100,000 µg/L, the TCE in the soil may represent organic vapors in the soil gas rather than adsorption onto the soil. Representatives of EPA, the Texas Department of Water Resources (TDWR), and the USAF-OEHL agreed with this conclusion and saw no need for further excavation to remove TCE.

Phthalates were still present in the west wall at concentrations of 400,000 µg/Kg. Because phthalates in upper zone ground water beneath the site have been detected only at concentrations less than 10 µg/L, it was suggested that phthalates are relatively immobile in the soils and are rapidly adsorbed by the soils. It was concluded (on the advice of technical representatives of EPA, TDWR, and USAF-OEHL) that there was no need to excavate for additional phthalate removal.

Metals in soil samples were all reduced to acceptable levels in accordance with the EP toxicity test. It was concluded that additional excavation at the chrome pit site was not necessary and the pit was subsequently filled and graded over.

Results of the die yard pit excavation indicated that some areas of the excavation walls and floors still contained some volatile organics, base/neutral and organic acids. The volatile organic compounds, ranging from 0 to 5,637 µg/Kg, were thought to be present only in soil gas and not adsorbed into the soil. Base/neutral compounds consisted of dichlorobenzene and phthalates. It was thought, based on much lower concentrations being present in ground water beneath the site, that these compounds were relatively immobile. Metals were also present but at

concentrations acceptable in accordance with the EP toxicity test. It was concluded, based on the advice of technical representatives of EPA, TDWR, and USAF-OEHL, that additional excavation was unnecessary. The site was subsequently filled, graded over, and repaved.

According to H&M, installation of french drains in these excavations for ground-water removal was not appropriate because of low permeability and small saturated thickness of the upper zone at these sites. They concluded that, if necessary, additional remedial measures for control of contaminated ground water in the upper zone might be required after completion of their (H&M) Phase II investigation.

C. SURFACE-WATER INVESTIGATIONS

It has been determined by Hargis & Montgomery that migrating wastes in the upper zone ground water has a significant potential for reaching the ground surface and surface waters along the Meandering Road Creek and along the edge of portions of Lake Worth. In fact, the earliest indications of contamination in 1982 were found in Meandering Road Creek, entering from the ground water via a storm sewer outfall.

In January 1983, quantitative surface-water samples were taken from this creek at two points and at the storm sewer outfall west of the west parking area to investigate the surface migration pathway. Data from this sampling episode are summarized in Table 22. The major finding was that several trace metals, volatile organics, and other organics were significantly above background levels in water entering this creek, which flows to Lake Worth. Also, the concentrations of these pollutants were generally higher in

Table 22
EPA PRIORITY POLLUTANTS IN SURFACE WATERS
WEST OF AIR FORCE PLANT 4 ON JANUARY 11, 1983

Constituent	STATION		
	St. S. Outfall	C-1	C-2
Metals (mg/L):			
Arsenic	0.07	ND[a]	ND
Copper	0.02	ND	ND
Iron	0.25	0.10	0.09
Mercury	0.17	ND	ND
Strontium	NA[b]	1.14	0.78
Zinc	0.03	0.01	0.01
Organics (μg/L):			
Benzene	37	ND	ND
Chloroform	8	ND	ND
1,1-Dichloroethylene	76	ND	15
Methylene chloride	1,200	ND	ND
Tetrachloroethylene	4	ND	ND
Toluene	6	ND	ND
Trichloroethylene	34	ND	ND
m,p-xylene	17	ND	ND
Butyl benzyl phthalate	ND	12	125
Diethyl phthalate	3	2	17
Di-N-butyl phthalate	38	5	19
Di-N-octyl phthalate	ND	1	3
Naphthalene	ND	ND	6

[a]ND: None detected

[b]NA: Not analyzed

Source: Hargis & Montgomery, 1983

Laboratory: Allied Analytical and Research Laboratories

the downstream sample. It should be noted that some remedial actions had already been completed in this area (french drain), which were observed to substantially reduce odorous substances reaching the creek.

Additional surface-water quality samples were collected from creek stations C-1 and C-2 on May 6, 1983, as well as from an additional station designated as C-3 (see Figure 18), which is located in the creek below the storm sewer outfall. This additional sampling confirmed the previous results indicating the presence of low levels of priority pollutants, including trace metals and organics (see Table 23).

On June 2, 1983, two additional creek stations, C-4 and C-5, were sampled, as well as two Lake Worth stations, L-1 and L-2 (see Figure 18). Very low levels of a few trace metals and organic compounds were detected in these samples.

Additional sampling of the west parking lot storm sewer outfall in September 1983 indicated the continued presence of volatile organics entering the creek at this point. In particular, 1,2-trans-dichloroethylene was measured at 2,100 μg/L; trichloroethylene at 570 μg/L; and vinyl chloride at 140 μg/L. Although earlier analysis (see Table 22) detected 1,200 μg/L of methylene chloride, this analysis did not detect methylene chloride. The most recent information concerning surface-water sampling along the western boundary of Air Force Plant 4 was collected on January 16, 1984. Table 23 summarizes trace metals and organics that were found above detection levels in these samples. Low, but significant concentrations, are still present in the creek. Note that Station C-3 is upstream from C-2 (Figure 18) and that a slight increase in contaminant concentrations is still being observed at the downstream station. Sampling of

Table 23
EPA PRIORITY POLLUTANTS IN SURFACE WATERS
WEST OF AIR FORCE PLANT 4 ON JANUARY 16, 1984

Constituent	Station				
	C-1	C-2	C-3	C-4	C-5
Metals (mg/L):					
Barium	0.085	0.11	0.084	0.063	0.10
Copper	ND[a]	ND	ND	ND	0.004
Iron	0.047	ND	ND	ND	0.035
Manganese	ND	ND	ND	ND	0.001
Organics (µg/L):					
1,2-Trans-Dichloroethylene	ND	48	19	ND	ND
Trichloroethylene	ND	58	16	ND	ND

[a]ND: None detected

Source: Hargis & Montgomery, 1984

Laboratory: Brown & Caldwell

the west storm sewer outfall in March and April of 1984 detected very low levels of 1,1-dichloroethylene (9 μg/L) and trichloroethylene (9 μg/L).

D. DISPOSAL SITES IDENTIFICATION AND EVALUATION

Interviews were conducted with past and present base personnel (Appendix C) to identify disposal and spill sites at Air Force Plant 4. Each site was screened based on the information obtained from the interviews and available records from the base and outside agencies. Using the decision-tree process described under "Methodology" (Section I.E.), a determination was made whether a potential exists for hazardous material contamination in any of the identified sites. For those sites where hazardous material contamination was considered significant, a determination was made whether significant potential exists for contaminant migration from these sites. These sites were then rated using the U.S. Air Force Hazard Assessment Rating Methodology (HARM), which was developed jointly by the Air Force, CH2M HILL, and Engineering-Science for specific application to the Air Force Installation Restoration Program. The HARM system considers four aspects of the hazard posed by a specific site: 1) the receptors of the contamination, 2) the waste and its characteristics, 3) potential pathways for waste contamination migration, and 4) any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating. A more detailed description of the HARM system is included in Appendix J.

A total of 20 disposal and spill sites were identified at Air Force Plant 4. Each site was rated using the HARM rating system. A complete listing of the sites, indicating potential hazards, is presented in Table 24. Copies of the

Table 24
DISPOSAL AND SPILL SITES SUMMARY

Site No.	Site Description	Contamination	Migration	Rating
1	Landfill No. 1	Yes	Yes	Yes
2	Landfill No. 2	Yes	Yes	Yes
3	Landfill No. 3	Yes	Yes	Yes
4	Landfill No. 4	Yes	Yes	Yes
5	FDTA No. 2	Yes	Yes	Yes
6	FDTA No. 3	Yes	Yes	Yes
7	FDTA No. 4	Yes	Yes	Yes
8	FDTA No. 5	Yes	Yes	Yes
9	FDTA No. 6	Yes	Yes	Yes
10	Chrome Pit No. 1	Yes	Yes	Yes
11	Chrome Pit No. 2	Yes	Yes	Yes
12	Chrome Pit No. 3	Yes	Yes	Yes
13	Die Pits	Yes	Yes	Yes
14	Fuel Saturation Area No. 1	Yes	Yes	Yes
15	Fuel Saturation Area No. 2	Yes	Yes	Yes
16	Fuel Saturation Area No. 3	Yes	Yes	Yes
17	Former Fuel Storage Site	Yes	Yes	Yes
18	Solvent Lines	Yes	Yes	Yes
19	NARF Area	Yes	Yes	Yes
20	Wastewater Collection Basins	Yes	Yes	Yes

completed rating forms are included in Appendix K, and a summary of the hazard ratings for the sites is given in Table 25. Descriptions of each site, including a brief discussion of the rating results, are presented below. Approximate locations of the sites are shown in Figure 19. Approximate operating dates for the identified disposal and spill sites are shown in Figure 20.

1. LANDFILLS

Landfills were used for disposal of various waste materials at Air Force Plant 4 from the time of original construction in 1942 until the last landfill was closed in the early 1980s. These landfills were typically located in low areas adjacent to Meandering Road on the west side of Air Force Plant 4. Four landfill sites were confirmed to be present at Air Force Plant 4 and are described below.

a. Site No. 1, Landfill No. 1

Landfill No. 1 (overall score of 88) was used for disposal of much of the facilities' wastes from 1942 until about 1966. This site encompasses approximately six acres and is located west of Warehouse 3 (Facility No. 14) between the fence and Meandering Road. Currently this site is completely covered by an employee parking area.

Several types of hazardous and non-hazardous wastes were reportedly disposed of in Landfill No. 1. Drums of liquid wastes were buried in the landfill, and tanks and bousers loaded with chemical wastes (solvents, thinners, paints, etc.) were emptied into the landfill or into shallow pits located at various locations throughout the landfill area. Miscellaneous contaminated oils and fuels were also disposed of in pits and were routinely burned. Sludge from

Table 25
SUMMARY OF DISPOSAL AND SPILL SITE RATINGS

Site	Site Description	Receptors	Characteristics	Pathways	Factor for for Waste Management Practices	Overall Score	Page Reference of Site Rating Form
1	Landfill No. 1	78	100	100	0.95	88	K-1, 2
2	Landfill No. 2	78	60	80	1.0	73	K-3, 4
3	Landfill No. 3	78	100	80	1.0	86	K-5, 6
4	Landfill No. 4	78	40	80	1.0	66	K-7, 8
5	FDTA No. 2	78	48	37	0.95	51	K-9, 10
6	FDTA No. 3	78	48	48	1.0	58	K-11, 12
7	FDTA No. 4	78	48	48	1.0	58	K-13, 14
8	FDTA No. 5	78	48	42	0.95	53	K-15, 16
9	FDTA No. 6	78	48	56	1.0	61	K-17, 18
10	Chrome Pit No. 1	78	53	42	0.95	55	K-19, 20
11	Chrome Pit No. 2	78	53	42	0.95	55	K-21, 22
12	Chrome Pit No. 3	78	75	80	0.95	74	K-23, 24
13	Die Pits	78	45	80	0.95	64	K-25, 26
14	Fuel Saturation Area No. 1	75	56	30	0.95	51	K-27, 28
15	Fuel Saturation Area No. 2	78	56	37	0.95	54	K-29, 30
16	Fuel Saturation Area No. 3	78	80	37	0.95	62	K-31, 32
17	Former Fuel Storage Site	78	60	80	1.0	73	K-33, 34
18	Solvent Lines	78	70	35	0.95	58	K-35, 36
19	NARF Area	78	50	37	0.10	6	K-37, 38
20	Wastewater Collection Basins	78	70	42	1.0	63	K-39, 40

GN14649.61

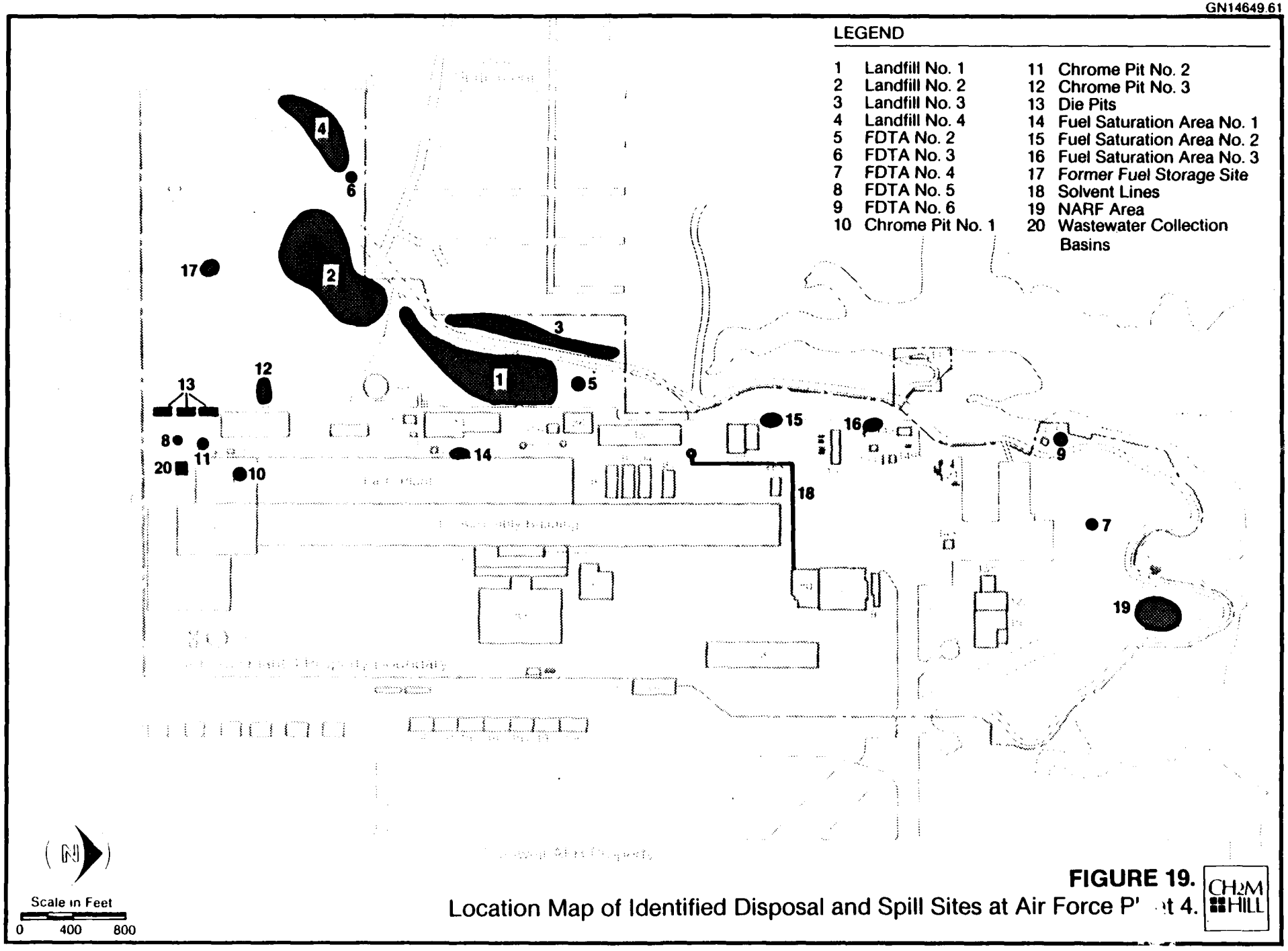


FIGURE 19.
Location Map of Identified Disposal and Spill Sites at Air Force P' t 4.

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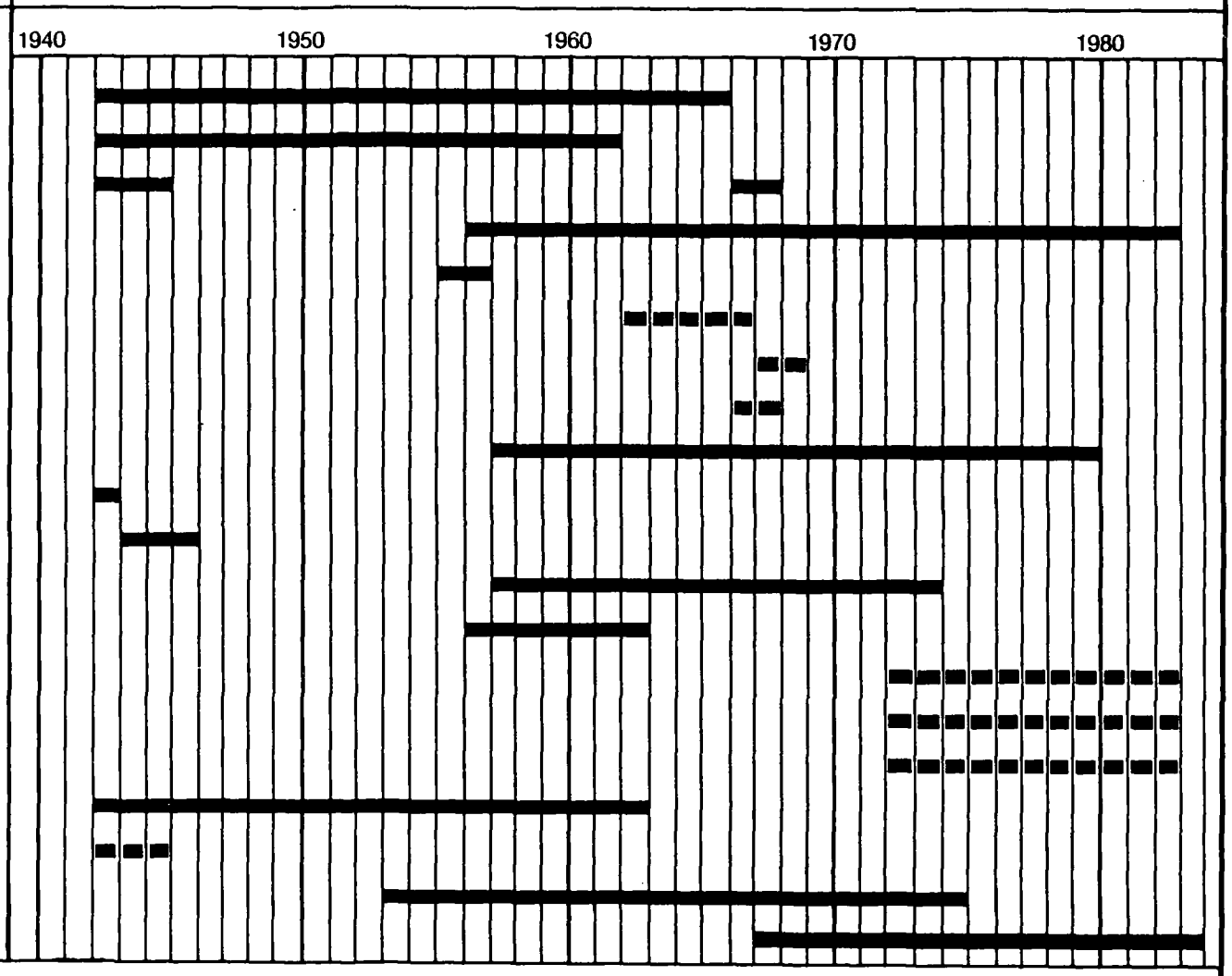
SITE NO.	SITE DESCRIPTION
1	Landfill No. 1
2	Landfill No. 2
3	Landfill No. 3
4	Landfill No. 4
5	FDTA No. 2
6	FDTA No. 3
7	FDTA No. 4
8	FDTA No. 5
9	FDTA No. 6
10	Chrome Pit No. 1
11	Chrome Pit No. 2
12	Chrome Pit No. 3
13	Die Pits
14	Fuel Saturation Area No. 1
15	Fuel Saturation Area No. 2
16	Fuel Saturation Area No. 3
17	Former Fuel Storage Area
18	Solvent Lines
19	NARF Area
20	Wastewater Collection Basins



LEGEND

Known Period of Activity

Suspected Period of Activity

FIGURE 20.
Historical Summary— Activities at Disposal Sites at Air Force Plant 4.

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these pits was periodically dredged out and deposited in the landfill area. At least five separate or overlapping pits are discernible on historical aerial photographs of this site. Other hazardous wastes suspected to be present at this site include metals (e.g., mercury, magnesium, etc.), chromate sludges, and cyanide. Although some hazardous wastes are suspected to be scattered throughout much of the landfill, the majority of the fill material probably consists of trash, rubble, plasters (aircraft moldings), lumber, and fill dirt.

Extensive remedial actions have been conducted at this site since it was closed during the 1960s. Before the parking lot was graded for paving, two 6-inch perforated pipes were laid on bedrock to channel leachate drainage to a stormwater outfall to Meandering Road Creek. In 1982 and 1983, following identification of hazardous substances in this storm drain, the original drain lines were connected to an additional 20 feet of 4-inch perforated pipe and routed into a 36-inch sump for pumping to the ground surface. In addition, a 90-foot length of perforated 4-inch drain line (french drain) was placed on bedrock upgradient from the existing storm sewer to intercept flows and to allow collection and disposal. The existing 36-inch storm sewer and catch basins were lined with PVC material in order to eliminate infiltration of percolate.

In 1983 additional remedial actions were conducted at this site. Since the main source of residual contamination was suspected to be the former waste oil pits, a portion of the site was excavated to bedrock and removed from the Air Force Plant 4 facility to an approved hazardous waste facility. To make this excavation a portion of the parking lot was removed and approximately 11,000 cubic yards of earth were removed to bedrock. Six 24-inch drainlines

were placed in the bottom of this pit and connected to a collector box for surface collection of percolate. The pit was backfilled and has been reconverted to a parking area. Percolate from the three collection points is periodically pumped, analyzed for pollutants, and disposed of off-site as hazardous waste when necessary.

Landfill No. 1 (Site No. 1) received an overall HARM rating score of 88, primarily due to: 1) the reported disposal of a large quanitity of hazardous wastes, 2) many receptors in the vicinity of the site, including residential development, surface water bodies, and water supply wells, and 3) the confirmed presence of migration of hazardous substances from the site. Because of the remedial actions that have been conducted at this site to date, the HARM score was reduced by 5 percent on the basis of waste management practices. However, because of the reports concerning considerable random dumping of hazardous substances throughout the landfill, and because of the presence of several oil and chemical waste pits other than those excavated, it is suspected that a considerable quantity of hazardous materials may still be present at Site No. 1.

b. Site No. 2, Landfill No. 2

Landfill No. 2 (overall score of 73) is located in the northern portion of the present radar range, west of Warehouse 2. This site occupies approximately 7.5 acres of land bordering Meandering Road and is south of the employee parking area. The site originally consisted of some low areas and a livestock watering hole. The majority of this site was reportedly filled with construction rubble, plasters, and fill dirt during the early 1940s. However, some activity at the stock watering hole at this site is

evident on aerial photographs up until at least 1962. This area was reportedly used for disposal of lumber and tires and was assumed to be periodically burned. There were no verbal reports of hazardous substances being deposited at this site; however, it is likely that small quantities of wastes were infrequently disposed of at Site No. 2.

Landfill No. 2 (Site No. 2) received an overall HARM rating score of 73, primarily due to: 1) presence of residential areas within one mile of the site, 2) the proximity of a creek within 420 feet of the site with surface flows to Lake Worth, 3) the presence of water supply wells within 1,300 feet of the site, and 4) indirect evidence of contaminant migration. An upper zone monitoring well installed at this site in 1983, HM-2, confirmed the presence of several VOCs in shallow ground water beneath the site (see Appendix G, Table G.1). The presence of these contaminants is considered to be indirect evidence of a contaminant migration pathway at the site.

c. Site No. 3, Landfill No. 3

Landfill No. 3 (overall score of 86) is located west of Landfill No. 1 between Meandering Road and Meandering Road Creek. This landfill covers approximately 3 acres of land that was formerly a low area bordering the creek. Interviewees reported that this site was used for disposal of miscellaneous wastes from about 1942 to 1945, including hazardous liquid wastes consisting of mixed oils and solvents. One or more pits were present in this area during the 1940s and were used for holding and burning some of the liquid wastes. Other wastes are suspected to have been disposed of on the ground and then buried. There was no evidence of significant activity at this site from about 1945 until 1966. During the period from 1966 until 1967,

fill dirt and rubble was used to finish filling and grading this site. Water quality analyses from upper zone monitoring wells at this site (HM-26 and HM-27) have indicated the presence of elevated levels of VOCs in the ground water (see Appendix G, Table G.1). This data was considered to be indirect evidence for contaminant migration at Site No. 3.

Landfill No. 3 (Site No. 3) received an overall HARM rating score of 86, primarily due to: 1) the reported disposal of large quantities of hazardous liquid wastes at this site, 2) the presence of nearby vulnerable receptors such as residential areas, Lake Worth, and water supply wells, 3) the presence of a surface water pathway for waste migration in the adjacent creek leading to Lake Worth, and 4) indirect evidence of a ground-water migration pathway.

d. Site No. 4, Landfill No. 4

Landfill No. 4 (overall score of 66) is located near the southwest boundary of the Air Force Plant 4 facility. This landfill occupies approximately 2 acres of land west of Meandering Road and was formerly part of the low area bordering the adjacent creek. Landfill No. 4 was reportedly used for disposal of clean construction rubble from its start in about 1956 until closure some time in the early 1980s. Aerial photographs of the site and at least one memo dated 1973 indicate that other types of wastes may have been disposed of at this site from the time of closure of Landfill No. 1 (1966) until at least 1973. Based on this evidence, small suspected quantities of high hazard wastes (solvents, oils, fuels, thinners, etc.) are thought to be present in this landfill. Two upper zone monitoring wells installed at this site in 1982, HM-5 and HM-9, have been

found to contain VOCs and other organic compounds (see Appendix G, Table G.1). This data is considered to be indirect evidence of migration at this site. Recent data from these wells have been negative for these compounds.

Landfill No. 4 (Site No. 4) received an overall HARM rating score of 66, primarily due to: 1) its proximity to the installation boundary (150 feet) and adjacent residential areas, 2) its proximity to the Meandering Road Creek (100 feet), 3) the presence of water supply wells within 2,000 feet of the site, and 4) indirect evidence of a shallow ground-water pathway for contaminant migration.

2. FIRE DEPARTMENT TRAINING AREAS

Fire department training exercises consisting of open burning of fuels and other flammable liquids have long been a routine activity for the Air Force Plant 4 fire department. During the early 1940s there was little controlled burning and no actual drills. By 1945, however, training exercises were being held regularly in waste oil pits in Landfill No. 1 (Site No. 1). Other specifically designated fire department training areas (FDTAs) at Air Force Plant 4 are described below:

a. Site No. 5, FDTA No. 2

FDTA No. 2 (overall score of 51) was used for approximately 2 years from 1955-1956. This site consisted of a 50-foot diameter earthen ring located just north of Landfill No. 1 (Site No. 1). Exercises were held infrequently (twice per year); however, disposal of waste oils and fuels and uncontrolled burns may have been more frequent. This site is currently located under the pavement in the west employee parking area.

FDTA No. 2 (Site No. 5) received an overall HARM rating score of 51, primarily due to: 1) the proximity of the installation boundary (400 feet) and adjacent residential areas, 2) the proximity of the site to Meandering Road Creek (400 feet), and 3) the presence of water supply wells within approximately 1,200 feet of the site.

b. Site No. 6, FDTA No. 3

FDTA No. 3 (overall score of 58) was reportedly used during the mid-1960s for routine fire department training exercises. This site is located north of Landfill No. 4 (Site No. 4) between Meandering Road and the adjacent creek. Training exercises used small quantities (about 250 gallons per exercise) of waste fuels and oils. This site is not readily visible on historical aerial photographs, so that its location and current condition could not be accurately determined.

FDTA No. 3 (Site No. 6) received an overall HARM rating score of 58, primarily due to: 1) the proximity of the installation boundary (80 feet) and adjacent residential areas, 2) the proximity of the site to Meandering Road Creek (120 feet), and 3) the presence of water supply wells within 2,000 feet of the site.

c. Site No. 7, FDTA No. 4

FDTA No. 4 (overall score of 58) was reportedly used for fire department training exercises during the late 1960s. This site is thought to be located north of the north employee parking area, at a location known as "Tater Hill." Training exercises used small quantities (about 250 gallons per exercise) of waste fuels

and oils. This site is not readily visible on historical aerial photographs of Air Force Plant 4, so that its location and current condition could not be accurately determined.

FDTA No. 4 (Site No. 7) received an overall HARM rating score of 58, primarily due to: 1) the proximity of the installation boundary (400 feet) and adjacent residential areas, 2) the proximity of the site to Lake Worth (400 feet), and 3) the presence of water supply wells within 2,500 feet of the site.

d. Site No. 8, FDTA No. 5

FDTA No. 5 (overall score ot 53) was reportedly used for fire extinguisher training during the mid-1960s. This site consisted of a shallow pit about 10-feet by 20-feet in size, in which waste fuels, oils, or chemicals were deposited for training exercises. This site is located in the die yard area south of Warehouse 1 and has been graded and paved.

FDTA No. 5 (Site No. 8) received an overall HARM rating score of 53, primarily due to: 1) the proximity of the installation boundary (350 feet) and adjacent residential areas, 2) the presence of water supply wells within 1,000 feet of the site, and 3) the suspected presence of groundwater within 10 feet of the soil surface at this site.

e. Site No. 9, FDTA No. 6

FDTA No. 6 (overall score of 58) was the designated FDTA from the late 1950s until 1980, when it was closed. This site consisted of a 50-foot diameter

gravel-lined ring surrounded by a low, earthen berm. FDTA No. 6 is located north and adjacent to the DYNAFORM facility, Facility No. 175. Before 1970, training exercises were conducted two times per year at this site. After 1970, exercises were conducted at monthly intervals at this site. Approximately 250 gallons of waste fuels and oils were reportedly used for each exercise. In addition, it is suspected that larger quantities of contaminated fuels and oils were deposited in the FDTA between exercises.

In 1983 FDTA No. 6 (Site No. 9) was excavated and removed as part of the hazardous waste remedial actions being conducted at Air Force Plant 4. The excavated material was analyzed and disposed of at approved hazardous waste landfills off of the facility. No monitoring wells have been installed at this site to determine the status of ground-water contamination.

FDTA No. 6 (Site No. 9) received an overall HARM rating score of 58, primarily due to: 1) the proximity of the site to the installation boundary (220 feet), residential areas, Lake Worth (220 feet), and water supply wells (2,000 feet), which gave it a Total Gross Score of 61, and 2) a 5-percent reduction of this Total Gross Score due to waste management practices (limited containment).

3. CHROME WASTE DISPOSAL PITS

Chromium-containing wastes have been produced and disposed of on Air Force Plant 4 since the early 1940s. These wastes consist of dilute and concentrated solutions of plating wastes containing chromium and other heavy metals. Typical disposal of these solutions was by pumping them into unlined earthen pits and allowing excess water to evaporate or infiltrate. Locations and HARM rating scores for several of these chrome pits are presented below.

a. Site No. 10, Chrome Pit No. 1

Chrome Pit No. 1 (overall score of 55) is located under the present process building, Facility No. 181, and was used during the early 1940s. It is suspected that miscellaneous liquid and solid chemical wastes, in addition to chrome wastes, were disposed of at this site. The actual location of this site could not be accurately confirmed based on interviews or aerial photographs.

Chrome Pit No. 1 (Site No. 10) received an overall HARM rating score of 55, primarily due to: 1) its proximity to the installation boundary (800 feet) and adjacent residential areas, and 2) the presence of water supply wells within 1,200 feet of the site.

b. Site No. 11, Chrome Pit No. 2

Chrome Pit No. 2 (overall score of 55) is located in the present die yard area and was used during the mid-1940s. It is suspected that miscellaneous liquid and solid chemical wastes, in addition to chromate solutions, were disposed of at this site. The actual location of this site could not be accurately confirmed based on interviews or aerial photographs.

Chrome Pit No. 2 (Site No. 11) received an overall HARM rating score of 55, primarily due to: 1) its proximity to the installation boundary (500 feet) and adjacent residential areas, and 2) the presence of water supply wells within 3,000 feet of the site.

c. Site No. 12, Chrome Pit No. 3

Chrome Pit No. 3 (overall score of 74) is located west of Warehouse 1 in the radar range area. This

pit had approximate dimensions of 66-feet by 165-feet and was approximately 10- to 15-feet in depth. Chromate and other chemical wastes were disposed of at this site from about 1957 until 1973. Barium chromate sludge, dilute metal solutions, and drums of unidentified liquids were disposed of in this pit.

Soil borings and shallow groundwater sampling conducted in 1982 confirmed contamination at this site. Approximately 8,900 cubic yards of containminated soils were excavated from this site during December 1983, and January 1984, and disposed of at an approved hazardous waste landfill off of the Air Force Plant 4 facility. Soil testing conducted during the excavation indicated that most significantly contaminated soils were removed from the site.

Chrome Pit No. 3 (Site No. 12) received an overall HARM rating score of 74, primarily due to 1) the proximity of the site to the installation boundary (900 feet), residential areas, and water supply wells (2,000 feet), which gave it a Total Gross Score of 78, and 2) a 5-percent reduction of this Total Gross Score due to waste management practices (limited containment).

d. <u>Site No. 13, Die Pits</u>

The die pits (overall score of 64) are [illegible] the west side of the present die yard near the [illegible] Air Force Plant 4. Three pits with [illegible] dimensions of 20-feet by 90-feet were [illegible] this site in 1956. These pits were used for [illegible] chromate sludges, metal solutions, and other [illegible] until 1962, when the site was graded and the [illegible] was paved. One interviewee reported that [illegible] contaminated soils at this site were spread

around the die yard during the grading and levelling activities. The site of the original pits was excavated in 1983-84, and approximately 1,100 cubic yards of contaminated soils was disposed of at an approved hazardous waste landfill off of the Air Force Plant 4 facility. No quantitative analysis of soils from other parts of the die yard were made at that time.

The die pits (Site No. 13) received an overall HARM rating score of 64, primarily due to: 1) the proximity of the site to the installation boundary (100 feet), residential areas, and water supply wells (1,000 feet), which gave it a Total Gross Score of 68, and 2) a 5-percent reduction of this Total Gross Score due to waste management practices (limited containment).

4. FUEL SATURATION AREAS

Air Force Plant 4 has a number of buried fuel lines and belowground and aboveground fuel storage tanks. Tanks and fuel lines in contact with the ground reportedly have had historical leakage problems due to corrosion caused by high levels of electrolysis. Descriptions of several identified fuel saturation sites on Air Force Plant 4 are given below.

a. Site No. 14, Fuel Saturation Area No. 1

Fuel Saturation Area No. 1 (overall score of 51) is located west of, and adjacent to, the Parts Plant, Facility No. 5. This area is just north of the fuel tank truck unloading and pumping station. The ground at this site reportedly became saturated by fuels due to leaks in buried fuel lines from the 1970s up until the early 1980s.

Fuel Saturation Area No. 1 (Site No. 14) received an overall HARM rating score of 51, primarily due to: 1) the proximity of the site to residential areas (1,200 feet), and 2) the presence of water supply wells within 2,000 feet of the site.

b. Site No. 15, Fuel Saturation Area No. 2

Fuel Saturation Area No. 2 (overall score of 54) is located just northwest of the Paint Shop, Facility No. 176. This site reportedly became saturated by fuels due to leaks in buried fuel lines between the 1970s and the early 1980s.

Fuel Saturation Area No. 2 (Site No. 15) received an overall HARM rating score of 54, primarily due to: 1) the proximity of the site to the installation boundary (250 feet) and residential areas, 2) the presence of water supply wells within 2,000 feet of the site, and 3) the proximity of the site to Lake Worth (500 feet).

c. Site No. 16, Fuel Saturation Area No. 3

Fuel Saturation Area No. 3 (overall score of 62) is located just southwest of Facility No. 142. This site reportedly became saturated by fuels due to leaks in buried fuel lines from the mid-1970s until the early 1980s.

Fuel Saturation Area No. 3 (Site No. 16) received an overall HARM rating score of 62, primarily due to: 1) a large reported quantity of fuel-saturated soils at this site, 2) the proximity of the installation boundary (200 feet) and adjacent residential areas, 3) the presence of water supply wells within 3,000 feet of the site, and 4) the proximity of the site to Lake Worth (500 feet).

d. Site No. 17, Former Fuel Storage Site

The former fuel storage site (overall score of 73) is located at the southwest corner of the Air Force Plant 4 facility, near the center of the radar range area. This site was the former location of a 100,000-gallon JP-4 aboveground fuel storage tank from the early 1940s until it was relocated in 1962. Sampling at this site in 1982 confirmed that soils and underlying groundwater are contaminated by fuels and other organic compounds.

The former fuel storage site (Site No. 17) received an overall HARM rating score of 73, primarily due to: 1) the proximity of the site to the installation boundary (520 feet) and adjacent residential areas, 2) the presence of water supply wells withi 2,100 feet of the site, and 3) the indirect evidence of migration of hazardous wastes into the groundwater at this site.

5. OTHER SITES

a. Site No. 18, Solvent Lines

The Solvent Lines site (overall score of 58) is located along the route of the former buried solvent lines from the northeast corner of Facility No. 15 to the test lab, Facility No. 80. These lines reportedly leaked during the 1940s before they were drained, capped, and abandoned-in-place in 1944. The actual locations of the leaks could not be determined based on interviews. The contents of these solvent lines reportedly included xylene, methyl ethyl ketone, and kerosene.

The Solvent Lines (Site No. 18) received an overall HARM rating score of 58, primarily due to: 1) the

proximity of the site to the installation boundary (550 feet) and adjacent residential areas, and 2) the presence of water supply wells within 2,500 feet of the site.

b. Site No. 19, NARF Area

The Nuclear Aerospace Research Facility (NARF) area (overall score of 6) was formerly located at the north end of Air Force Plant 4, just south of Lake Worth. This facility reportedly housed several experimental atomic reactors between 1953 and 1974. Small quantities of dilute radioactive solutions were discharged from this site to Lake Worth, but all high level contamination was reportedly contained onsite. Large quantities of nuclear activation material were produced at this site as an undesirable side effect of neutron bombardment. Those activation products were reportedly contained onsite, and the entire facility was decommissioned and disposed of by contractor removal in 1974. A total of over 2 million pounds of miscellaneous parts and 15 million pounds of concrete rubble were hauled offsite to Barnwell, South Carolina. Post-closure at this site reportedly found no remaining contamination.

The NARF area (Site No. 19) received an overal HARM rating score of 6, primarily due to: 1) the proximity of the site to the installation boundary (300 feet), Lake Worth (300 feet), and water supply wells (3,000 feet), which gave it a Total Gross Score of 55, and 2) a 90-percent reduction of this Total Gross Score due to waste management practices (full containment and in full compliance).

c. Site No. 20, Wastewater Collection Basins

The Wastewater Collection Basins site (overall score of 63) is located just south of the Process Building (Facility No. 181). Two concrete-lined waste basins with approximately 85,000-gallon capacity each are used to collect and settle suspended solids from chemical wastewaters before discharge to the City of Fort Worth sanitary sewer system. Supernatant from these basins is analyzed for pH and chrome prior to discharge to the sewer. Settled sludge is periodically removed from these basins, dewatered, and disposed of off-site. The basins have been used from approximately 1966 until the present. Written correspondence and interviewees indicated that several spills of vapor degreaser tanks in the Process Building have occurred since installation of these tanks. Much of the spilled chemicals (primarily trichloroethylene) have flowed to the basins via floor drains. Because of concerns about VOCs and the possibility of cracks or leaking drains in these basins, they are suspected as being a possible source of ground-water contamination by organic chemicals and metals.

The Waste Collection Basins site (Site No. 20) received an overall HARM rating score of 63, primarily due to: 1) the proximity of the site to the installation boundary (400 feet) and adjacent residential areas, 2) the presence of water supply wells within 1,200 feet of the site, and 3) the presence of ground water within 10 feet of the ground surface at the site.

E. ENVIRONMENTAL STRESS

During the visit to Air Force Plant 4 in April 1984, major known former or present waste disposal areas were

examined for signs of vegetatative stress possibly related to the presence or migration of hazardous wastes. No significant environmental stress related to these sites was observed.

V. CONCLUSIONS

V.
CONCLUSIONS

A. Information obtained through the review of available reports, interviews with present and former employees, plant records, aerial photographs, and field observations indicates that hazardous wastes have been disposed of on Air Force Plant 4 property in the past.

B. No direct evidence was found to indicate that migration of hazardous contaminants beyond the Air Force Plant 4 boundary has occurred.

C. Indirect evidence indicates that migration of hazardous contaminants beyond the Air Force Plant 4 boundary has occurred in the past. Contaminated ground water beneath the west employee parking lot was determined in late 1982 to be seeping into a buried stormwater pipe and subsequently discharging into Meandering Road Creek. This condition was eventually eliminated through remedial activities in the vicinity of the parking lot. Continued findings of metals and volatile organic compounds in water samples collected from Meandering Road Creek, adjacent to Air Force Plant 4, suggest that contaminated ground water from Air Force Plant 4 may be leaching into the creek.

D. Studies completed to date by General Dynamics have confirmed ground-water contamination in the upper zone over much of Air Force Plant 4 property. The upper zone ground water is not known to be used as a potable water source in the vicinity of Air Force Plant 4. A potential exists for contamination of the Paluxy Aquifer, a potable water source for the neighboring city of White Settlement, in those areas where the overlying confining bed separating the aquifer from the contaminated upper zone is absent. Contamination

in the Paluxy Aquifer has been confirmed at one location east of the west employee parking lot, less than 100 feet east of the excavation of the former waste oil pits. However, the absence of contaminants in other Paluxy monitoring and production wells on and near Air Force Plant 4 property has indicated that contamination of this aquifer is not widespread. Additional Paluxy wells to better define the vertical and horizontal extent of contamination within the Paluxy Aquifer are currently being installed.

E. The presence of volatile organic compounds, including trichloroethylene (40 to 4,000 μg/L) and 1,2-trans-dichloroethylene (13 to 1,800 μg/L) in upper zone monitor wells HM-11 and HM-31, located along the south property boundary, causes concern that migration of hazardous contaminants beyond the Air Force Plant 4 property may be occurring to the south. However, EPA monitor wells located approximately 700 to 800 feet further south have been free of these contaminants. The presence of volatile organic compounds, including trichloroethylene (10 to 500 μg/L) and 1,2-trans-dichloroethylene (120 to 10,000 μg/L) in upper zone monitor wells HM-21, 26, and 27, located near the west property line causes concern for potential contaminant migration beyond Air Force Plant 4 property to the west.

F. No evidence of significant environmental stress due to past disposal/spills of hazardous wastes was observed at Air Force Plant 4.

G. The potential exists for surface-water migration of hazardous contaminants due to the proximity of identified sites to Meandering Road Creek and to Lake Worth. In

addition, upper zone ground water carrying dissolved contaminants may discharge to these surface waters.

H. Table 26 presents a priority listing of the rated sites and their overall scores. The following sites were designated as areas showing the most significant potential (relative to other Air Force Plant 4 sites) for environmental concerns:

1. SITE NO. 1, LANDFILL NO.1

Several types of hazardous and non-hazardous wastes were reportedly disposed of in Landfill No. 1, including drums of liquid wastes and contents of tanks and bousers loaded with chemical wastes (solvents, thinners, paints, etc.). Miscellaneous contaminated oils and fuels and other hazardous wastes are suspected to be present at this site, including metals (e.g., mercury, magnesium, etc.), chromate sludges, and cyanide.

Extensive remedial actions have been conducted at this site since it was closed during the 1960s; however, evidence of contamination still remains.

Landfill No. 1 (Site 1) received an overall HARM rating score of 88, primarily due to: 1) the reported disposal of a large quantity of hazardous wastes, 2) many receptors in the vicinity of the site, including residential development, surface water bodies, and water supply wells, and 3) the confirmed presence of migration of hazardous substances from the site. Because of the remedial actions that have been conducted at this site to date, the HARM score was reduced by 5 percent on the basis of waste management practices. However, because of the reports concerning considerable random dumping of hazardous

Table 26
PRIORITY LISTING OF DISPOSAL AND SPILL SITES

Ranking	Site No.	Site Name	Overall Score
1	1	Landfill No. 1	88
2	3	Landfill No. 3	86
3	12	Chrome Pit No. 3	74
4	17	Former Fuel Storage Site	73
--	2	Landfill No. 2	73
5	4	Landfill No. 4	66
6	13	Die Pits	64
7	20	Wastewater Collection Basins	63
8	16	Fuel Saturation Area No. 3	62
9	9	FDTA No. 6	58
--	6	FDTA No. 3	58
--	7	FDTA No. 4	58
--	18	Solvent Lines	58
10	10	Chrome Pit No. 1	55
--	11	Chrome Pit No. 2	55
11	15	Fuel Saturation Area No. 2	54
12	8	FDTA No. 5	53
13	5	FDTA No. 2	51
--	14	Fuel Saturation Area No. 1	51
14	19	NARF Area	6

substances throughout the landfill, and because of the presence of several oil and chemical waste pits other than those excavated, it is suspected that a considerable quantity of hazardous materials may still be present at Site No. 1.

2. SITE NO. 3, LANDFILL NO. 3

Interviewees reported that this site was used for disposal of miscellaneous wastes from about 1942 to 1945, including hazardous liquid wastes consisting of mixed oils and solvents. One or more pits were present in this area during the 1940s and were used for holding and burning some of the liquid wastes. Other wastes are suspected to have been disposed of on the ground and then buried. Water quality analyses from upper zone monitoring wells at this site (HM-26 and HM-27) have indicated the presence of elevated levels of VOCs in the ground water (see Appendix G, Table G.1). This data was considered to be indirect evidence for contaminant migration at Site No. 3.

Landfill No. 3 (Site 3) received an overall HARM rating score of 86, primarily due to: 1) the reported disposal of large quantities of hazardous liquid wastes at this site, 2) the presence of nearby vulnerable receptors such as residential areas, Lake Worth, and water supply wells, 3) the presence of a surface water pathway for waste migration in the adjacent creek leading to Lake Worth, and 4) indirect evidence of a ground-water migration pathway.

3. SITE NO. 12, CHROME PIT NO. 3.

Chromate and other chemical wastes were disposed of at this site from about 1957 until 1973. Barium chromate sludge, dilute metal solutions, and drums of unidentified liquids were disposed of in this pit.

Soil borings and shallow groundwater sampling conducted in 1982 confirmed contamination at this site. Contaminated soils were excavated from this site during December 1983, and January 1984. Soil testing conducted during the excavation indicated that most significantly contaminated soils were removed from the site.

Chrome Pit No. 3 (Site 12) received an overall HARM rating score of 74, primarily due to 1) the proximity of the site to the installation boundary (900 feet), residential areas, and water supply wells (2,000 feet), which gave it a Total Gross Score of 78, and 2) a 5-percent reduction of this Total Gross Score due to waste management practices (limited containment).

4. SITE NO. 17, FORMER FUEL STORAGE SITE

This site was the former location of a 100,000-gallon JP-4 aboveground fuel storage tank from the early 1940s until it was relocated in 1962. Sampling at this site in 1982 confirmed that soils and underlying groundwater are contaminated by fuels and other organic compounds.

The former fuel storage site (Site 17) received an overall HARM rating score of 73, primarily due to: 1) the proximity of the site to the installation boundary (520 feet) and adjacent residential areas, 2) the presence of water supply wells within 2,100 feet of the site, and 3) the indirect evidence of migration of hazardous wastes into the groundwater at this site.

5. SITE NO. 2, LANDFILL NO. 2

The site originally consisted of some low areas and a livestock watering hole. The majority of this site was reportedly filled with construction rubble, plasters, and fill dirt during the early 1940s. However, some activity at the stock watering hole at this site is evident on aerial photographs up until at least 1962. This area was reportedly used for disposal of lumber and tires and was assumed to be periodically burned. There were no verbal reports of hazardous substances being deposited at this site; however, it is likely that small quantities of wastes were infrequently disposed of at Site No. 2.

Landfill No. 2 (Site 2) received an overall HARM rating score of 73, primarily due to: 1) presence of residential areas within one mile of the site, 2) the proximity of a creek within 420 feet of the site with surface flows to Lake Worth, 3) the presence of water supply wells within 1,300 feet of the site, and 4) indirect evidence of contaminant migration. An upper zone monitoring well installed at this site in 1983, HM-2, confirmed the presence of several VOCs in shallow ground water beneath the site (see Appendix G, Table G.1). The presence of these contaminants is considered to be indirect evidence of a contaminant migration pathway at the site.

6. SITE NO. 4, LANDFILL NO. 4

Landfill No. 4 was reportedly used for disposal of clean construction rubble from its start in about 1956 until closure some time in the early 1980s. Aerial photographs of the site and at least one memo dated 1973 indicate that other types of wastes may have been disposed of at this site from the time of closure of

Landfill No. 1 (1966) until at least 1973. Based on this evidence, small suspected quantities of high hazard wastes (solvents, oils, fuels, thinners, etc.) are thought to be present in this landfill. Two upper zone monitoring wells installed at this site in 1982, HM-5 and HM-9, have been found to contain VOCs and other organic compounds (see Appendix G, Table G.1). This data is considered to be indirect evidence of migration at this site. Recent data from these wells have been negative for these compounds.

Landfill No. 4 (Site 4) received an overall HARM rating score of 66, primarily due to: 1) its proximity to the installation boundary (150 feet) and adjacent residential areas, 2) its proximity to the Meandering Road Creek (100 feet), 3) the presence of water supply wells within 2,000 feet of the site, and 4) indirect evidence of a shallow ground-water pathway for contaminant migration.

7. SITE NO. 13, DIE PITS

These pits were used for disposal of chromate sludges, metal solutions, and other chemical wastes until 1962, when the site was graded and the entire die yard was paved. One interviewee reported that some of the contaminated soils at this site were spread around the die yard during the grading and levelling activities. The site of the original pits was excavated in 1983-84. No quantitative analysis of soils from other parts of the die yard were made at that time.

The die pits (Site 13) received an overall HARM rating score of 64, primarily due to: 1) the proximity of the site to the installation boundary (100 feet), residential areas, and water supply wells (1,000 feet), which gave it a Total Gross Score of 68, and 2) a 5-percent reduction of this Total Gross Score due to waste management practices (limited containment).

8. SITE NO. 20, WASTEWATER COLLECTION BASINS

Two concrete-lined waste basins with approximately 85,000-gallon capacity each are used to collect and settle suspended solids from chemical wastewaters before discharge to the City of Fort Worth sanitary sewer system. The basins have been used from approximately 1966 until the present. Written correspondence and interviewees indicated that several spills of vapor degreaser tanks in the Process Building have occurred since installation of these tanks. Much of the spilled chemicals (primarily trichloroethylene) have flowed to the basins via floor drains. Because of concerns about VOCs and the possibility of cracks or leaking drains in these basins, they are suspected as being a possible source of ground-water contamination by organic chemicals and metals.

The Waste Collection Basins site (Site 20) received an overall HARM rating score of 63, primarily due to: 1) the proximity of the site to the installation boundary (400 feet) and adjacent residential areas, 2) the presence of water supply wells within 1,200 feet of the site, and 3) the presence of ground water within 10 feet of the ground surface at the site.

9. SITE NO. 16, FUEL SATURATION AREA NO. 3

This site reportedly became saturated by fuels due to leaks in buried fuel lines from the mid-1970s until the early 1980s.

Fuel Saturation Area No. 3 (Site 16) received an overall HARM rating score of 62, primarily due to: 1) a large reported quantity of fuel-saturated soils at this

site, 2) the proximity of the installation boundary (200 feet) and adjacent residential areas, 3) the presence of water supply wells within 3,000 feet of the site, and 4) the proximity of the site to Lake Worth (500 feet).

10. SITE NO. 9, FDTA NO. 6

Before 1970, training exercises were conducted two times per year at this site. After 1970, exercises were conducted at monthly intervals at this site. Approximately 250 gallons of waste fuels and oils were reportedly used for each exercise. In addition, it is suspected that larger quantities of contaminated fuels and oils were deposited in the FDTA between exercises.

In 1983 FDTA No. 6 (Site 9) was excavated and removed as part of the hazardous waste remedial actions being conducted at Air Force Plant 4. No monitoring wells have been installed at this site to determine the status of ground-water contamination.

FDTA No. 6 (Site 9) received an overall HARM rating score of 58, primarily due to: 1) the proximity of the site to the installation boundary (220 feet), residential areas, Lake Worth (220 feet), and water supply wells (2,000 feet), which gave it a Total Gross Score of 61, and 2) a 5-percent reduction of this Total Gross Score due to waste management practices (limited containment).

11. SITE NO. 6, FDTA NO. 3

Training exercises used small quantities (about 250 gallons per exercise) of waste fuels and oils. This site is not readily visible on historical aerial photographs, so that its location and current condition could not be accurately determined.

FDTA No. 3 (Site 6) received an overall HARM rating score of 58, primarily due to: 1) the proximity of the installation boundary (80 feet) and adjacent residential areas, 2) the proximity of the site to Meandering Road Creek (120 feet), and 3) the presence of water supply wells within 2,000 feet of the site.

12. SITE NO. 7, FDTA NO. 4

Training exercises used small quantities (about 250 gallons per exercise) of waste fuels and oils. This site is not readily visible on historical aerial photographs of Air Force Plant 4, so that its location and current condition could not be accurately determined.

FDTA No. 4 (Site 7) received an overall HARM rating score of 58, primarily due to: 1) the proximity of the installation boundary (400 feet) and adjacent residential areas, 2) the proximity of the site to Lake Worth (400 feet), and 3) the presence of water supply wells within 2,500 feet of the site.

13. SITE NO. 18, SOLVENT LINES

These lines reportedly leaked during the 1940s before they were drained, capped, and abandoned-in-place in 1944. The actual locations of the leaks could not be determined based on interviews. The contents of these solvent lines reportedly included xylene, methyl ethyl ketone, and kerosene.

The Solvent Lines (Site 18) received an overall HARM rating score of 58, primarily due to: 1) the proximity of the site to the installation boundary (550 feet) and adjacent residential areas, and 2) the presence of water supply wells within 2,500 feet of the site.

14. SITE NO. 10, CHROME PIT NO. 1

It is suspected that miscellaneous liquid and solid chemical wastes, in addition to chrome wastes, were disposed of at this site. The actual location of this site could not be accurately confirmed based on interviews or aerial photographs.

Chrome Pit No. 1 (Site 10) received an overall HARM rating score of 55, primarily due to: 1) its proximity to the installation boundary (800 feet) and adjacent residential areas, and 2) the presence of water supply wells within 1,200 feet of the site.

15. SITE NO. 11, CHROME PIT NO. 2

It is suspected that miscellaneous liquid and solid chemical wastes, in addition to chromate solutions, were disposed of at this site. The actual location of this site could not be accurately confirmed based on interviews or aerial photographs.

Chrome Pit No. 2 (Site 11) received an overall HARM rating score of 55, primarily due to: 1) its proximity to the installation boundary (500 feet) and adjacent residential areas, and 2) the presence of water supply wells within 3,000 feet of the site.

16. SITE NO. 15, FUEL SATURATION AREA NO. 2

This site reportedly became saturated by fuels due to leaks in buried fuel lines between the 1970s and the early 1980s.

Fuel Saturation Area No. 2 (Site 15) received an overall HARM rating score of 54, primarily due to:

1) the proximity of the site to the installation boundary (250 feet) and residential areas, 2) the presence of water supply wells within 2,000 feet of the site, and 3) the proximity of the site to Lake Worth (500 feet).

17. SITE NO. 8, FDTA NO. 5

This site consisted of a shallow pit in which waste fuels, oils, or chemicals were deposited for training exercises. This site is located in the die yard area south of Warehouse 1 and has been graded and paved.

FDTA No. 5 (Site 8) received an overall HARM rating score of 53, primarily due to: 1) the proximity of the installation boundary (350 feet) and adjacent residential areas, 2) the presence of water supply wells within 1,000 feet of the site, and 3) the suspected presence of groundwater within 10 feet of the soil surface at this site.

18. SITE NO. 5, FDTA NO. 2

Exercises were held infrequently (twice per year); however, disposal of waste oils and fuels and uncontrolled burns may have been more frequent. This site is currently located under the pavement in the west employee parking area.

FDTA No. 2 (Site 5) received an overall HARM rating score of 51, primarily due to: 1) the proximity of the installation boundary (400 feet) and adjacent residential areas, 2) the proximity of the site to Meandering Road Creek (400 feet), and 3) the presence of water supply wells within approximately 1,200 feet of the site.

19. SITE NO. 14, FUEL SATURATION AREA NO. 1

The ground at this site reportedly became saturated by fuels due to leaks in buried fuel lines from the 1970s up until the early 1980s.

Fuel Saturation Area No. 1 (Site 14) received an overall HARM rating score of 51, primarily due to: 1) the proximity of the site to residential areas (1,200 feet), and 2) the presence of water supply wells within 2,000 feet of the site.

I. The remaining site (Site 19, NARF Area) was not considered to present significant concern for adverse effects on health or the environment.

VI. RECOMMENDATIONS

VI.
RECOMMENDATIONS

A. INTRODUCTION

The priority for continued monitoring at Air Force Plant 4 is considered high in light of confirmed findings of ground-water contamination. On-going monitoring efforts should be supplemented as described below to complete the confirmation and quantification of groundwater contamination at the installation. General and site-specific recommendations are provided.

Tables 27 and 28 present a listing of the recommended monitoring sites, parameters to be measured, and the rationale for the analyses. Specifically, monitoring is recommended at all sites listed in Table 26 (Section V), with the exception of Site No. 19, the NARF Area.

B. PHASE II MONITORING

1. INTRODUCTION

The Phase II Installation Restoration Program consists of the necessary fieldwork to confirm the direction, rate of movement, and the extent of contamination. As currently implemented, USAF-OEHL conducts Phase II in five stages:

- Stage 1: Confirmation of Contamination
- Stage 2: Quantification of Contamination
- Stage 3: Movement of Contamination
- Stage 4: Extent of Contamination
- Stage 5: Remedial Action Recommendations

Table 27
RECOMMENDED MONITORING ANALYSES

Location	Sample Type			Analyses			
	GW	Soil	SW	VOC	B/N	Heavy Metals	Jet Fuel
Site No. 1		X		X	X	X	
Site No. 3	X			X	X	X	
			X	X	X	X	
		X		X	X	X	
Site No. 12	X			X	X	X	
Site No. 13	X			X	X	X	
Site No. 17	X						X
Site No. 2		X		X	X	X	
	X			X	X	X	
Site No. 4	X			X	X	X	
Site No. 20	X			X		X	
Site No. 14		X					X
	X						X
Site No. 15		X					X
	X						X
Site No. 16		X					X
	X						X
Site No. 9		X		X	X		
Site No. 5		X		X	X		X
	X			X	X		X
Site No. 6		X		X	X		X
	X			X	X		X
Site No. 7		X		X	X		X
	X			X	X		X
Site No. 8		X		X	X		X
	X			X	X		X
Site No. 18		X		X			
	X			X			
Site No. 10		X		X	X	X	
Site No. 11		X		X	X	X	
	X			X	X	X	

Legend:
GW: Ground water
SW: Surface water
VOC: Volatile organic compounds
B/N: Base/neutral organic compounds

Table 28
RATIONALE FOR RECOMMENDED ANALYSES

Parameters	Rationale
VOC	Organic solvents used at Air Force Plant 4; persistent components of fuels and other POL products, e.g., benzene and toluene
B/N	Fuel components; synthetic chemicals
Heavy metals (particularly chromium)	Paint wastes; metal treating and plating operations
Jet fuel	Jet fuel contamination

Stage 1, Confirmation of Contamination, consists of field monitoring (soil analyses, ground-water samples, etc.) to confirm the existence of contaminants at the site. If contamination is confirmed, the study proceeds to Stage 2, Quantification of Contamination, where additional monitoring is conducted to define the magnitude of the contamination. Stage 3, Movement of Contamination, consists of further field studies (e.g., hydrogeological and additional ground-water sampling) to determine if contaminants are migrating from the site, and if so, in what direction. Stage 4, Extent of Contamination, consists of continuing investigations to define the overall size of the affected area.

After conclusion of the first four stages, Remedial Action Recommendations (Stage 5) are made. Recommendations are made for each site in accordance with the findings. Each site will be listed by categories. Category I shall include sites where no further action (including remedial action) is required. Data for these sites is considered sufficient to rule out unacceptable health or environmental risks. Category II sites are those requiring additional monitoring or work to quantify or further assess the extent of current or future contamination. Category III sites are those that will require remedial actions (ready for IRP Phase IV actions). In each case, the Phase II contractor will summarize or present the results of field data, environmental or regulatory criteria, or other pertinent information supporting these conclusions.

2. GENERAL RECOMMENDATIONS

a. Upper Zone Water Table Measurement

Water level measurements should be made in each upper zone monitor well--existing and proposed--to

better define the hydraulic gradients within the upper zone. Measurements should be made during both dry and wet seasons to determine the effects of precipitation and evapotranspiration on the localized hydraulic gradients near each identified disposal site.

b. Paluxy Water Table Measurement

Water level measurements should be made in each Paluxy monitor well, existing and proposed, to define the hydraulic gradient in the vicinity of Air Force Plant 4.

2. SITE-SPECIFIC RECOMMENDATIONS

a. General

The recommendations for specific sites include installation of soil borings and monitoring wells. Soil borings are proposed as single boreholes, and in several cases, particularly for landfills, as a grid of boreholes. The grid approach was chosen as the most practical method to define the horizontal and vertical extent of contamination at a specific site. Figures for each site show the approximate location for the grid systems; however, the number and location of the boreholes should be considered approximate. The Phase II contractor should review available aerial photographs to best delineate the site boundaries prior to mapping the grid system. During installation, the Phase II contractor should expand the grid as required to adequately define the horizontal extent of contamination. Unless stated otherwise, all borings should be installed to the top of the Walnut Formation.

At sites for which grid systems have been proposed, borehole installation should be conducted in a staged approach. The first set of holes should be drilled at the grid nodes located in the area(s) considered most likely to contain the suspected contamination. A certified geologist should be present to examine soil profiles and characteristics and to inspect for signs of soil contamination (odor, discoloration, vapors). Continuous soil samples should be collected and classified by texture, appearance, odor, and organic vapor detection. Selected samples, based on the judgment of the onsite certified geologist, should be analyzed in accordance with Table 27. Second and additional (if required) stages of drilling, sampling, and analysis should be conducted at selected nodes located radially outward from the initial nodes until the horizontal and vertical extent of contamination has been defined.

Proposed monitor wells include upper zone and Paluxy wells. Construction should be in accordance with those recently installed by Hargis & Montgomery. Figures 21, 22, and 23 show the typical construction for upper zone and Paluxy monitor wells.

The recommended monitoring analyses in Table 27 generally apply to first-round sampling events. Recommended analyses for additional rounds of sampling may require revision based on the findings of the first round of sampling.

b. Landfill No. 1 (Site No. 1)

Soil borings are recommended to delineate the remaining area of contamination within the landfill. A grid system of borings located on 50-foot centers as shown in Figure 24 is proposed, to define the areal limits of the

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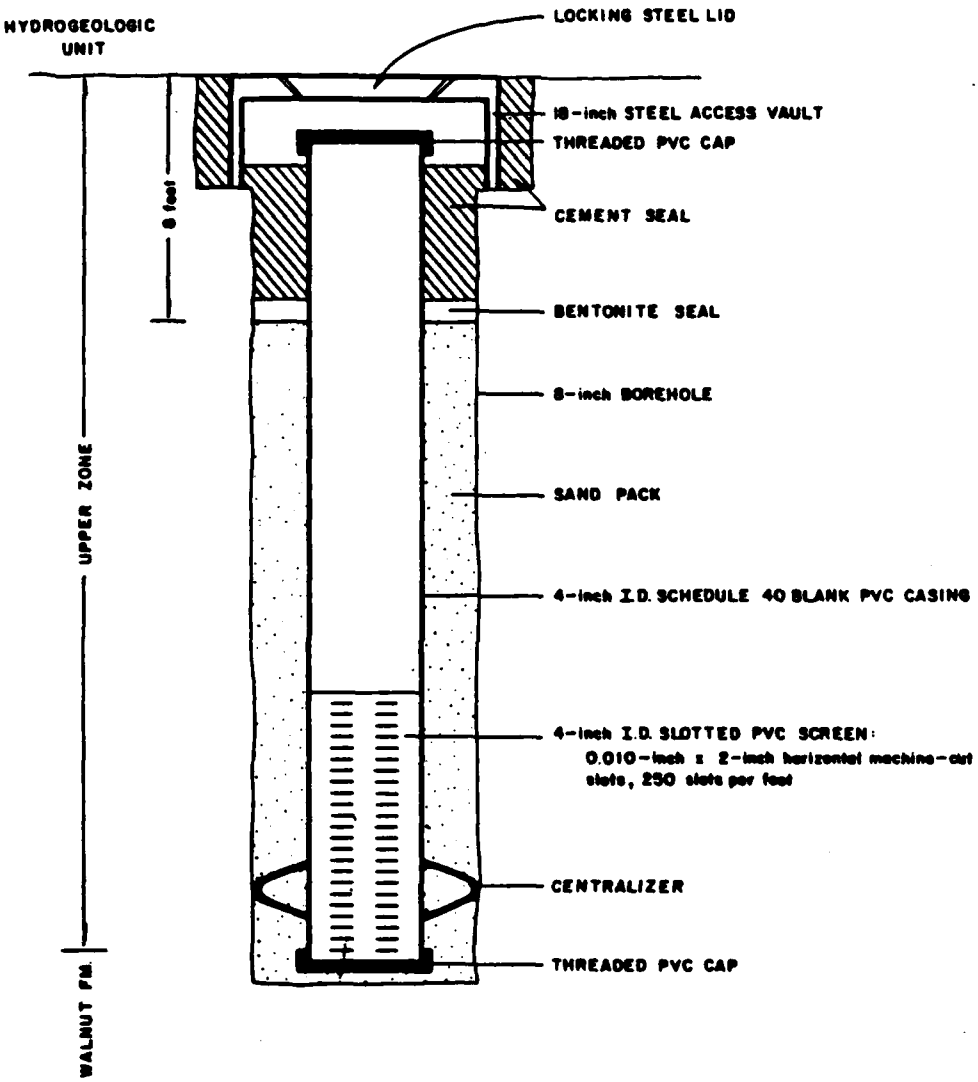

Source: Hargis & Montgomery

FIGURE 21.
Typical Upper Zone Monitor Well.

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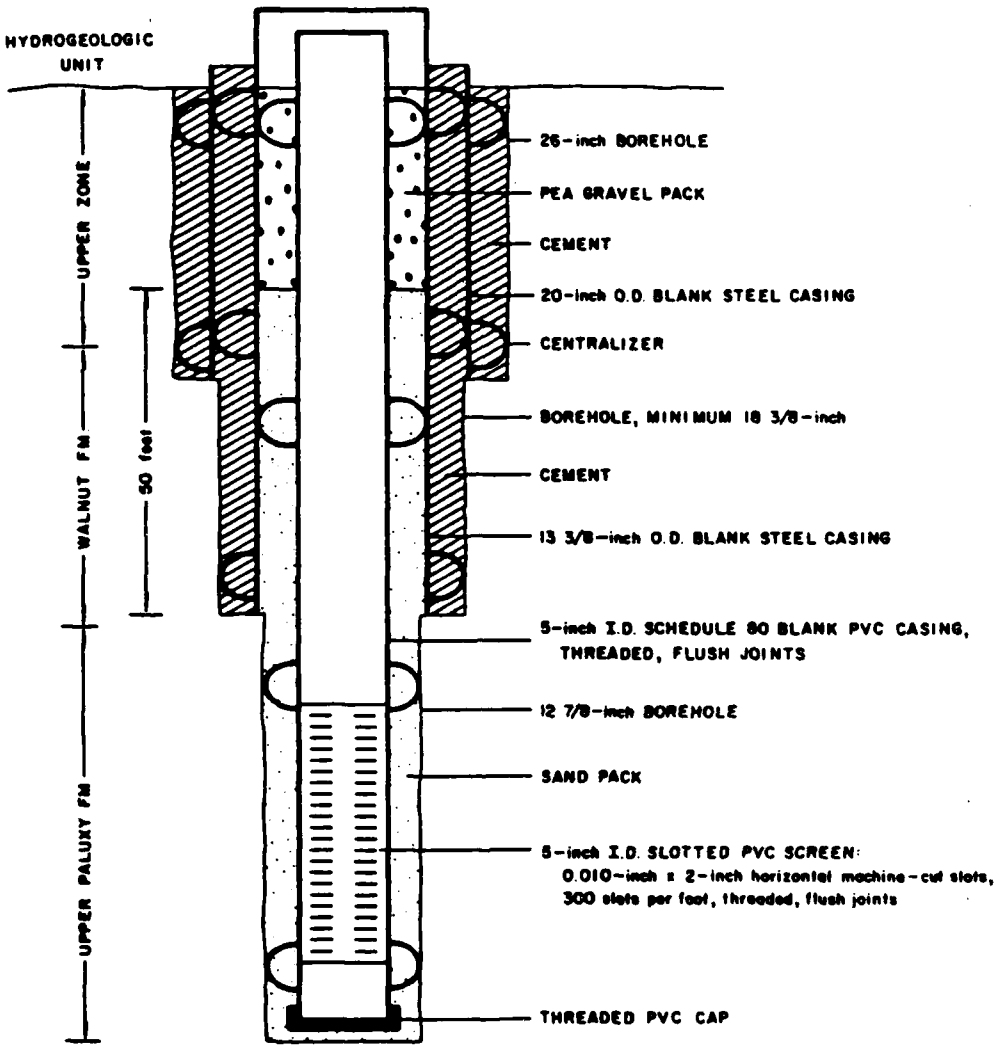

Source: Hargis & Montgomery.

FIGURE 22.
Typical Upper Paluxy Monitor Well.

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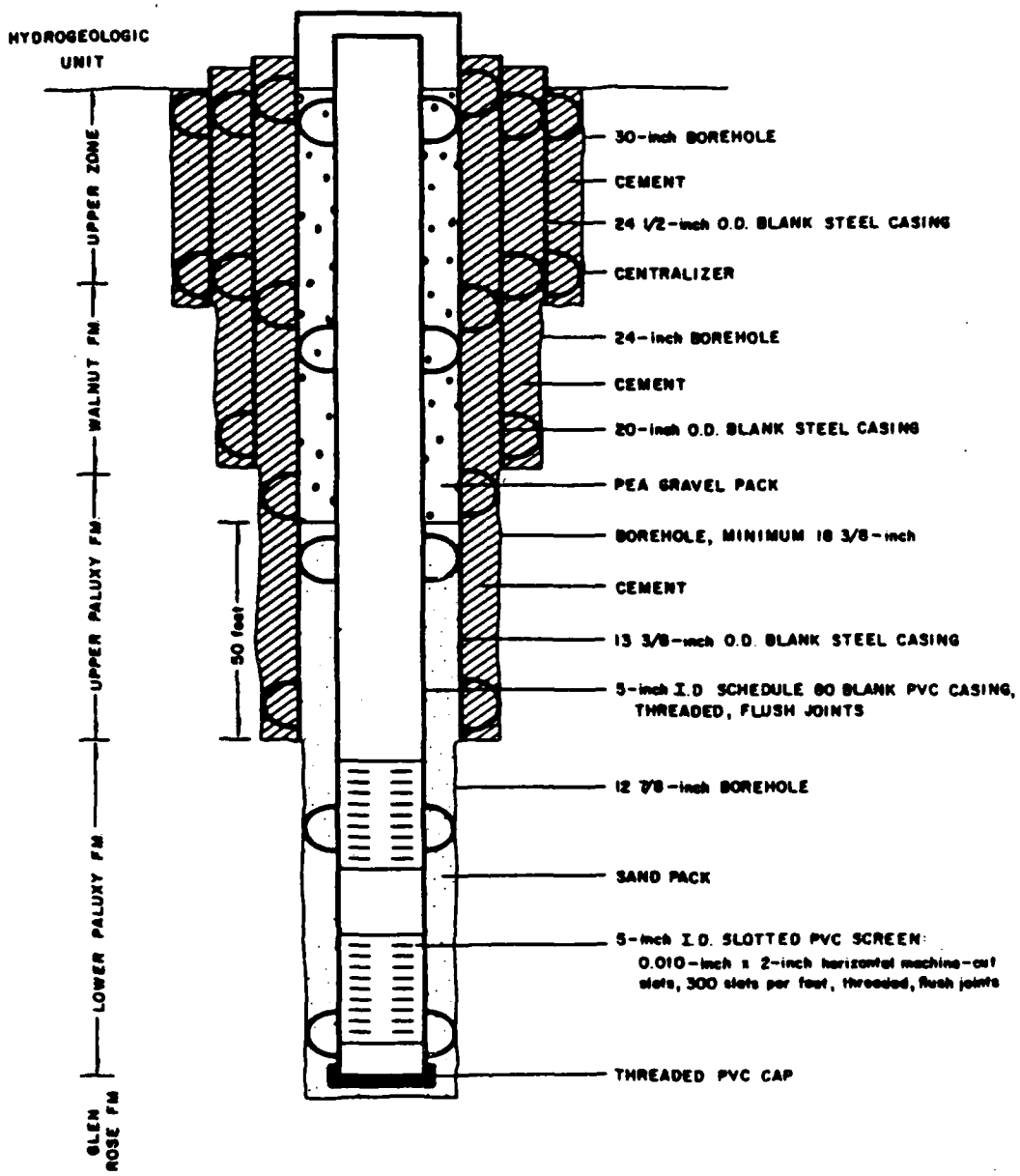

Source: Hargis & Montgomery.

FIGURE 23.
Typical Lower Paluxy Monitor Well.

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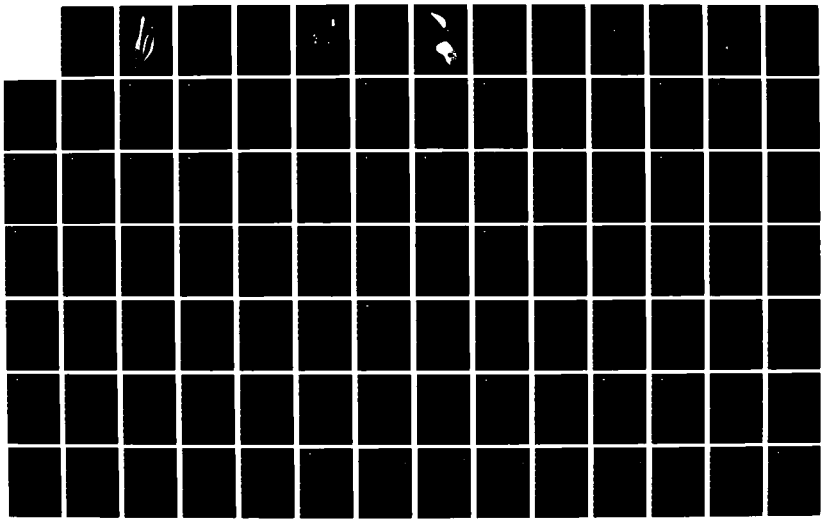

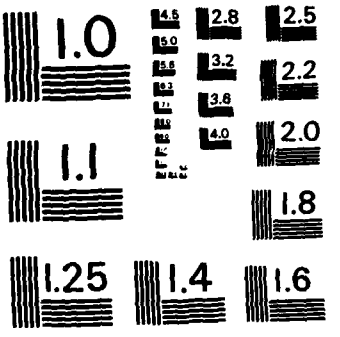

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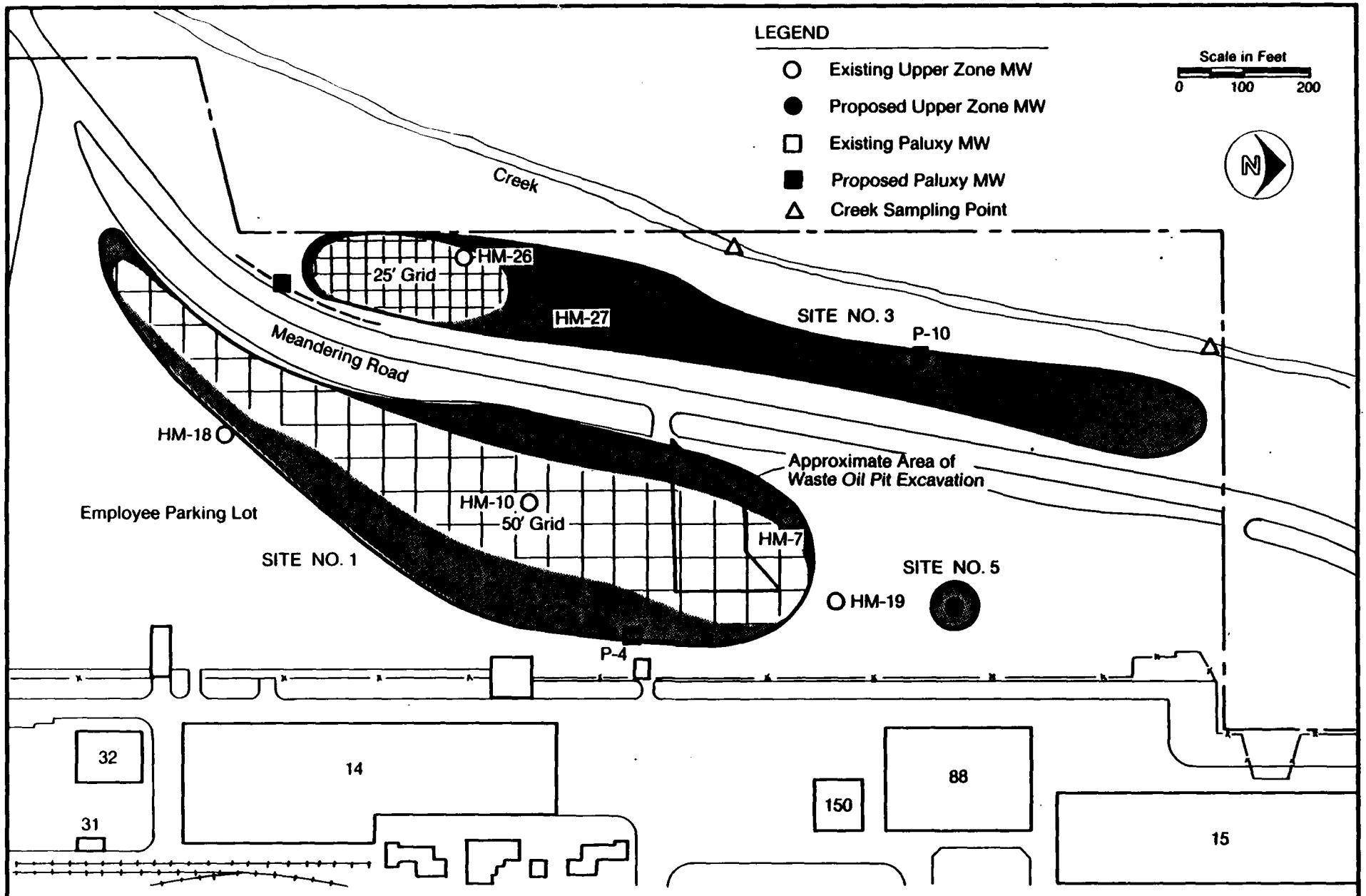

FIGURE 24.
Recommended Preliminary Sampling Locations for Sites No. 1, 3, and 5.

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contaminated fill. Installation of the boreholes, sampling and analysis of soil samples, should be conducted as outlined above (Section VI.B.3.a., "General").

Based on the physical appearance and odor of soils removed during the borehole installation, the Phase II contractor may consider it advisable to convert one or several boreholes to upper zone monitoring wells.

Ground-water recovery and disposal operations at the site of the waste oil pits excavation should be continued.

c. Landfill No. 3 (Site No. 3)

Soil borings are recommended to delineate the area of suspected contamination associated with a former waste disposal pit located within Landfill No. 3. A grid system of borings located on 25-foot centers located approximately as shown in Figure 24 is proposed to define the areal limits of contamination.

A 25-foot grid (as opposed to a 50-foot grid) has been chosen for this site because the suspected area of contamination is smaller than in Landfill No. 1 and a larger spaced grid system would not provide sufficient data to properly define the areal limits of contamination. Installation of the boreholes, sampling and analysis of soil samples, should be conducted as outlined above (Section VI.B.3.a., "General").

Current plans at Air Force Plant 4 include the installation of a Paluxy well at this site (see Figure 18). In addition, a second Paluxy well downgradient of the site and located approximately as shown in Figure 24

should be installed into the upper sand member. This well should be located based on actual potentiometric data establishing downgradient direction. If contamination is found in the upper sand member of either of the two Paluxy wells, then wells should also be constructed into the lower sand member to determine if contamination has moved downward through the aquifer. Wells should be sampled in accordance with Table 27.

The creek along the western boundary of this site should continue to be monitored in accordance with Table 27.

d. Chrome Pit No. 3 and Die Pits (Sites No. 12 and 13, respectively)

Existing upper zone and Paluxy monitor wells in the vicinity of these sites are considered adequate for ground-water monitoring (Figure 25). Continued post-closure monitoring should be conducted and analyses should include metals (particularly chromium), VOCs, and B/N organic compounds.

e. Former Fuel Storage Area (Site No. 17)

Examination of existing upper zone monitor well HM-8 for the existence of a free product lens of fuel is recommended. The well should first be drawn down and allowed to recover. This procedure is necessary since this well is screened below the water table, rather than across the water table. A thorough drawdown of the well should allow recovery of any floating fuel on the ground water in the vicinity of the well. The existence and estimated thickness of a lens of free product fuel can be determined

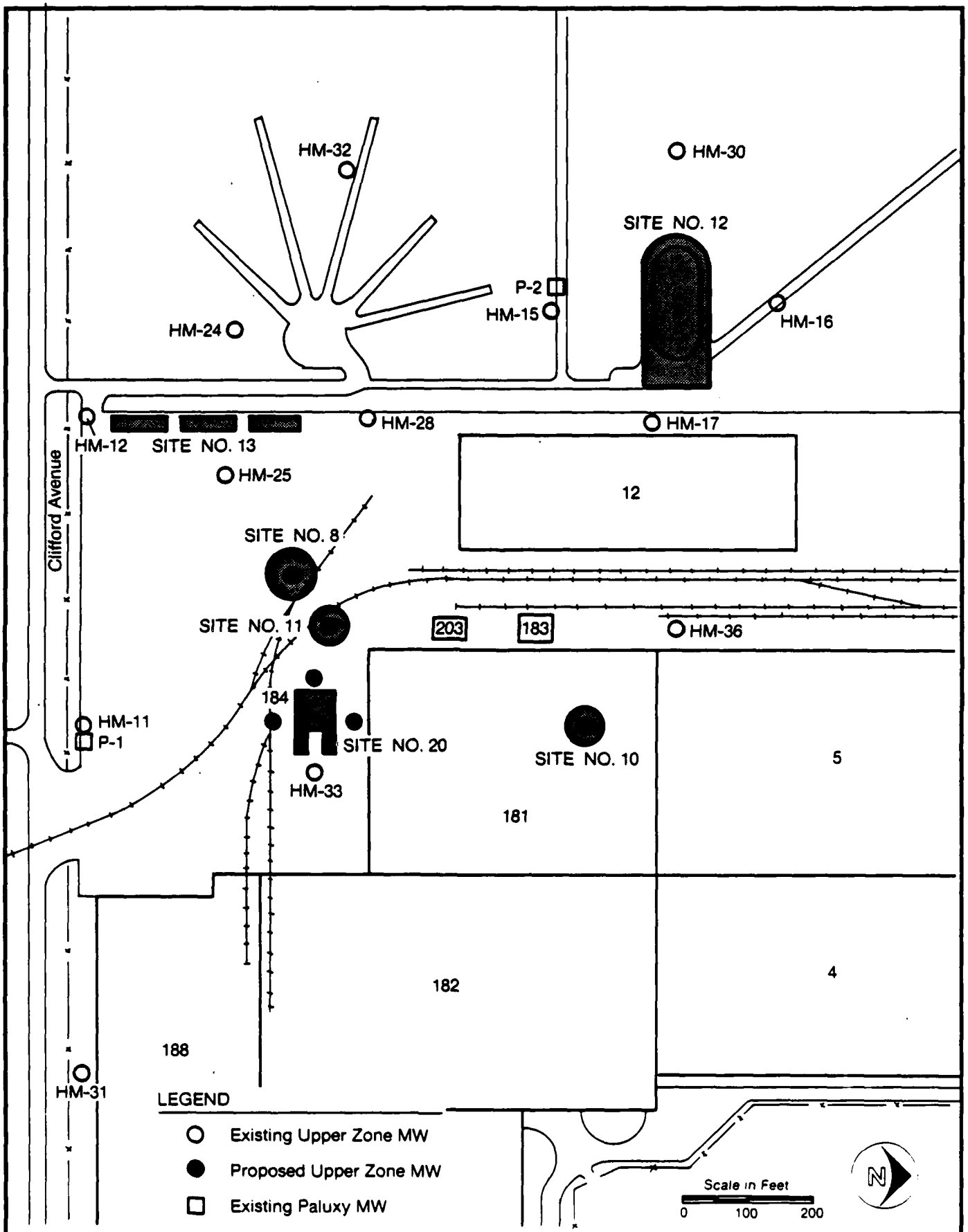

FIGURE 25.
Recommended Preliminary Sampling Locations for Sites No. 8, 10, 11, 12, 13, and 20.

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with a special metal tape coated with water and oil-finding pastes. If no sign of fuel are detected, then no further action is recommended at this site.

If a fuel lens is detected in HM-8, four upper zone monitor wells, screened across the water table, should be installed on the periphery of the former fuel tank storage location, spaced 90 degrees apart. Determine the approximate areal extent and thickness of the lens with the metal tape coated with water and oil-finding pastes.

f. Landfill No. 2 (Site No. 2)

Soil borings in the vicinity of the former stock watering hole are recommended to delineate the boundaries of suspected contamination at this site. A grid system of borings located on 25-foot centers with approximate locations as shown in Figure 26 is proposed, to define the areal limits of contamination.

Installation of boreholes, sampling and analysis of soil samples should be conducted as outlined in Section VI.B.3.a., "General".

One borehole should be converted to an upgradient monitor well and three boreholes should be converted to downgradient monitor wells as shown approximately in Figure 26.

One downgradient Paluxy monitor well should also be installed. This well should be constructed into the upper sand member of the Paluxy Formation. If subsequent analyses of ground water indicate contamination in the upper sand member, a second Paluxy well should be installed into the lower sand member.

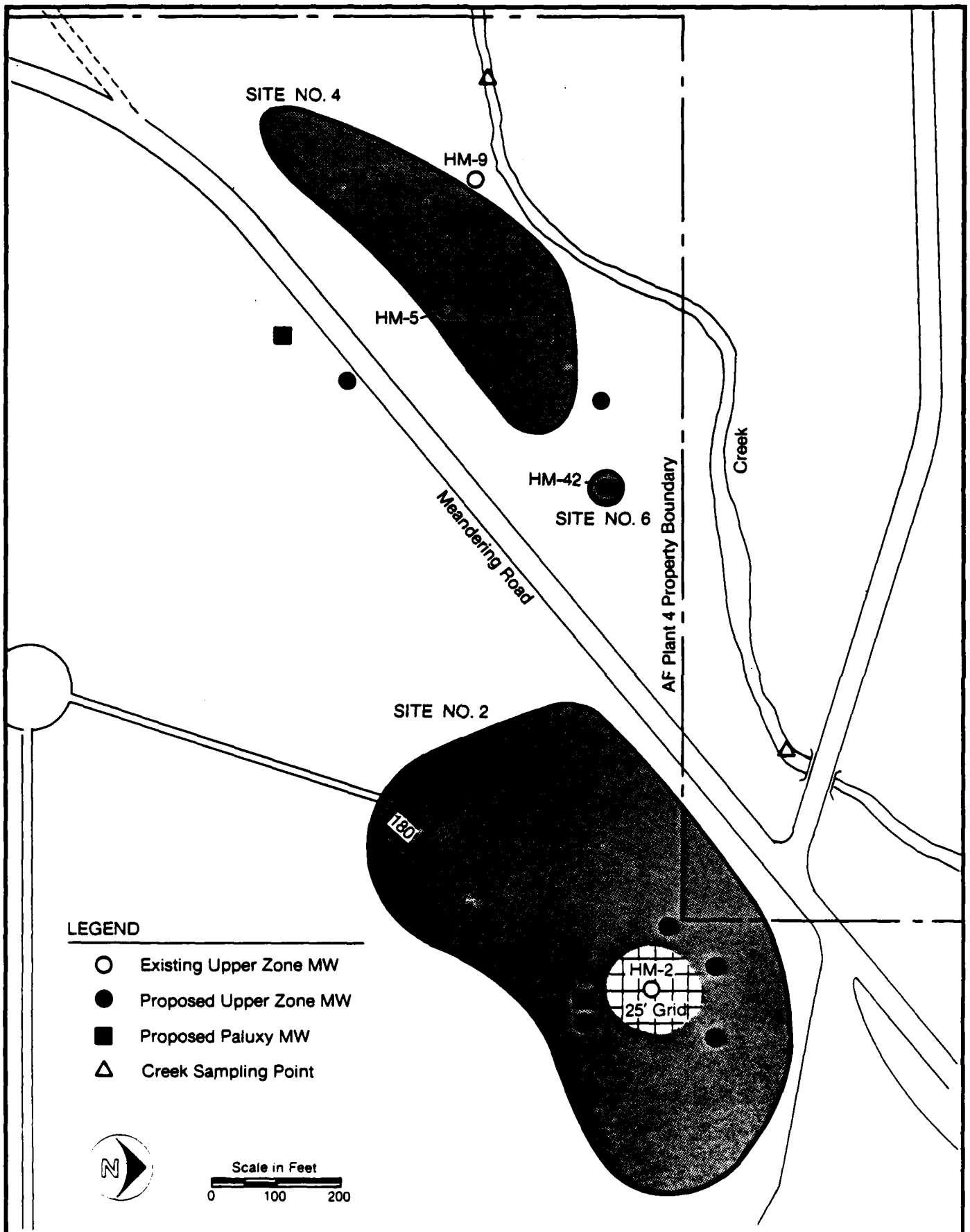

FIGURE 26.
Recommended Preliminary Sampling Locations for Sites No. 2, 4, and 6.

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Ground-water samples from the proposed upper zone wells and the proposed Paluxy well should be analyzed in accordance with Table 27. Continued monitoring should be dependent on the findings of the first sample event.

g. Landfill No. 4 (Site No. 4)

Two downgradient and one upgradient upper zone monitor wells are recommended and should be located as shown in Figure 26. Note that one of the downgradient wells and the upgradient are at the locations proposed by Hargis & Montgomery for Wells HM-42 and 43 (see Figure 18).

A Paluxy downgradient well into the upper sand member is also proposed (Figure 26). If found to be contaminated, a Paluxy well into the lower sand member should also be installed.

Sampling and analysis of wells, including the existing (HM-5, 9) and proposed wells should be in accordance with Table 27.

h. Wastewater Collection Basins (Site No. 20)

In addition to upper zone monitor well HM-33, located east of the site, install three upper zone wells on the remaining three sides (Figure 25). The purpose of these wells is to determine if contaminants are leaching through the bottom of the basins. Justification for this concern is based on the continual findings of contamination in upper zone monitor well HM-31, located about 700 feet east-southeast from the basins.

Wells, including existing HM-33, should be sampled and analyzed in accordance with Table 27. In addition, water table levels should be measured to determine

the hydraulic gradient in the vicinity of the basins. If contamination is found beneath the basins, knowing the local hydraulic gradient could be useful in confirming the basins as a possible source of the contamination being detected in HM-31.

1. Fuel Saturation Areas No. 1, 2, and 3 (Sites No. 14, 15, and 16, respectively)

Three soil borings are recommended along the length of the buried fuel line. The borings should be completed in the areas of suspected fuel saturation and to at least 2 feet below the water table elevation (see Figure 27).

Based on a visual analysis of the soils, at least one borehole should be converted to an upper zone monitor well. To permit detection and measurement of a free product fuel lens on the water surface, the well should be screened across the water table, at least one foot above and two feet below.

The well should be sampled and analyzed in accordance with Table 27. During the first round of sampling, after the well has been pumped down and allowed to recover, the presence and estimated thickness of a free product fuel lens should be determined. This can be accomplished through the use of a special steel measuring tape coated with water and oil-finding pastes.

If findings indicate that saturation below the fuel line exists and may extend over much of the pipeline, a program should be developed to investigate the entire fuel line and subsurface.

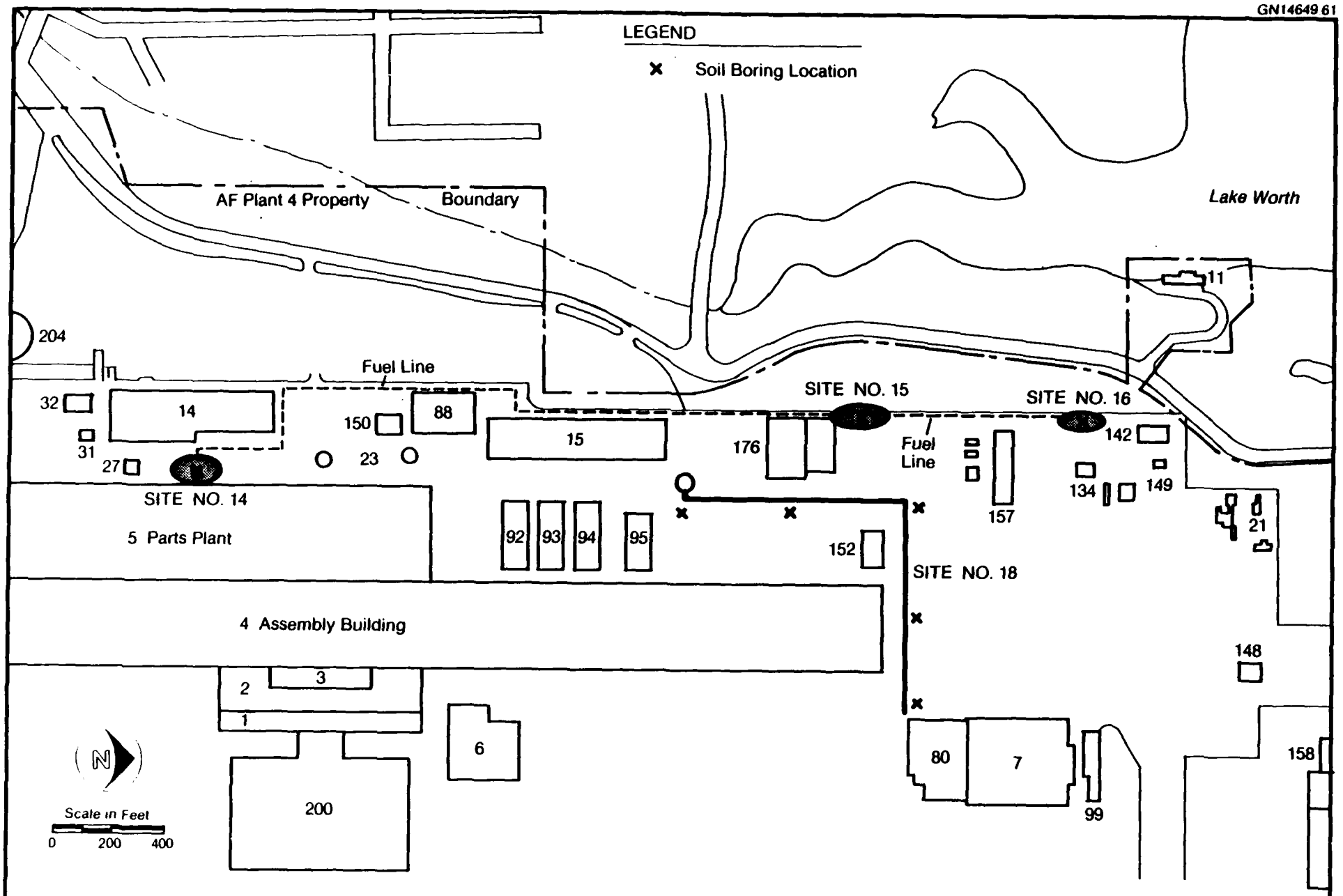

FIGURE 27.
Recommended Preliminary Sampling Location for Sites No. 14, 15, 16, and 18.

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j. FDTA No. 6 (Site No. 9)

Three shallow soil borings are recommended at this site, located along the periphery of the filled area shown approximately in Figure 28. Although this site was excavated and filled in 1983, no post-closure sampling has been conducted, and reportedly ground water does not exist in the area of the site. Soil borings are recommended to confirm that all contamination was removed during the excavation.

The boreholes should be installed to the top of the Walnut Formation (less than 10 feet), and soil samples should be collected and selectively analyzed in accordance with Table 27.

k. FDTAs No. 2, 3, 4, and 5 (Sites No. 5, 6, 7, and 8, respectively)

A single soil boring installed in the approximate center of each site is recommended (Figures 24 through 28). This soil boring should be converted to an upper zone monitor well. Reference to General Dynamics aerial photographs should aid the Phase II contractor in establishing the location for the boreholes. Sampling and analysis of soil samples should be conducted as outlined in Section VI.B.3.a., "General". Based on soil boring analyses, upgradient and downgradient upper zone monitor wells should be installed to monitor ground-water quality and water elevations. The number and precise location of these wells should be established by the Phase II contractor.

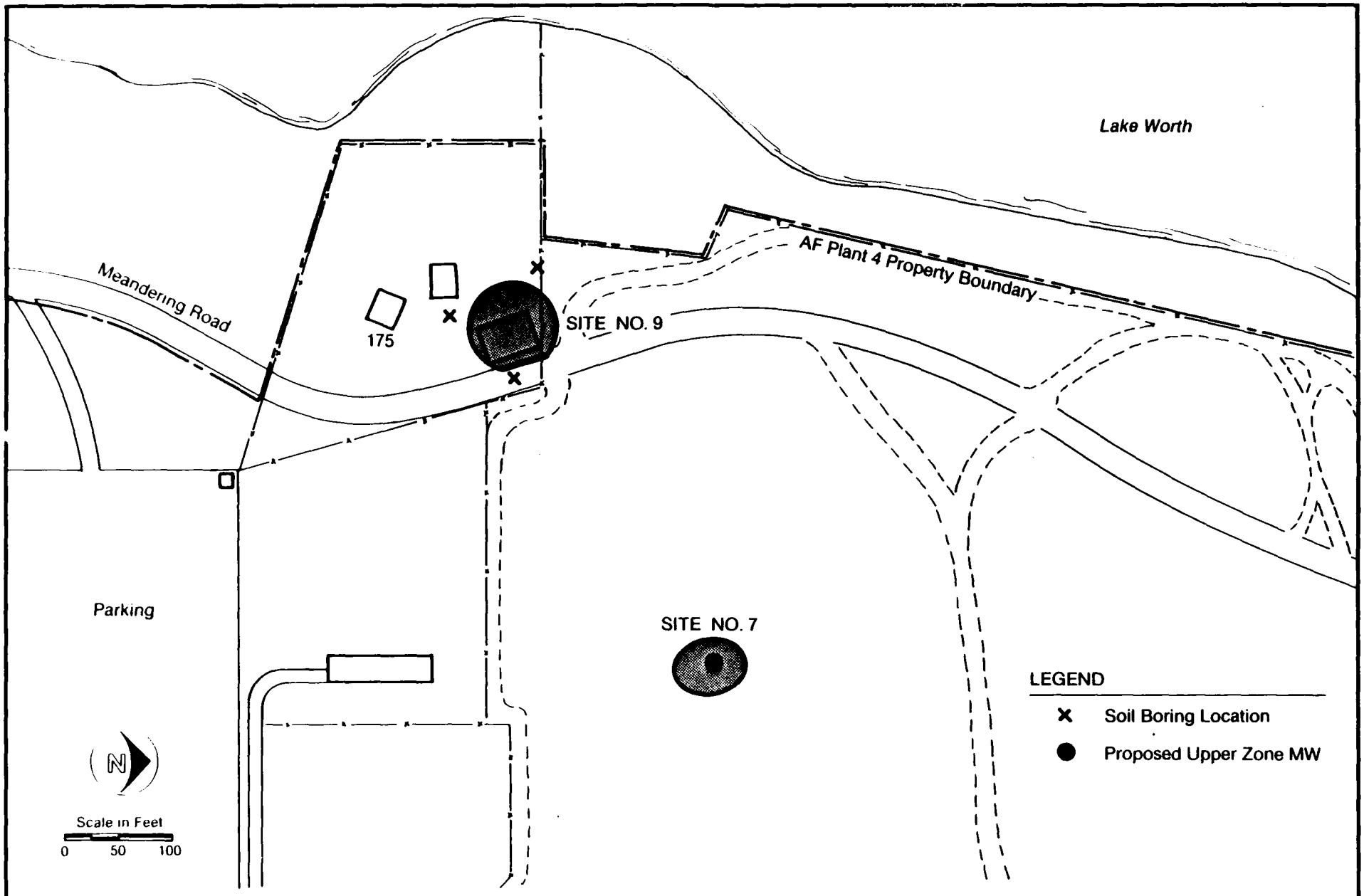

FIGURE 28.
Recommended Preliminary Sampling Locations for Sites No. 7 and 9.

l. Solvent Lines (Site No. 18)

Five soil borings are recommended along the length of the suspected leaking solvent lines (Figure 27). Borehole samples should be collected and analyzed as outlined in Section VI.B.3.a., "General".

The boreholes should be completed as upper zone monitor wells and sampled in accordance with Table 27.

m. Chrome Pit No. 1 (Site No. 10)

This site is located beneath the Process Building (Building No. 181). If an exhaustive review of early aerial photographs (prior 1967) or General Dynamics drawings enables the Phase II contractor to adequately locate the site, it is recommended that a soil boring be made into this site and completed as an upper zone monitor well. If the boring is installed, samples should be collected and analyzed as outlined in Section VI.B.3.a, "General". The monitor well should be sampled and analyzed in accordance with Table 27.

If the site cannot be adequately located, continued monitoring of upper zone Wells HM-33 and 36 (located to the south and northwest of the Process Building) for metals and VOCs is recommended.

n. Chrome Pit No. 2 (Site No. 11)

A single boring located in the approximate center of this site and converted to an upper zone monitor well is recommended (Figure 25). Borehole samples should be collected and analyzed as outlined in Section VI.B.3.a., "General". The borehole should be completed as an upper zone monitor well and sampled and analyzed in accordance with Table 27.

3. OTHER

a. Off-Site Monitoring

Off-site wells, including the EPA monitor wells (EPA-1, 2, and 3), and the City of White Settlement Wells (No. 1, 6, and 12), should be sampled at least semi-annually to detect possible contamination. Analyses should include volatile organic compounds. Location of these wells is shown in Figure 17.

b. Outfall No. 1 Monitoring

Based on findings by Carswell AFB of volatile organic compounds in the tributary that receives the Outfall No. 1 discharge, it is recommended that the outfall be sampled and analyzed for VOCs. The outfall should be sampled during a dry period when only base flow exists and again during a wet period when flow includes storm water from Air Force Plant 4. Based on the findings of the first set of samples, additional sampling may be considered necessary.

c. Buried Pipelines Monitoring

Based on the findings of volatile organic compounds in monitor well HM-31 (see discussion in Section IV. B. 2. c., "Phase II Investigation"), it is recommended that the buried sanitary, storm, and industrial wastewater pipelines that run past this well be sampled and analyzed for VOCs to determine if a potential exists for contamination of HM-31 from these lines. If VOCs are detected and at levels that could possibly explain the findings in HM-31, the respective pipeline(s) should be investigated for possible leaks and the appropriate corrective actions taken.

C. OTHER IRP RECOMMENDATIONS

1. ABANDONED WELLS

Section III.C., "Hydrology", pointed out that at least one abandoned water well and perhaps more exist on Air Force Plant 4 property. Because these wells could possibly provide a pathway to the aquifer, it is recommended that an investigation be conducted to locate and determine the condition of each well by visual inspection and through borehole geophysical logging. Based upon the conditions, cap or plug each well.

2. INACTIVE POL STORAGE TANKS

The buried 10,000-gallon gasoline tank located at the JP-4 unloading area, and the two buried 8,000-gallon gasoline tanks located at the northeast corner of Warehouse No. 1 (Building No. 12) should be inspected to determine if empty or not. If found to contain liquid, the contents should be sampled and analyzed, and based on the findings of the analyses, appropriate remedial actions (IRP Phase IV) should be taken.

Appendix A

RESUMES OF TEAM MEMBERS

DAVID M. MOCCIA
Industrial Reclamation
Department Manager

Education

B.S., Chemical Engineering, University of Florida

Experience

Since joining CH2M HILL, Mr. Moccia has developed expertise in water and wastewater treatment and hazardous waste management. Projects for municipal clients include the design of a reverse osmosis water treatment plant and several preliminary designs for activated sludge wastewater treatment facilities. He has also completed wastewater investigations, pilot studies, and engineering designs for clients in the food, chemicals, and metal treating industries. In hazardous waste projects, Mr. Moccia has been involved with the identification of possible hazardous waste contaminated sites, assessments of potential for contaminant migration, and the preparation of master plans for the management of uncontrolled hazardous waste sites.

In his present position as Manager of the Industrial Reclamation Department, Mr. Moccia is responsible for project execution, fiscal management, business development, and staffing for the department.

In the area of water treatment, Mr. Moccia completed the process design and managed the engineering design of a 3.0-mgd reverse osmosis water treatment plant for the Englewood Water District in south Florida. The facility was designed to provide potable water from brackish well water having a total dissolved solids concentration of 4,700 ppm. The design included chemical addition to prevent precipitation of minerals, micron filtration to remove fine particles in the raw water, spiral-wound membranes to reduce the total dissolved solids concentration, degassification to remove hydrogen sulfide and carbon dioxide, chemical addition to adjust pH, chlorination to provide disinfection, and potable water storage. Prior to distribution, the treated water is combined with treated water from three lime softening water treatment plants.

Mr. Moccia participated in the design of a 9.5-mgd wastewater treatment plant for Alexander City, Alabama. He was responsible for the process design of an activated sludge process, including sludge thickening and dewatering. Components of the system included aeration basins, clarifiers, chlorination facilities, a dissolved air flotation system for thickening sludge, a thickened sludge holding basin, and

belt filter presses for sludge dewatering prior to off-site disposal. Although the plant was a municipal facility, the raw wastewater was comprised largely of wastewaters from a large textile plant in Alexander City.

Mr. Moccia's experience in industrial wastewater treatment includes a study and process design completed for a south Georgia organic chemicals plant. He was responsible for the wastewater characterization, pretreatment, laboratory and pilot plant studies, and process design of a facility to treat up to 39,000 pounds per day of BOD_5. Studies showed that the wastewater was very amenable to biological treatment but was nutrient-deficient and would require addition of nitrogen and phosphorus. The wastewater temperature was found to be excessively high, requiring cooling prior to biological treatment. Various toxic shock loading tests determined the potential impact of uncontrolled spills. The process design included modification to existing pretreatment equipment, in-line equalization basins, a pH neutralization basin, aeration basins, clarifiers, belt filter press sludge dewatering facilities and chemical addition facilities for nutrient addition and pH adjustment.

In the food processing industry, Mr. Moccia has been involved in various wastewater studies and designs for Perdue, Inc., a poultry processor. Projects were completed for plants located in North Carolina, Virginia, Maryland, and Delaware. Poultry processing wastewater is generally high in oil and grease, solids, BOD_5 and blood and requires pretreatment prior to effective biological treatment. At the Virginia location wastewater characterization and pretreatment studies were completed followed by process and engineering designs for a 2.0 mgd activated sludge treatment system. Due to water quality limitations on the receiving creek, Mr. Moccia was involved in various stages of negotiations with the regulatory agencies concerning discharge criteria and discharge permit requirements. Similar services provided to the other plants included an effluent spray irrigation feasibility study, design of a complete pretreatment system utilizing a dissolved air flotation tank, and evaluation and recommendations for improvements to two activated sludge treatment systems.

Examples of Mr. Moccia's involvement in hazardous waste projects include several studies completed for the U.S. Air Force in accordance with the Department of Defense's (DoD) Installation Restoration Program (IRP). The IRP represents DoD's policy to identify and fully evaluate suspected problems associated with past hazardous materials disposal

sites on DoD facilities (e.g., Air Force bases), to control the migration of hazardous contamination, and to control hazards to health and welfare that may have resulted from these past operations. Phase I of this program, the Records Search, included a search and review of installation records to identify possible hazardous waste-contaminated sites and to assess the potential for contaminant migration from the installation. Mr. Moccia participated in and managed Phase I Records Searches at MacDill AFB, Florida; Dobbins AFB, Georgia; Richards-Gebaur AFB, Missouri; Bergstrom AFB, Texas; and Cannon AFB, New Mexico.

Mr. Moccia has directed the preparation of Remedial Action Master Plans (RAMP) for several uncontrolled hazardous waste sites including a landfill and refinery/petrochemical waste disposal sites. The documents served to identify the scope and sequence of remedial investigations, feasibility studies, and other onsite or offsite remedial actions applicable to the uncontrolled site. The plans included work statement and order-of-magnitude cost estimates for recommended remedial projects, preliminary health and safety requirements, and community relations strategies.

Professional Registration

Professional Engineer, Florida, Georgia, North Carolina

Membership in Professional Organizations

Florida Engineering Society
Florida Pollution Control Association
National Society of Professional Engineers
Water Pollution Control Federation
Tau Beta Pi

GNRE2

GARY E. EICHLER
Hydrogeologist

Education

M.S., Geology with Minor in Civil Engineering, University of Florida
B.S., Cum Laude, Construction and Geology, Utica College of Syracuse University

Experience

Mr. Eichler has been responsible for groundwater projects for both water supply and effluent disposal. Studies have included site selection, well design, construction services, monitoring and testing programs, determination of aquifer characteristics, and well field design. In addition, he has conducted numerous studies to determine pollution potential of toxic and hazardous wastes. Prior to joining CH2M HILL, Mr. Eichler was an engineering geologist with an environmental consulting firm. His responsibilities included project management, soils investigations, siting studies, groundwater and surface-water reports, and federal and state environmental impact studies.

Mr. Eichler has been responsible for exploration drilling, testing and design of well fields having a combined total installed capacity of over 75 mgd. Many of these well fields for potable water supply are located in the coastal aquifer in close proximity to saltwater.

His experience includes responsibility for the design and installation of shallow aquifer well fields in unconsolidated formations. Mr. Eichler has designed and installed screened wells, both natural and gravel packed, as well as open hole wells using both cable tool and rotary drilling methods.

Project responsibilities have included management and team participation on more than 20 hazardous waste disposal projects. The studies included initial site investigations, determination of pollutant travel time and direction, and evaluation of the potential for contaminant migration.

Mr. Eichler has been involved in geophysical logging and performance testing of deep disposal wells for both municipal effluent and hazardous waste.

He has conducted projects to determine saltwater intrusion potential and has been responsible for the design of monitoring programs to warn against intrusion.

GARY E. EICHLER

Mr. Eichler has conducted hydrogeological projects using aquifer computer modeling techniques to predict the effects of future large scale groundwater withdrawals.

Professional Registration

Certified Professional Geologist, Certificate No. 4544

Membership in Professional Organizations

American Institute of Professional Geologists
American Water Resources Association
Association of Engineering Geologists
Geological Society of America
Southeastern Geological Society
National Water Well Association
Florida Well Drillers Association

Publications

With U. P. Singh, C. R. Sproul, and J. I. Garcia-Bengochea. "Aquifer Testing of the Boulder Zone of South Florida." ASCE Publication Preprint 82-030. 1982.

Engineering Properties and Lime Stabilization of Tropically Weathered Soils. Master's Thesis. Department of Geology, University of Florida. August 1974.

GNRE3

ROBERT L. KNIGHT
Ecologist

Education

Ph.D., Systems Ecology, University of Florida
M.S.P.H., Environmental Chemistry and Biology, University of North Carolina
B.A., Zoology, University of North Carolina

Experience

Dr. Knight's responsibilities at CH2M HILL involve all aspects of environmental study, including design and implementation of field studies, data analysis and interpretation, project management, environmental systems overview analysis, impact analysis, prediction, and assessment. His experience has covered a wide range of applied research problems in aquatic and terrestrial environments, including computer simulation analyses.

Dr. Knight has managed several marine ecology field studies in Florida including: a 4-year study of estuarine metabolism at the Crystal River Nuclear Power Plant; a baseline conditions assessment of seagrass and oyster reef ecology in the Withlacoochee and Crystal Bays; and a 1-year productivity study and preparation of a simulation model of the Indian River estuary.

Dr. Knight participated in the design and implementation of long-term studies of fate and effects of toxic metals in stream mesocosms. He had direct responsibility for the chemical and biological monitoring of algal and insect populations, prepared a toxicity simulation model for cadmium, and developed general techniques for quantification of toxicity in biological systems.

Dr. Knight performed extensive field work at Silver Springs, Florida, to investigate the relationship between plant productivity and consumer organizations. As one part of that study, he developed a new microcosm design for the study of flowing aquatic systems.

Dr. Knight has conducted several studies on the feasibility of using natural and artificial wetlands for the assimilation of domestic wastewaters. Wetland systems include *Spartina* salt marshes and pocosins in North and South Carolina, hardwood swamp and prairie wetlands in Florida, and a marsh wetland in Mississippi. He has played a major role in site investigations and in developing management criteria for wetland and land treatment systems.

ROBERT L. KNIGHT

Dr. Knight has participated in a number of hazardous waste studies, including three Superfund sites, a hazardous waste landfill, and six Air Force bases, nationwide. He has prepared ecological assessments of susceptible environments and has participated in water quality sampling in groundwater studies.

Dr. Knight has considerable expertise in the study of phytoplankton and other algae in aquatic systems. He has conducted field verification studies of the Algal Assay Procedure, studied the effects of power plant entrainment on phytoplankton, and provided taxonomy and enumeration of phytoplankton and periphyton from rivers and streams.

Publications

Dr. Knight has authored several technical papers on ecosystem metabolism, phytoplankton ecology, and heavy metal dynamics in aquatic systems. Representative papers include:

Energy Model of a Cadmium Stream with Correlation of Embodied Energy and Toxicity Effect. EPA-600/53-048. U.S. EPA, Athens, Georgia. 1982.

"In Defense of Ecosystems," co-authored with D. Swaney. American Naturalist, 117:991-992, 1981.

"A Control Hypothesis for Ecosystems--Energetics and Quantification with the Toxic Metal Cadmium," in W. Mitsch, R. W. Bosserman, and J.M. Klopatek (eds.) Energy and Ecological Modelling. Elsevier Publishing Co., pp. 601-615, 1981.

Record of Estuarine and Salt March Metabolism at Crystal River, Florida, 1977-1981, co-authored with W. F. Coggins. Final Summary Report to Florida Power Corporation, Dept. of Environmental and Engineering Sciences, University of Florida, Gainesville. 1982.

"Large-Scale Microcosms for Assessing Fates and Effects of Trace Contaminants," co-authored with J. W. Bowling, J. P. Giesy, and H. J. Kania. In: J. P. Giesy (ed.) Microcosms in Ecological Research, USDE pp. 224-247, 1980.

"Fates of Cadmium Introduced into Channel Microcosms," co-authored J. P. Giesy, J. W. Bowling, H. J. Kania, and S. Mashburn. Environment International, 5:159-175, 1981.

Energy Basis of Control in Aquatic Ecosystems. Ph.D. Dissertation, University of Florida. 1980.

ROBERT L. KNIGHT

Fate and Biological Effects of Mercury Introduced into Artificial Streams, co-authored with H. J. Kania and R. J. Beyers. PEA-600/3-76-060. U.S. EPA, Athens, Georgia. 1976.

Effects of Entrainment and Thermal Shock on Phytoplankton Numbers and Diversity. Department of Environmental Sciences and Engineering, Publication 336, University of North Carolina, Chapel Hill. 1973.

RE2

Appendix B

OUTSIDE AGENCY CONTACT LIST

Appendix B
OUTSIDE AGENCY CONTACT LIST

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   United States Department of Agriculture
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   Fort Worth, Texas 76115
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3. Mr. Harold Beierman
   Wildlife Biologist
   United States Fish and Wildlife Service
   Fort Worth, Texas
   817/334-3871

4. Mr. Bruce Thompson
   Program Leader
   Non-Game Wildlife Program
   Texas Parks and Wildlife Department
   Austin, Texas
   512/479-4979

5. Mr. Dennis Palafox
   Pollution Surveillance Program Leader
   Texas Parks and Wildlife Department
   Austin, Texas
   512/479-4864

6. Mr. Donald Eubank
   Assistant District Supervisor
   Solid Waste Branch
   Texas Department of Water Resources
   Duncanville, Texas
   214/298-6171

7. Mr. David Barker
   Solid Waste Section
   Texas Department of Water Resources
   Austin, Texas
   512/475-5695

8. Mr. Seyed M. Mohammadi
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   Solid and Hazardous Wastes
   Texas Department of Health
   Arlington, Texas
   817/261-2911

9. Mr. James Highland
Federal Facilities Coordinator
United States Environmental Protection Agency
Region 6
Dallas, Texas
214/767-9930

10. Mr. William B. Hathaway
Deputy Administrator
Air and Waste Management Division
United States Environmental Protection Agency
Region 6
Dallas, Texas
214/767-9708

11. Mr. Kelly Nash
Geologist
Environmental Protection Agency
Region 6
Dallas, Texas
214/767-9706

Appendix C

AIR FORCE PLANT 4 RECORDS SEARCH INTERVIEW LIST

Appendix C
AIR FORCE PLANT 4 RECORDS SEARCH INTERVIEW LIST

Interviewee	Area of Knowledge	Years at Installation
1	Facilities Engineering	43
2	Facilities Engineering	32
3	Facilities Engineering	35
4	Facilities Engineering and Maintenance	32
5	Facilities Engineering and Maintenance	34
6	Facilities Engineering and Maintenance	34
7	Salvage	32
8	Fire Department	36
9	Fire Department	35
10	Fire Department	19
11	Fuels	34
12	Fuels	34
13	Environmental Health	28
14	Electrical Maintenance	33
15	Transportation	42
16	Transportation	34
17	Transportation	40
18	Transportation	38
19	Transportation	41
20	Transportation	33
21	Transportation	35
22	Transportation	38
23	Chemical Maintenance	9
24	Chemical Maintenance	30
25	Waste Treatment/Chemical Process	29
26	Entomology	5
27	Sanitation	22
28	Utility Layout	35
29	Construction	35
30	Shipping Clerk	39
31	Government Property Administration	30
32	AFPRO	2

Appendix D

INSTALLATION HISTORY

Appendix D
INSTALLATION HISTORY

On January 3, 1941, after several weeks of negotiations between the War Department, Consolidated Aircraft, and local officials, plans were announced for a new aircraft assembly plant in Fort Worth, Texas. In April of that year ground was broken, and the following February, Consolidated's Fort Worth plant began wartime production. Workmen used over 27,000 tons of steel to construct the main assembly and manufacturing plant, which was completed 100 days ahead of schedule. The main plant, which is as long as 12 city blocks and as high as a 6-story building, was the largest air conditioned building in the world when completed.

Consolidated Aircraft commenced operation in 1942 with production of the B-24 bomber. The first B-24 from Fort Worth was accepted by the Air Force 3 months ahead of schedule, in May 1942. By November 1943, a total of 30,547 people were employed in the plant. The Division's original workforce included 11,577 women; it was the era of "Rosie the Riveter." During the peak of production, B-24 deliveries reached 175 per month. By the end of World War II, over 3,000 B-24 bombers and conversions had been built at Fort Worth.

In 1943, the Army Air Forces placed its first order for long-range B-32 bombers. As the war drew to a close, however, the War Department reduced its requirement for long-range aircraft. Fort Worth produced 124 of the bombers. With the end of the war and the feverish war-time production effort, fewer personnel were necessary and employment at Fort Worth dropped to below 18,000 by 1950.

The end of the war allowed designers at Fort Worth and planners in the Army Air Forces to refocus their attention

on a giant bomber project that had been suspended during the war production effort. This aircraft was the B-36 Peacemaker. Although preliminary design work for the B-36 had been conducted in San Diego, fabrication of the prototype was assigned to Fort Worth. While most of the effort in the early 1940s went to production of the B-24 and the B-32, by war's end manufacture of the XB-36 was well underway. The XB-36 was first test flown in August 1946. Thousands of Fort Worth employees were on hand as the bomber, flown by B.A. Ericson and Gus Green, soared aloft, and the program got underway. As the B-36 program progressed, the bomber's performance steadily improved to the point where the final B-36s were markedly superior to the first versions. The last production version was the B-36J. The last of these models was delivered to the Strategic Air Command on 11 August 1954, ending production after 7 years and 385 aircraft. During time period, employment at Fort Worth increased as a result of the Korean War effort, peaking in late 1951 when 31,103 people were employed. In 1953, General Dynamics purchased control of Consolidated Vultee from the Atlas Corporation. The following year the merger was finalized and the company name was officially changed to Convair, a division of General Dynamics Corporation.

In 1954, the year that Fort Worth produced the last B-36, the Air Force ordered the worlds' first supersonic bomber, the B-58. No bomber made such a definite break with the past as the B-58. On 1 December 1959, the first production B-58 left the Division and was taken across the runway to Carswell Air Force Base. B-58 production ended 2 years later after 116 aircraft had been built. The Air Force retired the B-58 in January 1970. Employment, after peaking again in early 1957 during initial production of the B-58, gradually declined to a low of 10,697 in late 1962.

In 1962 Fort Worth received the Department of Defense contract to develop another supersonic aircraft. Tooling up for the F-111 manufacturing program began in the fall of 1963, and the first F-111 was rolled out 2 weeks ahead of schedule on 15 October 1964. The F-111 made its first flight in December 1964. In October 1967, the first fighter version was delivered to the Tactical Air Command at Nellis Air Force Base. Two years later, the first bomber version was delivered to the Strategic Air Command at Carswell Air Force Base. Fort Worth produced a total of 562 F-111s. Although the last F-111 was delivered in September 1976, Fort Worth continues to provide support services for the aircraft with spare parts and modification programs. Employment went through another cycle during the F-111 program, peaking during initial production in mid-1968 at 30,641 and falling back to 6,000 in 1974 during the end of the program.

During this same time period, General Dynamics reorganized several times. In 1961 the Convair plants, including Fort Worth, were all made separate divisions. In 1969, Fort Worth and San Diego were reunited to become the Convair Aerospace Division. And, in 1974, Fort Worth once again became a separate division.

General Dynamics was awarded the contract to develop a new lightweight, low-cost fighter, which led to production of the F-16 at Fort Worth. The first production F-16 made its maiden flight in August 1978. The Fort Worth assembly lines are currently producing fifteen F-16 fighters each month. To date, the three F-16 assembly lines have produced over 1,000 F-16 aircraft.

Appendix E

DESCRIPTIONS OF SOIL ASSOCIATIONS

Appendix E
DESCRIPTIONS OF SOIL ASSOCIATIONS

1. Sanger-Purves-Slidell Association--Nearly level and gently sloping, deep and shallow, clayey soils; on uplands.

This map unit is dominantly made up of well drained soils that have slopes of 0 to 5 percent. Wide cracks form in these soils when they are dry. This unit makes up about 21 percent of the county. It is about 28 percent Sanger soils, 15 percent Purves soils, 10 percent Slidell soils, and 47 percent less extensive areas of Aledo, Bolar, Frio, Lindale, Mingo, and San Saba soils and Urban land.

The gently sloping Sanger soils are on uplands. Permeability is very slow. Typically, the surface layer is clay about 20 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. From a depth of 20 to 80 inches is brownish silty clay.

The nearly level and gently sloping Purves soils are on uplands. Permeability is moderately slow. Typically, the surface layer is dark grayish brown clay about 7 inches thick. At a depth of 7 to 15 inches is brown clay. Below that is fractured limestone interbedded with thin layers of clayey marl.

The nearly level and gently sloping Slidell soils are on uplands. Permeability is very slow.

Typically, these soils are clay to a depth of 70 inches. They are very dark gray in the upper part, grading to grayish brown in the lower part. The underlying material from a depth of 70 to 80 inches is light brownish gray silty clay containing yellowish mottles.

2. Aledo-Bolar-Sanger Association--Gently sloping to moderately steep, very shallow to deep, loamy and clayey soils; on uplands.

This map unit is dominantly made up of well drained soils that have slopes of 1 to 20 percent. This unit makes up about 20 percent of the county. It is about 38 percent Aledo soils, 12 percent Bolar soils, 12 percent Sanger soils, and 38 percent less extensive areas of Brackett, Frio, Luckenbach, Maloterre, Purves, San Saba, Slidell, and Suney soils and Urban land.

The gently sloping to moderately steep Aledo soils are on high ridgetops and moderately steep side slopes, where they are mixed with narrow bands of Bolar and Maloterre soils. Permeability is moderate. Typically, the surface layer is dark grayish brown clay loam about 8 inches thick. The subsoil, to a depth of 31 inches, is clay loam that is brown in the upper part, grading to light yellowish brown loam in the lower part. Below that is fractured limestone interbedded with clayey marl.

The gently sloping Sanger soils are on uplands. These soils are very slowly permeable. Typically, the surface layer is clay about 20 inches thick

that is very dark grayish brown in the upper part and dark grayish brown in the lower part. From a depth of 20 to 80 inches is brownish silty clay.

3. Frio-Trinity Association--Nearly level, deep, clayey soils; on flood plains.

This map unit is dominantly made up of well drained and somewhat poorly drained soils that have slopes of 0 to 1 percent. The unit makes up 7 percent of the county. It is about 50 percent Frio soils, 9 percent Trinity soils, and 41 percent less extensive areas of Arents, Ovan, Pulexas, and Whitesboro soils, and Urban land.

Frio soils are on broad flood plains. The soils are well drained, and permeability is moderately slow. Typically, the surface layer is silty clay about 24 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. From a depth of 24 to 80 inches is brown silty clay loam.

Trinity soils are on broad flood plains, and the largest areas in the map unit are along the West Fork of the Trinity River in the eastern part of the county. These soils are somewhat poorly drained, and permeability is very slow. Typically, these soils are dark gray clay to a depth of about 63 inches. They have very dark grayish brown mottles below a depth of 32 inches.

4. Bastsil-Silawa Association--Nearly level to sloping, deep, loamy soils; on stream terraces.

This map unit is dominantly made up of well drained soils that have slopes of 0 to 8 percent. The unit makes up about 4 percent of the county. It is about 40 percent Bastsil soils, 20 percent Silawa soils, and 40 percent less extensive areas of Arents, Aquilla, Pulexas, Rader, and Silstid soils and Urban land.

The nearly level and gently sloping Bastsil soils are on high terraces. Permeability is moderate. Typically, the surface layer is pale brown fine sandy loam about 11 inches thick. The subsoil, from a depth of 11 to 80 inches, is sandy clay loam that is yellowish red in the upper part, red in the middle part, and yellowish red in the lower part.

The gently sloping to sloping Silawa soils are on terraces, typically below the Bastsil soils. Permeability is moderate. Typically, the surface layer is dark yellowish brown fine sandy loam about 6 inches thick. The subsoil, to a depth of about 46 inches, is sandy clay loam. It is red in the upper 15 inches and yellowish red below. From a depth of 46 to 60 inches, it is reddish yellow fine sandy loam.

Appendix F

INVENTORY OF EXISTING POL STORAGE TANKS
Source: General Dynamics

* INDUSTRIAL AND/OR CHEMICAL PROCESS, STORAGE, TREATMENT AND COLLECTION SITES
(Revised 1 September 1982)

MAP GRID	FAC NO.	NOTES	TYPE OF FACILITY	LOAD Fill Line to Bottom	LOCATION ABOVE GROUND	CONTAINMENT BURIED	CONTAINMENT DIKE	CONTAINMENT TRENCH	DRAWING NO.
C/7.5	148	3	Class I, Sludge Storage: Temporary Bulk Containment Facility	-	Yes	No	Yes	No	5CG-526
D/8.5	175	3	Fire Training Pit	-	Yes	No	Yes	No	5-175C-504
D/2	181	3	Chemical Process and Heat Treat Facilities	-	Yes	No	No	Yes	5-181C-504
D/2	183	3	Deionized Water Facility	-	Yes	No	No	Yes	5-183C-504
D/2	184	3	Liquid Waste Disposal Pits	-	No	No	No	Yes	5-181C-504 C2 and C3
D/2	203	3	Chemical Waste Treatment Facility	-	Yes	No	No	Yes	5-203C-625
B/7	210	-	Fuel Sta. Shelter (North)	-	Yes	No	No	No	3-210/212C-504 (Lana Corp)
B/7	211	-	Fuel Sta. Shelter (Center)	-	Yes	No	No	No	3-210/212C-504 (Lana Corp)
B/7	212	-	Fuel Sta. Shelter (South)	-	Yes	No	No	No	3-210/212C-504 (Lana Corp)
D/2	T-39	3	Chemical Waste Holding/Treatment Tank	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-41	3	Chemical Waste Holding/Treatment Tank	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-42	3	Chemical Waste Holding/Teatment Tank	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-11	3	Mixed Acid Waste Teatment Tank	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-12	3	Mixed Acid Waste Holding Tank	Yes	Yes	No	No	Yes	5-181C-625
D/2-3	T-850	3	Waste Machine Coolant Treatment Tank	Yes	Yes	No	Yes	Yes	5-181C-625
D/2-3	T-851	3	Waste Mixed Oil Testment Tank	Yes	Yes	No	Yes	Yes	5-181C-625
D/2-3	T-870	3	Waste Chrome Holding Tank	No	Yes	No	No	Yes	5-181C-625
D/2-3	T-871	3	Waste Chrome Holding Tank	No	Yes	No	No	Yes	5-181C-625
D/2-3	T-872	3	Waste Chrome Treatment Tank	Yes	Yes	No	No	Yes	5-203C-625
D/2-3	T-852	3	Waste Caustic Etchant Holding Tank	No	Yes	No	No	Yes	5-181C-625
D/2-3	T-853	3	Waste Caustic Etchant Holding Tank	No	Yes	No	No	Yes	5-181C-625
D/3-4	B-32	3	Hazardous Waste, Barrels: Paint Solvent, Oil, Etc.	N/A	Yes	No	Yes	No	
D-3	B-13	3	Salvage Bldg. 13 Misc. Collection Areas	N/A	Yes	No	No	No	

TANK FARM STORAGE - CHEMICALS

D/2	T-2	-	Trichloroethylene	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-5	5	Sodium Sulfahydrate	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-6	5	Sodium Sulfahydrate	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-16	5	Caustic Soda, Rayon Grade	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-22	5	Sodium Hydroxide	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-8	5	Sulfuric Acid, Concentrated	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-9	5	Hydrochloric Acid, Concentrated	Yes	Yes	No	No	Yes	5-181C-625
D/2	T-15	5	Nitric Acid, Concentrated	Yes	Yes	No	No	Yes	5-181C-625

INDUSTRIAL AND CHEMICAL WASTE COLLECTION SYSTEM

		3	West IW Line (Down Fence)	N/A	No	Yes	No	No	5-GG-457
		3	West IW Line West Wall B-5	N/A	No	Yes	No	No	5-GG-457
		3	North/South IW Line Col.	N/A	No	Yes	No	No	5-GG-457
		3	North/South IW Line Col.	N/A	No	Yes	No	No	5-GG-457
		3	East IW Line East Wall B-4	N/A	No	Yes	No	No	5-GG-457
		3	East IW Line Run Way	N/A	No	Yes	No	No	5-GG-457

* Revisions

Appendix G

CHEMICAL ANALYSES OF GROUND- AND SURFACE-WATER SAMPLES

Table G.1 Minimum/Maximum Concentration Range of Volatile Organic Compounds in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.2 Minimum/Maximum Concentration Range of Base/ Neutral Organic Compounds in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.3 Minimum/Maximum Concentration Range of Organic Acid Compounds in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.4 Minimum/Maximum Concentration Range of Trace Metals and Cyanide in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.5 Minimum/Maximum Concentration Range of Oil and Grease and Fuel Hydrocarbons in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.1

Minimum/Maximum Concentration Range of Volatile Organic Compounds in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.1
MINIMUM/MAXIMUM CONCENTRATION RANGE OF VOLATILE ORGANIC COMPOUNDS IN WATER SAMPLES
COLLECTED FROM ON-SITE AND OFF-SITE WELLS AND MEANDERING ROAD CREEK
DECEMBER 1982-JANUARY 1984

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-1	HM-2	HM-3a	HM-3b	HM-4a	HM-4b	HM-5	HM-6
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	63/210	ND/230	88/130	730/1,603	ND/7	ND/303
Bis (Chloromethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND/5,100
Chlorobenzene	ND	ND	ND	ND	32/89	242/480	ND	ND/65,000
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND/2,000	ND/1,000	400/460	64/370	522/1,000	810/3,405	ND/457	588/1,000
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND/119
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND/21	ND/47	ND	ND/1,655
1,2-Dichloroethane	ND	ND	ND	ND/8	ND	ND/11	ND	ND/2,016
1,1-Dichloroethylene	16/156	ND	13/5,476	42/135	ND/14	ND/7	ND	1,500/150,000
1,2-Dichloropropane	ND	ND	ND/36	ND	ND/24	294/460	ND	ND
1,3-Dichloropropylene	ND	ND	ND	ND	ND	ND/86	ND	ND
Ethylbenzene	ND/108	ND/61	482/7,400	960/30,000	4/25	55/100	ND/5	520/20,000
Methyl Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND/390	ND/2,000	7,105/170,000	2,000/89,000	2,150/15,000	10/25,000	ND/2,300	345/100,000
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND/1	ND	ND	ND	ND
Tetrachloroethylene	ND/17	ND	ND/67	ND/425	ND	ND/6	ND/2	1,024/80,000
Toluene	ND/55	ND/21	31,000/65,000	70,000/2,000,000	30/530	920/1,750	ND/290	30,000/200,000
1,2-Trans-Dichloroethylene	ND	ND	ND/11,000	ND/20,000	ND/72	ND/36	ND/6	ND/87,000
1,1,1-Trichloroethane	ND	ND	ND	ND/88	19/50	ND	ND	2,900/6,000
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	50,000/124,000	ND/1,442	25,000/100,000	20,000/130,000	68/3,000	487/960	ND/300	77,000/500,000
Trichlorofluoromethane	ND/2,714	ND	ND/59	ND	ND/31	ND	ND	142/17,000
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND/6,600

ND: None detected

Table G.1--continued

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-7	HM-8	HM-9	HM-10	HM-11	HM-12	HM-13	HM-14
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	46/123	ND/8	ND	ND/3	ND/1	ND/2	ND	ND/1
Bis (Chloromethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND/140	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND/77	ND/198	ND/4	ND/28	ND	ND/91	ND	ND/2
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND29	ND	ND	ND/73	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND/18	ND	ND	ND	ND
1,1-Dichloroethylene	ND/1,100	ND/5	ND	ND	ND/25	ND	ND	ND
1,2-Dichloropropane	ND/17	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropylene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	475/1,500	ND/5	ND/4	ND	ND	ND	ND	ND
Methyl Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND/41	ND/142	ND/49	ND/73	ND	ND/1	ND	ND/4
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ND/592	ND/17	ND/21	ND/5	ND/24	ND	ND	ND
Toluene	1,600/7,000	ND/52	ND/51	ND/15	ND/1	ND/5	ND/38	ND/1
1,2-Trans-Dichloroethylene	ND/9,000	ND	ND	ND/8	ND/1,000	ND	ND	ND
1,1,1-Trichloroethane	ND/26	ND/200	ND	ND/3,500	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ND/7,500	ND/160	ND/154	37/130	40/560	ND/4	ND/31	ND/3
Trichlorofluoromethane	ND	ND	ND/59	ND/42	ND/87	ND	ND	ND
Vinyl Chloride	ND/20,000	ND	ND	ND	ND	ND	ND	ND

ND: None detected

Table G.1--continued

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-15	HM-16	HM-17	HM-18	HM-19	HM-20	HM-21	HM-22
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND/2	ND/3	ND/2	ND	ND	6/60	ND
Bis (Chloromethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	5/133	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND/62	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND/1	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND/3	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND/150	ND
1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND	33/12,000	ND
1,2-Dichloropropane	ND	ND	ND/2	ND	ND	ND	ND	ND
1,3-Dichloropropylene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	4/154	ND
Methyl Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND/8	ND	ND	ND	ND/5,189	ND/550	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ND	ND	ND	ND	ND	ND	ND/44	ND
Toluene	ND	ND/82	ND/4	ND	ND	ND/27	27/1,870	ND
1,2-Trans-Dichloroethylene	ND	ND/8	1/56	ND/28	28/99	ND/8	ND/10,000	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND/54	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	5,600	904/5,300	1,800/4,600	ND/5	9/25	389/3,200	10/830	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND/10,000	ND

ND: None detected

Table G.1--continued

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-23	HM-24	HM-25	HM-26	HM-27	HM-28	HM-29	HM-30
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	120/320	ND	ND/5.2	ND	ND/9	ND
Bis (Chloromethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND/660	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND/3.2	14/38	6/13	ND/5.6	ND	3/15	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND/6.5	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	ND	ND	ND/6	ND	ND	ND	ND/17	ND
1,2-Dichloropropane	ND	ND/3	ND/35	ND	ND	ND	ND	ND
1,3-Dichloropropylene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND/36	ND	ND/17	ND	ND	ND
Methyl Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Chloride	ND	ND	ND	ND	ND	ND	ND/2.8	ND
Methylene Chloride	ND	ND/8	ND/1,200	ND/2.0	ND/200	ND/72	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ND	ND	ND/23	ND	ND/4	ND	ND/3	ND
Toluene	ND	ND	23/110	ND	ND/10	ND	ND	ND
1,2-Trans-Dichloroethylene	ND	ND	ND/260	30/420	85/1,200	280/500	6.4/25	ND
1,1,1-Trichloroethane	ND/8.9	ND/9.0	ND/8	ND/10	ND/4.9	ND/7.2	4/7.3	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ND	ND/5	ND/15	23/160	40/1,800	750/930	910/5,400	14/1,100
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND/12	ND/170	ND	ND/5	ND

ND: None detected

Table G.1--continued

Constituents (micrograms per liter)	HM-31	Paluxy Monitor Wells				White Settlement Wells		
		P-1	P-2	P-3	P-4	WS-1	WS-2	WS-12
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND/2	ND	ND	ND	ND	ND	ND
Bis (Chloromethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND/3.3	ND/2.2	ND/2.2
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropylene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND/3.2	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ND/8.5	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Trans-Dichloroethylene	1,500/3,100	ND	ND	ND	49/1,700	ND	ND	ND
1,1,1-Trichloroethane	ND/4.1	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	1,100/8,700	ND	ND	ND	ND/60	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND/85	ND	ND	ND	ND/1,100	ND	ND	ND

ND: None detected

Table G.1--continued

Constituents (micrograms per liter)	Residential Wells				Meandering Creek			
	Johnson	Spudich	Stines	Walker	C-1	C-2	C-3	C-4
Acrolein	ND	ND	ND	ND	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND/2	ND
Bis (Chloromethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	4.7	5.1	5.2	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND/15	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropylene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Trans-Dichloroethylene	ND	ND	ND	ND	ND	ND/48	7/19	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ND	ND	ND	ND	ND	ND/58	3/16	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND

ND: None detected

Table G.1--continued

Constituents (micrograms per liter)	C-5	EPA Monitor Wells		
		EPA-1	EPA-2	EPA-3
Acrolein	ND	ND	ND	ND
Acrylonitrile	ND	ND	ND	ND
Benzene	ND	ND	ND	ND
Bis (Chloromethyl) ether	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND
Chlorodibromomethane	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND
2-chloroethylvinyl ether	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND
1,1-Dichloroethylene	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND
1,3-Dichloropropylene	ND	ND	ND	ND
Ethylbenzene	ND	ND	ND	ND
Methyl Bromide	ND	ND	ND	ND
Methyl Chloride	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND
Tetrachloroethylene	ND	ND	ND	ND
Toluene	ND	ND	ND	ND
1,2-Trans-Dichloroethylene	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND
Trichloroethylene	ND	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND

ND: None detected

Table G.2

Minimum/Maximum Concentration Range of Base/Neutral Organic Compounds in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.2
MINIMUM/MAXIMUM CONCENTRATION RANGE OF BASE/NEUTRAL COMPOUNDS
IN WATER SAMPLES COLLECTED FROM ON-SITE AND OFF-SITE WELLS
AND MEANDERING ROAD CREEK--DECEMBER 1982-JANUARY 1984

Base/Neutral Compounds (micrograms per liter)	Upper Zone Monitor Wells				
	HM-1	HM-2	HM-3a	HM-3b	HM-4a
Acenaphthene	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	13
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	24	820
1,3-Dichlorobenzene	ND	ND	ND	ND	27
1,4-Dichlorobenzene	ND	ND	ND	3	290
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND	2	ND
Dimethyl Phthalate	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	ND/2,700	ND/72	ND	8	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND/13	ND	ND	ND	2
Di-N-octyl Phthalate	ND	ND	ND	ND	ND
1,2-Diphenylhydrazine	ND/15	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	2
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	8
Naphthalene	ND/10	ND	7	ND	3
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND/6	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND/25	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Upper Zone Monitor Wells				
	HM-4b	HM-5	HM-6	HM-7	HM-8
Acenaphthene	ND/7	ND	ND	ND/25	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND/200	ND	ND	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	900/3,000	ND	140/931,000	16/160	ND/3
1,3-Dichlorobenzene	ND	ND	ND/346,000	ND/24	ND
1,4-Dichlorobenzene	76/650	ND	18/521,000	ND/51	ND/4
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND	ND	ND/15
Dimethyl Phthalate	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	ND	ND/31	ND	ND/106	ND/17
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND	ND	ND	ND
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND/5	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND
Naphthalene	ND/18	ND/1	39/557,000	25/280	ND/7
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND/5	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Upper Zone Monitor Wells				
	HM-9	HM-10	HM-11	HM-12	HM-13
Acenaphthene	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND/3	ND	ND	ND	ND
Dimethyl Phthalate	ND	ND/52	ND	ND	ND
Di-N-Butyl Phthalate	ND/4	ND/213	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND/5	ND	ND	ND
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Upper Zone Monitor Wells				
	HM-14	HM-15	HM-16	HM-17	HM-18
Acenaphthene	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND	ND	ND
Dimethyl Phthalate	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	ND	ND	ND/2	ND	ND
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND	ND	ND	ND
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND/1	ND	ND/1
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Upper Zone Monitor Wells				
	HM-19	HM-20	HM-21	HM[illegible]	HM-23
Acenaphthene	ND	ND	ND	ND	--
Acenaphthylene	ND	ND	ND	ND	--
Anthracene	ND	ND	ND	ND	--
Benzidine	ND	ND	ND	ND	--
Benzo (a) anthracene	ND	ND	ND	ND	--
Benzo (a) pyrene	ND	ND	ND	ND	--
3,4-Benzofluoranthene	ND	ND	ND	ND	--
Benzo (g,h,i) perylene	ND	ND	ND	ND	--
Benzo (K) fluoranthene	ND	ND	ND	ND	--
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	--
Bis (2-chloroethyl) ether	ND	ND	ND	ND	--
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	--
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	--
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	--
Butyl Benzyl Phthalate	ND	ND	ND/2	ND	--
2-Chloronaphthalene	ND	ND	ND	ND	--
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	--
Chrysene	ND	ND	ND	ND	--
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	--
1,2-Dichlorobenzene	ND	ND	100/350	ND	--
1,3-Dichlorobenzene	ND	ND	ND/58	ND	--
1,4-Dichlorobenzene	ND	ND	20/206	ND	--
3,3'-Dichlorobenzidine	ND	ND	ND	ND	--
Diethyl Phthalate	ND	ND	ND	ND	--
Dimethyl Phthalate	ND	ND	ND	ND	--
Di-N-Butyl Phthalate	ND	ND	ND	ND	--
2,4-Dinitrotoluene	ND	ND	ND	ND	--
2,6-Dinitrotoluene	ND	ND	ND	ND	--
Di-N-octyl Phthalate	ND	ND	ND	ND	--
1,2-Diphenylhydrazine	ND	ND	ND	ND	--
Fluoranthene	ND	ND	ND	ND	--
Fluorene	ND	ND	ND	ND	--
Hexachlorobenzene	ND	ND	ND	ND	--
Hexachlorobutadiene	ND	ND	ND	ND	--
Hexachlorocyclopentadiene	ND	ND	ND	ND	--
Hexachloroethane	ND	ND	ND	ND	--
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	--
Isophorone	ND	ND	ND	ND	--
Naphthalene	ND	ND	ND/8	ND	--
Nitrobenzene	ND	ND	ND	ND	--
N-Nitrosodimethylamine	ND	ND	ND	ND	--
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	--
N-Nitrosodiphenylamine	ND	ND	ND/1	ND	--
Phenanthrene	ND	ND	ND	ND	--
Pyrene	ND	ND	ND	ND	--
1,2,4-Trichlorobenzene	ND	ND	ND	ND	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	--

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Upper Zone Monitor Wells				
	HM-24	HM-25	HM-26	HM-27	HM-28
Acenaphthene	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND/8.0
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND/1	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	150/680	ND	ND	ND
1,3-Dichlorobenzene	ND	3.6/34	ND	ND	ND
1,4-Dichlorobenzene	ND	60/300	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND	ND	ND
Dimethyl Phthalate	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	ND	ND	ND/4.8	ND	ND/5.9
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND	ND	ND	ND
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND
Naphthalene	ND	18/45	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND/13	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Upper Zone Monitor Wells			Paluxy Monitor Wells	
	HM-29	HM-30	HM-31	P-1	P-2
Acenaphthene	ND	ND	ND	ND/36	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND/8.0	ND/6.4	ND	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND	ND	ND
Dimethyl Phthalate	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	ND/4.9	ND/4.6	ND	ND/5.8	ND/4.4
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND	ND	ND	ND
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND/54	ND
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Paluxy Monitor Wells		White Settlement Wells		
	P-3	P-4	WS-1	WS-2	WS-12
Acenaphthene	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND/3	ND	ND/3
Dimethyl Phthalate	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	ND	ND	ND/19	ND	ND/11
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND	ND/3	ND	ND
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Residential Wells				Meandering Road Creek
	Johnson	Spudich	Stines	Walker	C-1
Acenaphthene	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND
Benzo (a) anthracene	ND	ND	ND	ND	ND
Benzo (a) pyrene	ND	ND	ND	ND	ND
3,4-Benzofluoranthene	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	ND	ND	ND	ND	ND
Benzo (K) fluoranthene	ND	ND	ND	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	ND	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	ND	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	ND	ND	ND
Butyl Benzyl Phthalate	ND	ND	ND	ND	12
2-Chloronaphthalene	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND	ND	ND
Diethyl Phthalate	ND	ND	ND	ND	2
Dimethyl Phthalate	ND	ND	ND	ND	ND
Di-N-Butyl Phthalate	ND	ND	ND	ND	5
2,4-Dinitrotoluene	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND
Di-N-octyl Phthalate	ND	ND	ND	ND	1
1,2-Diphenylhydrazine	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	Meandering Road Creek C-2	C-3	C-4	C-5	EPA Monitor Wells EPA-1
Acenaphthene	ND	ND	--	ND	ND
Acenaphthylene	ND	ND	--	ND	ND
Anthracene	ND	ND	--	ND	ND
Benzidine	ND	ND	--	ND	ND
Benzo (a) anthracene	ND	ND	--	ND	ND
Benzo (a) pyrene	ND	ND	--	ND	ND
3,4-Benzofluoranthene	ND	ND	--	ND	ND
Benzo (g,h,i) perylene	ND	ND	--	ND	ND
Benzo (K) fluoranthene	ND	ND	--	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND	--	ND	ND
Bis (2-chloroethyl) ether	ND	ND	--	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND	--	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND	--	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND	--	ND	ND
Butyl Benzyl Phthalate	ND/125	ND	--	ND	ND
2-Chloronaphthalene	ND	ND	--	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	--	ND	ND
Chrysene	ND	ND	--	ND	ND
Dibenzo (a,h) Anthracene	ND	ND	--	ND	ND
1,2-Dichlorobenzene	ND	ND	--	ND	ND
1,3-Dichlorobenzene	ND	ND	--	ND	ND
1,4-Dichlorobenzene	ND	ND	--	ND	ND
3,3'-Dichlorobenzidine	ND	ND	--	ND	ND
Diethyl Phthalate	ND/17	ND	--	ND	ND
Dimethyl Phthalate	ND	ND	--	ND	ND
Di-N-Butyl Phthalate	ND/19	ND	--	ND	ND
2,4-Dinitrotoluene	ND	ND	--	ND	ND
2,6-Dinitrotoluene	ND	ND	--	ND	ND
Di-N-octyl Phthalate	ND/3	ND	--	ND	ND
1,2-Diphenylhydrazine	ND	ND	--	ND	ND
Fluoranthene	ND	ND	--	ND	ND
Fluorene	ND	ND	--	ND	ND
Hexachlorobenzene	ND	ND	--	ND	ND
Hexachlorobutadiene	ND	ND	--	ND	ND
Hexachlorocyclopentadiene	ND	ND	--	ND	ND
Hexachloroethane	ND	ND	--	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND	--	ND	ND
Isophorone	ND	ND	--	ND	ND
Naphthalene	ND/6	ND	--	ND/7.2	ND
Nitrobenzene	ND	ND	--	ND	ND
N-Nitrosodimethylamine	ND	ND	--	ND	ND
N-Nitrosodi-N-propylamine	ND	ND	--	ND	ND
N-Nitrosodiphenylamine	ND	ND	--	ND	ND
Phenanthrene	ND	ND	--	ND	ND
Pyrene	ND	ND	--	ND	ND
1,2,4-Trichlorobenzene	ND	ND	--	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	--	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.2--continued

Base/Neutral Compounds (micrograms per liter)	EPA Monitor Wells	
	EPA-2	EPA-3
Acenaphthene	ND	ND
Acenaphthylene	ND	ND
Anthracene	ND	ND
Benzidine	ND	ND
Benzo (a) anthracene	ND	ND
Benzo (a) pyrene	ND	ND
3,4-Benzofluoranthene	ND	ND
Benzo (g,h,i) perylene	ND	ND
Benzo (K) fluoranthene	ND	ND
Bis (2-chloroethyoxy) methane	ND	ND
Bis (2-chloroethyl) ether	ND	ND
Bis (2-Chloroisopropyl) ether	ND	ND
Bis (2-Ethylhexyl) Phthalate	ND	ND
4-Bromo phenyl Phenyl Ether	ND	ND
Butyl Benzyl Phthalate	ND	ND
2-Chloronaphthalene	ND	ND
4-Chlorophenyl phenyl ether	ND	ND
Chrysene	ND	ND
Dibenzo (a,h) Anthracene	ND	ND
1,2-Dichlorobenzene	ND	ND
1,3-Dichlorobenzene	ND	ND
1,4-Dichlorobenzene	ND	ND
3,3'-Dichlorobenzidine	ND	ND
Diethyl Phthalate	ND	ND
Dimethyl Phthalate	ND	ND
Di-N-Butyl Phthalate	ND	ND
2,4-Dinitrotoluene	ND	ND
2,6-Dinitrotoluene	ND	ND
Di-N-octyl Phthalate	ND	ND
1,2-Diphenylhydrazine	ND	ND
Fluoranthene	ND	ND
Fluorene	ND	ND
Hexachlorobenzene	ND	ND
Hexachlorobutadiene	ND	ND
Hexachlorocyclopentadiene	ND	ND
Hexachloroethane	ND	ND
Indeno (1,2,3-c,d) Pyrene	ND	ND
Isophorone	ND	ND
Naphthalene	ND	ND
Nitrobenzene	ND	ND
N-Nitrosodimethylamine	ND	ND
N-Nitrosodi-N-propylamine	ND	ND
N-Nitrosodiphenylamine	ND	ND
Phenanthrene	ND	ND
Pyrene	ND	ND
1,2,4-Trichlorobenzene	ND	ND
2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.3

Minimum/Maximum Concentration Range of Organic Acid Compounds in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.3

MINIMUM/MAXIMUM CONCENTRATION RANGE OF ORGANIC ACID COMPOUNDS IN WATER SAMPLES COLLECTED FROM ON-SITE AND OFF-SITE WELLS AND MEANDERING ROAD CREEK DECEMBER 1982-JANUARY 1984

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-1	HM-2	HM-3a	HM-3b	HM-4a	HM-4b	HM-5	HM-6
2-Chlorophenol	ND	ND	ND	ND	ND	ND/78	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND/580	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloro-m-Cresol	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND

ND: None detected

--: Constituent not analyzed

Table G.3--continued

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-7	HM-8	HM-9	HM-10	HM-11	HM-12	HM-13	HM-14
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	260/2,450	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloro-m-Cresol	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.3--continued

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-15	HM-16	HM-17	HM-18	HM-19	HM-20	HM-21	HM-22
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND/2	ND	ND	ND	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloro-m-Cresol	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.3--continued

Constituents (micrograms per liter)	Upper Zone Monitor Wells							
	HM-23	HM-24	HM-25	HM-26	HM-27	HM-28	HM-29	HM-30
2-Chlorophenol	ND	ND	ND	ND	ND	ND/78	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloro-m-Cresol	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND/7.7	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.3--continued

Constituents (micrograms per liter)	HM-31	Paluxy Monitor Wells				White Settlement Wells		
		P-1	P-2	P-3	P-4	WS-1	WS-2	WS-12
2-Chlorophenol	ND	ND	ND	ND	ND	ND/78	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloro-m-Cresol	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.3--continued

Constituents (micrograms per liter)	Residential Wells				Meandering Creek			
	Johnson	Spudich	Stines	Walker	C-1	C-2	C-3	C-4
2-Chlorophenol	ND	ND	ND	ND	ND	ND/78	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND
p-Chloro-m-Cresol	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	7	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.3--continued

Constituents (micrograms per liter)	C-5	EPA Monitor Wells		
		EPA-1	EPA-2	EPA-3
2-Chlorophenol	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND
p-Chloro-m-Cresol	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND
Phenol	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND

ND: None detected
--: Constituent not analyzed

Table G.4

Minimum/Maximum Concentration Range of Trace Metals and Cyanide in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.4

MINIMUM/MAXIMUM CONCENTRATION RANGE OF TRACE METALS AND CYANIDE IN WATER SAMPLES COLLECTED FROM ON-SITE AND OFF-SITE WELLS AND MEANDERING ROAD CREEK DECEMBER 1982-JANUARY 1984

	Upper Zone Monitor Wells							
Constituents (mg/L)	HM-1	HM-2	HM-3a	HM-3b	HM-4a	HM-4b	HM-5	HM-6
Antimony	BDL/0.62	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	0.28/0.43	BDL/0.13	BDL/.025	BDL/.13	BDL/.001	BDL/.14	BDL/.11	.13/.28
Beryllium	.002	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	BDL/0.15	BDL	BDL/.009	BDL/.011	BDL/.010	.008/.026	BDL/.023	BDL/.011
Chromium (Total)	37.0/45.7	BDL	BDL/0.13	BDL/.026	BDL/.25	.01/.15	BDL	BDL/.026
Chromium (Hexavalent)	BDL/44.7	BDL	BDL	BDL	BDL/.01	BDL	BDL	BDL
Copper	0.67/0.78	BDL	BDL/.028	BDL/.019	BDL/.03	.01/.074	BDL/.014	BDL/.022
Iron	1.54/2.0	BDL/.08	.04/.066	.092/.19	.11/2.6	.08/10.74	.024/.10	.072/.35
Lead	BDL	BDL/.07	BDL	BDL	BDL	BDL/.12	BDL	.07/.12
Manganese	.02/.026	BDL/.07	.19/.21	.012/.38	.03/.72	.03/8.5	.004/.27	.002/1.2
Mercury	BDL/.12	BDL/.05	BDL	BDL/.008	BDL	BDL	BDL	BDL/.07
Nickel	.07/.36	BDL/.01	.01/.076	BDL/.076	BDL/.32	.01/.27	BDL/.042	.01/.03
Selenium	BDL/.08	BDL	BDL	BDL/.035	BDL	BDL/.15	BDL	BDL
Silver	BDL/.02	BDL	BDL	BDL	BDL/.01	BDL/.13	BDL	BDL
Thallium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	.01/.04	.022/.05	.032/.07	.05/.18	.03/.50	.03/.38	BDL/.08	.02/.73
Strontium	.08/.094	.21/.51	.10/1.43	.06/2.13	1.6/2.08	2.6/4.74	3.6/3.69	1.08/1.67
Cyanide	2.8/4.61	BDL	BDL	.028/7.83	BDL	BDL	BDL	BDL

BDL: Below detection limit

--: Constituent not analyzed

Table G.4--continued

Constituents (mg/L)	Upper Zone Monitor Wells							
	HM-7	HM-8	HM-9	HM-10	HM-11	HM-12	HM-13	HM-14
Antimony	BDL	BDL	BDL	BDL	BDL	.24	BDL	BDL
Arsenic	BDL/.08	BDL/.16	BDL	BDL	BDL	BDL	BDL	BDL
Beryllium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cadmium	BDL/.005	BDL	BDL/.009	BDL.015	BDL/.006	BDL/.007	BDL	BDL/.004
Chromium (Total)	BDL/.016	BDL	BDL/.022	BDL/.04	BDL	BDL/.019	BDL/.25	BDL
Chromium (Hexavalent)	BDL	BDL	BDL	BDL/.01	BDL	BDL	BDL	BDL
Copper	DL	BDL	BDL/.018	.01/.036	BDL	BDL/.013	BDL/.013	BDL
Iron	.062/15	BDL/.10	.033/.11	.028/.09	.03/.33	.02/.14	.02/1.2	BDL/.03
Lead	BDL	BDL/.07	BDL	BDL	BDL	BDL/.07	BDL	BDL
Manganese	.432/1.05	BDL/.11	.021/1.2	.03/.41	.006/.028	.018/.05	.002/.06	BDL/.08
Mercury	BDL	BDL/.08	BDL/.06	BDL/.05	BDL	BDL	BDL	BDL
Nickel	BDL/.062	BDL	BDL/.062	BDL/.056	BDL	BD1/.048	BDL/.24	BDL/.042
Selenium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Silver	BDL	BDL	BDL	BDL	BDL	BDL/.01	BDL/.008	BDL
Thallium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	.01/.13	BDL/.03	.01/.052	.04/.27	.080/.14	.046/.23	.046/.21	0.22/.21
Strontium	.90/2.64	.23/.37	3.2/4.34	1.15/1.79	.36/.41	1.3/2.45	.28/.33	.32/.40
Cyanide	BDL	BDL	BDL	0.02	BDL	BDL	BDL	BDL

BDL: Below detection limit
--: Constituent not analyzed

Table G.4--continued

Constituents (mg/L)	Upper Zone Monitor Wells							
	HM-15	HM-16	HM-17	HM-18	HM-19	HM-20	HM-21	HM-22
Antimony	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Beryllium	--	BDL	BDL	BDL	BDL	BDL	BDL	.009
Cadmium	--	BDL/.003	BDL/.008	BDL/.006	BDL/.005	BDL/.014	BDL/.019	BDL
Chromium (Total)	--	BDL/.006	BDL	BDL	BDL/.019	.02/.27	BDL/.022	.015
Chromium (Hexavalent)	--	BDL	BDL	BDL	BDL	BDL	BDL	--
Copper	--	BDL/.019	BDL/.013	BDL	BDL/.013	BDL/.019	BDL/.019	.24
Iron	--	BDL/.19	BDL/.24	.050/.57	BDL/.49	.02/.16	BDL/.56	.13
Lead	--	BDL	BDL/.032	BDL/.31	BDL/.020	BDL	BDL	BDL
Manganese	--	.022/.08	.003/.09	.012/.23	BDL/.60	.03/.55	BDL/.18	.047
Mercury	--	BDL/.009	BDL	BDL	BDL	BDL	BDL	BDL
Nickel	--	.01/.042	BDL/.056	.02/.048	.015/.042	BDL/.076	.03/.082	.080
Selenium	--	BDL/.001	BDL	BDL	BDL	BDL	BDL	BDL
Silver	--	BDL	BDL/.018	BDL	BDL/.007	BDL/.184	BDL	BDL
Thallium	--	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	--	.034/.23	.20/.22	.032/.076	.072/.15	.03/.53	.10/.27	.037
Strontium	--	.31/.45	.42/.78	.36/.72	.86/1.7	.25/.57	.52/1.2	6.0
Cyanide	--	BDL/.03	BDL	BDL	BDL	BDL	BDL	--

BDL: Below detection limit
--: Constituent not analyzed

Table G.4--continued

Constituents (mg/L)	Upper Zone Monitor Wells							
	HM-23	HM-24	HM-25	HM-26	HM-27	HM-28	HM-29	HM-30
Antimony	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Beryllium	.0005/.001	BDL	BDL	BDL	BDL	BDL	BDL/.001	BDL/.001
Cadmium	BDL/.003	BDL/.008	BDL	BDL	BDL	BDL	BDL/.008	BDL
Chromium (Total)	BDL/.006	BDL/.006	BDL	BDL/.026	BDL/.010	BDL	.31/.42	BDL/.003
Chromium (Hexavalent)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL/.110
Copper	BDL/.012	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Iron	.086/.50	BDL/.64	0.49/1.2	BDL/.87	.037/.61	BDL/.85	.029/.18	.034/.40
Lead	BDL	BDL	BDL/.050	BDL/.037	BDL/.024	BDL	BDL	BDL
Manganese	BDL/.063	.031/.13	.14/.36	.020/.15	.080/.28	.008/.31	.002/.15	BDL/.037
Mercury	BDL	BDL/.0014	BDL	BDL	BDL	BDL/.003	BDL	BDL
Nickel	.008	BDL/.014	BDL/.005	BDL	.007	BDL	BDL/.010	.007/.009
Selenium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Silver	BDL/.18	BDL/.020	BDL/.021	BDL/.015	BDL/.017	BDL/.013	BDL/.19	BDL/.015
Thallium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	.13/.16	.21/1.1	.024/.054	BDL/.031	BDL/.071	.053/.16	.004/.047	.035/.14
Strontium	.16/.26	.77/3.6	.37/.54	2.2/2.3	1.6/1.7	.49/3.2	.14/.20	.20/.33
Cyanide	BDL	BDL	BDL	BDL	BDL	BDL	BDL/.02	BDL/.02

BDL: Below detection limit
--: Constituent not analyzed

Table G.4--continued

Constituents (mg/L)	HM-31	Paluxy Monitor Wells				White Settlement Wells		
		P-1	P-2	P-3	P-4	WS-1	WS-2	WS-12
Antimony	BDL	BDL	BDL/.051	BDL	BDL	BDL	BDL	BDL
Arsenic	BDL	BDL/.006	BDL	BDL	BDL	BDL	BDL	BDL
Beryllium	BDL	BDL	BDL/.002	BDL	BDL/.001	BDL	BDL/.001	BDL/.001
Cadmium	BDL	BDL	BDL/.003	BDL/.007	BDL	BDL	BDL	BDL/.004
Chromium (Total)	BDL/.39	BDL	BDL/.013	BDL	BDL/.003	BDL	BDL	BDL/.003
Chromium (Hexavalent)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Copper	BDL/.007	BDL	BDL/.023	BDL	BDL/.014	BDL	BDL	BDL
Iron	.013/.92	.008/.081	BDL/.077	.015/.59	.027/.16	0.3/.18	.120/.16	.04/.075
Lead	BDL/.059	BDL	BDL	BDL	BDL	BDL/.05	BDL	BDL
Manganese	.002/.097	.004/.018	.019/.042	.025/.090	.12/.31	.02/.025	.025/.031	.005/.017
Mercury	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Nickel	BDL	BDL/.028	BDL/.010	BDL/.011	BDL/.01	BDL	BDL/.008	BDL/.007
Selenium	BDL	BDL/.009	BDL	BDL	BDL	BDL	BDL	BDL
Silver	BDL/.018	BDL/.042	BDL/.016	BDL/.019	BDL/.016	BDL	BDL/.022	BDL
Thallium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	.081/.16	.13/.20	.08/.27	.021/.37	.094/.11	BDL/.11	.019/.029	BDL/.04
Strontium	.71/1.1	1.7/3.49	3.7	3.1/3.8	3.1/4.1	4.3/4.4	4.1/4.2	2.9/3.0
Cyanide	BDL	BDL	BDL	BDL	BDL	BDL/.05	BDL	BDL/.03

BDL: Below detection limit
--: Constituent not analyzed

Table G.4--continued

Constituents (mg/L)	Residential Wells				Meandering Road Creek			
	Johnson	Spudich	Stines	Walker	C-1	C-2	C-3	C-4
Antimony	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Arsenic	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Beryllium	.001	BDL	BDL	.001	BDL	BDL	BDL	.001
Cadmium	.003	BDL	BDL	BDL	BDL	BDL	BDL	BDL/.004
Chromium (Total)	.003	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (Hexavalent)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Copper	BDL	BDL	BDL	BDL	BDL	BDL/.013	BDL	BDL/.005
Iron	0.22	3.6	.027	.074	.047/.10	BDL/.09	BDL/0.58	BDL/.26
Lead	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Manganese	.016	.040	BDL	.13	BDL	BDL/.056	BDL/.022	BDL/.026
Mercury	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Nickel	.004	BDL	BDL	.008	BDL	BDL/.034	BDL	BDL
Selenium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Silver	.023	.018	.016	BDL	BDL	BDL	BDL	BDL/.004
Thallium	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	.049	.096	.009	.039	.01	.01/.022	.008	.012
Strontium	3.2	3.8	0.55	2.6	1.14	.63/.78	.049	.77
Cyanide	BDL	BDL	BDL	--	BDL	BDL	--	BDL

BDL: Below detection limit
--: Constituent not analyzed

Table G.4--continued

Constituents (mg/L)	C-5	EPA Monitor Wells		
		EPA-1	EPA-2	EPA-3
Antimony	BDL	<0.003	<0.003	<0.003
Arsenic	BDL	<0.003	<0.003	<0.003
Beryllium	BDL	0.001	<0.0005	0.001
Cadmium	BDL	0.012	<0.002	0.014
Chromium (Total)	BDL	0.012	0.003	0.011
Chromium (Hexavalent)	BDL	<0.02	<0.02	<0.02
Copper	BDL/.016	<0.028	0.003	0.013
Iron	.035/.34	0.072	0.23	0.051
Lead	BDL	<0.002	<0.002	<0.003
Manganese	.001/.009	0.008	0.012	0.014
Mercury	BDL	<0.0002	<0.0002	<0.0002
Nickel	BDL	<0.003	<0.003	<0.003
Selenium	BDL	<0.003	<0.003	<0.003
Silver	BDL/.015	0.008	<0.002	<0.002
Thallium	BDL	<0.002	<0.002	<0.002
Zinc	BDL	<0.003	<0.003	0.007
Strontium	0.31	1.7	4.1	1.1
Cyanide	BDL	<0.02	<0.02	<0.02

BDL: Below detection limit
--: Constituent not analyzed

Table G.5

Minimum/Maximum Concentration Range of Oil and Grease and Fuel Hydrocarbons in Water Samples Collected From On-Site and Off-Site Wells and Meandering Road Creek--December 1982-January 1984

Table G.5
MINIMUM/MAXIMUM CONCENTRATIONS OF OIL/GREASE AND FUEL HYDROCARBONS
IN WATER SAMPLES COLLECTED FROM ON-SITE AND OFF-SITE WELLS AND MEANDERING ROAD CREEK
DECEMBER 1982-JANUARY 1984

Sample Identifier	Oil/Grease (mg/L)	Hydrocarbons Typically Found in Fuel (mg/L)
HM-1	--	--
HM-2	--	ND
HM-3	--	--
HM-4	--	--
HM-5	--	ND
HM-6	448,000/550,000	0.2/112,000
HM-7	6/9.8	0.2/34
HM-8	3.6	ND/0.1
HM-9	--	--
HM-10	6/11.6	ND/BDL
HM-11	--	--
HM-12	--	--
HM-13	--	BDL
HM-14	--	BDL
HM-15	--	--
HM-16	--	--
HM-17	--	--
HM-18	BDL	BDL
HM-19	BDL/7.2	ND/BDL
HM-20	1.9/30	BDL/1
HM-21	1.9/25	BDL
HM-22	--	--
HM-23	--	--
HM-24	--	--
HM-25	--	--
HM-26	BDL/66	ND/BDL
HM-27	BDL/260	ND/0.55
HM-28	--	--
HM-29	--	--
HM-30	--	--
HM-31	--	--
P-1	--	ND
P-2	--	--
P-3	BDL	ND
P-4	BDL	ND
WS-1	--	ND/BDL
WS-2	25	ND/0.2
WS-12	--	ND/0.1
Johnson	--	--
Spudich	--	--
Stines	--	--
Walker	36	ND
C-1	--	--
C-2	BDL	ND/BDL
C-3	BDL	ND/BDL
C-4	--	--
C-5	BDL	ND/BDL
EPA-1	--	--
EPA-2	--	--
EPA-3	--	--

ND: None detectable

BDL: Detectable, but below detectable limits
--: Constituent not analyzed

Appendix H

CHEMICAL ANALYSES FROM WEST EMPLOYEE PARKING LOT AREA COLLECTION POINTS

Table H.1 New French Drain (Drain System Installed in Bottom of Excavation)

Table H.2 French Drain (Installed 1982)

Table H.3 Outfall (Storm Sewer Outfall)

Table H.4 Pipe (Pipe Drain)

Table H.1

New French Drain (Drain System Installed in Bottom of Excavation)

3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224

ALLIED ANALYTICAL & RESEARCH LABORATORIES

Chemists

Consultants & Technologists

214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS New French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: New French Drain
Purgeables
U.S.E.P.A. Method 624

COMPOUND	MDL,ppb	CONC.,ppb
Chloromethane	10	BDL
Bromomethane	10	BDL
Vinyl Chloride	10	BDL
Chloroethane	10	BDL
Methylene Chloride	3	BDL
Trichlorofluoromethane	10	BDL
1, 1 Dichloroethylene	3	294
1, 1 Dichloroethane	5	BDL
trans-1, 2-Dichloroethylene	2	4
Chloroform	2	5
1, 2 Dichloroethane	3	5
1, 1, 1 Trichloroethane	4	BDL
Carbon Tetrachloride	3	BDL
Bromodichloromethane	2	BDL
1, 2 Dichloropropane	6	BDL

BDL = Below Minimum Detectable Level (MDL)

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Chemists
Consultants & Technologists
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS New French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth,Tx

ANALYSIS

Sample ID: New French Drain
U.S.E.P.A. Method 625
Base-Neutral Extractables

COMPOUND	MDL,ppb	CONC.,ppb
1, 3 Dichlorobenzene	2	BDL
1, 4 Dichlorobenzene	4	BDL
Hexachloroethane	2	BDL
1, 2 Dichlorobenzene	2	BDL
Bis (2-chloroisopropyl) ether	6	BDL
Hexachlorobutadiene	1	BDL
1, 2, 4 Trichlorobenzene	2	BDL
Naphthalene	2	BDL
Bis (2-chloroethyl) ether	6	BDL
Hexachlorocyclopentadiene	50	BDL
Nitrobenzene	2	BDL
Bis (2-chloroethoxy) Methane	5	BDL
2-Chloronaphthalene	2	BDL
Acenaphthylene	4	BDL
Acenaphthene	2	BDL

BDL = Below Minimum Detectable Level (MDL)

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P.O. Box 24330
Dallas, Texas 75224

ALLIED ANALYTICAL & RESEARCH LABORATORIES

Chemists
Consultants & Technologists

214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS New French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: New French Drain

Purgeables

COMPOUND	MDL,ppb	CONC.,ppb
trans-1, 3-Dichloropropylene	5	BDL
Trichloroethylene	2	216
Dibromochloromethane	3	BDL
cis-1, 3-Dichloropropylene	10	BDL
1, 1, 2-Trichloroethane	5	BDL
Benzene	4	4
2-Chloroethylvinylether	10	BDL
Bromoform	5	BDL
Tetrachloroethylene	4	16
1, 1, 2, 2 Tetrachloroethane	7	BDL
Toluene	6	BDL
Chlorobenzene	6	BDL
Ethyl Benzene	7	BDL
Acrolein	50	BDL
Acrylonitrile	50	BDL

BDL = Below Minimum Detectable Level (MDL)

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P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE: Water

DATE SUBMITTED: 4/3/84

IDENTIFYING MARKS: New French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY: General Dynamics, Inc.
Attn: Walter Hill

ADDRESS: P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: New French Drain

Base-Neutrals

COMPOUND	MDL,ppb	CONC.,ppb
Isophorone	2	BDL
Fluorene	2	BDL
2, 6 Dinitrotoluene	2	BDL
1, 2 Diphenylhydrazine	2	BDL
2, 4 Dinitrotoluene	6	BDL
n-Nitrosodiphenylamine	2	BDL
Hexachlorobenzene	2	BDL
4-Bromophenyl Phenyl Ether	2	BDL
Phenanthrene	5	BDL
Antharacene	2	BDL
Dimethyl Phthalate	2	BDL
Diethyl Phthalate	22	BDL
Fluoranthene	2	BDL
Pyrene	2	BDL
Di-n-butyl Phthalate	2	BDL
Benzidene	44	BDL
Butyl Benzyl Phthalate	3	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS New French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: New French Drain

Base-Neutral

COMPOUND	MDL,ppb	CONC.,ppb
Chrysene	3	BDL
Bis (2-ethylhexyl) Phthalate	3	BDL
Benzo (a) anthracene	8	BDL
Benzo (b) fluoranthene	5	BDL
Benzo (k) fluoranthene	3	BDL
Benzo (a) pyrene	3	BDL
Indeno (1,2,3-cd) Pyrene	4	BDL
Dibenzo (a,h) anthracene	3	BDL
Benzo (g,h,i) perylene	4	BDL
n-Nitrosodimethylamine	100	BDL
n-Nitrosodi-n-propylamine	2	BDL
4-Chlorophenyl phenyl ether	4	BDL
3, 3 Dichlorobenzidene	17	BDL
2, 3, 7, 8 TCDD	50	BDL
Bis (chloromethyl) ether	6	BDL
Di-n-octyl Phthalate	3	BDL

BDL = Below Minimum Detectable Level (MDL)

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3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS New French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: New French Drain
Acid & Pesticide Extractables
E.P.A. Method 625

COMPOUND	MDL,ppb	CONC.,ppb
2-Chlorophenol	3	BDL
Phenol	2	BDL
2, 4 Dichlorophenol	3	BDL
2-Nitrophenol	4	BDL
p-Chloro-m-Cresol	3	BDL
2, 4, 6 Trichlorophenol	3	BDL
2, 4 Dimethylphenol	3	BDL
2, 4 Dinitrophenol	42	BDL
4, 6 Dinitrophenol	24	BDL
4-Nitrophenol	2	BDL
Pentachlorophenol	4	BDL
b-Endosulfan	100	BDL
a-BHC	100	BDL
4-BHC	100	BDL
b-BHC	4	BDL

BDL = Below Minimum Detectable Level (MDL)

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8896

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS New French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: New French Drain

Acid & Pesticide

COMPOUND	MDL,ppb	CONC.,ppb
Aldrin	2	BDL
Heptaclor	2	BDL
Heptaclor Epoxide	2	BDL
a-Endosulfan	100	BDL
Dieldrin	3	BDL
4, 4-DDE	6	BDL
4, 4-DDD	3	BDL
4, 4-DDT	5	BDL
Endrin	100	BDL
Endrin Aldehyde	100	BDL
Endosulfan Sulfate	6	BDL
d-BHC	3	BDL
Chlordane	1000	BDL
Toxaphene	5000	BDL
PCB (total)	100	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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Table H.2

French Drain (Installed 1982)

ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: French Drain
Purgeables
U.S.E.P.A. Method 624

COMPOUND	MDL,ppb	CONC.,ppb
Chloromethane	10	BDL
Bromomethane	10	BDL
Vinyl Chloride	10	BDL
Chloroethane	10	BDL
Methylene Chloride	3	BDL
Trichlorofluoromethane	10	235
1, 1 Dichloroethylene	3	44516
1, 1 Dichloroethane	5	BDL
trans-1, 2-Dichloroethylene	2	22
Chloroform	2	2292
1, 2 Dichloroethane	3	597
1, 1, 1 Trichloroethane	4	922
Carbon Tetrachloride	3	36
Bromodichloromethane	2	BDL
1, 2 Dichloropropane	6	BDL

BDL = Below Minimum Detectable Level (MDL)

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: French Drain

Purgeables

COMPOUND	MDL,ppb	CONC.,ppb
trans-1, 3-Dichloropropylene	5	BDL
Trichloroethylene	2	66284
Dibromochloromethane	3	BDL
cis-1, 3-Dichloropropylene	10	BDL
1, 1, 2-Trichloroethane	5	BDL
Benzene	4	BDL
2-Chloroethylvinylether	10	BDL
Bromoform	5	BDL
Tetrachloroethylene	4	11156
1, 1, 2, 2 Tetrachloroethane	7	BDL
Toluene	6	14058
Chlorobenzene	6	19
Ethyl Benzene	7	191
Acrolein	50	BDL
Acrylonitrile	50	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: French Drain
Base-Neutral Extractables
U.S.E.P.A. Method 625

COMPOUND	MDL,ppb	CONC.,ppb
1, 3 Dichlorobenzene	2	50
1, 4 Dichlorobenzene	4	BDL
Hexachloroethane	2	BDL
1, 2 Dichlorobenzene	2	421
Bis (2-chloroisopropyl) ether	6	BDL
Hexachlorobutadiene	1	BDL
1, 2, 4 Trichlorobenzene	2	BDL
Naphthalene	2	21
Bis (2-chloroethyl) ether	6	BDL
Hexachlorocyclopentadiene	50	BDL
Nitrobenzene	2	BDL
Bis (2-chloroethoxy) Methane	5	BDL
2-Chloronaphthalene	2	BDL
Acenaphthylene	4	BDL
Acenaphthene	2	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE: Water

DATE SUBMITTED: 4/3/84

IDENTIFYING MARKS: French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY: General Dynamics, Inc.
Attn: Walter Hill

ADDRESS: P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: French Drain

Base-Neutral

COMPOUND	MDL,ppb	CONC.,ppb
Isophorone	2	BDL
Fluorene	2	BDL
2, 6 Dinitrotoluene	2	BDL
1, 2 Diphenylhydrazine	2	BDL
2, 4 Dinitrotoluene	6	BDL
n-Nitrosodiphenylamine	2	BDL
Hexachlorobenzene	2	BDL
4-Bromophenyl Phenyl Ether	2	BDL
Phenanthrene	5	BDL
Antharacene	2	BDL
Dimethyl Phthalate	2	BDL
Diethyl Phthalate	22	BDL
Fluoranthene	2	BDL
Pyrene	2	BDL
Di-n-butyl Phthalate	2	8
Benzidene	44	BDL
Butyl Benzyl Phthalate	3	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES. BY_____

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P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: French Drain

Base-Neutral

COMPOUND	MDL,ppb	CONC.,ppb
Chrysene	3	BDL
Bis (2-ethylhexyl) Phthalate	3	37
Benzo (a) anthracene	8	BDL
Benzo (b) fluoranthene	5	BDL
Benzo (k) fluoranthene	3	BDL
Benzo (a) pyrene	3	BDL
Indeno (1,2,3-cd) Pyrene	4	BDL
Dibenzo (a,h) anthracene	3	BDL
Benzo (g,h,i) perylene	4	BDL
n-Nitrosodimethylamine	100	BDL
n-Nitrosodi-n-propylamine	2	BDL
4-Chlorophenyl phenyl ether	4	BDL
3, 3 Dichlorobenzidene	17	BDL
2, 3, 7, 8 TCDD	50	BDL
Bis (chloromethyl) ether	6	BDL
Di-n-octyl Phthalate	3	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
Chemists
Consultants & Technologists
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: French Drain
Pesticide Extractable
U.S.E.P.A. Method 625

COMPOUND	MDL,ppb	CONC.,ppb
b-Endosulfan	100	BDL
a-BHC	100	BDL
4-BHC	100	BDL
b-BHC	4	BDL
Aldrin	2	BDL
Heptaclor	2	BDL
Heptaclor Epoxide	2	BDL
a-Endosulfan	100	BDL
Dieldrin	3	BDL
4, 4-DDE	6	BDL
4, 4-DDD	3	BDL
4, 4-DDT	5	BDL
Endrin	100	BDL
Endrin Aldehyde	100	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES

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P.O. Box 24330
Dallas, Texas 75224

Chemists
Consultants & Technologists

214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS French Drain

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: French Drain

Pesticide

COMPOUND	MDL,ppb	CONC.,ppb
Endosulfan Sulfate	6	BDL
d-BHC	3	BDL
Chlordane	1000	BDL
Toxaphene	5000	BDL
PCB (total)	100	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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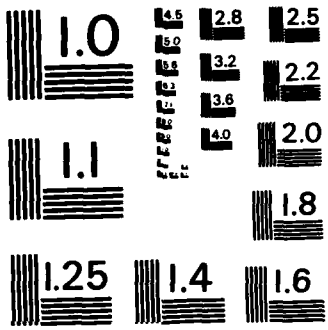
Table H.3

Outfall (Storm Sewer Outfall)

AD-A160 057 INSTALLATION RESTORATION PROGRAM RECORDS SEARCH FOR AIR FORCE PLANT 4 TEXAS(U) CH2M HILL INC GAINESVILLE FL AUG 84 F08637-83-G-0007 4/5

UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
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April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Outfall

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Outfall
Purgeables
U.S.E.P.A. Method 624

COMPOUND	MDL,ppb	CONC.,ppb
Chloromethane	10	BDL
Bromomethane	10	BDL
Vinyl Chloride	10	BDL
Chloroethane	10	BDL
Methylene Chloride	3	BDL
Trichlorofluoromethane	10	BDL
1, 1 Dichloroethylene	3	9
1, 1 Dichloroethane	5	BDL
trans-1, 2-Dichloroethylene	2	BDL
Chloroform	2	BDL
1, 2 Dichloroethane	3	BDL
1, 1, 1 Trichloroethane	4	BDL
Carbon Tetrachloride	3	BDL
Bromodichloromethane	2	BDL
1, 2 Dichloropropane	6	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Outfall

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Outfall

Purgeables

COMPOUND	MDL,ppb	CONC.,ppb
trans-1, 3-Dichloropropylene	5	BDL
Trichloroethylene	2	BDL
Dibromochloromethane	3	BDL
cis-1, 3-Dichloropropylene	10	BDL
1, 1, 2-Trichloroethane	5	BDL
Benzene	4	BDL
2-Chloroethylvinylether	10	BDL
Bromoform	5	BDL
Tetrachloroethylene	4	BDL
1, 1, 2, 2 Tetrachloroethane	7	BDL
Toluene	6	BDL
Chlorobenzene	6	BDL
Ethyl Benzene	7	BDL
Acrolein	50	BDL
Acrylonitrile	50	BDL

BDL = Below Minimum Detectable Level (MDL)

H. Morris Weller, President

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Outfall

ANALYTICAL REPORT NO. 62660

SUBMITTED BY
General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Outfall
Base-Neutral Extractables
U.S.E.P.A. Method 625

COMPOUND	MDL,ppb	CONC.,ppb
1, 3 Dichlorobenzene	2	BDL
1, 4 Dichlorobenzene	4	BDL
Hexachloroethane	2	BDL
1, 2 Dichlorobenzene	2	BDL
Bis (2-chloroisopropyl) ether	6	BDL
Hexachlorobutadiene	1	BDL
1, 2, 4 Trichlorobenzene	2	BDL
Naphthalene	2	BDL
Bis (2-chloroethyl) ether	6	BDL
Hexachlorocyclopentadiene	50	BDL
Nitrobenzene	2	BDL
Bis (2-chloroethoxy) Methane	5	BDL
2-Chloronaphthalene	2	BDL
Acenaphthylene	4	BDL
Acenaphthene	2	BDL

BDL = Below Minimum Detectable Level (MDL)

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Dallas, Texas 75224

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Chemists
Consultants & Technologists

214/337-6996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Outfall

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Outfall

Base-Neutral

COMPOUND	MDL,ppb	CONC.,ppb
Isophorone	2	BDL
Fluorene	2	BDL
2, 6 Dinitrotoluene	2	BDL
1, 2 Diphenylhydrazine	2	BDL
2, 4 Dinitrotoluene	6	BDL
n-Nitrosodiphenylamine	2	BDL
Hexachlorobenzene	2	BDL
4-Bromophenyl Phenyl Ether	2	BDL
Phenanthrene	5	BDL
Antharacene	2	BDL
Dimethyl Phthalate	2	BDL
Diethyl Phthalate	22	BDL
Fluoranthene	2	BDL
Pyrene	2	BDL
Di-n-butyl Phthalate	2	BDL
Benzidene	44	BDL
Butyl Benzyl Phthalate	3	BDL

BDL = Below Minimum Detectable Level (MDL)

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Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Outfall

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Outfall

Base-Neutral

COMPOUND	MDL,ppb	CONC.,ppb
Chrysene	3	BDL
Bis (2-ethylhexyl) Phthalate	3	BDL
Benzo (a) anthracene	8	BDL
Benzo (b) fluoranthene	5	BDL
Benzo (k) fluoranthene	3	BDL
Benzo (a) pyrene	3	BDL
Indeno (1,2,3-cd) Pyrene	4	BDL
Dibenzo (a,h) anthracene	3	BDL
Benzo (g,h,i) perylene	4	BDL
n-Nitrosodimethylamine	100	BDL
n-Nitrosodi-n-propylamine	2	BDL
4-Chlorophenyl phenyl ether	4	BDL
3, 3 Dichlorobenzidene	17	BDL
2, 3, 7, 8 TCDD	50	BDL
Bis (chloromethyl) ether	6	BDL
Di-n-octyl Phthalate	3	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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Chemists
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214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Outfall

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Outfall
Pesticide Extractable
U.S.E.P.A. Method 625

COMPOUND	MDL,ppb	CONC.,ppb
b-Endosulfan	100	BDL
a-BHC	100	BDL
4-BHC	100	BDL
b-BHC	4	BDL
Aldrin	2	BDL
Heptaclor	2	BDL
Heptaclor Epoxide	2	BDL
a-Endosulfan	100	BDL
Dieldrin	3	BDL
4, 4-DDE	6	BDL
4, 4-DDD	3	BDL
4, 4-DDT	5	BDL
Endrin	100	BDL
Endrin Aldehyde	100	BDL

BDL = Below Minimum Detectable Level (MDL)

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Chemists
Consultants & Technologists

214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Outfall

ANALYTICAL REPORT NO. 62660

SUBMITTED BY
General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Outfall

COMPOUND	Pesticide MDL,ppb	Pesticide CONC.,ppb
Endosulfan Sulfate	6	BDL
d-BHC	3	BDL
Chlordane	1000	BDL
Toxaphene	5000	BDL
PCB (total)	100	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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Table H.4

Pipe (Pipe Drain)

ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Pipe

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Pipe
Purgeables
U.S.E.P.A. Method 624

COMPOUND	MDL,ppb	CONC.,ppb
Chloromethane	10	BDL
Bromomethane	10	BDL
Vinyl Chloride	10	BDL
Chloroethane	10	BDL
Methylene Chloride	3	BDL
Trichlorofluoromethane	10	210
1, 1 Dichloroethylene	3	52505
1, 1 Dichloroethane	5	BDL
trans-1, 2-Dichloroethylene	2	122
Chloroform	2	754
1, 2 Dichloroethane	3	4295
1, 1, 1 Trichloroethane	4	906
Carbon Tetrachloride	3	21
Bromodichloromethane	2	BDL
1, 2 Dichloropropane	6	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Pipe

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Pipe

Purgeables

COMPOUND	MDL,ppb	CONC.,ppb
trans-1, 3-Dichloropropylene	5	BDL
Trichloroethylene	2	9330
Dibromochloromethane	3	BDL
cis-1, 3-Dichloropropylene	10	BDL
1, 1, 2-Trichloroethane	5	BDL
Benzene	4	10
2-Chloroethylvinylether	10	BDL
Bromoform	5	BDL
Tetrachloroethylene	4	531
1, 1, 2, 2 Tetrachloroethane	7	BDL
Toluene	6	5706
Chlorobenzene	6	24
Ethyl Benzene	7	BDL
Acrolein	50	BDL
Acrylonitrile	50	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES. BY_____ _____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Pipe

ANALYTICAL REPORT NO. 62660

SUBMITTED BY
General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Pipe
U.S.E.P.A. Method 625
Base-Neutral Extractables

COMPOUND	MDL,ppb	CONC.,ppb
1, 3 Dichlorobenzene	2	77
1, 4 Dichlorobenzene	4	BDL
Hexachloroethane	2	BDL
1, 2 Dichlorobenzene	2	468
Bis (2-chloroisopropyl) ether	6	BDL
Hexachlorobutadiene	1	BDL
1, 2, 4 Trichlorobenzene	2	BDL
Naphthalene	2	29
Bis (2-chloroethyl) ether	6	BDL
Hexachlorocyclopentadiene	50	BDL
Nitrobenzene	2	BDL
Bis (2-chloroethoxy) Methane	5	BDL
2-Chloronaphthalene	2	BDL
Acenaphthylene	4	BDL
Acenaphthene	2	BDL

BDL = Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES

Chemists

Consultants & Technologists

214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Pipe

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Pipe

Base-Neutrals

COMPOUND	MDL,ppb	CONC.,ppb
Isophorone	2	BDL
Fluorene	2	BDL
2, 6 Dinitrotoluene	2	BDL
1, 2 Diphenylhydrazine	2	BDL
2, 4 Dinitrotoluene	6	BDL
n-Nitrosodiphenylamine	2	BDL
Hexachlorobenzene	2	BDL
4-Bromophenyl Phenyl Ether	2	BDL
Phenanthrene	5	BDL
Antharacene	2	BDL
Dimethyl Phthalate	2	BDL
Diethyl Phthalate	22	BDL
Fluoranthene	2	BDL
Pyrene	2	BDL
Di-n-butyl Phthalate	2	5
Benzidene	44	BDL
Butyl Benzyl Phthalate	3	BDL

BDL - Below Minimum Detectable Level (MDL)

ALLIED ANALYTICAL & RESEARCH LABORATORIES, BY_____

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ALLIED ANALYTICAL & RESEARCH LABORATORIES
3031 Glenfield
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Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Pipe

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Pipe

Base-Neutral

COMPOUND	MDL,ppb	CONC.,ppb
Chrysene	3	BDL
Bis (2-ethylhexyl) Phthalate	3	BDL
Benzo (a) anthracene	8	BDL
Benzo (b) fluoranthene	5	BDL
Benzo (k) fluoranthene	3	BDL
Benzo (a) pyrene	3	BDL
Indeno (1,2,3-cd) Pyrene	4	BDL
Dibenzo (a,h) anthracene	3	BDL
Benzo (g,h,i) perylene	4	BDL
n-Nitrosodimethylamine	100	BDL
n-Nitrosodi-n-propylamine	2	BDL
4-Chlorophenyl phenyl ether	4	BDL
3, 3 Dichlorobenzidene	17	BDL
2, 3, 7, 8 TCDD	50	BDL
Bis (chloromethyl) ether	6	BDL
Di-n-octyl Phthalate	3	BDL

BDL = Below Minimum Detectable Level (MDL)

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3031 Glenfield
P.O. Box 24330
Dallas, Texas 75224
Chemists
Consultants & Technologists
214/337-8996

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Pipe

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Pipe
Pesticide Extractables
E.P.A. Method 625

COMPOUND	MDL,ppb	CONC.,ppb
b-Endosulfan	100	BDL
a-BHC	100	BDL
4-BHC	100	BDL
b-BHC	4	BDL
Aldrin	2	BDL
Heptaclor	2	BDL
Heptaclor Epoxide	2	BDL
a-Endosulfan	100	BDL
Dieldrin	3	BDL
4, 4-DDE	6	BDL
4, 4-DDD	3	BDL
4, 4-DDT	5	BDL
Endrin	100	BDL
Endrin Aldehyde	100	BDL
Endosulfan Sulfate	6	BDL

BDL = Below Minimum Detectable Level (MDL)

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P.O. Box 24330
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ALLIED ANALYTICAL & RESEARCH LABORATORIES

Chemists

Consultants & Technologists

214/337-8896

April 26, 1984

SAMPLE Water

DATE SUBMITTED 4/3/84

IDENTIFYING MARKS Pipe

ANALYTICAL REPORT NO. 62660

SUBMITTED BY General Dynamics, Inc.
Attn: Walter Hill

ADDRESS P. O. Box 748
Fort Worth, Texas 76101

ANALYSIS

Sample ID: Pipe

Pesticide

COMPOUND	MDL,ppb	CONC.,ppb
d-BHC	3	BDL
Chlordane	1000	BDL
Toxaphene	5000	BDL
PCB (total)	100	BDL

BDL = Below Minimum Detectable Level (MDL)

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Appendix I

CHEMICAL ANALYSES OF SOILS COLLECTED DURING THE RADAR RANGE (CHROME PIT) AND DIE YARD (DIE PITS) EXCAVATION

RADAR RANGE EXCAVATION

Purgeable, USEPA Method 8240

Micrograms Per Kilogram

	WALL				FLOOR		
	SOUTH	WEST	NORTH	EAST	EAST	CENTER	WEST
Soil samples taken 12-29-83:							
Trichloroethylene	ND	ND	ND	ND	ND	1,915	139,647
Soil samples from west floor only after 4 feet deeper on 1-5-85:							
Chloroform							488
Trichloroethylene							2,522
Soil samples from west floor only after 5 feet deeper on 1-11-84:							
Trichloroethylene							4,827

Analyzed by Allied Analytical & Research Laboratories

*ND (Not Detected)

RADAR RANGE EXCAVATION

Base/Neutral Extractables, USEPA Method 8270

Micrograms Per Kilogram

	WALL				FLOOR		
	SOUTH	WEST	NORTH	EAST	EAST	CENTER	WEST
Soil samples taken 12-29-83:							
Di-n-butyl phthalate	1,473	307	2,186	ND	751	1,817	20,348
Bis (2-ethylnexyl) phthalate	9,810	411,989	9,571	ND	ND	4,275	6,422
Soil samples from west floor only after 4 feet deeper on 1-5-84:							
Di-n-butyl phthalate							12,663
Bis (2-ethylhexyl) phthalate							3,743
Soil samples from west floor only after 5 feet deeper on 1-11-84:							
Naphthalene							317
Di-n-butyl phthalate							8,466
Bis (2-ethylhexyl) phthalate							30,657

Analyzed by Allied Analytical & Research Laboratories

*ND (Not Detected)

RADAR RANGE EXCAVATION

Acid & Pest. Extractables, USEPA Method 8270

Micrograms Per Kilogram

	WALL				FLOOR		
	SOUTH	WEST	NORTH	EAST	EAST	CENTER	WEST
Soil samples taken 12-29-83:							
All Compounds	NONE	NONE	NONE	NONE	NONE	NONE	NONE
Soil samples from west floor only after 4 feet deeper on 1-5-84:							
All Compounds							NONE
Soil samples from west floor only after 5 feet deeper on 1-11-84							
All Compounds							NONE

Analyzed by Allied Analytical & Research Laboratories

*ND (Not Detected)

RADAR RANGE EXCAVATION

EP Toxicity

Pesticide/Herbicide

	WALL				FLOOR		
Soil Sample Taken 12-29-83:	SOUTH	WEST	NORTH	EAST	EAST	CENTER	WEST
Endrin	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Lindane	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	<1	<1	<1	<1	<1	<1	<1
Toxaphene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2, 4-D	<1	<1	<1	<1	<1	<1	<1
2, 4,5-TP Silvex	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Analyzed by Allied Analytical & Research Laboratories

RADAR RANGE EXCAVATION

Priority Pollutant Metals

Milligrams Per Liter in Extract

	WALL				FLOOR		
Soil Samples Taken 12-29-83:	SOUTH	WEST	NORTH	EAST	EAST	CENTER	WEST
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	0.006	<0.005	<0.005	<0.005	0.007	<0.005	<0.005
Chromium	0.020	<0.010	0.175	<0.010	0.015	0.044	26.30
Copper	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.029	0.031	<0.010	<0.010	0.033	<0.010	0.014
Lead	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.47
Thallium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.622	0.541	0.207	0.509	0.391	0.307	0.141
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	<0.001	0.001	0.004	0.001	0.001	<0.001	<0.001
Arsenic	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Selenium	<0.001	<0.001	<0.001	0.001	0.001	0.001	0.002

Analyzed by Allied Analytical & Research Laboratories

RADAR RANGE EXCAVATION

EP Toxicity-Metals

Milligrams Per Liter in Extract

Soil Samples Taken 12-29-83:	WALL				FLOOR		
	SOUTH	WEST	NORTH	EAST	EAST	CENTER	WEST
Barium	2.95	2.08	2.31	1.62	1.27	1.59	1.21
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	0.02	<0.01	0.18	<0.01	0.02	0.04	26.3
Lead	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Analyzed by Allied Analytical & Research Laboratories

RADAR RANGE EXCAVATION

EP Toxicity-Metals

Milligrams Per Liter in Extract

Soil-West Floor	1-5-84	1-11-84
Silver	<0.01	<.01
Barium	0.93	0.19
Beryllium	<0.001	<.001
Cadmium	<0.005	<.005
Chromium	19.2	.054
Copper	<0.01	<.01
Nickel	0.03	<.01
Lead	<0.05	<.05
Antimony	0.30	<.05
Thallium	<0.1	<.1
Zinc	0.50	.478
Arsenic	<0.002	<.0005
Selenium	<0.001	<.0005
Mercury	<0.001	<.0005

Analyzed by Allied Analytical & Research Laboratories

DIE YARD EXCAVATION

Purgeables, USEPA Method 8240

Micrograms Per Kilogram

	WALL				FLOOR			
Soils Sampled 1-5-84:	SOUTH	WEST	NORTH	EAST	SOUTH	MID SOUTH	MID NORTH	NORTH
Methylene Chloride	101	671	64	ND	170	371	1,669	3,553
1.1 Dichlorethylene	ND	299	35	ND	ND	ND	ND	ND
1.1 Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ND	71	ND	1,044	24	ND	ND	252
Toluene	ND	733	7	5,637	121	18	ND	1,185
Chlorobenzene	64	91	44	59	137	47	78	144
Ethyl Benzene	ND	242	ND	350	56	ND	ND	46

Analyzed by Allied Analytical & Research Laboratories

*ND (Not Detected)

DIE YARD EXCAVATION

Base/Neutral Extractables, USEPA Method 8270

Micrograms Per Kilogram

	WALL				FLOOR			
Soils Sampled 1-5-84:	SOUTH	WEST	NORTH	EAST	SOUTH	MID SOUTH	MID NORTH	NORTH
1.3 Dichlorobenzene	ND	ND	ND	ND	8,251	1,271	ND	ND
1.2 Dichlorobenzene	ND	ND	ND	ND	85,255	ND	ND	ND
Naphthalene	ND	ND	ND	ND	490	ND	ND	ND
Bis(2-chloroethoxy) Methane	ND	ND	ND	ND	337	ND	26	107
Acenapthalene	ND	ND	ND	ND	50	ND	ND	ND
Di-n-butyl phthalate	5,804	7,992	9,147	6,359	3,871	7,365	3,690	8,418
Bis(2-ethylhexyl) phthalate	ND	6,234	11,248	ND	13,575	ND	1,808	4,125

Analyzed by Allied Analytical & Research Laboratories

*ND (Not Detected)

DIE YARD EXCAVATION

Acid & Pest. Extractables, USAEPA Method 8270

Micrograms Per Kilogram

Soil Sampled 1-5-84:	WALL				FLOOR			
	SOUTH	WEST	NORTH	EAST	SOUTH	MID SOUTH	MID NORTH	NORTH
Phenol	ND	ND	ND	ND	3,942	ND	ND	ND
All Other Compounds	ND	ND	ND	ND	ND	ND	ND	ND

Analyzed by Allied Analytical & Research Laboratories

*ND (Not Detected)

DIE YARD EXCAVATION

Priority Pollutant Metals

Milligrams Per Liter in Extract

	WALL				FLOOR			
Soil Samples Taken 1-5-84:	SOUTH	WEST	NORTH	EAST	SOUTH	MID SOUTH	MID NORTH	NORTH
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	<0.005	<0.005	0.011	0.006	0.091	<0.005	<0.005	<0.005
Chromium	<0.01	0.02	0.25	0.14	0.34	0.01	<0.01	<0.01
Copper	<0.01	<0.01	<0.01	0.01	0.04	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	0.02	0.03	0.02	0.01	<0.01	<0.01
Lead	<0.05	<0.05	<0.05	<0.05	0.11	<0.05	<0.05	<0.05
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Thallium	<0.1	<0.1	<0.1	<0.1	0.18	<0.1	<0.1	<0.1
Zinc	0.32	0.32	0.39	0.36	0.39	0.38	0.35	0.39
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	<0.001	<0.001	0.001	0.002	0.001	<0.001	<0.001	0.001
Selenium	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001

Analyzed by Allied Analytical & Research Laboratories

DIE YARD EXCAVATION

EP Toxicity-Metals

Milligrams Per Liter in Extract

	WALL				FLOOR			
Soil Samples Taken 1-5-84:	SOUTH	WEST	NORTH	EAST	SOUTH	MID SOUTH	MID NORTH	NORTH
Barium	1.53	10.50	3.95	5.23	9.42	1.44	0.98	1.68
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	<0.005	<0.005	0.011	0.006	0.091	<0.005	<0.005	<0.005
Chromium	<0.01	0.02	0.25	0.14	0.34	0.01	<0.01	<0.01
Lead	<0.05	<0.05	<0.05	<0.05	0.11	<0.05	<0.05	<0.05
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Arsenic	<0.001	<0.001	0.001	0.002	0.001	<0.001	<0.001	0.001

Analyzed by Allied Analytical & Research Laboratories

Appendix J

HAZARD ASSESSMENT RATING METHODOLOGY

USAF INSTALLATION RESTORATION PROGRAM
HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DoD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DoD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, 11 December 1981)

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Records Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with representatives from the USAF Occupational and Environmental Health Laboratory (OEHL), Air Force Engineering and Services Center (AFESC), Engineering-Science (ES), and CH2M HILL. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering

Science, and CH2M HILL met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DoD program needs.

The model uses data readily obtained during the Record Search portion (Phase I) of the IRP. Scoring judgements and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly

no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DoD properties.

Site scores are developed using the appropriate ranking factors according to the method presented in the flow chart (Figure 1). The site rating form is provided in Figure 2, and the Rating Factor Guidelines are provided in Table 1.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, the potential pathways for waste contaminant migration, and any efforts to contain the contamination. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

The receptors category rating is calculated by scoring each factor, multiplying by a factor-weighting constant, and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence 80 points are assigned, and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface-water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular

migration route. The three pathways are evaluated, and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factors, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Scores for sites at which there is no containment are not reduced. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

HAZARD ASSESSMENT RATING METHODOLOGY FLOW CHART

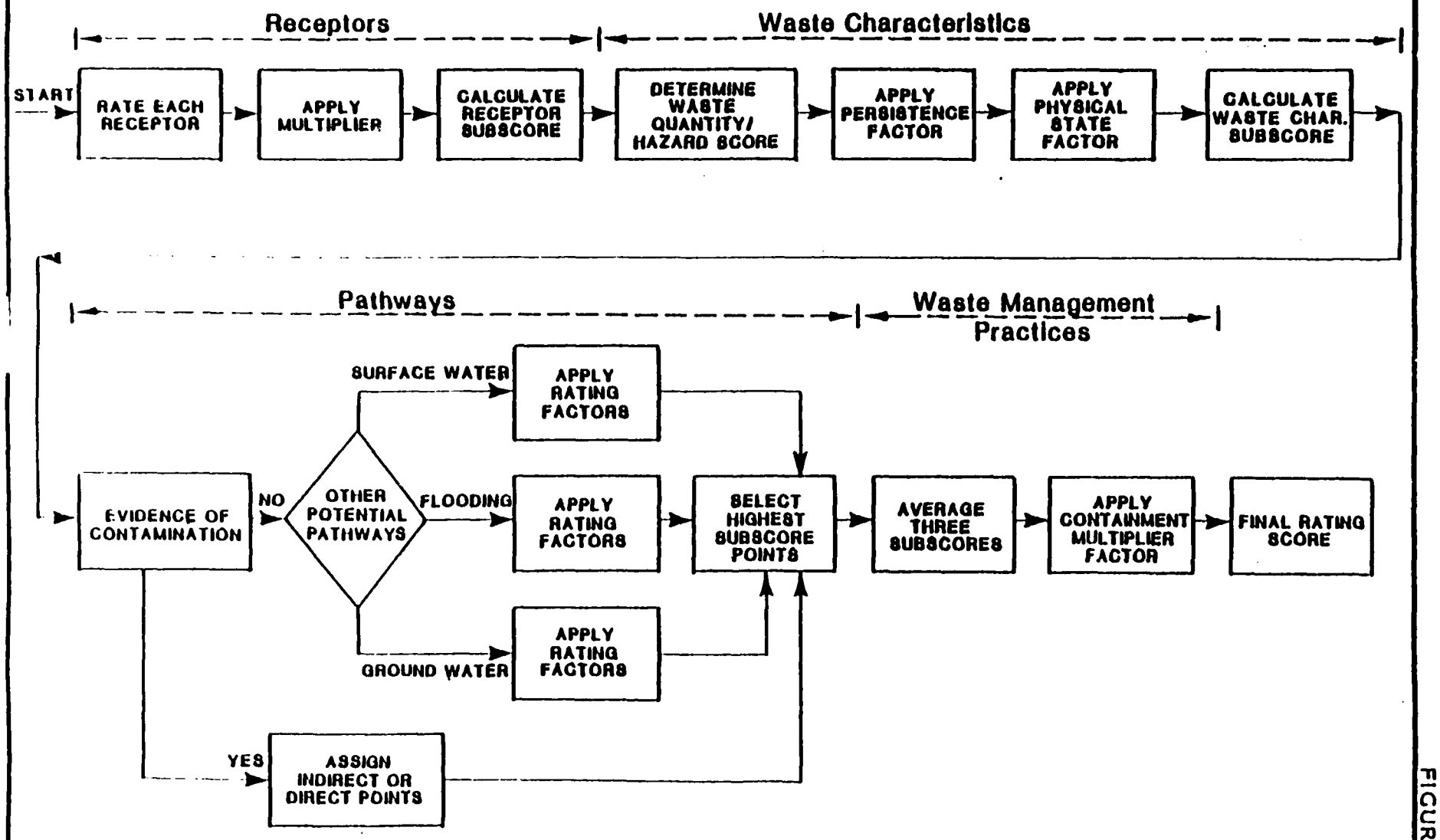

FIGURE 1

FIGURE 2

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE _____

LOCATION _____

DATE OF OPERATION OR OCCURRENCE _____

OWNER/OPERATOR _____

COMMENTS/DESCRIPTION _____

SITE RATED BY _____

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		
		Subtotals	_____	_____

Receptors subscore (100 X factor score subtotal/maximum score subtotal) _____

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) _____
2. Confidence level (C = confirmed, S = suspected) _____
3. Hazard rating (H = high, M = medium, L = low) _____

Factor Subscore A (from 20 to 100 based on factor score matrix) _____

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

_____ X _____ = _____

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

_____ X _____ = _____

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore _____

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
		Subtotals	_____	_____

Subscore (100 X factor score subtotal/maximum score subtotal) _____

2. Flooding

		1		

Subscore (100 x factor score/3) _____

3. Ground-water migration

Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		
		Subtotals	_____	_____

Subscore (100 x factor score subtotal/maximum score subtotal) _____

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore _____

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors _____
Waste Characteristics _____
Pathways _____

Total _____ divided by 3 = _____
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

_____ X _____ = _____

Table 1
HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1-25	26-100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1-mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or Industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1-mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands	10
F. Water quality/use designation of nearest surface water body	Agricultural or Industrial use	Recreation, propagation and management of fish and wildlife	Shellfish propagation and harvesting	Potable water supplies	6
G. Ground-water use of uppermost aquifer	Not used, other sources readily available	Commercial, industrial, or irrigation, very limited other water sources	Drinking water, municipal water available	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1-15	51-1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1-50	51-1,000	Greater than 1,000	6

Table 1--Continued

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records
- o Knowledge of types and quantities of wastes generated by shops and other areas on base

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site

A-3 Hazard Rating

Rating Factors	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

Table 1--Continued

II. WASTE CHARACTERISTICS--Continued

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:

For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

Confidence Level

- o Confirmed confidence levels (C) can be added.
- o Suspected confidence levels (S) can be added.
- o Confirmed confidence levels cannot be added with suspected confidence levels.

Waste Hazard Rating

- o Wastes with the same hazard rating can be added.
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Multiply Point Rating Persistence Criteria	From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

Table 1--Continued

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 Potential for Surface Water Contamination

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10 to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($>10^{-6}$ cm/sec)	6
Rainfall intensity based on 1-year 24-hour rainfall	<1.0 inch	1.0 to 2.0 inches	2.1 to 3.0 inches	>3.0 inches	8

B-2 Potential for Flooding

Floodplain	Beyond 100-year floodplain	In 100-year floodplain	In 10-year floodplain	Floods annually	1

B-3 Potential for Ground-Water Contamination

Depth to ground water	Greater than 500 feet	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to + 20 inches	Greater than +20 inches	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8

Table 1--Continued

B-3 Potential for Ground-Water Contamination--Continued

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence, fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. Waste Management Practices Factor

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Fire Protection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1, or III-6-3, then leave blank for calculation of factor score and maximum possible score.

Appendix K

SITE RATING FORMS

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 1--Landfill No. 1

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1942-1966

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Landfill; 6 acres; below parking lot; remedial measures taken; confirmed contamination

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 100

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	40	108

Subscore (100 x factor score subtotal/maximum score subtotal) 37

2. Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	2	8	16	24
Direct access to ground water	0	8	0	24
		Subtotals	48	114

Subscore (100 x factor score subtotal/maximum score subtotal) 42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 100

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	100
Pathways	100
Total 278 divided by 3 =	93
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

93 x 0.95 = 88

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 2--Landfill No. 2

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Early 1940s-1962

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Landfill; 7.5 acres; small quantities hazardous wastes

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous [illegible] 100 points for direct evidence or 80 points [illegible] then proceed to C. If no evidence or [illegible]				
			[illegible]	80
B. Rate the migration potential for three [illegible] and ground-water migration [illegible]				
1. Surface-water migration				
Distance to nearest surface water			[illegible]	[illegible]
Net precipitation				[illegible]
Surface erosion				[illegible]
Surface permeability			[illegible]	[illegible]
Rainfall intensity			[illegible]	[illegible]
			[illegible]	[illegible]
Subscore (100 x factor score subtotal/maximum [illegible]				[illegible]
2. Flooding				[illegible]
3. Ground-water migration				
Depth to ground water		[illegible]	[illegible]	[illegible]
Net precipitation		[illegible]	[illegible]	16
Soil permeability	[illegible]	[illegible]	16	24
Subsurface flows	[illegible]	8	8	24
Direct access to ground water	0	8	0	24
		Subtotals	40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore **80**

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	60
Pathways	80
Total 218 divided by 3 =	73
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

73 x 1.0 = **73**

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 3--Landfill No. 3

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1942-1945

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Landfill; 3 acres; hazardous liquid wastes; solvents; oils

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 1.0 = 100

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

			Subscore	80

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
		Subtotals	62	108
Subscore (100 x factor score subtotal/maximum score subtotal)				57

2. Flooding	1	1	1	3
	Subscore (100 x factor score/3)			33

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	2	8	16	24
Direct access to ground water	0	8	0	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	100
Pathways	80
Total 258 divided by 3 =	86
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

86 x 1.0 = 86

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 4--Landfill No. 4

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1956-early 1980s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Landfill; 2 acres; mostly rubble; some suspected hazardous wastes

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

40 x 1.0 = 40

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.0 = 40

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	80
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
		Subtotals	62	108
Subscore (100 x factor score subtotal/maximum score subtotal)				57
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	2	8	16	24
Direct access to ground water	0	8	0	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 57

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	40
Pathways	80
Total 198 divided by 3 =	66
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

66 x 1.0 = 66

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 5--FDTA No. 2

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1955-1956

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Fire burn training area; oils; solvents

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	40	108

Subscore (100 x factor score subtotal/maximum score subtotal) 37

2. Flooding

	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	32	114

Subscore (100 x factor score subtotal/maximum score subtotal) 28

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 37

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	48
Pathways	37
Total 163 divided by 3 =	54
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

54 x 0.95 51

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 6--FDTA No. 3

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Mid-1960s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Fire burn training area; waste fuels and oils; suspected solvents

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	0
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
		Subtotals	52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	1	1	1	3
	Subscore (100 x factor score/3)			33
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	0	8	0	24
		Subtotals	32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	48
Pathways	48
Total 174 divided by 3 =	58
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

58 x 1.0 = 58

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 7--FDTA No. 4

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Late 1960s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Fire burn training area; waste fuels, oils; suspected solvents

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	0
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
		Subtotals	52	108
Subscore (100 x factor score subtotal/maximum score subtotal)				48
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 48

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	48
Pathways	48
Total 174 divided by 3 =	58
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

58 x 1.0 = 58

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 8--FDTA No. 5

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Mid-1960s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Used for fire extinguisher training; waste fuels, oils

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	0
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	32	108
Subscore (100 x factor score subtotal/maximum score subtotal)				30
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	48
Pathways	42
Total 168 divided by 3 =	56
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

56 x 0.95 = 53

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 9--FDTA No. 6

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Late 1950s-1983

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Closed; excavated in 1983; waste fuels, oils

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
		Subtotals	60	108

Subscore (100 x factor score subtotal/maximum score subtotal) 56

2. Flooding

Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	32	114

Subscore (100 x factor score subtotal/maximum score subtotal) 28

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 56

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	48
Pathways	56
Total 182 divided by 3 =	61
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

61 x 0.95 = 58

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 10--Chrome Pit No. 1

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Early 1940s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: First chrome pit; below Process Building; chrome sludge

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 1.0 = 70

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

70 x 0.75 = 53

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	32	108

Subscore (100 x factor score subtotal/maximum score subtotal) 30

2. Flooding

	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	48	114

Subscore (100 x factor score subtotal/maximum score subtotal) 42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	53
Pathways	42
Total 173 divided by 3 =	58
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

58 x 0.95 = 55

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 11--Chrome Pit No. 2

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Mid-1940s

OWNER/OPERATOR: Air Force Plant 4, Texas

COMMENTS/DESCRIPTION: Second chrome pit; chrome sludge

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 1.0 = 70

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

70 x 0.75 = 53

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	0
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	32	108
Subscore (100 x factor score subtotal/maximum score subtotal)				30
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	48	114
Subscore (100 x factor score subtotal/maximum score subtotal)				42

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	53
Pathways	42
Total 173 divided by 3 =	58
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

58 x 0.95 = 55

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 12--Chrome Pit No. 3

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1957-1973

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Third chrome pit; excavated in January 1984; chromium sludge and soils removed

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 0.75 = 75

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	80
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
		Subtotals	44	108
Subscore (100 x factor score subtotal/maximum score subtotal)				41
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	32	114
Subscore (100 x factor score subtotal/maximum score subtotal)				28

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	75
Pathways	80
Total 233 divided by 3 =	78
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

78 x 0.95 = 74

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 13--Die Pits

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1956-1962

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Disposal of chromate sludges, metal solutions; pits excavated January 1984

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 0.75 = 45

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	32	108

Subscore (100 x factor score subtotal/maximum score subtotal) 30

2. Flooding

	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	56	114

Subscore (100 x factor score subtotal/maximum score subtotal) 49

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	45
Pathways	80
Total 203 divided by 3 =	68
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

68 x 0.95 64

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 14--Fuel Saturation Area No. 1

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1970s-early 1980s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Suspected fuel saturation due to leaking fuel line; located west and adjacent to Parts Plant (Building 5)

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	2	6	12	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	135	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 75

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 0.8 = 56

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

56 x 1.0 = 56

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	32	108

Subscore (100 x factor score subtotal/maximum score subtotal) 30

2. Flooding

Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
		Subtotals	32	114

Subscore (100 x factor score subtotal/maximum score subtotal) 28

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 30

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	75
Waste Characteristics	56
Pathways	30
Total 161 divided by 3 =	54
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

54 x 0.95 = 51

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 15--Fuel Saturation Area No. 2

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1970s-early 1980s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Suspected fuel saturation due to leaking fuel line; located southwest of Paint Shop (Building 176)

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 0.8 = 56

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

56 x 1.0 = 56

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	0
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	40	108
Subscore (100 x factor score subtotal/maximum score subtotal)				37
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 37

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	56
Pathways	37
Total 171 divided by 3 =	57
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

57 x 0.95 = 54

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 16--Fuel Saturation Area No. 3

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Mid 1970s-early 1980s

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Suspected fuel saturation due to leaking fuel line; southwest of Acid Test Building (No. 142); confirmed fuel saturation

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 0.8 = 80

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.0 = 80

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	0
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	40	108
Subscore (100 x factor score subtotal/maximum score subtotal)				37
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 37

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	80
Pathways	37
Total 195 divided by 3 =	65
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

65 x 0.95 = 62

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 17--Former Fuel Storage Site

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Early 1940s-1962

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Former location of JP-4 aboveground tank; saturation discovered below tank when relocated in 1962

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	2	6	12	18
Rainfall intensity	2	8	16	24
		Subtotals	44	108

Subscore (100 x factor score subtotal/maximum score subtotal) 41

2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	60
Pathways	80
Total 218 divided by 3 =	73
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

73 x 1.0 = 73

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 18--Leaking Solvent Lines

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: Early 1940s-1945

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Leaking solvent lines; abandoned-in-place in 1945; suspected leakage of xylene, MEK, kerosene

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 1.0 = 70

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

70 x 1.0 = 70

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	32	108

Subscore (100 x factor score subtotal/maximum score subtotal) 30

2. Flooding

	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	1	8	8	24
		Subtotals	40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 35

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	70
Pathways	35
Total 183 divided by 3 =	61
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

61 x 0.95 = 58

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 19--NARF Area

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1953-1974

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Nuclear Aerospace Research Facility; housed atomic reactors; facility decommissioned 1974

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 1.0 = 100

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

100 x 0.5 = 50

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface-water migration

Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	40	108

Subscore (100 x factor score subtotal/maximum score subtotal) 37

2. Flooding

Flooding	0	1	0	3

Subscore (100 x factor score/3) 0

3. Ground-water migration

Depth to ground water	2	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	40	114

Subscore (100 x factor score subtotal/maximum score subtotal) 35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 37

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	50
Pathways	37
Total 165 divided by 3 =	55
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

55 x 0.10 = 6

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE: Site No. 20--Wastewater Collection Basins

LOCATION: Air Force Plant 4, Texas

DATE OF OPERATION OR OCCURRENCE: 1967-Present

OWNER/OPERATOR: Air Force Plant 4

COMMENTS/DESCRIPTION: Receives wastewater from chemical waste treatment system and some sump flows from buildings; receives some accidental TCE discharges; suspect possible leakage into subsurface

SITE RATED BY: David Moccia, Bob Knight, Gary Eichler

I. RECEPTORS

	Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A.	Population within 1,000 feet of site	3	4	12	12
B.	Distance to nearest well	3	10	30	30
C.	Land use/zoning within 1 mile radius	3	3	9	9
D.	Distance to reservation boundary	3	6	18	18
E.	Critical environments within 1 mile radius of site	0	10	0	30
F.	Water quality of nearest surface-water body	3	6	18	18
G.	Ground-water use of uppermost aquifer	2	9	18	27
H.	Population served by surface-water supply within 3 miles downstream of site	3	6	18	18
I.	Population served by ground-water supply within 3 miles of site	3	6	18	18
			Subtotals	141	180

Receptors subscore (100 x factor score subtotal/maximum subtotal) 78

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) L
2. Confidence level (C = confirmed, S = suspected) S
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 70

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

70 x 1.0 = 70

C. Apply physical state multiplier

Subscore B x Physical State Multiplier = Waste Characteristics Subscore

70 x 1.0 = 70

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.				
			Subscore	0
B. Rate the migration potential for three potential pathways: surface-water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.				
1. Surface-water migration				
Distance to nearest surface water	2	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	0	6	0	18
Rainfall intensity	2	8	16	24
		Subtotals	40	108
Subscore (100 x factor score subtotal/maximum score subtotal)				37
2. Flooding	0	1	0	3
	Subscore (100 x factor score/3)			0
3. Ground-water migration				
Depth to ground water	3	8	16	24
Net precipitation	0	6	0	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
		Subtotals	40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2, or B-3 above.

Pathways Subscore 42

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	78
Waste Characteristics	70
Pathways	42
Total 190 divided by 3 =	63
	Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

63 x 1.0 = 63

Appendix L

GLOSSARY OF TERMS

Appendix L
GLOSSARY OF TERMS

ALLUVIUM - A general term for clay, silt, sand, gravel, or similar unconsolidated detrital material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semisorted sediment in the bed of the stream or on its flood plain or delta, or as a code or fan at the base of a mountain slope; especially such a deposit of fine-grained texture deposited during time of flood.

AQUIFER - A geologic formation, or group of formations, that contains sufficient saturated permeable material to conduct ground water to yield economically significant quantities of ground water to wells and springs.

BOWSER - A small mobile tank used to recover and transport POL products.

CONFINING STRATA - A strata of impermeable or distinctly less permeable material stratigraphically adjacent to one or more aquifers.

CONTAMINANT - As defined by section 104(a)(2) of CERCLA, shall include, but not be limited to, any element, substance, compound, or mixture, including disease causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformation, in such organisms or their offspring.

DOWNGRADIENT - A direction that is hydraulically down slope. The downgradient direction can be determined through a potentiometric survey or through the evaluation of existing water level elevations referenced to a common datum (mean sea level).

EP TOXICITY - A laboratory test designed to identify if solid waste is hazardous. A liquid extract from the solid waste is analyzed for selected metals and pesticides. If one or more of the parameters tested for is present in concentration greater than a maximum value then the solid waste is considered a hazardous waste in accordance with RCRA definition.

ESKER - A widening ridge of stratified glacial drift, steep-sided, 3 to 15 m in height, and from a fraction of a mile to over 160 km in length.

EVAPOTRANSPIRATION - Evaporation from the ground surface and transpiration through vegetation.

FRACTURES - As a mineral characteristic, the way in which a mineral breaks when it does not have cleavage. May be conchoidal (shell-shaped), fibrous, hackly, or uneven.

GLACIAL TILL - Unsorted and unstratified drift, generally unconsolidated, deposited directly by and underneath a glacier without subsequent reworking by water from the glacier, and consisting of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

GROUND MORAINE - Till deposited from a glacier as a veneer over the landscape and forming a gently rolling surface.

GROUND WATER - All subsurface water, especially that part that is in the zone of saturation.

HAZARDOUS WASTE (expanded version of the RCRA definition) - A solid waste which because of its quantity, concentration, or physical, chemical or infectious characteristics may -

(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible, illness; or

(B) pose a substantial present or potential hazard tc human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed.

ICE-CONTACT DEPOSITS - Stratified drift deposited in contact with melting glacier ice, such as an esker, kame, kame terrace, or a feature marked by numerous kettles.

JOINTS - A break in a rock mass where there has been no relative movement of rock on opposite sides of the break.

LACUSTRINE - Pertaining to, produced by, or formed in a lake or lakes; e.g., "lacustrine sands" deposited on the bottom of a lake or formed along the margin of a lake.

LEACHING - The separation or dissolving out of soluble constituents from a rock or ore body by percolation of water.

LOAM - A rich, permeable soil composed of a friable mixture of relatively equal and moderate proportions of clay, silt, and sand particles, and usually containing organic matter (humus) with a minor amount of gravelly material.

METAMORPHOSED (METAMORPHIC) - Pertaining to the process of mineralogical and structural adjustment of solid rocks to physical and chemical conditions which have been imposed at

depth below the surface zones of weathering and cementation, and which differ from the conditions under which the rocks in question originated.

MIGRATION (Contaminant) - The movement of contaminants through pathways (ground water, surface water, soil, and air).

NET PRECIPITATION - Mean annual precipitation minus mean annual evapotranspiration. Evapotranspiration is sometimes estimated by pan evaporation measurements.

PD-680 (Type I and Type II) - A military specification for petroleum distillate (aliphatic) used as a safety cleaning solvent. The primary difference between PD-680 Type I and Type II is the flash point of the material. The flash points are 100°F and 140°F for PD-680 Types I and II, respectively. Currently, only Type II is authorized for use at Air Force installations.

PERMEABILITY - The capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

POTENTIOMETRIC SURFACE - An imaginary surface that represents the static head of ground water and is defined by the level to which water will rise in a cased well.

SOIL HORIZONS -

(A) A-Horizon - The uppermost mineral horizon of a soil; zone of leaching.

(B) B-Horizon - Occurs below the A-Horizon; the mineral horizon of a soil or the zone of accumulation.

(C) C-Horizon - Occurs below the B-Horizon; a mineral horizon of a soil consisting of unconsolidated rock material that is transitional in nature between the parent material below and the more developed horizons above.

SOLUM - Upper part of a soil profile, in which soil-forming processes occur; A and B horizons.

SPOTTING CHARGE - A small explosive charge, the size of a shotgun shell, which is contained in training ordnance to score the impact of training ordnance.

STRATA - Plural of stratum.

STRATUM - A single and distinct layer, of homogeneous or gradational sedimentary material (consolidated rock or unconsolidated earth) of any thickness, visually separable from other layers above and below by a discrete change in the character of the material deposited or by a sharp physical break in deposition, or by both.

TRANSMISSIVITY - A measure of the amount of water that can be transmitted horizontally by the full saturated thickness of the aquifer under a hydraulic gradient.

UNSATURATED ZONE (Vadose Zone or Zone of Aeration) - A subsurface zone containing water under pressure less than that of the atmosphere, including water held by capillarity; and containing air or gases generally under atmospheric pressure. This zone is limited above by the land surface and below by the surface of the zone of saturation.

UPGRADIENT - A direction that is hydraulically up slope. The upgradient direction can be determined through a potentiometric survey or through the evaluation of existing water level elevations referenced to a common datum (mean sea level).

WATER TABLE - The upper limit of the portion of the ground completely saturated with water.

Appendix M

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS USED IN THE TEXT

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A/C	Aircraft
AFB	Air Force Base
AFESC	Air Force Engineering and Services Center
AFRES	Air Force Reserves
AG	Aboveground
AGE	Aerospace Ground Equipment
AVGAS	Aviation Gasoline
Bldg.	Building
bls	Below Land Surface
BOD_5	Biochemical Oxygen Demand (5-day)
°C	Degrees Celsius (Centigrade)
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
cm/sec	Centimeters per Second
COD	Chemical Oxygen Demand
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DoD	Department of Defense
DPDO	Defense Property Disposal Office
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
°F	Degrees Fahrenheit
ft/min	Feet per Minute
gal/yr	Gallons per Year
gpd	Gallons per Day
gpm	Gallons per Minute
HARM	Hazard Assessment Rating Methodology
IRP	Installation Restoration Program
JP	Jet Petroleum
lb	Pounds
lb/yr	Pounds per Year
MAJCOM	Major Command
mg/l	Milligrams per Liter

mgd	Million Gallons per Day
mo.	Month
MOGAS	Motor Gasoline
mph	Miles per Hour
msl	Mean Sea Level
NDI	Non-Destructive Inspection
No.	Number
NPDES	National Pollutant Discharge Elimination System
OEHL	Occupational and Environmental Health Laboratory
PCB	Polychlorinated Biphenyls
POL	Petroleum, Oil, and Lubricants
ppm	Parts per Million
RCRA	Resource Conservation and Recovery Act
SAC	Strategic Air Command
SCS	Soil Conservation Service
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UG	Underground
USAF	United States Air Force
USDA	United States Department of Agriculture
VOC	Volatile Organic Compound
μg/l	Micrograms per Liter

Appendix N

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REFERENCES

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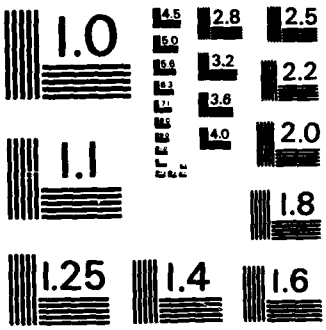

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Appendix O
SUPPLEMENTAL REVIEW OF ARCHIVAL FILES

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SUPPLEMENTAL REVIEW OF ARCHIVAL FILES

A. INTRODUCTION

CH2M HILL was retained on August 15, 1984, to review additional files at Air Force Plant 4 under Contract No. F08637-80-G0010-5009-05. The onsite installation visit to complete this additional work was conducted by CH2M HILL from August 16 through August 17, 1984. Activities performed during the visit included a detailed search of 13 boxes of archival files. These files arrived from the Washington National Records Center in Suitland, Maryland after the initial site visit was completed in May 1984. The CH2M HILL records search for this supplemental work was performed by Mr. Clif McFarland, Chemical Engineer (B.S. Chemical Engineering, 1981). His resume is included at the end of this appendix.

Individuals from the Air Force who assisted in the supplemental records search include:

1. Major Al Lussier, AFPRO, Air Force Plant 4

2. Tom Brown, AFPRO, Air Force Plant 4

B. BACKGROUND

The 13 boxes of archival files examined during the supplemental records search were contract files dating from the late 1940s to the mid-1970s. Contract files are comprised of actual contracts, internal memoranda of the contracts group, supplemental background information, and external correspondence of the contracts group. It was believed that additional information relevant to the IRP could be gleaned from these files.

The contracts files at AF Plant 4 mainly contained documents pertaining to various retooling efforts over the years. In addition, a large number of orders for material from jet engine test stands and machine parts to bookshelves and desks was included.

Some information relevant to the IRP was discovered. Information on the NARF, safety reports, water pollution abatement memoranda, progress reports on the chemical wastewater treatment plant installation, a report on the sanitary sewer system, wastewater discharge permits, and supplemental installation history was located. These subjects will be discussed item by item in the following section.

C. FINDINGS

There were no major new findings. Information obtained during the supplemental records search, discussed below, confirms the findings presented in the body of this report.

1. The NARF

The Nuclear Aerospace Research Facility (NARF) comprised about 120 acres at the northern extremity of AF Plant 4. A part of the NARF restricted area extended into Lake Worth, which is a principal water supply for the City of Fort Worth. Three nuclear reactor systems were located within the NARF area. Two were adapted leftovers from a previous project. The third was a critical nuclear mock-up reactor to support the two higher powered test reactors.

Extensive research and development activities were conducted at the NARF during the 1950s and 1960s. Various materials were subjected to nuclear radiation to determine what effect this would have on their physical properties.

Electrical and mechanical components were irradiated to determine what effect this would have on their operability. Work was also conducted on the development of a nuclear powered aircraft. In addition, aircraft exposed to nuclear radiation were decontaminated at the NARF.

To support the activities at the NARF, both nuclear raw material and interim waste storage was provided. There were several problems over the years with the irradiated water collection and storage system. Irradiated water storage tanks were discovered leaking in the 1950s. This problem was quickly corrected, but not before a small, but undetermined, amount of irradiated water seeped into the ground. The floor drain of Building 158, in which highly contaminated material was stored, was discovered to be dead-ended into the ground. A 4-inch vitrified tile line was installed connecting the drain to the irradiated water collection system. A drain located just outside Building 158, once connected to a storm sewer, was also later connected by a vitrified tile line to the irradiated water collection system to prevent irradiated water from entering Lake Worth via the storm sewer system. As reported in Section IV.B.5.b. "Site No. 19, NARF Area," small quantities of dilute radioactive solutions were discharged to Lake Worth. However, all high level radiation was contained onsite.

In 1974, the NARF area was decommissioned and cleared of radiological activity to levels suitable for unrestricted occupancy. An inventory of all NARF facilities and equipment was conducted at the outset of the decommissioning process. A preliminary radiological evaluation was performed on all inventoried items, structures, and related areas. The results were used in the inventory to show the radiological condition, decontaminability, and the disposal actions expected for each listed item.

The radiological history of the site was reviewed, updated, and documented as a baseline for determining the extent of reclamation which could be expected, and to measure the efficiency of the decontamination operations.

Decisions regarding alternatives for handling land, structures, and non-severable equipment were made. Alternatives included decontamination, disassembly for disposal, and removal for disposal.

Initial disposal operations were necessary to remove high-level radioactive materials to permit subsequent lower-level radiation measurements. The reactors were unloaded and fuel elements were shipped for disposal. Highly radioactive equipment items were removed and disposed of.

Following the removal of the fuel elements and other high-level sources of radiation, the major decontamination process was begun.

The remaining reactor systems were dismantled; radioactive or contaminated components were processed as radioactive solid waste and disposed of offsite. Other remaining radioactive equipment was removed and processed as radioactive waste.

A detailed survey of the reactor area and other NARF areas and structures was performed. Soil and vegetation assays were obtained from contiguous areas. Core samples of structures and substrata in the immediate vicinity of the reactor location were taken for analysis.

All exposed surfaces were decontaminated. Disassembly of structures and remaining equipment was necessary to effect decontamination of normally inaccessible

surfaces.

Contaminated debris and waste was packaged and shipped in accordance with applicable DOT regulations to Barnwell, South Carolina.

Radiological evaluation of the cleanup process was performed on a continuing basis until the decommissioning was completed at which time a final survey was performed.

Documentation throughout the decommissioning program had a dual purpose. It demonstrated that the decommissioning was proceeding effectively, and it provided, upon the completion of decommissioning, substantiating data which permitted the release of the concerned areas and facilities for unrestricted use. Throughout the decommissioning activities, a quality assurance program was utilized to ensure proper control of activities in accordance with the decommissioning plan. Inspections, tests, and evaluations were performed to validate the information generated during the decommissioning. The final post-closure report found no remaining contamination.

2. Safety Reports

Several safety reports from the 1960s were discovered. The major concern of these reports was the location and correction of fire hazards; general housekeeping was of secondary concern.

In 1969, subsequent to one of these safety reports, it was proposed to remove a 12,000-gallon above ground gasoline storage tank and replace it with an underground tank. The old above ground tank was located approximately 55 feet south of the lumber storage building (Building

No. 106), and approximately 70 feet west of Warehouse No. 2. The new tank, listed in Table 11 (page IV-20 of this report) as Facility No. 26, is buried near the northwest corner of Warehouse No. 2.

In the project justification, written in 1969, no mention is made of possible environmental impacts of burying this tank. This is not surprising because 15 years ago the risks to groundwater associated with this type of activity were not widely recognized. The tank was relocated in accordance with accepted environmental procedures.

3. Water Pollution Abatement

Several letters and memoranda from 1968 concerning the initiation of the Air and Water Pollution Abatement program were uncovered. These documents are the oldest discovered in which direct reference is made to environmental problems.

In March 1968, the USAF stipulated that all Air Force plants were required to submit a vast amount of air and water pollution control data. In addition, requirements were established for continuous monitoring of all environmental pollutants and the submittal of various reports. One report was to indicate air and water pollution problem areas, proposed solutions, estimated costs of the proposed solutions, and type and year of funding proposed. A second report was required to establish priorities for accomplishing pollution control actions. Finally, annual reports summarizing pollution control progress were requested.

Air Force policy established at that time stated that the preferred method of pollution control was prevention at the source by modification or modernization of operations generating pollutants. Where complete operational control

of pollutants was not feasible, treatment methods were to be included in any facility modification. Major new construction of pollution control facilities was considered to be a method of last resort.

4. Wastewater Treatment Plant Installation

In apparent response to the USAF Air and Water Pollution Abatement program begun in the late 1960s, a process wastewater treatment facility was designed and constructed. Construction of the treatment facility began on July 20, 1970, with completion initially planned for December 1970. Portions of the facility came on line in 1971, but modifications continued through 1972.

Operational problems with the sludge centrifuge caused significant delays in project completion. The centrifuge was eventually replaced with a filter press. A description of the system as it currently operates is presented in Section IV.A.7. "Wastewater Treatment."

5. Sanitary Sewer System

In 1967, the consulting firm of Freese, Nichols, and Endress (FNE) was retained to study the sanitary sewer system at AF Plant 4. Their report was primarily concerned with the adequacy of the system to receive the additional hydraulic loads expected in the sanitary sewer system from facilities under construction at that time. FNE also determined flow rates in the entire system and verified the integrity of the system. The FNE report concluded that significant problems did not exist within the sanitary sewer system at AF Plant 4.

General domestic sewage at AF Plant 4 is collected

in a plant-wide gravity sewer system and is discharged untreated to the City of Fort Worth sanitary sewer system.

6. Wastewater Discharge Permits

A 1971 Texas Water Quality Board discharge permit described the type of wastewater discharge from each of the five outfalls (001 through 005). The discharges remain basically the same today except for Outfall 003.

Discharge from Outfall 003, except for stormwater, was water used to quench the exhaust from jet engines being tested. Water was used to protect the cell structure and to reduce the noise level. Under optimum conditions, the quenched water evaporated and no water was discharged. Under certain conditions, however, some water was washed into Lake Worth through Outfall 003. This discharge was described as dark in color; it contained unburned carbon and possibly some VOCs. Outfall 003 no longer receives quench water from the jet engine test facility.

The 1971 permit also contains qualitative information on the types of compounds discharged from AF Plant 4 outfalls 001 through 005. At least trace amounts of pesticides, surfactants, phenols, oil and grease, zinc, sodium, potassium, bromide, phosphorus, manganese, magnesium, iron, copper, calcium, aluminum, chloride, sulfate, nitrate, ammonia, organic nitrogen, and solids were discharged. No quantitative data were found for the early 1970s.

7. Installation History

A real property survey completed in 1971 contains information supplemental to that presented in Appendix D, "Installation History."

AF Plant 4 was constructed in 1942 of permanent type construction. The original plant contained buildings totalling 1,961,000 square feet. During World War II, additional buildings of permanent type construction were added, increasing the total covered area to 4,024,000 square feet by the end of 1945. There was no building construction from 1946 through 1949. From 1950 through 1966, progressive building additions increased the total covered area to 4,742,000 square feet.

A major expansion of plant facilities was made for the F-111 production program beginning in 1966. By mid-1968, a new process building, raw material warehouse, general warehouse, engineering and office building, aircraft paint facility, aircraft run stations, various manufacturing mezzanines, special projects buildings, and laboratories were added. Total covered area in 1971 at AF Plant 4 was 6,553,000 square feet.

GNR226

CLIFTON J. McFARLAND
Chemical Engineer

Education

B.S., Chemical Engineering, Massachusetts Institute of Technology (1981)

Experience

Mr. McFarland's engineering experience includes hazardous waste treatment, contaminated groundwater cleanup, soil and groundwater sampling, and mechanical design of industrial process facilities.

Mr. McFarland was assistant project manager on the evaluation of hazardous materials disposal practices at Air Force Plant 59 in Binghamton, New York. He was responsible for assessing and rating the relative hazard levels at the plant's various disposal sites. He also participated in the analysis of the operation of the plant's various wastewater treatment systems.

Mr. McFarland performed preliminary soil sampling for the State of Florida's EDB investigation in Lake Wales. He has also sampled groundwater for the General Development Corporation at several locations in Florida.

Mr. McFarland's project experience in the area of contaminated groundwater cleanup includes a conceptual design for Pratt & Whitney Aircraft of West Palm Beach, Florida. This work involved process design of various treatment alternatives, technical and economic evaluation of each alternative, a more detailed design of the proposed process, and computer modeling an air stripping column. He also assisted on a feasibility study conceptual design for groundwater cleanup for the Biscayne Aquifer/Dade County, Florida, Superfund site.

Before joining CH2M HILL, Mr. McFarland was a design engineer for a large petrochemical firm. He was responsible for design and construction of a major modification to a process plant cooling water system in Los Angeles, California. In addition, he was a member of the design team for a shale oil semi-works project in Salt Lake City, Utah.

Membership in Professional Organizations

American Institute of Chemical Engineers
Tau Beta Pi Honorary Society

CLIFTON J. McFARLAND
Publications

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